The Complete Garmin G1000 Course Manual

Understanding and Flying the Garmin G1000

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Textbook and Course Manuscript

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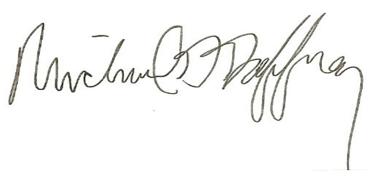

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Syllabus Introduction

The "Complete Garmin G1000"
Course Manual

Thank you for choosing this course as your introduction into flying a Garmin G1000 equipped aircraft, one of the most sophisticated, yet user friendly avionic systems ever devised. The course you have chosen has been designed to take a very practical, no-nonsense approach to teaching you how to operate this fantastic system that has become standard delivery equipment in Cirrus, Cessna, Diamond, Beech, and Mooney aircraft.

This course is built upon 14 chapters that will provide extremely useful to you as you learn about your aircraft. You will learn many new concepts including ones that the Federal Aviation Administration are now introducing to help pilots and flight instructors cope with the integrated avionics suite without sacrificing situational awareness while they operate the aircraft.

This course **is based on the Technically Advanced Aircraft (TAA) Featuring the Garmin G1000 Course developed by Flightlogics of West Melbourne, FL**. It is based on a FAA FITS Accepted pilot ground school training course delivery methodology concepts but incorporates the FAA/Industry Training Syllabus (FITS) scenario based learning. The original program was accepted by the FAA FITS Program Manager.

This syllabus utilizes the building block theory of learning, which recognizes that each area of knowledge or skill must be presented on the basis of previously learned knowledge or skills. Each study unit is based upon FITS training scenario objectives where you take an active part in the briefings and debriefings with the software lessons. You do this by partaking in the learning through the use of preplanned scenarios. After all the study units of the Ground Course are complete, there is a self evaluation to record the level of learning that has been achieved. The software then records its assessment of your performance and recommends when the objectives of the study unit are achieved. You may only continue to the next study unit when you achieve the desired level of proficiency as defined in the study unit completion standards.

FAA/Industry Training Standards (FITS) Compliance

The study unit lesson plans in this program were designed to be compliant with FITS Accepted guidelines established by the FAA FITS Program Manager. All the study units were designed to follow a real world, scenario based learning situation that will help you, the Pilot in Training (PT), more quickly and more permanently benefit from the value of the study unit and incorporate those lessons into your every day flying procedures. This is important for you, the Pilot in Training (PT), so that these study units can reinforce the situational awareness and concepts of Single Pilot Resources Management (SPRM), aeronautical decision making, and overall aviation safety. The following logo is the symbol of acceptance of the program by the FAA FITS Program Manager.

We sincerely hope you enjoy the material and the course.

Note: Our special thanks go out to the following organizations for their direct and indirect assistance in providing information, pictures, answers, and in general patience during the production of this manual. Their help indicates their commitment to general aviation and aviation safety

- **ASA Publications**
- **Garmin Corporation**
- **Cirrus Aircraft Corporation**
- **The Federal Aviation Administration**
- **Diamond Aircraft**
- **Cessna Aircraft**
- **Mooney Corporation**

Warning: Because there are differences between manufacturers and even among models by model year, pilots are warned to always use the aircraft operating handbook and checklists provided with their aircraft. The information contained in this program is general and advisory in nature and is designed to provide the pilot with important technique information, but cannot be relied upon as the sole source of information for the model aircraft they are flying.

Study Unit 1- FITS and Flying TAA Aircraft

Study Unit Objectives:
The objective of this Study Unit is for the pilot to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the definition of FAA/Industry Training Standard and Technically Advanced Aircraft and how they interrelate to the safe operation of aircraft equipped with the Garmin G1000 glass cockpit. In addition, the pilot will be able to distinguish between the scan flow of a traditional aircraft and a TAA aircraft. The pilot will understand why the distractions of the TAA aircraft can pose an increased burden on flight safety if a smooth and consistent scan flow is not maintained.

Completion Standards:
The pilot will be able to understand the definition of FITS and TAA and how they interrelate as to the safe operation of aircraft equipped with the Garmin G1000 glass cockpit. In addition, the pilot will be able to distinguish between the scan flow of a traditional aircraft and a TAA aircraft and understand why the distractions of the TAA aircraft can pose an increased burden on flight safety if a smooth scan flow is not maintained. These completion standards will be verified by successful completion of the study unit quiz at the end of this section with correct answers to all questions. When the pilot has correctly answered all the study unit quiz questions, then they may proceed to the next study unit.

Introduction to flying Technically Advance Aircraft (TAA)

The Garmin G1000 equipped aircraft falls into a class of aircraft configurations referred by the Federal Aviation Administration (FAA) as Technically Advanced Aircraft or TAA. TAA aircraft are defined into several subgroups and categories, but for the most part, one can define TAA aircraft as:

Definition: TAA Aircraft (Figure 1.1) *An aircraft which has a Primary Flight Display (PFD), an integrated Global Positioning System (GPS) or like guidance system, an autopilot which can couple to that guidance system, and a Flight Management System (FMS) which provides for a way to enter information or retrieve information from a database and submit it to this integrated suite of aircraft systems, usually supplemented by computer software. Glass cockpit aircraft are considered synonymous with TAA.*

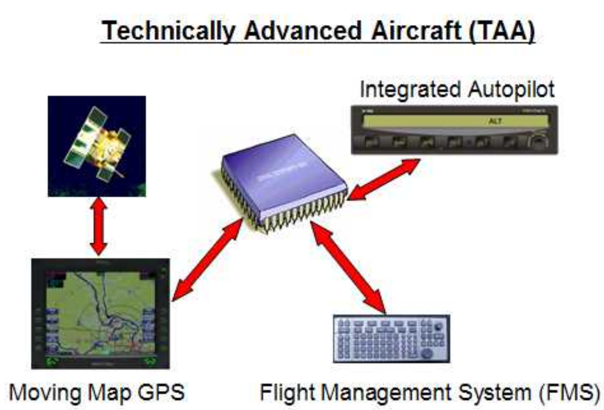

Figure 1.1 – Chief distinctions of a TAA aircraft

Looking at this definition of TAA aircraft, we can see that there are at least 3 requirements, in order for an aircraft to be classified as TAA. Notice that the definition says nothing about being a glass cockpit aircraft, but the industry has implied that TAA aircraft have glass cockpits. It just so happens that as technology has caught up with cockpit design, so has the FAA's acceptance of using glass cockpit displays to display flight instrumentation.

Take a look at the following pictures to see an evolution of cockpits leading up to TAA designation.

Figure 1.2 – Traditional aircraft panel (1969 Citabria 7ECA)

Figure 1.3 – Traditional aircraft panel (2002 Cessna Skyhawk SP)

Figure 1.4 – Traditional aircraft (1998 Diamond Da20-C1)

Figure 1.5 – Technically Advanced Aircraft (TAA) panel (2006 Piper Archer)

Figure 1.6 – TAA Garmin Perspective Plus Cirrus SR20

Figure 1.7 – TAA G1000 Equipped Panel (2007 Cessna Mustang)

TAA aircraft are significantly more complex than non-TAA aircraft because the systems that make these functions operate and integrate are controlled by a computer. They are subject to additional amounts of training on the part of the pilot and maintenance personnel. Not only is this training required in order for the pilot to properly operate the system, but it is required in order to interpret system malfunctions that may or may not constitute a real emergency. The FAA believes that the FITS training model is the most effective model for pilots to learn about TAA aircraft. It is important to ensure safe operations of such an aircraft because of the distractions that having so many rich features can present to the basic tasks of piloting an aircraft.

Scan Flow

One of the biggest challenges that pilots have when transitioning to a glass cockpit aircraft such as the Garmin G1000 equipped aircraft is focus on the areas of the cockpit that need attention in a routine and orderly fashion without losing concentration on the basic tasks of flying the aircraft. We call this "Scan Flow".

Definition: Scan Flow *The order used by the pilot or crew of an aircraft when monitoring the various components of the flight deck, the systems, the electronics and radios, while at the same time maintaining situational awareness outside of the aircraft.*

Traditional Scan Flow for non-TAA Aircraft

When we were first taught to fly an aircraft in VFR, many pilots had a relatively simple aircraft and cockpit with basic flight and engine instruments required by CFR part 91.205. The following diagram (figure 1.8) represents the basic flow of a traditional aircraft. The boxes represent what the pilot does with their eyes and their attention as they scan the cockpit and their surroundings outside the aircraft.

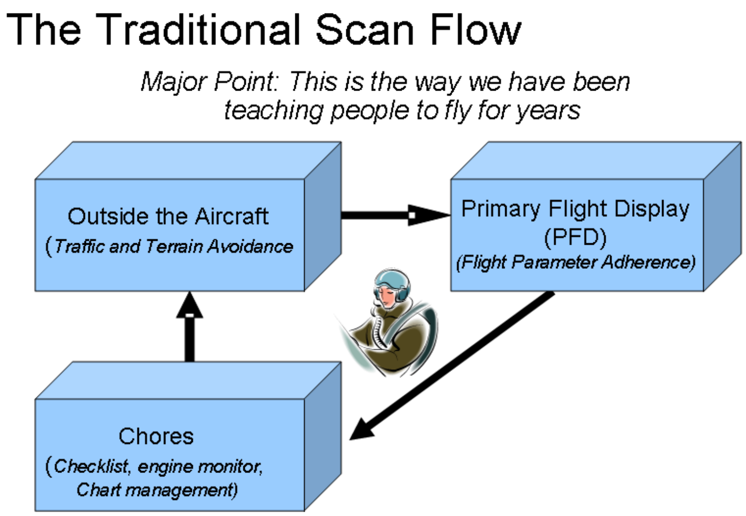

Figure 1.8 – Scan Flow of traditional aircraft

The Scan Flow for TAA Aircraft

With the increasing complexity of TAA aircraft, we must modify our scan flow to balance out the time we spend monitoring our systems in a way which does not materially impact the attention we are spending on the fundamentals of flight and situational awareness. The biggest distraction for us is the addition of the Multifunction Flight Display (MFD). As we will see in the following study units, the MFD contains many important functions which help enhance the pilot's "electronic" situational awareness, but also represents a significant distraction due to its vibrant colors and robust menu functions which tends to command the pilot's attention. We like to say that *"People will watch the MFD of a TAA aircraft like a kid watching cartoons on a Saturday morning"*. Don't get caught in this trap. Learn the scan flow and keep it going at all times. It is not uncommon for a pilot to become focused on a cockpit task for long periods of time. The scan flow diagrams help the pilot remember to keep their eyes moving, even if the task they are working on is not complete.

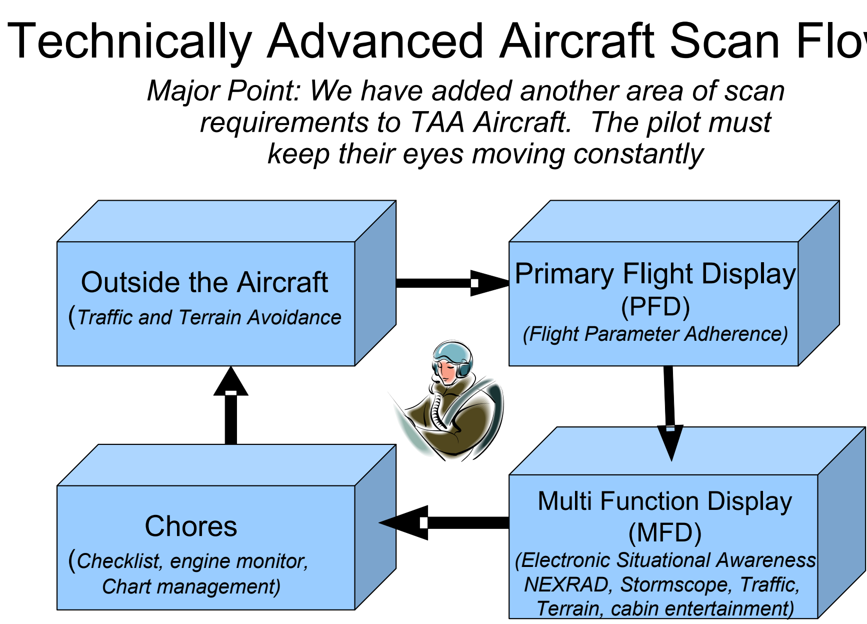

Figure 1.9 – Scan Flow for TAA Aircraft

How to Use the Scan Flow in a TAA aircraft

If we look at the tasks that the pilot is being asked to monitor and look at the time available for each task, we see that each area could be allocated only 15 seconds per every minute of flight. In other words, the pilot should divide their attention evenly even when they are focusing on a complex task that may demand more time from that minute. For example, the pilot is flying along on a trip between their home airport and another local airport that is not tower controlled. The pilot receives an aural traffic advisory from the Garmin G1000. Which is more important to the pilot: to look out the window to spot the traffic or to look on the Multifunction Flight Display to identify where the traffic alert came from? The answer in this scenario is both! In this case, the pilot must rapidly look between the two areas in his scan while not losing altitude or letting his heading drift off.

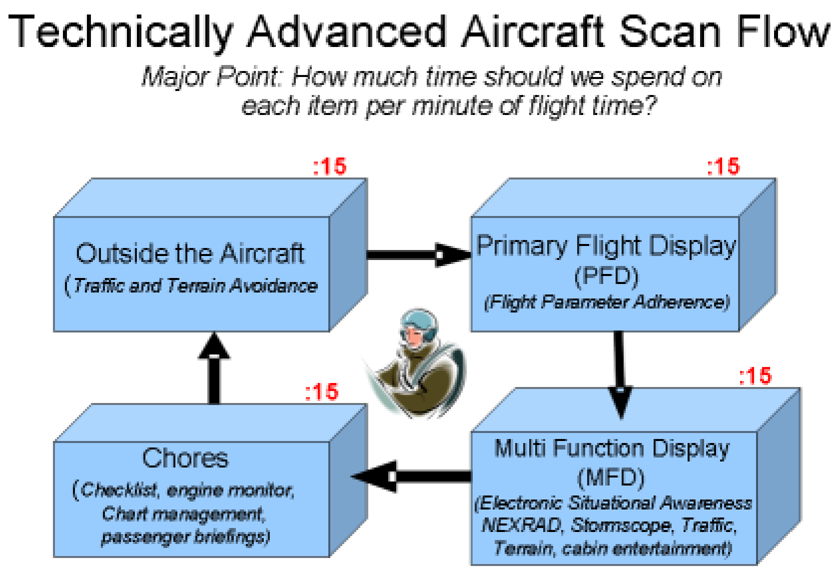

Figure 1.10 –TAA aircraft Scan Flow and dividing our attention

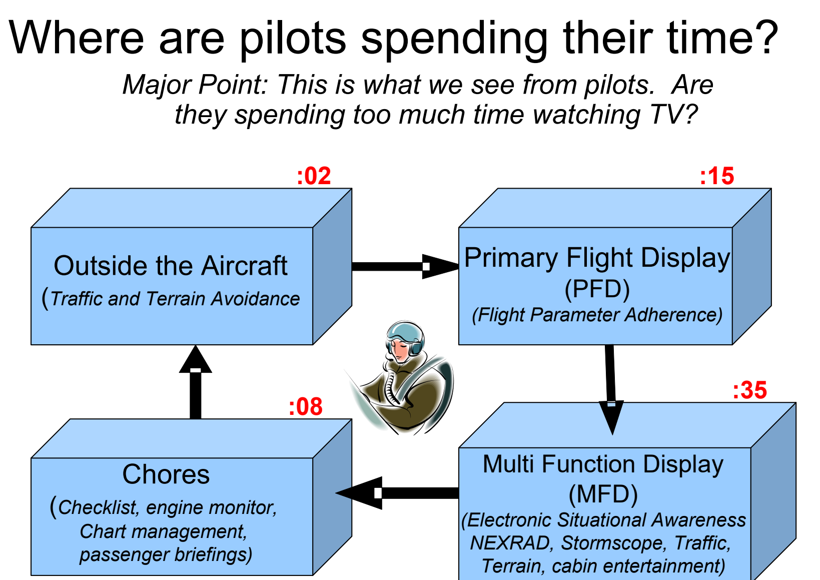

Figure 1.11 –Where are pilots spending their time?

Single Pilot Resource Management

Definition: <u>Single Pilot Resource Management (SRM)</u> *A methodical process used in the cockpit piloted by a single crew member to ensure that all procedures are adhered to, vigilance is maintained, aeronautical decision making is optimized, and safety is enhanced.*

Definition: <u>Crew Resource Management(CRM)</u> *A methodical process used in the cockpit piloted by coordinated actions of multiple crew members to ensure that all procedures are adhered to, vigilance is maintained, aeronautical decision making is optimized, and safety is enhanced.*

The advent of technically advanced aircraft has brought about the need to review the procedures used in the cockpit of these aircraft to prevent a spike in preventable accidents. The airlines and pilots of crewed aircraft have used Crew Resources Management (CRM) for years as a way to avoid preventable accidents from occurring; and it has worked. Single Pilot Resources Management (SRM) was created from the lessons learned from CRM procedures developed originally by United Airlines and other major airlines. SPRM is a mindset, an approach to professionally managing the cockpit and the systems of more complex aircraft. It combines all of the major safety disciplines such as using aeronautical decision making and employing a good, consistent scan flow and planning ahead of the path of the aircraft to avoid stressful situations that can lead to good pilots making bad decisions.

Use of Aircraft Checklists

According to the experts, one of the most important things that the pilot can do to properly manage the pilot's aircraft and avoid otherwise preventable occurrences is to use the pilot's checklist in a timely manner. The manufacturer provides a checklist for every aircraft when it is delivered based upon the equipment that is most commonly installed in that aircraft. The Garmin G1000 system is an example of a system which has an extensive checklist associated with it. This will allow the pilot to use the system to help them make sure that they have remembered everything. It is acceptable for pilots to create a more complete checklist by amending the manufacturer's checklist items with ones of the pilot's own, but never eliminate any items from the manufacturer's basic list. An example of this is an aircraft that has radar installed. The checklist may not remind the pilot to turn the radar off for ground operations or to turn it on once airborne. By adding items that the pilot learns from this course or from the pilot's flight instructor, the pilot will be enhancing the safety of every operation that they conduct. If the pilot is using a handheld checklist, add or highlight important items. The important part is to use the checklist every time that a flight is conducted and to incorporate the onscreen checklist as a part of safe operations.

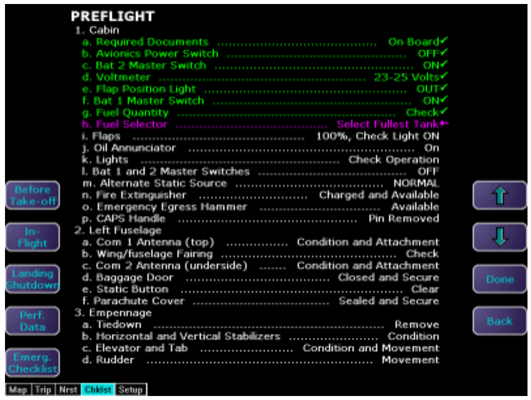

Figure 1.12 – Onscreen electronic checklist

Introduction to FAA/Industry Training Standard (FITS)

The Federal Aviation Administration has been tasked by the US Congress with overseeing and regulating the evolution of aviation. Part of this task involves promoting aviation safety and inspiring regulations which pilots, mechanics, aircraft manufacturers, aircraft operators, and flight training professionals follow to ensure that safety of flight is maintained for the flying and the non-flying public. As cockpit automation has evolved and moved from the advanced jet cockpits, finally reaching general aviation in the last several years, it became clear that traditional teaching methodologies could no longer ensure that pilots could stay ahead of that technology safely. To address this, the FAA, working with leaders throughout general aviation developed a new training methodology called FITS.

Definition: FAA/Industry Training Standard (FITS) (Figure 1.13) *A training methodology and accompanying set of training standards which uses a student-centric, scenario-based approach to teach complex procedures to reduce the total number of general aviation accidents by integrating risk management, aeronautical decision making, situational awareness, and single pilot resource management into every flight operation.*

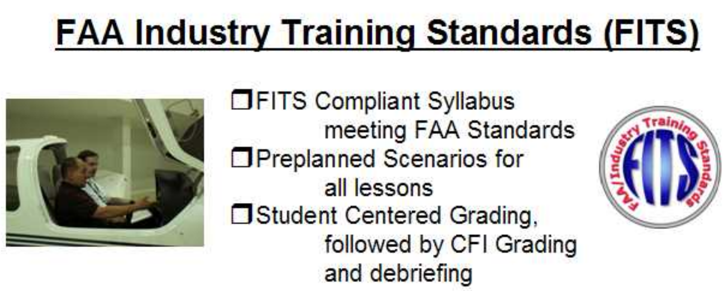

Figure 1.13 – FITS program components

This software employs FITS training techniques to help the pilot most effectively learn about the Garmin G1000 and its safe operation. Each study unit has been carefully constructed to promote the pilot's thorough understanding of the area covered in that study unit. As the pilot progresses through the software, pay close attention to the study unit description and its stated goals for learning comprehension. At the end of each study unit is a study unit quiz which portrays a flight scenario for which the quiz questions are based.

In ground or software based training for pilots, we can classify the level of FITS learning accomplishment into three main areas:

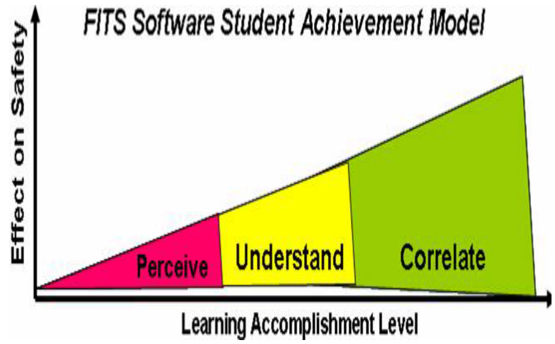

Figure 1.14 – FITS Software Student Achievement Model

- **Perceive** –at the completion of the software study unit, the pilot will be able to describe the scenario activity and understand some underlying concepts, principles, and procedures that comprise the topic, but may not yet understand how this fits in the grand scheme.

  Note: Progression to the next scenario should not be attempted until the pilot can function at the Understand level.

- **Understand**– at the completion of the software study unit the pilot will be able to describe the classroom scenario topic in terms of definitions, basic usage, and applicability, and can start to demonstrate those topics in lab sessions or in a study unit exam.

  Note: This is the minimum grading level that the pilot can be considered at in order to complete the study unit and move on to the next study unit.

- **Correlate** – at the completion of the software study unit, the pilot is able to thoroughly understand the topic without referring back to the reference material in the study unit and can correlate this topic with other topics and can properly integrate those topics with risk management, aeronautical decision making, situational awareness, and single pilot resource management into the pilot's flight operations.

  Note: This grading level would be considered above average for the pilot to complete the study unit and move on to the next area.

The pilot's learning goal is to "perceive", then "understand" the material presented and by the end of the program, the pilot can correlate the material that the pilot have covered with all the pilot's other aviation experiences. This will guarantee the most thorough level of knowledge transfer and result in the most enjoyable experience with using the Garmin G1000 glass cockpit system.

Conclusion

The pilot must maintain vigilance in the cockpit and avoid the automation distractions that tend to pull them away from flying the aircraft and performing basic cockpit management duties. This premise is the same regardless of whether the pilot is flying a Diamond, Cessna, Mooney, and Beech aircraft equipped with a G1000 glass cockpit system. With this in mind, let us go to the study unit quiz and see if the pilot is ready to move into the G1000 system Overview in study unit 2.

Remember

- ❑ TAA aircraft are ones with an integrated autopilot, moving map GPS, and some kind of flight management system to control them
- ❑ FITS is the recommended training methodology for TAA aircraft by the FAA and many insurance companies because student centered training and scenarios produce longer lasting training results that are believed to have a positive effect on operational safety
- ❑ The biggest distraction to pilots flying TAA aircraft is the Multifunction Flight Displays (MFD)

FITS Study Unit Debriefing

The pilot has now covered the area of the FITS training methodology in a TAA aircraft and why it is so crucial to properly learning to fly the Garmin G1000.

- ❑ Understanding the concept of FITS training will help the pilot understand that in ground or software training, it is important that the lessons be based upon scenarios to help the pilot learn more effectively. It is this scenario, and the pilot's participation in constructing it and learning from it that will result in the most effective learning experience for the pilot as well!
- ❑ Understanding why technically advanced aircraft are different from traditionally equipped aircraft will help the pilot realize that it is because the complexity of the cockpit and the requirement to maintain a constant vigilance over it and management of it requires a more disciplined scan flow looking at four major areas rather than three.
- ❑ Understanding why Single Pilot Resources Management (SRM) is a skill and discipline that is important to enhancing safety while operating an Garmin G1000 aircraft, then the pilot will realize that planning ahead of the path of the aircraft and not getting caught flying an aircraft with systems the pilot don't fully understand or cannot remember the exact procedures for can be hazardous to the pilot's safety.

Understanding these areas and correlating them into a pilot's everyday flying skills and application of them to the operation of a Garmin G1000 equipped aircraft, will enhance situational awareness and increase overall piloting safety. The pilot is operating at a "Correlate" level of FITS accomplishment! It's time take the quiz and then to move to study unit two!

Study Unit 1: Introduction to FITS and TAA Aircraft Quiz

The Quiz Session Scenario

This Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this session, you are asked to evaluate the differences between a conventional aircraft and a TAA aircraft. The pilot in training should imagine a flight scenario where they are flying a G1000 equipped aircraft between Spirit of St. Louis Airport (KSUS) and Kansas City Downtown airport (KMKC), both tower controlled airports. Consider the following questions about this scenario:

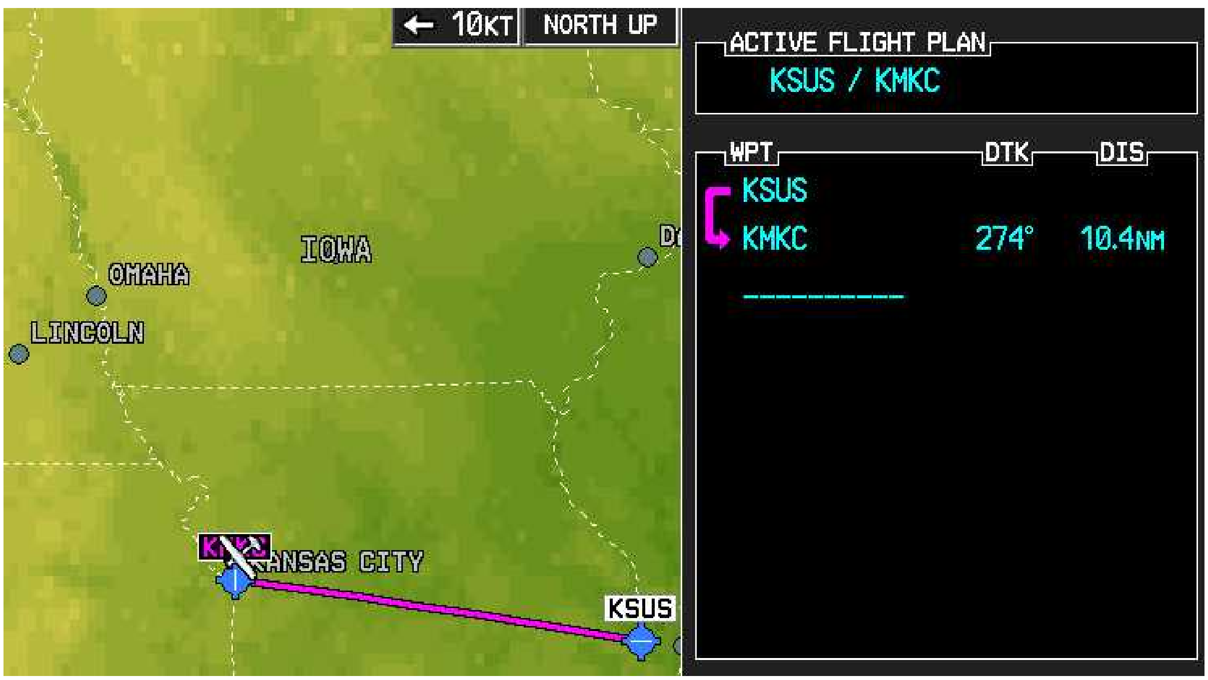

Figure 1.7 – Study Unit 1 Scenario diagram

Question 1: How do you distinguish that you are flying a TAA aircraft?

- **a) The aircraft has a GPS with a color map and weather**
- **b) The aircraft has an integrated GPS and an auto pilot that can couple to that guidance system, and a flight management system to control them**
- **c) The aircraft has an autopilot with altitude hold**

Question 2: Why is the scan flow different for TAA aircraft than for traditional aircraft?

a) **The pilot must look inside the aircraft more**

b) **The pilot has an extra item in the scan, usually a MFD**

c) **There is no difference is the scan flow**

Question 3: What are some of the hazards associated with the TAA scan flow as the pilot approaches the destination airport in this scenario?

a) **Fixation on one area of the scan flow for too long of a period**

b) **Too many items to scan**

c) **System is too complicated to use and should be turned off**

Question 4: What is the correct statement regarding the FITS training methodology and its relationship to your training in the G1000?

a) **FITS is designed to help pilots better at practicing stalls and slow flight**

b) **FITS only is useful when learning glass cockpit aircraft systems**

c) **You should be able to understand or correlate the material you study in this program in order to pass the course**

Question 5: What statement is true regarding the use of an aircraft checklist in the TAA cockpit for this flight?

a) **The checklist is not as important on such a short flight**

b) **The on screen checklist will completely eliminate the need for a handheld checklist**

c) **The on screen checklist once activated will help reduce cockpit workload, but may not include all items of importance to the pilot**

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will point you back to the appropriate reference area in the chapter. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 2- System Overview and Line Replaceable Units

Study Unit Objectives:
The objective of this Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the basic Garmin G1000 system components and the interoperability of the Line Replaceable Units (LRU) by reviewing the content of this study unit and then taking the study unit quiz at the end which will ask you some questions about the material that you covered.

Completion Standards:
When this study unit is complete, you will be able to understand the features of the basic Garmin G1000 system components and the interoperability of the Line Replaceable Units (LRU) that make the system work. You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer wrong, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

G1000 System Overview

Figure 2.1 – The G1000 panel mounted LRUs

The Garmin G1000 glass cockpit automation system was introduced to general aviation aircraft in November 2003 and quickly has evolved to be one of the two prominent systems installed in new aircraft manufactured today. Garmin, based in Olathe, Kansas has become synonymous with aircraft and marine based GPS receivers and appliances. So far, Cessna, Diamond, Mooney, and Beech have all standardized on the Garmin G1000 glass cockpit system for most of their newly manufactured general aviation aircraft manufactured in 2004 and later. The most significant advance in the design of a system like the G1000 is that it is a software driven computer that depends upon very specific software version control so that the same component installed in a Cessna will act differently from the same component installed in a Diamond or Mooney. This is very significant for general aviation because it is the first time that the FAA has allowed for the certification of small aircraft that used largely generic parts and components between the aircraft manufacturers that only were differentiated by software programs that were installed after manufacture and updated periodically to provide for revisions to the systems without removing the components from the aircraft.

Definition: <u>Garmin G1000 Equipped Aircraft</u> *An aircraft which has an integrated glass cockpit model G1000 manufactured by Garmin Corporation of Olathe, Kansas installed in place of the traditional aircraft instruments and radios.*

The diagram above (figure 2-1) portrays the portion of the system which is visible in the cockpit. This array of components is actually three different components installed in close proximity to each other giving the appearance of a common installation. These three components are actually a small part of the overall system. The components are referred to as Line Replaceable Units (LRU). The left screen is called the Primary Flight Display (PFD) and contains the flight instruments and other aspects of the system of most interest to you in maintaining flight parameter adherence. The right screen is called the Multi Function Display (MFD) and contains the information of interest to you in maintaining electronic situational awareness. The middle section is called the Audio Panel and is the main navigation, communication, intercom, and overall audio control input device signal routing. We will learn about each of these in the next several study units.

Standby Instruments

Figure 2.2 – The panel standby instruments

To date, most general aviation manufacturers have chosen to outfit G1000 equipped aircraft with a set of standby instruments powered by traditional power sources to use in the event of a G1000 system malfunction or loss of electrical power. As you start to learn the G1000 system, you will find that you will quickly adapt to using the electronic flight instruments contained in the system. Most pilots are glad that the standby instruments are there, just in case. Keep these in your scan flow to help you keep the big picture of what your aircraft is doing. As you get more time in the G1000, you will find that you need to look at them less but you will still crosscheck them periodically as a good operating practice.

Line Replaceable Units (LRU)

The Garmin G1000 system is a fully solid-state, electric powered integrated cockpit automation system that does not require any gyroscopes to operate but instead uses accelerometers and other leveling technologies to determine orientation. It designed using a modular component concept called Line Replaceable Units (LRUs).

Definition: <u>Line Replaceable Unit (LRU)</u> *A modular aircraft equipment design started in the late 1960s which consolidates parts of a common system or components of a system into a common aircraft location such as an equipment box, tray, or circuit board, facilitating ease of aircraft or system maintenance and troubleshooting.*

This LRU design philosophy is advantageous to you because it provides for subsystem redundancy and system modularity keeping system maintenance upkeep and software and database updating easy. Notice in the following diagram (figure 2.3) that the PFD, the MFD, and the Audio Panel are the pilot interface point to the rest of the LRUs of the system. Once the pilot understands how to use the controls of these three components, they have mastered the entire system.

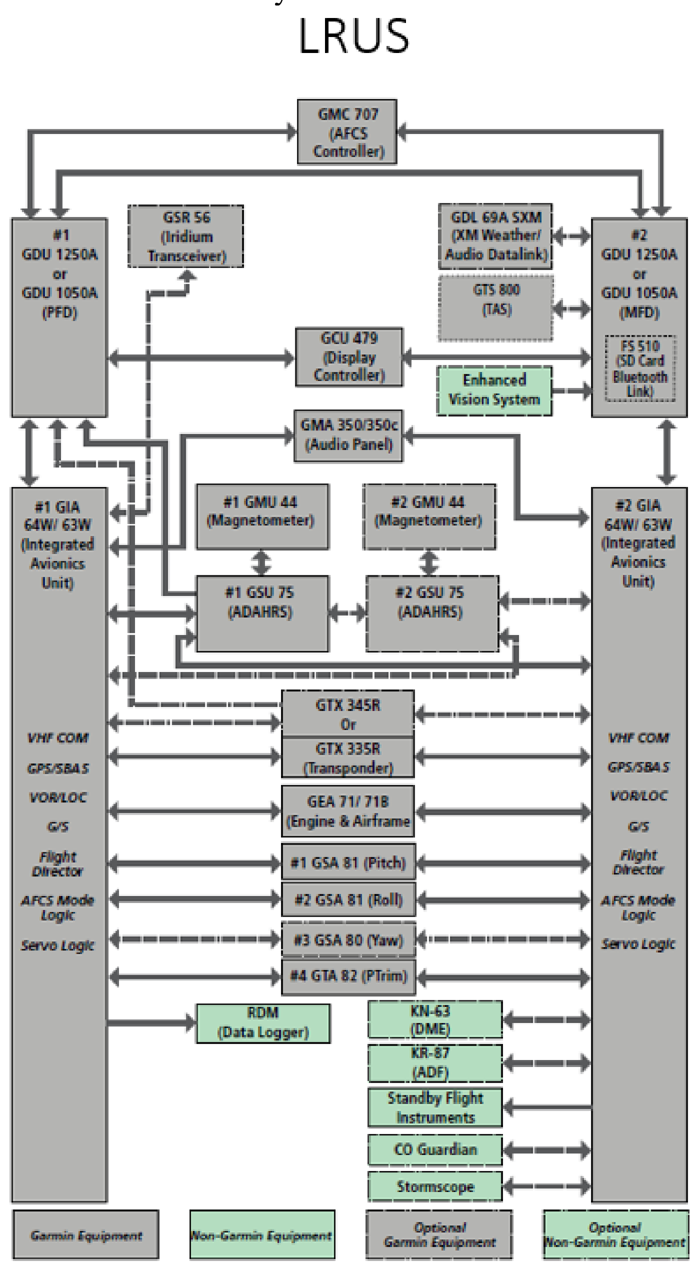

Figure 2.3 – The Garmin G1000 system LRU schematic

This LRU design philosophy is advantageous to the mechanic because it provides for ease of subsystem maintenance. If a component of the system fails, the system generates "codes" which can be interpreted by the mechanic and then only that affected LRU must be replaced. Once the mechanic understands how to check the status of the components by reading and interpreting the codes, they have mastered the management and maintenance of the entire system.

The system is comprised of twelve or more different LRUs, each responsible for one or more functions that comprise the entire system. A system such as the G1000 allows for replacing the individual component that failed instead of replacing large parts of the system. This makes for quick changeovers and less time in the maintenance shop. Another beneficial feature of the G1000 system is that all parts are interchangeable between the different make and models of aircraft since the content of the system is software driven. In this section, we will provide a system overview and all of the components. With all Garmin products, product nomenclature follows a very specific naming standard. The first letter is always a "G" to designate Garmin. The second two letters generally will be an abbreviation for the major function of the component. The numbers typically have no real meaning to the end user but simply represent a series number of the Garmin Engineering Department's final release of the product. For instance, the GDU 1040 is a Garmin Display Unit that is 10.40 inches measured diagonally. A larger version of that display unit that will be used on Cessna's Mustang VLJ will be 15" diagonally and might be named the GDU 1500.

Importance of System Cooling

Figure 2.4 – The MFD cooling fan

One of the biggest enemies of electronic systems is the buildup of heat. Garmin has designed its G1000 system with a number of system cooling fans to move heat away from the LRUs as soon and as efficiently as possible. There are vents built into the aircraft in several strategic locations that need to be familiar to you. One is on top of the instrument panel glare shield. Pilots should be careful not to place charts or checklists on the glare shield that might hinder avionics cooling. Another critical cooling area is in the avionic rack installed in the rear of the aircraft. This is designed so it can't be covered by the pilot, but the pilot can be vigilant to the sound of the cooling fans, or the lack of them at system power up. Operating with an inoperative cooling fan will bring up a message on the crew alerting system. Sometimes pulling then resetting the circuit breaker can resolve the problem and extinguish the alert.

GDU 1040 Garmin Display Unit model 1040

Figure 2.5 – The GDU1040 Display Unit

The GDU1040 is the most visible part of the G1000 system because it is installed in front of the pilot. The GDU1040 is the display unit for both the PFD and the MFD and except for aircraft with the Garmin autopilot installed, such as the Beech aircraft products; the part number is the same for the two units. On those aircraft with the non-Garmin autopilot installed, the displays are identical and can serve as either the PFD or the MFD as long as the software is updated so the system knows which display to send the information to. The GDU1040s communicate with each other and the GIA 63 through a high-speed data bus Ethernet connection. These screens are only an inch thick and only weigh about 10 pounds each. That is because they do not have any real system processors located in them. Care of the screen should be accomplished by following Garmin instructions as found in your aircraft POH, but in general, using a soft cloth and a non-ammonia based glass cleaner such as eyeglass cleaning solutions are the best for removing smudges and fingerprints. Keep pointed objects away from the screens to avoid scratching them.

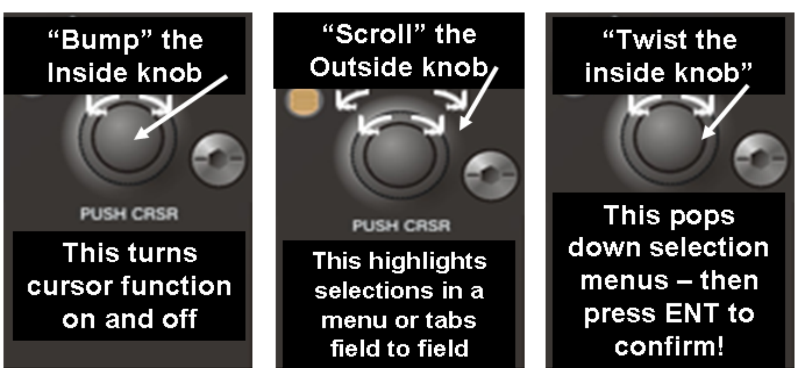

Figure 2.6 –Bump, Scroll, and Twist the FMS knob

The knobs and buttons located around the perimeter of the screens, covered more thoroughly in study unit 3, are the main interfaces of the system for the pilot. Most knobs consist of an inner, an outer, and a push function. We refer to this as “bump, scroll, and twist”.

GIA 63 Garmin Integrated Avionics model 63

Figure 2.7 – The GIA 63 Integrated Avionics control box

There are two of these units installed in the aircraft. Each one contains a navigation receiver, a communications transceiver, a glideslope receiver, and a GPS receiver. The GIA 63 also serves as the main microprocessor for almost all of the data of the entire system. The GIA 63 serves as the main communication hub for the entire system by linking all of the system LRUs with both the PFD and MFD displays. The GIA 63 units are installed in the rear avionics bay of most light aircraft installations. It is cooled by an avionics fan in order to prevent premature electronic component failures caused by heat buildup. Most of the systems functions are only visible to you through the display screens. The pilot will see screens and crew advisories that refer to GIA 63 number 1 and GIA 63 number 2. In general, number 1 provides information to the PFD and NAV1 and COM1 and GIA 63 number 2 provides data to the MFD and NAV2 and COM2, but this is largely transparent to you unless one of them fails or is moved offline by a circuit breaker. The GIA units have a data bus between them that moves data between the two units in a process called “crossfilling”; so they act as one integrated system.

Definition: <u>Automation Crossfilling</u> *A process where data entered on one display unit is simultaneously updated on the other unit to avoid conflicting data that could lead to errors in the system.*

GRS 77 Garmin Reference System model 77

Figure 2.8 – The GRS 77 Reference System (AHRS)

The GRS 77 is the attitude, heading, and reference system, and is also known as AHRS. This system provides the attitude, heading, rate of turn, and yaw information to the displays via the GIA 63 units. The unit contains advanced tilt sensors, accelerometers and rate sensors and is fully contained in the sealed box shown in the diagram. The GRS 77 also interfaces with two other LRUs called the Air Data Computer (GDC) and the magnetometer (GMU 44) in order to provide the pilot with a complete picture of the aircrafts position relative to the horizon. This unit also uses GPS signals sent from the GIA 63. The actual attitude and heading information is sent to the GDU 1040 display and to the GIA 63 units. The AHRS unit requires very little initialization time and is accomplished while the aircraft is moving and up to bank angles of up to 20 degrees. The AHRS will operate in the absence of the other reference inputs like the GPS, ADC or magnetometer. When power is activated and the AHRS starts to initialize, the pilot will first see red Xs covering several of the instruments on their Primary Flight Display. This is normal. As soon as the unit is ready, it will automatically remove the red Xs from the screen letting you know that the system is ready.

Note: Never attempt a takeoff with an instrument displaying a red X.

MU 44 Garmin Magnetic Unit model 44

Figure 2.9 – The GMU 44 Magnetometer

The GMU 44 is a solid state device which senses magnetic field vectors from the earth and converts them to magnetic course and heading information for forwarding to the GRS77 AHRS LRU. This device is located at a remote point on the aircraft such as out on the middle of the wing free from magnetic inference caused by electronic systems of the aircraft. It should be handled with care by maintenance personnel. No magnetic tools should be used in its vicinity in order to maintain its functional integrity. It is possible for this unit to fail and the GRS77 AHRS unit could continue to function but magnetic heading information would be removed from the Horizontal Situation Indicator (HSI) on the PFD.

GDC 74a Garmin Data Computer model 74a

Figure 2.10 – The GDC 74A Data Computer

The GDC 74a Data Computer is like a Pitot Static system with an E6B flight computer built in. This LRU is responsible for deriving, airspeed, altitude, rate of climb and receives information from the GTP 59 outside air temperature probe to compute true airspeed, density altitude, pressure altitude, and other elements important to the G1000 system for performing its multitude of tasks. Notice from the diagram that it has two hose connection nipples for connection to the pitot line and the static line. If this unit were to removed from the aircraft, the IFR pitot static check required by regulations every 24 months for IFR flight would have to be conducted to ensure system integrity.

GEA 71 Garmin Engine/Airframe interface unit model 71

Figure 2.11 – The GEA 71 Engine/Airframe interface control box

The GEA 71 is the processing unit for all of the engine and airframe instrumentation and sensors, including manifold pressure, RPM, oil temperature/pressure, cylinder head temperature, electrical system integrity, exhaust gas temperature, fuel flow, and vacuum system (if installed). If the engine is turbocharged, it will also receive information regarding turbine inlet temperature. The system can also provide airframe information like door or canopy latch integrity, landing gear position, flap position, and other systems but this will vary by aircraft manufacturer. The GEA 71 unit is largely invisible to you as only the information is shown on the engine and airframe monitoring display or the crew advisory and alerting system.

GMA 1347 Garmin Manager of Audio model 1347

Figure 2.12 – The GMA 1347 Management of Audio panel

The GMA 1347 is the audio panel like control LRU used by the G1000 system. It is made of solid state components but contains all of the pilot controls for selecting audio input and output similar to its analog predecessors found on aircraft manufactured over the past 30 years. It integrates NAV/COM audio, the intercom system and marker beacon. The unit operates similar to most other audio panels. Contained in the audio panel are the controls for the intercom and the reversionary mode backup button. This device is covered more in detail in study unit 8.

GTX 33 Garmin Transponder model 33

Figure 2.13 – The GTX 33 Mode S Transponder control box

The GTX 33 Transponder is a "Mode S" radar transponder which fully supports the FAA ATC system mode A and mode C radar transponder standards. In addition to receiving and decoding the standard transponder signals, it also fully supports the Mode S digital functions which include Ground mode and Traffic Information Service. These are covered more in detail in study unit 7.

GTP 59 Garmin Temperature Probe model 59

Figure 2.14 – The GTP 59 OAT Probe sensor

The GTP 59 outside air temperature probe is used to sense and send the outside air temperature to the GDC 74a air data computer for processing. The pilot should check this unit prior to flight to make sure that the probe mast and the moisture seal at the bottom of the probe are not damaged. It is installed on top of Cessna Aircraft and on the bottom of Diamond Aircraft. Other manufacturer's locations will vary.

GDL 69 XM Satellite Data Link Control Box

Figure 2.15 – The GDL 69 XM Satellite receiver control box

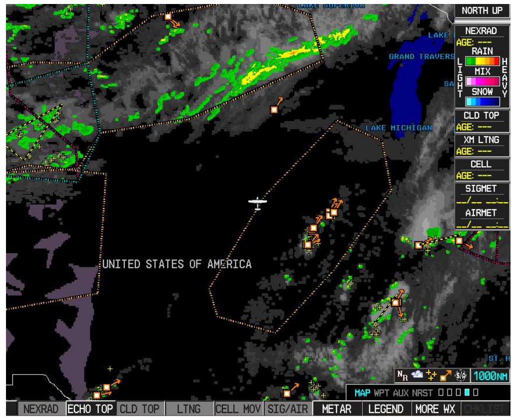

Figure 2.16 – The XM Satellite Receiver in Weather mode

The GDL 69 is the data link system that interfaces with the G1000 to bring both XM weather and entertainment to the airplane. The advantage of XM is that it is broadcast in the S-band frequency so that uplink is possible at any altitude in North America. XM weather contains a wide variety of information not limited to NEXRAD RADAR DEPICTION, XM lightning data, cloud tops, echo tops, METAR and TAF information, SIGMETS and AIRMETS, and even hurricane track information. Currently, many of the first G1000 aircraft are being retrofitted with GDL 69 so that they are able to take advantage of this new technology. You will see more information about this in the Multi Function Display study unit 10.

Conclusion

The G1000 system is made up of separate but integrated control devices known as line replaceable units (LRU) that interact with each other to produce an avionics production in the cockpit which appears seamless. The separation of the LRUs allows the function to operate autonomously and provides for ease of operation, troubleshooting, and maintenance. It also provides for a distribution of weight across the aircraft to keep within the airframe original certification weight and balance envelope. The individual units have no controls other than what the pilot sees in the cockpit. The system is operated using software that resides within one or more units and that software defines behaviors of the system even if the LRUs are identical to that installed in another manufacturer's airframe. This provides for part interchangeability and prevents maintenance personnel from having to understand discrete repair procedures, like they have had to do on previous generations of aircraft cockpit designs.

Remember

- ❑ The LRUs provide for redundant data flow within the system
- ❑ Each LRU is operated by system software which enables or disables functions of the system as determined by the airframe manufacturer
- ❑ Adequate cooling is essential to ensure LRU longevity
- ❑ Systems annunciations are provided to the cockpit display units to report LRU integrity and to provide you with adequate time to make decisions upon any system degradation

FITS Study Unit Debriefing:

You have now covered the area of the Garmin G1000 system modules and the concept of Line Replaceable Units (LRU) and should now see that a technically advanced aircraft (TAA) such as the Garmin G1000 is constructed and operated differently than traditional aircraft.

- ❑ If you now understand that the G1000 uses LRUs to create redundancy for its systems and that this redundancy is what makes these systems so dependable, then you should also be able to distinguish basic cause and effect of LRU system properties and their failures.
- ❑ If you now understand why knowing the functions of these LRUs and their basic interdependencies will help you to troubleshoot the aircraft properly when necessary and to aid in the proper decision making when error codes arise, then you also should realize that these systems can dramatically improve your situational awareness by providing you with information you never before had at your fingertips.
- ❑ If you now understand that this system is a digital system featuring many systems which are driven by software and computers, then you will realize the importance of keeping the software and the databases which drive it current and up to date.

If you not only understand these three areas, but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a “Correlate” level of FITS accomplishment! It’s time take the quiz and then to move to study unit three!

Study Unit 2: System Overview and Line Replaceable Units Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you will be asked to demonstrate an understanding of the Garmin G1000 system block diagram, the interrelationship of the system components, and how each component provides flight reference, navigation, communication, and aircraft system information to you when flying the G1000 equipped aircraft.

The pilot in training should imagine a flight scenario where they are flying a G1000 equipped aircraft between Kansas City Downtown airport (KMKC) and Lexington, Missouri (KLXT), a non-tower controlled airport. Consider the following questions about this scenario:

Figure 2.17 – Study unit 2 quiz scenario diagram

Question 1: You are flying your local flight to the destination airport and your magnetometer fails. What information will you lose?

a) **Altitude information**

b) **GPS and course guidance information**

c) **Heading information as reported on the HSI**

Question 2: What does the GRS 77 AHRS control for the G1000 system?

a) **Reference information such as Attitude, Heading, and turn rate**
b) **Engine temperature information**
c) **Altitude and Airspeed information**

Question 3: You are flying on your way to your destination and you receive a system annunciation saying that you have a GIA Cooling Fan failure. What should you do?

a) **Reset the circuit breaker, let it cool and push it back in to see if the alert resets**
b) **Land as soon as possible to avoid avionics failure**
c) **Press CLR to see if the fault resets itself using the GEA 71 LRU**

Question 4: You are preparing for takeoff and you see a red x appear on your oil pressure gauge. What should you do?

a) **Abort the takeoff and return to have the GRS 77 replaced**
b) **Abort the takeoff and cross check other indicators looking for other abnormalities to determine if shut down is required**
c) **Abort the takeoff and immediately shut off the engine to avoid damage**

Question 5: You are flying on your trip and you notice that the true airspeed box has a red x in it but your flight instruments on the PFD appear normal. What would you suspect happened to the system?

a) **The PFD has a wiring problem**
b) **The aircraft has a plugged or iced over pitot tube**
c) **The GTP 59 OAT probe has developed a sending unit problem**

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will offer a link back to the appropriate reference area in the study unit. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 3- Knob, Button and Control Functions

Study Unit Objectives:
The objective of this Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the Garmin G1000 knob, button and control functions by reviewing the content of this study unit. You will then take the study unit quiz at the end which will ask you some questions about the material that you covered.

Completion Standards:
When this study unit is complete, you will be able to understand the features of the Garmin G1000 knob, button and control functions. You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer wrong, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

Introduction to information and controls contained in the G1000

Figure 3.1 – Cirrus Sr-20 Garmin Perspective cockpit layout

The Garmin 1000 is an integrated avionics and flight data display system. It allows the user to display and/or modify the following areas and information. Regardless of which aircraft model the G1000 is installed in, the knobs, buttons, and controls all perform the same functions:

1. Flight instrumentation – The flight instrumentation is contained on the PFD situated in front of the pilot. It contains the same kind of information you would expect on a conventional aircraft cockpit but some of the information is represented in a more efficient vertical tape format. You will learn much more about this in the PFD study unit 5.
2. Navigation instrumentation – The navigation instrumentation is represented by a course deviation indicator (CDI) needle that is located on top of the electronic representation of the heading indicator. When these two pieces of information are combined together, we call this a horizontal situation indicator (HSI). The HSI can show GPS, NAV1 or NAV2 information by pressing the CDI softkey. You will learn more about this in the PFD study unit 5.

3. GPS/Moving Map Database - the heart of the G1000 system is two independently operating highly accurate GPS receivers and their software driven interface with the Jeppesen map database containing information about terrain, obstacles, and information about known aeronautical waypoints and facilities. These units interact with the portions of the G1000 which tracks information about its environmental and spatial orientation data and you have a truly integrated suite, and highly dependable glass cockpit system.
4. Communication radios – The G1000 uses its computers to operate two integral digital VHF COM transceivers.
5. Navigation/VOR radios - The G1000 uses its computers to operate two integral digital VHF NAV Receivers to provide reliable information for the tracking of VORs, Localizers, and ILS transmitters.
6. Aeronautical Database – The Jeppesen databases are updated via a Secure Digital (SD) style disk similar to those used by digital cameras. Once the information is loaded into the system, it is used by the various parts of the G1000 until that data expires. The system keeps track of the expiration date and alerts the pilot when it is time to update the database.
7. Engine instrumentation – The G1000 has an interface system with the engine and the airframe systems which provide real time monitoring information to you. When there is an abnormality in the engine or airframe systems, this information is shown to you on both the engine indicators and the Crew Alerting System.
8. Flight planning functions – One of the noticeable enhancements of the G1000 is in the area of integrated flight planning. Once you master the procedure of creating and reusing flight plans instead of using the Direct-to navigation key, you will find that your cockpit workload has been greatly reduced. You will find out more about flight planning in study unit 11 later in this program.

Navigating Around the G1000

Knobs, buttons, and controls

Figure 3.2 – The GDU 1040 Display Screen

The G1000 display screen has several general parts that you must become familiar with. The knobs, controls, and buttons are the same between the PFD and the MFD because the units are identical (except in aircraft utilizing the Garmin Autopilot. In these aircraft, the MFD will have added controls to control the autopilot functions.) It is the system software that makes the PFD and the MFD different. Let us first look at the functions of all the knobs and controls.

GDU1040 Display Soft Keys

Figure 3.3 – GDU display "softkeys"

The soft keys that underlie both the PFD and the MFD are used to change the options shown on the screen and to make common menu selections in particular modes of PFD and MFD operation. These options will be discussed more in detail in other study units.

RANGE Selector knob

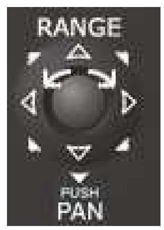

Figure 3.4 – Range selector knob

The RANGE knob is the most complex knob on the entire display unit because it has multiple functions. In addition to having range control authority of the MFD Map and the PFD Inset Map, it also controls joystick functions for moving the mouse pointer around the map. Twisting the knob controls the zoom function of the MFD map or PFD inset. It can zoom out as far as 2000 miles and can zoom in as close as 500 feet. If the menus are set up with auto-zoom (recommended) the map sometimes may be set to a resolution that does not suit your needs and you can use the range knob to adjust this. Pressing in on the knob activates the "Pan" pointer function and a box appears on the top of the MFD map to show you relative position to the point where the joystick is currently focused. These options will be discussed more in detail in the MFD and the PFD study units.

HDG or HEADING Selection Knob

Figure 3.6 – HDG Heading Control knob

The HDG or Heading selection knob is the control knob where the desired heading is set on the HSI. The Heading bug that it controls on the HSI is what the autopilot follows when it is engaged in HDG track mode.

Figure 3.7 – Depiction of HDG bug and CRS selection pop-up boxes on HSI

Figure 3.8 – HDG bug is pressed to center HDG bug on current heading

Figure 3.8 – HDG bug "snapped to lubber line" after pressing HDG knob

Pressing in on (or "bumping") the HDG knob serves to center the heading bug on the HSI to the current heading. This is very useful when using the autopilot in HDG mode. It is recommended that you do this when tracking VOR and LOC courses once you determine a heading that will hold the wind track angle constant.

ALT or ALTITUDE Selection Knob

Figure 3.9 – ALT knob moves Altitude bug reference pointer

Figure 3.10 – ALT bug has no bump function and must be twisted

The ALT or Altitude selection knob is the control knob where the desired reference altitude is set on the Altimeter Vertical Tape. The ALTITUDE bug that it controls on the ALTITUDE tape is NOT currently used by an external autopilot such as the KAP 140 found on many Cessna, Diamond, and Mooney aircraft. The ALT bug will be used by the integrated autopilot found on BEECH aircraft and the Cessna Mustang Jet. The outside knob controls thousands of feet and the inside knob controls hundreds of feet.

CRS/BARO Selection Knob

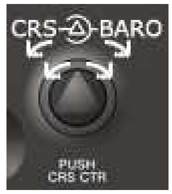

Figure 3.11 – BARO knob sets the altimeter setting into the G1000

Figure 3.12 – Altimeter setting read under Altimeter vertical tape

The CRS/BARO or Course and Barometric pressure selection knob controls two different functions. One, it allows the altimeter setting to be entered into the G1000 for processing. Second, it functions to adjust the OBS needle when operating in NAV1 or NAV2 navigation mode. You will see more about the CRS and OBS functions later in the PFD study unit 5.

Flight management System (FMS)

Figure 3.13 – Flight Management controls

The FMS section of the display is where most menus are activated and information is entered into the G1000 system. Future versions of the G1000 will have a small keyboard to do these functions, but this early release of the system uses the same style of inner and outer knob function as found on the Garmin 430 and Garmin 530 GPS radios. Each of these has a similar function on the PFD and the MFD but the behaviors and the appearance of the menus that the controls produce may be different due to the size or "real estate" of the screen that is dedicated to that menu.

Flight Management System - The Garmin Control Unit (GCU) Panel

Figure 3.14a – Garmin GCU Panel used on Cirrus Perspective Plus equipped aircraft

In November 2005, Garmin G1000-equipped Columbia 350 and 400 with the new READY Pad (Remote Access Data Entry) alpha-numeric key pad was announced as a new way for users of these aircraft to enter information into the system. The Cirrus Perspective equipped aircraft used an updated version of the READY panel called the GCU (Garmin Control Unit)-Notice that many of the same controls, including the FMS knob and the RANGE knob are installed on this remote panel.

Flight Management System (FMS) Control Knob

Figure 3.14b – The FMS knob

Figure 3.15 – FMS knob uses the "bump, scroll and twist" to activate menus

The FMS control knob has three main controls associated with it. The outer knob, the inner knob and then the "push for cursor"; which we refer to as "bump, scroll, and twist". Turning or scrolling the outer knob navigates in a tab function between different items in a menu or between different menus. The inner knob acts like a selection knob which brings up choices within a question such as "yes" or "no", "accept" or "cancel" and others and we call this "twist". The "press for cursor" or "bump" knob toggles between cursor on and cursor off. When cursor is on, you will see a blinking cursor on the screen. When the cursor is blinking, you cannot navigate away from that menu or page using the inner or the outer knob.

Note: When cursor is blinking, the scroll and twist functions of the outside and inside knob cannot navigate away from the current page or menu. To navigate to a different page, you must bump the cursor off.

ENT or Enter Key

Figure 3.16 – ENTER key

The enter button is used to accept menu options or commit selections of the G1000 into or out of the database or into any menu option.

CLR or CLEAR Key

Figure 3.17 – The CLEAR key

The CLEAR key is used to empty or clear a selection from an input field. It also serves to backup to the last menu or selection just as the "back" key works in a computer browser. If you ever make a mistake in inputting information in a menu or selection, press the CLEAR key.

Note: On the MFD, pressing and holding the CLR or CLEAR key is the simplest and quickest way back to the top level chapter and page or the MAP page 1.

D-> or Direct-to Key


Figure 3.18 – Direct-to key

The DIRECT-TO key is used to direct the aircraft toward a particular waypoint from the G1000 waypoint database. It is also used to direct the aircraft towards a particular point within a flight plan or to make a point of that flight plan the temporary destination so that the system offers you procedures such as instrument approaches and airport data for that particular waypoint without removing the rest of the information from the flight plan. The Direct-to key is also useful for redirecting the aircraft to a waypoint when it has drifted off a straight line course or has been vectored away from the course by ATC. Many pilots misuse this key when they should be creating a flight plan instead.

Note: When in Autopilot NAV mode, the NAV function will not ARM until the HSI CDI DBAR is within one course dot from centered. Using the Direct-to key is a quick way to force the autopilot to ARM from its current location.

MENU Key

Figure 3.19 – Menu key

The menu key is used to bring up context sensitive menu selections for a particular screen or mode. On the PFD, the MENU key brings up a menu box which controls the PFD and the MFD brightness. On the MFD, it brings up a host of other menu options that will be discussed in study unit 10.

PROC or PROCEDURE Key

Figure 3.20 – PROC Control key

The PROC or procedure key calls up the menu to select instrument procedures such as instrument approaches, instrument departures (SID) and instrument arrivals (STAR). Both the PFD and the MFD can both call up this option, but the menu that this button calls up is different on the PFD and the MFD. The MFD menu box is far more detailed. These will be addressed in more detail in the respective PFD and MFD study units.

FPL or FLIGHT PLAN Key

Figure 3.21 – FPL Flight Plan control key

The FPL or FLIGHT PLAN button calls up the menu to select information to creating, editing, or monitoring a Flight Plan. Both the PFD and the MFD can both call up this option, but the menu that this button calls up is different on the PFD and the MFD. The MFD Flight Plan menu box is far more detailed. These will be addressed in more detail in the FLIGHT PLANNING study unit 11.

Navigation radio controls (NAV)

Figure 3.22 – NAV Radio controls

The NAV controls section is for selecting VHF radio frequencies such as VOR and Localizer frequencies. The outer knob selects the MHz portion of the frequency in the inner portion of the knob selects the KHz portion of the frequency. For instance, to select the NAV frequency 117.4, you would use the outer knob to select the 117 and the inner portion to select the .40.

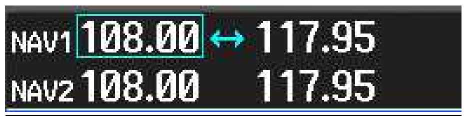

Figure 3.23 – NAV radio frequency display

The blue box always represents the target of all control movements including volume and is the standby position. The top line is NAV1 and the bottom line is NAV2.

Figure 3.24 – NAV Radio controls

To select between entering information into NAV radio 1 and NAV radio 2, you would press in or "bump" the inner portion of the NAV knob. The blue box moves up and down between the NAV1 and NAV2.

Figure 3.25 – NAV frequency toggle key

Once you put the new desired NAV frequency into the blue box, you use the NAV frequency toggle key or "flip-flop" key to move it from the standby position to the active position. You are now free to enter a new frequency into the standby position using the knob or you can select a frequency from the WPT or NRST dropdown menus and press ENT to copy that frequency into the blue box.

Figure 3.26 – NAV frequency auto identification feature

The G1000 has an automatic station identification feature that shows the station identifier next to the station frequency. This is accepted by the FAA as a valid station identification for the purposes of an FAA Checkride, but the Where ever this blue box just discussed is highlighted is where all control inputs including volume is directed.

Note: The FAA has determined that the auto station identifier is just as valid an identification as listening to a station Morse code identifier. To get credit for station identification on an FAA Airman Check ride, the applicant must point out the station identifier to acknowledge that they have actually verified that it is the correct station.

Figure 3.27 – NAV audio selection on the GMA 1347 Audio Panel

In order to actually listen to the Morse code identifier or to listen to a HIWAS transmission over that NAV frequency, you must press the NAV1 or NAV2 buttons on the GMA1347 Audio Panel in order to direct that audio source to the headsets or the speakers.

Figure 3.28– NAV volume ID knob

To select volume of the selected NAV station, use the Volume/ID knob. It will only adjust volume of the radio currently selected by the blue box around its frequency. To check for the identification of that station, press the volume knob in momentarily to activate the ID portion of the NAV radio. The Morse code identifier coming through the audio panel will be accentuated and become clearer. The use of this button can also aid the automatic identifier that comes up next to the station frequency for distant stations.

Figure 3.29 – NAV volume percent display

As the volume is adjusted, you will see a % symbol appear in the window to let you know where the volume is currently set. The volume knob only affects the volume of the radio with the blue highlighting box around its frequency.

NAV Radio Control Summary

Figure 3.30 – NAV frequency controls

- The NAV 1 and NAV 2 controls are located on the upper left hand corner of the screen. NAV 1 is located and the top row and NAV 2 on the bottom. The active NAV frequencies will be on the right (closest to screen) and standby on the left (farthest from the screen).
- To change the frequency, the blue box has to be around the frequency you wish to change. To move the box from NAV 1 to NAV 2, push the NAV frequency selector knob in.
- The NAV frequency selector is located on the left hand side of the GDU 1040, the larger knob controls MHz and the smaller knob controls kHz.
- To identify a VOR or LOC, make sure the appropriate NAV 1 or 2 is selected on the audio panel. Then press the NAV volume control "in" on the upper left hand side of the GDU 1040. "ID" will appear in between the standby and active frequency position.
- The VOR or LOC identifier will also be displayed to the right of the active NAV frequency. For example "STL" will appear if St. Louis VOR is in the active frequency.
- The color of the active NAV frequency depends on what is selected as the current CDI needle on the heading indicator. If VOR or LOC 1 is selected, then the active frequency in NAV 1 will be green. And if VOR or LOC 2 is selected as the CDI, the active NAV 2 will be green.

COMMUNICATION radio controls (COM)

Figure 3.31 – COM frequency control group

The COM controls section is for selecting VHF radio communication frequencies such as tower and ground control frequencies. The outer knob selects the MHz portion of the frequency in the inner portion of the knob selects the KHz portion of the frequency. For instance, to select the NAV frequency 136.975, you would use the outer knob to select the <u>136</u> and the inner portion to select the <u>.975.</u>

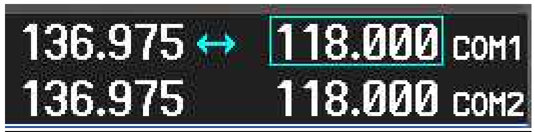

Figure 3.32 – COM frequency display box

Figure 3.33 – COM frequency control knob

To select between entering information into COM radio 1 and COM radio 2, you would press in or "bump" the inner portion of the NAV knob. The blue box moves up and down between the COM1 and COM2.

Figure 3.34 – COM frequency toggle key

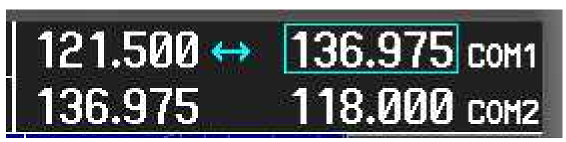

Figure 3.35 – COM frequency toggle selected box after flip-flop

Once you put the new desired COM frequency into the blue box, you use the COM toggle select key or "flip-flop" key to move it from the standby position to the active position. You are now free to enter a new frequency into the standby position.

Note: Pressing and holding the COM frequency toggle key automatically enters in and selects the emergency frequency 121.5 MHz.

Figure 3.36 – COM frequency selection on the GMA 1347 Audio Panel

In order to actually listen to the radio selected, you must press the MIC1 or MIC2 button on the GMA1347 Audio Panel in order to direct that radio audio to the speaker or the headsets. There will be more on this in the Audio Panel study unit 8.

Figure 3.37 – COM volume/SQ select knob

To adjust volume of the selected COM station, use the Volume/Squelch knob. It will only adjust volume of the radio currently selected by the blue box around its frequency. To check for the level of the volume or to listen to distant stations, press the VOLUME/SQUELCH knob to turn off the automatic squelch feature of the radio.

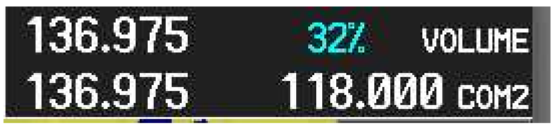

Figure 3.38 – COM frequency volume percent display

As the volume is adjusted, you will see a % symbol appear in the window to let you know where the volume is currently set. This avoids turning down a radio by accident because you did not realize that the blue box was set on another COM radio.

Note: Volume is always directed at the COM radio highlighted by the blue box.
Note: It is always recommended that you check the volume of a radio by pressing the volume knob prior to transmitting on a new frequency to avoid "stepping" on the frequency with insufficient volume

Com Radio Control Summary

Figure 3.39 – COM radio control group

- ❑ The COM 1 and COM 2 are located on the upper right hand corner of the GDU 1040.

- ❑ To change the frequency, turn the COM knobs on the right hand side of the GDU 1040 above the BARO and CRS selector. Use the large knob to change MHz and the small knob to change kHz.
- ❑ The top row will display the active and standby frequencies for COM1. The bottom row will display the active and standby frequency for COM2.
- ❑ The standby frequency is located on the right and can be changed by pushing in the COM frequency selector knob and moving the blue box over standby frequency on either COM1 or COM2.
- ❑ Once you have change the frequency and would like to make it the active frequency, press the flip switch just below the volume control.
- ❑ The Active frequency that the pilot is transmitting and receiving on will be green. All inactive frequencies will be white.
- ❑ To adjust the volume for COM 1, the blue box must be on the standby frequency in COM1. The turn the volume control knob on the very top right of the GDU 1040 to adjust the volume. A percentage of volume level will appear between the Active and standby frequencies.
- ❑ To adjust the volume for COM 2, you must press in the frequency selector knob to move the blue box down to the standby frequency on COM 2. Then use the volume control just like with COM 1.
- ❑ Push the volume control knob in to hear the squelch.

Using the Knobs, Buttons, and Controls with the Right Hand

Figure 3.40 – Using right hand to access all controls

Now that we have looked at the function of all the controls of the display unit, we can look at the best way for you to utilize all these controls. Because the PFD and the MFD are installed next to each other with the GMA1347 audio panel in the middle, we can see that every control of the system can be accessed using your right hand. This explains why Garmin put the NAV on the left side of the display screen and the COM on the right. This technique frees up the pilots left hand to control the aircraft and perform other chores.

Conclusion

In this study unit, we looked at all the knobs, buttons, and controls of the GDU1040 display units and looked at how to operate them. We see that most of the buttons have multiple functions and move in several different motion planes depending upon what you want to do with the control. It will take a little getting used to, but once you practice the functions of these controls, you will find that operating your G1000 integrated cockpit system to be much easier than you ever imagined.

Remember

- ❑ The controls have different functions depending upon whether you scroll, twist, or bump the control
- ❑ The same knob on the PFD and the MFD may produce a different view of the same menu function due to screen "real estate" space availability
- ❑ The system is laid out to be fully functional with your right hand freeing your left hand to control the aircraft
- ❑ A thorough knowledge of the controls and what they do will free your attention to maintain a good scan-flow while you are flying avoiding costly distractions

FITS Study Unit Debriefing:

You have now covered the area of the Garmin G1000 knobs, buttons, and controls and should now have a good understanding about how to operate the functions of the system using them.

- ❑ If you now understand that the G1000 knobs, buttons, and controls are generally the same between the PFD and the MFD, then you should understand that using a combination of the two with your right hand frees up your left hand to do the flying!
- ❑ If you now understand that the NAV and COM controls on the G1000 require some planning so that you get the sequence of button strokes correct, then you will also understand that this NAV and COM setup gives you much more flexibility over NAV and COM setups than in traditional aircraft.
- ❑ If you now understand that this system offers a host of features never before seen in general aircraft, then you will understand that practicing your keystroke knowledge of the knobs, buttons, and controls will make your job of operating this system much easier and more satisfying.

If you not only understand these three areas, but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a "Correlate" level of FITS accomplishment! It's time take the quiz and then to move to study unit four!

Study Unit 3: Knob, Button, and Control Functions Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to key in the information you need to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you will be asked to demonstrate an understanding of the Garmin G1000 knobs, buttons, and controls to ensure that you are ready to proceed to the next study unit.

For this quiz scenario, imagine that you have several hours now in your G1000 equipped aircraft. You should imagine a flight scenario where you are flying a G1000 equipped aircraft between Kansas City Downtown airport (KMKC) and Columbia, Missouri (KCOU), a tower controlled airport. Consider the following questions about this scenario:

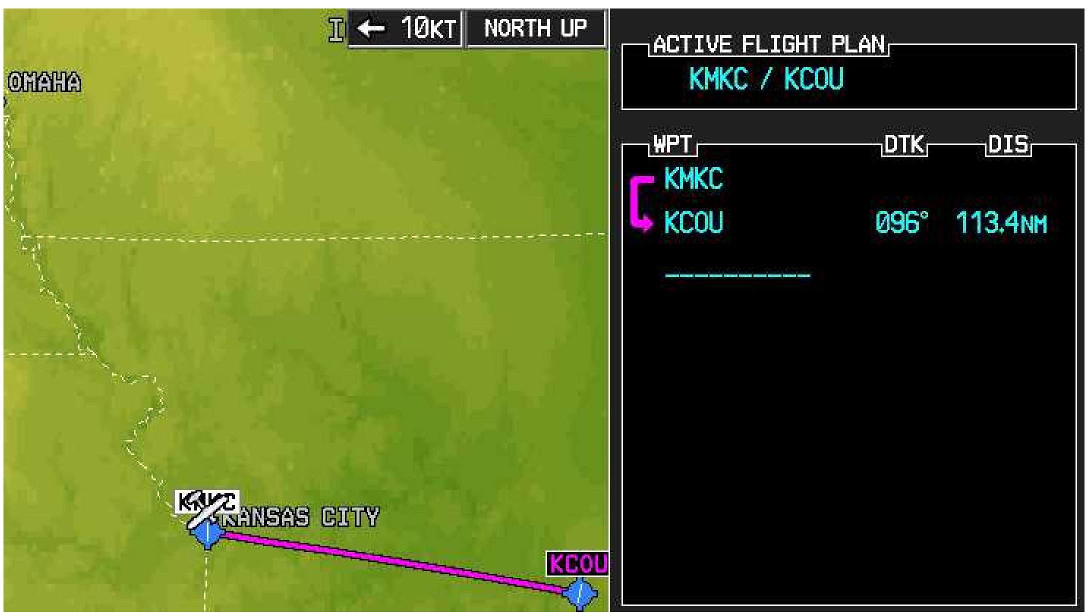

Figure 3.41 – Quiz scenario diagram

Question 1: You are preparing to depart and are getting your weather from the local AWOS at your airport. Where do you put the altimeter information into the G1000 equipped aircraft?

a) **Through the Autopilot BARO button and this sets the entire aircraft**
b) **You put it into the G1000 using the Baro knob, into the standby altimeter using the kolsman knob, and into the autopilot (if equipped)**
c) **You put it into the GPS database using the ALT knob on the GDU1040**

Question 2: You have completed your departure and you want to place the arrival CTAF frequency into your number 2 COM. How do you do this and make it active?

a) **You key in the frequency with the keypad and press enter**
b) **You use the inner and outer knobs of the FMS knob to select the frequency and then press the frequency toggle button**
c) **You use the inner and outer knobs of the COM knob to select the frequency and then press the toggle frequency button to make it active**

Question 3: You are now airborne and want to center the heading bug and the Altitude bug at your current heading and altitude. How do you do this?

a) **Press the Direct-to button and then select HDG and ALT**
b) **Turn the ALT and the HDG knob counterclockwise until they are centered**
c) **Press in ("bump") on the HDG and turn the ALT knobs to center these settings**

Question 4: You are trying to tune in ATIS on COM2 to get the weather at the destination airport and you find that you are a little far away and hear nothing in your headset. What can you do with the G1000 radios to help you?

a) **Turn the volume up on the GMA1347 Audio Panel**
b) **Make sure the blue box is around the active frequency and then turn up the volume control using the VOL/SQ knob**
c) **Pressing the VOL/SQ button in will turn off the squelch and allow you to hear the station at an increased distance**

Question 5: If you were on the trip half way to your destination and you wanted to hear the NAV radio identifier for an upcoming VOR and did not see the station identifier show up next to the frequency, how would you increase the sensitivity of the NAV radio that you were listening to?

a) **turn the volume up more using the NAV VOL/ID knob**
b) **make sure the blue box is around the active frequency and then turn up the VOL/ID volume control knob**
c) **press the NAV button on the Audio Panel and by pressing the NAV VOL/ID knob in to amplify the Morse code of the identifier**

Question 6: How do you use the FMS selection Knob to retrieve information from menus within the G1000?

a) Twist the knobs to select automatic search and then press ENT to make your final selection

b) Turn the inner knob and outer knobs to alphabetically spell station names and then press ENT for Entering the selection

c) Bump the inner knob to activate cursor, scroll with the outer knob to move to the correct field and twist the inner knob to select your choice in the drop down box followed by pressing ENT

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will offer a link back to the appropriate reference area in the study unit. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 4- Powering Up the G1000

Study Unit Objectives:
The objective of this Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the power-up sequence of the Garmin G1000 by reviewing the content of this study unit. You will then take the study unit quiz at the end which will ask you some questions about the material that you covered.

Completion Standards:
When this study unit is complete, you will be able to understand the power-up sequence of the Garmin G1000. You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer wrong, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

Getting Ready to Power-up the G1000

Where the G1000 gets its Power

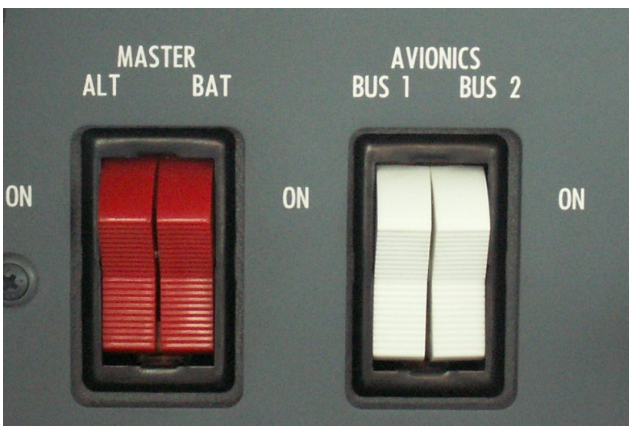

Figure 4.1 – Master and avionics switches on a Cessna G1000 panel

The G1000 system is a fully integrated system. Traditionally, when we started an aircraft we would turn on the Master Switch, start the engine, and then we would turn on the avionics master switch to avoid voltage spikes from damaging our radios during the power consumption of starting the engine.

In the G1000 system, it has been designed to operate on a very wide range of voltages so the possibility of avionics damage from voltage spikes during engine start have been largely minimized and no longer have to be of concern for system longevity. So when we turn the master switch on, the essential portions of the G1000 powers up at that time. The non-essential parts of the system are powered up with the Avionics switch after engine start.

Another thing that we have learned with the advent of digital power management systems such as the G1000 is that there is a measurable difference in current consumption between turning on the master switch with the "battery only" side of the switch, and turning it on with both sides of the switch which engages the alternator portion of the circuitry. This is essential after the engine is running but for preflight and starting sequences, especially when the battery may be weakened from the process of elongated periods of flight plan programming and other pre engine start duties. It is especially hard on a battery during cold temperatures. So in times of prolonged or extended battery use, it is permissible to use the battery side of the master switch to do many preflight engine start duties.

Figure 4.3 – Aircraft electrical bus

Once the engine starts, then press the "alternator" side of the master switch forward and watch the Battery Voltage quickly rise up to 28 volts and the ammeter show a positive charge. You will also see the Low Voltage caution on the crew alerting system go out. Using this procedure allows you to check the status of the charging system after the engine starts and to preserve battery power for operation.

Caution: Use of this procedure is recommended only when it is amended to your checklist to prevent the possibility that you could forget to turn on the alternator after engine start.

Figure 4.4 – Standby battery switch on a Cessna G1000 panel

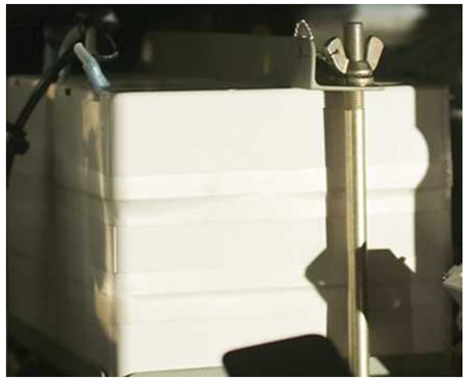

Figure 4.5 – Standby battery mounted behind the Cessna G1000 PFD panel

Many aircraft manufacturers have designed their G1000 aircraft with a standby battery and a standby battery circuit breaker bus for controlling or operating the system only from that battery in the event of an emergency. This picture above is the standby battery and its controlling switch from a Cessna aircraft. It has a test position that pilots are required to check prior to starting the aircraft. Making sure that this self-test switch illuminates the test light for 20 seconds will ensure that the standby battery has sufficient power to power the system in the event of an electrical power problem or alternator failure.

Start-up Flow

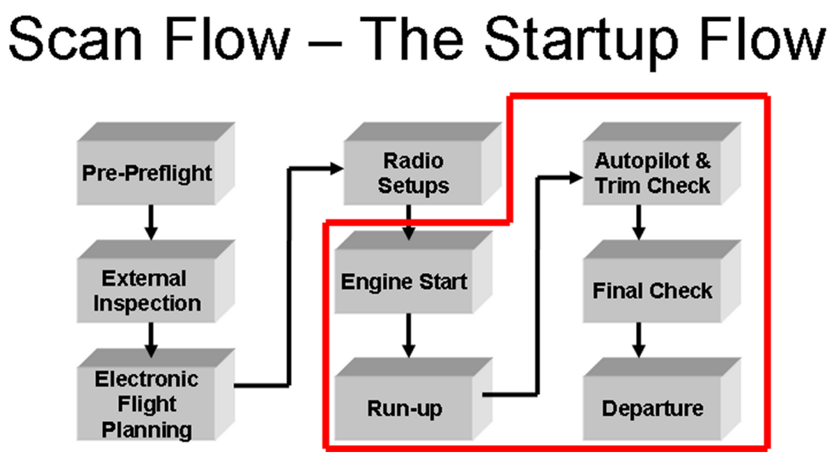

Figure 4.6 – TAA aircraft departure flow diagram

You must be aware that the TAA aircraft utilizes a different "flow" with regards to engine startup and preparation for departure. Because of the many distractions in the cockpit, you are advised to always use a checklist and to make sure that you never attempt any system setup or flight plan programming tasks while the aircraft is taxiing. It is better to stop the aircraft on the taxiway and make your adjustment than it is to risk accidentally running off the runway.

Power ON

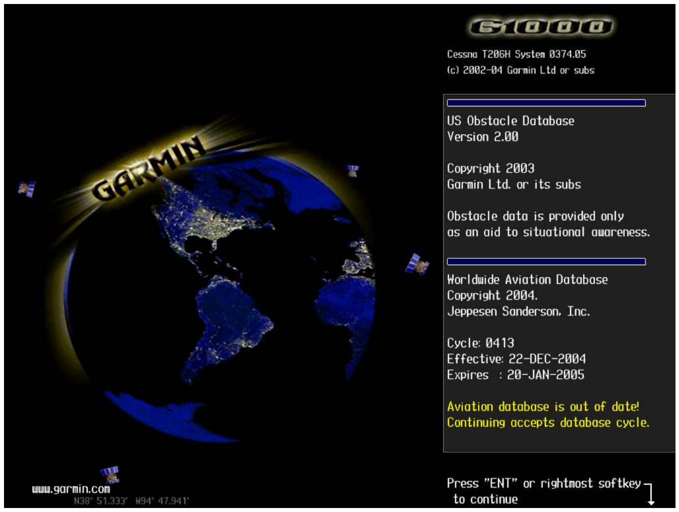

Figure 4.7 – G1000 system startup screen

When the G1000 first powers up, it displays the screen shown above to show the pilot the status of the system software and the database expiration dates. It is very important that the pilot read and understand the messages that appear on this screen. By pressing enter or pressing the FMS knob, it indicates to the system that you have accepted the status of the system software and all the database expiration dates.

Note: Never attempt IFR flight when the aviation database that has expired

System Databases

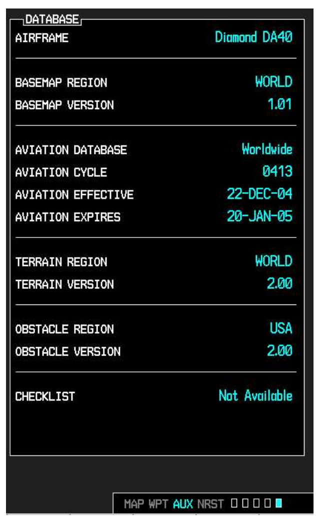

Figure 4.8 – System database version display page

There are several databases that the G1000 uses in order to perform its functions. The onscreen checklist will soon be enabled in upcoming system software updates. You will not be able to change the factory provided checklist for your model, but it will support check and click style checklist updating as you progress along your checklist items.

System software - This is the main software version that Garmin uses to program the functions for that particular aircraft model. All features are worked out with the manufacturer before such a software release is approved. Only an authorized person or avionics shop should install these updates and the appropriate aircraft logbook entries must be made including software versions installed and whether the aircraft was flight checked. You will typically get a service bulletin from your aircraft manufacturer letting you know what features of the G1000 behaviors this software will modify. This should be followed up with a revision to the Pilots Operating Handbook manual supplements concerning the G1000. Always keep your supplements in your aircraft up to date so that you have a ready reference in the event that you need assistance during a flight or during an emergency. When the aircraft was delivered, the manufacturer provided a system base version CD for that model aircraft. This CD should be kept with the aircraft POH and a copy should be made to keep with the aircraft logbooks so that anytime updates are made, a copy of the base software is available for the system to use as reference. Each time major software releases are made to the system; Garmin provides a new system software base CD, if they want the old one replaced. When this happens, this becomes the new base software CD. Mark the old original version with a sharpie marker that it is “superseded” and put it aside for safekeeping.

Base Map Region – This is the view that the Garmin G1000 uses to aid in the construction of maps and basic geography shown on the screen. There are a number of datum selections available in the Aux system setup screen. Garmin recommends using the WGS84 datum for most North American applications.

Aviation Database – This is the database that is updated from Jeppesen every 28 days by internet subscription or by mail. Without this update, the aircraft is not properly prepared for IFR flight as that the system would not be updated with important Airport, Instrument approach, and other important information that is released by the NOAA and the FAA on a cycle similar to that of Instrument Approach Chart and Airport Facility Directories.

Terrain Region – This database contains important information about the global database of terrain elevation; In other words, dirt and rocks. No manmade obstacles are contained in this database. This is updated annually or as prescribed by Garmin and Jeppesen.

Obstacle Region – This database contains important information about the local database of obstacle elevations; In other words, towers and smoke stacks. No terrain obstacles are contained in this database. This is updated annually or as prescribed by Garmin and Jeppesen.

Figure 4.9 – Secure Digital (SD) software update card

Figure 4.10 – The SD card reader that comes with the G1000

Updating Databases – Databases are updated using a secure Digital card similar to those used in a digital camera. Typically, you can use the data loader provided with the G1000 aircraft to download the update from the internet onto the SD card using the card reader that came with the G1000 or that are commercially available at camera and computer stores. To update the database, simply insert the SD card into the top SD card slot on the face of the GDU1040 for the PFD with the power off. Turn the aircraft power on. Once the PFD starts to power up, it will detect the card and ask you if you want to update the aviation database now. Press enter for yes. The database will be uploaded into the system. Turn the power off. Repeat the process for the MFD. The system will not allow the database to be read that is older than what is already installed in the aircraft. The system also will not startup if the database version is not the same in the PFD and the MFD.

Profiles

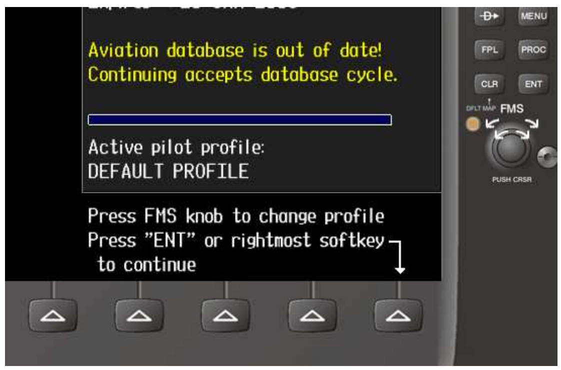

Figure 4.11 – Profiles selection

Some manufacturers, such as Diamond Aircraft, have created a concept called Profiles. A profile is a preconfigured set of standard system defaults that can vary from pilot to pilot. For instance, let's say that 3 pilots own an aircraft together. One pilot is from the US and likes his screens in English and his map in north-up mode, the second pilot is from Canada and likes the metric system; and the third pilot likes everything like the first pilot but he likes his screen in Track-up mode. The Profiles section allows up to 25 different configurations to be saved and recalled at G1000 startup. Each pilot can save their profile and assign it a name from the AUX SETUP menu which we will see in the MFD study unit 10 later. Currently, Profiles are standard in Diamond Aircraft and disabled in others, but upcoming system software releases will correct that problem.

Initial Power on Screen

Figure 4.12 – Initial Power on screen

Because the G1000 has the engine instruments integrated into the display unit screens, the instrumentation must appear on the screen to monitor engine conditions during start. The pilot must look at factors such as Oil Pressure and Fuel Flow in order to assure an efficient and productive engine start sequence. This is the same screen that you would see in the reversionary mode by pressing the RED button on the bottom of the GMA1347 audio panel. This screen is normal until the avionics master switch is engaged. As each of the LRUs power up, the red Xs will be replaced with the proper indication for that instrument.

Note: If any of the areas of the screen remain with a red X, then you must investigate this before continuing with your flight.

Conclusion

In this study unit, we looked at the startup sequence for initializing the Garmin G1000 system. You probably noticed that the some of the procedures discussed here are different from anything that you have done before in other traditional paneled aircraft. The system provides information to you by covering up inaccurate information provided by information whose data sources have become compromised by system failures or invalid data. Once the system properly initializes each instrument, it is uncovered by the red X and is displayed properly.

Remember to closely monitor the engine gauges during the engine start sequence and make sure that each gauge rises within a reasonable amount of time into a yellow or green operating range as prescribed by your aircraft and engine manufacturer.

Different aircraft manufacturers have different procedures, so use this as a general guide and by all means, follow the checklist provided by the manufacturer for the aircraft that you fly.

Remember

- ❑ A TAA aircraft uses a different startup flow sequence
- ❑ System and database updates should be kept current prior to attempting flight
- ❑ Red Xs cover instruments during initialization sequence until the G1000 deems the data as reliable

- ❑ You who has reasonable knowledge as to the proper procedure may update the aviation database but a logbook entry must be made to record that action
- ❑ Only authorized personnel should attempt system software updates
- ❑ Never attempt database updates while the aircraft is in flight
- ❑ Never attempt system adjustments or programming tasks while the aircraft is being taxied

FITS Study Unit Debriefing:

You have now covered the area of the G1000 startup procedure and should now understand why it is so crucial to properly learning to fly technically advanced aircraft (TAA) such as the Garmin G1000.

- ❑ If you now understand the concept of how to properly startup the G1000 then you will also understand how to determine if all of the systems have initialized correctly.
- ❑ If you now understand the concept of which systems initialize with the master switch and which initialize with the avionics master switch, then you will also understand the basics of the electrical system and how it feeds power to the G1000 and its systems.
- ❑ If you now understand about the various system software and databases and how they feed the G1000 its information to function, then you will also understand the importance of maintaining current database information as provided by Garmin and Jeppesen and avoiding operation of the system with out of date information.

If you not only understand these three areas, but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a “Correlate” level of FITS accomplishment! It’s time take the quiz and then to move to study unit five!

Study Unit 4: Powering Up the G1000 Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation.

In this study unit quiz, you will be asked to demonstrate an understanding of the power-up sequence of the Garmin G1000 to determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

During this quiz scenario, imagine that it has been some time since you were last at the airport. You have just climbed into the cockpit and are preparing to take this flight between Kansas City Downtown airport (KMKC) and Columbia, Missouri (KCOU), a tower controlled airport, back to Whiteman AFB, and then back to KMKC. Consider the following questions about this scenario:

Figure 4.13 –Study unit 4 quiz scenario

Question 1: How would you check the level of the fuel on your fuel gauges in your G1000 equipped aircraft prior to starting the preflight?

- **a) Turn on the master switch and the avionics master and turn on the fuel gauges by pressing enter**
- **b) Turn on the G1000 initiation screen using the master switch or the standby battery switch, if so equipped and wait for the Xs to disappear**
- **c) The fuel gauges will turn on when you start the engine**

Question 2: Before your flight today, how is the best way to make sure that your databases are current for IFR Flight??

a) **Pull out the SD Card from the MFD and read the expiration date off the label of the SD card**

b) **Start the G1000 MFD using the master switch and read the expiration date on the flight planning screen**

c) **Start the G1000 MFD using the master switch and avionics switch if necessary and read the expiration date on the initiation screen**

Question 3: You received a service bulletin with a new system base software CD from your aircraft manufacturer and you want to get your system updated ASAP. Which of the following is true regarding this software update?

a) **You can follow the instructions and update the software using your laptop computer**

b) **You will have to get an authorized person to install the software update using your new CD to transfer the data to a SD card and a logbook entry must be made**

c) **You can ignore the software update because the G1000 downloads all of its updates from satellites**

Question 4: You have just completed the startup sequence for your flight in your G1000 aircraft and notice your COM2 and NAV2 frequency boxes still have a red X through them. What should you do?

a) **Check to see that your avionics master switch is on and that no circuit breakers are popped**

b) **Shut the system down right away because it has developed a malfunction**

c) **Reach over and press the COM and NAV buttons to turn on the radio with the blue box pointer**

Question 5: You are taxiing to your departure runway to do your pre-departure checks and autopilot and trim system checks and you receive a call from ground control amending your departure clearance. What should you do?

a) **Stop the aircraft on the taxiway and input the changes after acknowledging the clearance route change**

b) **Reach over and twist in the changes to the flight plan as it is only a small change**

c) Acknowledge the change and wait until the aircraft is at stopped at the run-up area to input the change into the G1000

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will offer a link back to the appropriate reference area in the study unit. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 5: Primary Flight Display

Study Unit Objectives:
The objective of this software Study Unit is for you to move from the "Perception" level to the "Understand" level of FITS accomplishment regarding the operation of the Primary Flight Display and all of its associated functions.

Completion Standards:
When you have completed this study unit, you will be able to understand the features of the Garmin G1000 glass cockpit Primary Flight Display and demonstrate an understanding of its associated functions. You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

The Primary Flight Display

Figure 5.1 –Primary flight display

The Primary Flight Display is always situated in front of the pilot, so therefore on most aircraft, it is on the left side of the cockpit. It has most of the same features as the conventional cockpit except that the instruments are situated on a display screen and use a computer to optimize their display characteristics for the pilot. Let us compare the two types of cockpit arrangements to help you see how the different instruments have been placed.

PFD Display features compared to Traditional Instruments

Figure 5.2 – Traditional aircraft panel gauges

When you first look at the G1000 panel, you see several instruments that jump out at you and look familiar. But as you spend more time, you start to find certain trusted instruments appear to be missing from the electronic display screen. Don't worry; all of the instruments and their functions are there, they have just been transformed to a more logical location to take advantage of time tested pilot scan techniques to group information together.

Airspeed Indicator

Figure 5. 3 –Traditional Airspeed Indicator

Figure 5.4 –G1000 Vertical Airspeed Indicator

Notice the differences between the traditional gauge and the new tape representation?

- ❑ The traditional indicator was driven by a net difference between pitot and static pressure and drove a needle through the movement of a calibrated steel coil spring
- ❑ The glass portrayal on the G1000 is in a vertical tape format more closely aligned with what jets have used on their cockpit systems for the last 10-15 years
- ❑ All of the colored arcs are true to form and you will feel more at home because you can read the instrument easier
- ❑ The G1000 shows numerical value in the box while tape with color arc bands move up and down.
- ❑ Airspeed value on a "tape" scale shown by pointer
- ❑ Rate of change "trend indicator" on right side of tape shows what airspeed will be in 6 seconds allowing pilot to monitor airspeed trends. Trend indicators are shown in magenta.
- ❑ True airspeed readout on the bottom of tape as opposed to using knob on traditional indicator
- ❑ Airspeed "bugs" for Vr, Vx, Vg, and Vy slide up and down with the tape allow you to monitor critical airspeeds.

Attitude Indicator

Figure 5.5 –Traditional Attitude Indicator

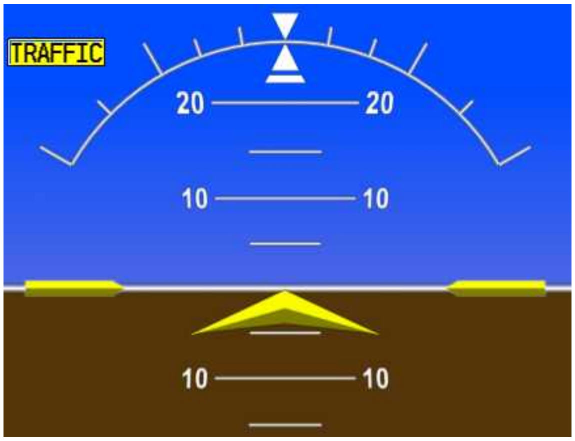

Figure 5.6 –G1000 Vertical Attitude Indicator

Notice the differences between the traditional gauge and the new tape representation?

- ❑ The traditional indicator was powered by a spinning gyro driven by vacuum pressure drawn through the case of the instrument by the vacuum pump
- ❑ The glass portrayal on the G1000 is a very similar round gauge style but much larger with other information integrated onto its face
- ❑ Notice the traffic alert symbol flashes on the screen to catch your attention during a traffic intrusion
- ❑ There is no gyro in the G1000 so you don't have to worry about tumbling gyro errors
- ❑ Much larger, translucent representation shows horizon in blue and ground in brown
- ❑ Shows pitch and bank scales much more clearly
- ❑ Red "chevrons" show at both 30deg. pitch up and down showing the pilot the way to level flight
- ❑ Skid/slip indicator is indicated by the "trapezoid" at the top of the roll scale, right below the bank pointer.

- ❑ The trapezoid below of the triangle moves to indicate the direction of rudder required

Altimeter

Figure 5.7–Traditional Attitude Indicator

Figure 5.8 –G1000 Vertical Attitude Indicator

Notice the differences between the traditional gauge and the new tape representation?

- ❑ The traditional indicator was driven by static pressure flowing into an aneroid bellows chamber which expanded and contracted with changes in pressure as altitude changed
- ❑ The glass portrayal on the G1000 is in a vertical tape format more closely aligned with what jets have user on their cockpit systems for the last 10-15 years
- ❑ Numerical readout of altitude bug setting shown on top is controlled by ALT knob and can be centered to current altitude by pressing ALT knob in
- ❑ Numerical altitude value shown in the pointer box
- ❑ Altitude value on a "tape" scale shown by pointer
- ❑ Altimeter setting shown on bottom of scale set with BARO knob
- ❑ Rate of change "trend indicator" on right side of altitude tape tells where altitude will be in 6 seconds alerting pilot to altitude change trends
- ❑ Remember that the altitude bug does not transfer information to an external (King KAP 140) autopilot and cannot be used to set or hold altitude

Altitude Bug

Figure 5.9 –Altitude bug selection knob

As discussed in study unit 3, the altitude bug is used to set the altitude reference bug. Turning the same knob on the MFD also moves the bug pointer on the PFD.

- The altitude selector knob is located on the lower left side of the GDU 1040.
- The numerical value of the altitude selected is shown above the altitude tape on PFD.
- A blue altitude bug will be shown on the altimeter when the selected altitude is in view.
- Turning the outer knob will change the bug in 1000ft. increments while turning the inner knob will change the altitude by 100ft. increments.

BARO Selector for entering in Altimeter Setting

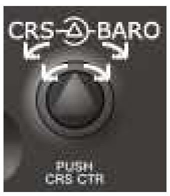

Figure 5.10–CRS and BARO Selection knob

Figure 5.11 –Altimeter setting display window

As discussed in study unit 3, the CRS or COURSE and BARO or barometric pressure section knob is used to set those respective functions. Turning the same knob on the MFD also moves the BARO and CRS displays on the PFD.

- The BARO Selector is on the right hand sight of the GDU 1040 and is outer knob of the CRS selector.
- Turning the BARO Selector right will increase the altimeter setting shown in the window below the Altitude tape. Turning it to the left will decrease it.

> *Note: Adjusting the barometric pressure using the BARO knob is only 1 of either 2 or three places in the aircraft where barometric pressure must be entered depending upon whether the aircraft is equipped with the Garmin autopilot*

Heading indicator (Horizontal Situation Indicator HSI)

Figure 5.12–Traditional Heading Indicator

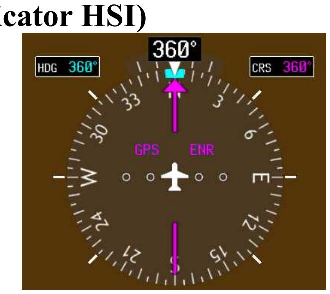

Figure 5.13 –G1000 HSI display

Figure 5.14–HSI display in ARC display mode

Notice the differences between the traditional gauge and the new dial representation?

- ❑ Traditional indicator was a gyroscope driven instrument, typically powered by vacuum and was prone to precession errors. The setting knob was required to be set prior to and periodically throughout each flight to keep the instrument calibrated with the magnetic compass.
- ❑ The G1000 HSI is an all electronic instrument with no gyros that is powered by the GMU 44 Magnetometer
- ❑ Value shown is always magnetic course
- ❑ Numerical value of heading shown in box at top of display
- ❑ Blue Heading Bug controlled by HDG knob and can be centered by pressing HDG in (bump)
- ❑ Magnetometer automatically sets compass so there is no knob to set and there is no precession like a traditional instrument
- ❑ Can be shown in 360 degree or Arc view mode using the PFD softkey button
- ❑ The blue box to the left of the top of the indicator represents what the heading bug is set to and this is what autopilot follows when set in HDG mode
- ❑ The selected course box on the top right side shows what the CDI course needle is set to

Heading Selector

Figure 5.15–HDG or Heading bug pointer selection knob

As discussed in study unit 3, the HDG or heading section knob is used to set the heading bug on the G1000 HSI. Turning the same knob on the MFD also moves the HDG bug on the PFD.

- o Knob on left side of the GDU 1040. Turning the knob will turn the blue heading bug around the heading indicator. There will also be a box displayed above and to the right of the heading indicator to show what heading the heading bug is selecting.
- o Pushing the Heading knob in will center the bug on the current heading.

PFD Softkey

Figure 5.16–PFD softkey

- Selecting the PFD Softkey will change the softkey selections
- The 360 mode is the display mode that is default where it shows the entire HSI
- The ARC display mode is where the HSI is displayed in a perspective arc view only showing the top 40% of the HSI. This mode will be very useful for the upcoming ground contoured “Nap of the Earth” PFD display mode that Garmin will be introducing on the Cessna Mustang allowing the pilot to see a three dimensional view of the terrain ahead of the aircraft along the flight plan
- The METRIC softkey will change your BARO selection and altitude in to metric measurements.
- The DFLTS softkey will change selection back to the default selection

Turn and Bank Indicator

Figure 5.17–Traditional Turn and bank indicator

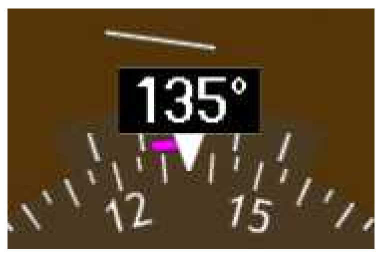

Figure 5.18 –G1000 rate of turn indicator

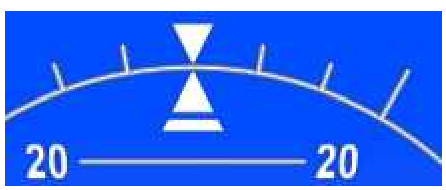

Figure 5.19– G1000 inclinometer in the shape of a trapezoid

Notice the differences between the traditional gauge and the new dial representation?

- ❑ The traditional indicator was gyroscopically driven, usually with electric power
- ❑ The inclinometer was a ball which rolled along a curved tube to show slip and skid
- ❑ The G1000 has split up these portrayals into 2 areas
- ❑ The rate of turn is now represented on the top of the HSI and is represented by a magenta trend indicator which moves left and right of the top of the HSI
- ❑ This rate indicator has two graduated lines which represent ½ standard rate and standard rate or 2 minute turn (3 degrees of turn per second)
- ❑ The ball function is now portrayed at the top of the Attitude Indicator and is shown by a “trapezoid” which moves right or left to show slip and skid

Panel Clock

Figure 5.20–Traditional panel clock

Figure 5.21 –G1000 system time

Notice the differences between the traditional gauge and the new dial representation?

- The traditional was a standalone device which needed a dedicated electrical circuit or internal backup battery to keep it current
- The glass portrayal is located on the lower portion of the PFD panel and derives its timekeeping reference from the atomic clock located in the GPS satellite itself

Course Deviation Indicator (GPS)

Figure 5.22–Traditional course deviation indicator (CDI)

Figure 5.23 –G1000 GPS CDI Indicator and DBAR

Figure 5.24–CDI indicator in HSI ARC mode

Figure 5.25 –HSI in VOR/LOC1 mode

Figure 5.26– HSI and CDI control softkeys

Notice the differences between the traditional gauge and the new dial representation?

- ❑ The traditional round gauge was a stand alone instrument that was tied to the autopilot through the NAV switch
- ❑ The G1000 version is superimposed on the compass so you can get a complete view of your navigation picture and progress
- ❑ CDI Needles are color coded to help you understand which NAV source is being displayed
- ❑
  - o **Green** Represents VOR/LOC needles A single needle is VOR/LOC1 and a double needle is VOR/LOC2
  - o **Magenta** Represents a GPS course or GPS system derived data.
  - o **Yellow** Currently not supported, but in future will represent ADF signals, if aircraft is equipped ands configured

- ❑ The DBAR represents the floating portion of the CDI needle and represents your relative position to the desired course
- ❑ The course needle is set automatically when in GPS modes to point directly to the next GPS waypoint and the DBAR shows where that course is relative to your current position
- ❑ The course needle is set manually by the CRS knob for VOR just like an OBS selector knob on a traditional CDI indicator and the DBAR shows where that course is relative to your current position

Figure 5.26–CDI control softkey

- ❑ Toggle from GPS to NAV/LOC1 to NAV/LOC2 by pressing the CDI softkey below the indicator
- ❑ Toggle from 360 degree to Arc view perspective by pressing PFD
- ❑ GPS courses are always shown in Magenta
- ❑ VOR and LOCALIZER courses are always shown in Green
- ❑ If and when ADF is added to representation, it will be shown in Yellow
- ❑ Needle always points to the station to avoid back-course indications when orientation to station is reversed
- ❑ 360 HSI presentations will show the heading indicator in a 360º format. This will also allow for the BRG 1 and BRG 2 to be displayed.

- ARC HSI will show the heading indicator in an arc format. About half of the heading indicator is shown in ARC mode and the BRG 1 and BRG 2 cannot be displayed.

Course Selection Knob or (Omni-Bearing Selector –OBS selector knob)

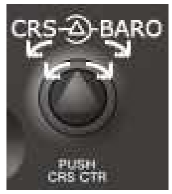

Figure 5.27–CRS knob used to set OBS course heading

- The omni-bearing selector is on the right hand side of the PFD. It is a small, triangular CRS knob located in the center of the BARO knob.
- While using a VOR you can push the CRS knob and the CDI will center on the radial the aircraft is currently on with a "To" indication.
- It can also be used when tracking a GPS to offset the bearing to allow the pilot to fly "around" restricted airspace or to avoid obstacles, mountainous terrain, or large bodies of water

OBS (Omni-Bearing Selector) Softkey

Figure 5.28–OBS softkey used to force GPS to obey CRS knob

- The OBS Softkey will allow the pilot to select a Bearing/Radial off of any airport, Navaid or waypoint.
- Once OBS is pressed, the GPS CDI needle is in OBS mode. The small knob on the FMS can be turned to select a particular Bearing/Radial.
- One example where OBS mode will be useful might be to avoid Class B airspace, restricted airspace, TFR, or mountainous terrain.

DME Selection Box

Figure 5.29–DME NAV selection box

- Future G1000 installations will support the installation of a traditional DME (Distance Measuring Equipment) and this box provides the G1000 with the instructions of which NAV to tie it to

BRG Bearing Selector Rings

Figure 5.30– BRG1 indicator box

Figure 5.31– BRG2 indicator box

Figure 5.32– Multiple CDI depiction rings

The BRG Bearing rings were added to Garmin G1000 aircraft software by a service bulletin in summer 2005. They addressed an early user desire to have more than one CDI needle more than one NAV source be displayed on the HSI at the same time.

- BRG 1 will display a NAV1 or GPS CDI needle over the primary CDI selection and show a box to the left of the heading indicator that shows degrees of bearing change.
- BRG 2 will display NAV2 or GPS CDI needle over the primary CDI selection and a box will be to the right of the heading indicator showing degrees of bearing change to that GPS or NAV course.

Course Deviation Indicator (Glideslope)


Figure 5.33–Traditional CDI with Glideslope

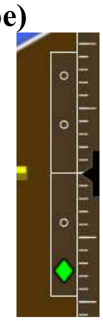
Figure 5.34 – G1000 Glideslope Indicator

Figure 5.35 – G1000 Glideslope Indicator with no signal received

Notice the differences between the traditional gauge and the new dial representation?

- The traditional indicator was a horizontal CDI needle that went across the face of the CDI
- The glass portrayal indicator is placed near the altimeter for more efficient viewing when pilot is checking altitude during decent
- Indicator uses green diamond to represent desired Glideslope position so in the diagram above, the aircraft is above the Glideslope
- Indicator uses "No GS" to show you when the indicator is not receiving the glideslope signal, is too far away from the signal, or is too far off of a dependable receiving angle

The Inset Map

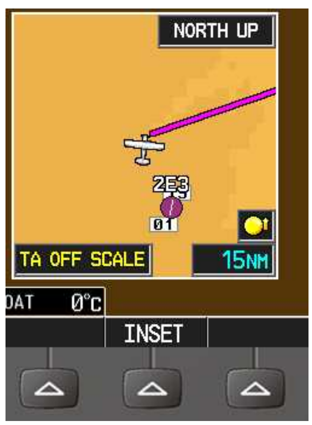

Figure 5.36 – Inset map display

The Inset map is a simplified version of the MFD display map for situational awareness purposes on the PFD screen. It is not customizable from the MFD Moving map and in fact, inherits its properties from the MFD. It can, however be turned on and off and have certain of its features activated and deactivated separate from the large map. It also has a separate DCLTR or declutter function from the MFD.

Figure 5.37 – Inset map softkey selections

The Inset Map Softkey on the lower left side of the PFD brings up a small window on the lower left of the screen.
The Inset Map reflects what is on the MFD moving map in general but also can be displayed at different range resolutions using the PFD RANGE knob.

- ❑ Softkey selections allow for Terrain, Topography, Traffic, and Weather if the aircraft is equipped. This data to be turned on or off.
- ❑ A de-clutter option is available with a DCLTR Softkey that removes groups of information from the screen with up to 3 stages of information removed. In general, the screen should be de-cluttered when in busy terminal areas or when shooting an instrument approach to clarify the screen.
- ❑ The range control on the right hand side of the PFD will zoom the inset map in or out independently of the large MFD Moving Map Display.
- ❑ Pressing in on the range knob places the Inset map in the PAN or map pointer mode and can be activated by the joystick function of the RNAGE knob

Note: When a waypoint is recognized from the database, it is shown in a highlighted fashion with some limited information about the waypoint listed. This cannot be used to populate Direct-to or Flight Plan menu boxes on the PFD.

The Main Function Boxes of the PFD

Flightplan Manu Box

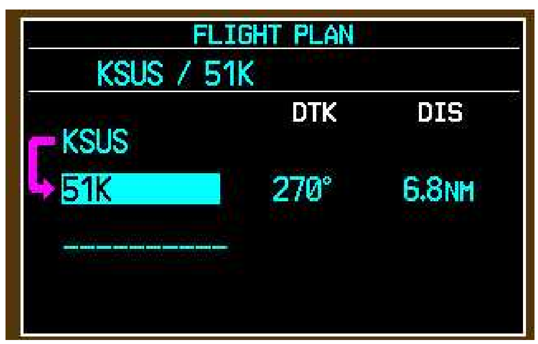

Figure 5.38 – PFD Flight Plan menu box

The Flight Plan box on the PFD is very useful for entering a Flight plan which could consist of a minimum of 2 and a maximum of 38 waypoints

- ❑ The FPL button is on the right hand side of the PFD in the FMS key group
- ❑ Pressing the FPL button will create a box on the lower right hand corner of the PFD screen.
- ❑ Using the FMS knob, first activate the curser by bumping the FMS knob, then scroll to the desired position, then twist the inside FMS knob to spell the identifier of the desired waypoint, then press ENT to select, and then ENT to confirm the selection.
- ❑ Procedures can be added to this flight plan using the PROC key
- ❑ You can use the recently used field to highlight and select up to 25 of the most recently used waypoints instead of spelling out waypoints with the twist knob over and over again

Direct-To Menu Box

Figure 5.39 – Direct-to menu box

The Direct-to box on the PFD is very useful for entering a route which consists of 1 waypoint

- The D-> button is on the right hand side of the PFD in the FMS key group
- Pressing the D->button will create a box on the lower right hand corner of the PFD screen.
- Using the FMS knob, first activate the curser by bumping the FMS knob, then scroll to the desired position, then twist the inside FMS knob to spell the identifier of the desired waypoint, then press ENT to select, and then ENT to confirm the selection.
- Procedures can be added to this flight plan using the PROC key
- You can use the NRST field to highlight and select up to the 25 nearest airport waypoints instead of spelling out waypoints with the twist knob over and over again.

Timer/Reference Menu Box

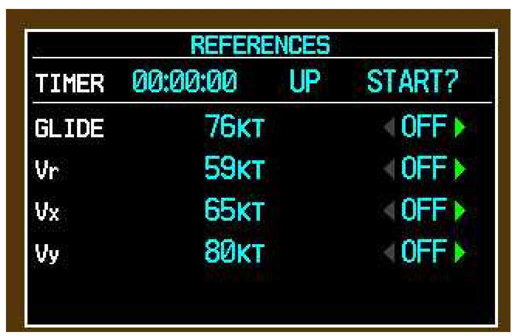

Figure 5.40 – Timer Reference menu box

- Can set a count up or down timer
- Can modify preset airspeed bugs

Figure 5.41 – Timer/Reference softkey

- TMR/REF Softkey will create a box in which a timer can be started or set to count down. Just move the curser with the big knob to UP and turn the small knob to select DN, then press ENT.
- References to airspeed (Airspeed bugs) for Glide, Vr, Vx, and Vy are also able to be changed in this box but cannot be saved when aircraft is shut down.

Figure 5.42 – Flashing Alert softkey

Note: No automatic or programmable audible indication is available to show you when a timer expires. If countdown timer is used and it reaches 00:00, then only ALERT flash occurs.

PFD Setup Menu

Figure 5.43 – PFD setup menu box

Figure 5.44–Menu softkey

- ❑ There are two ways to control the brightness of the displays:
- ❑ Use the Avionics dimming rheostat to brighten/dim the displays.
- ❑ Manually dim a single display
- ❑ On the PFD the brightness of the screens can be controlled manually.
- ❑ Press the MENU button on the PFD
- ❑ Select the brightness mode for the display in question, select manual, press enter, then turn the small FMS knob to increase or decrease the brightness of the display. Reverse this process to increase the brightness of the display.
- ❑ This menu may have to be used in periods of low light such as dawn or dusk

Note: Displays may flicker if fingers block the light sensor located next to the COM VOL/SQ knob. This is temporary and considered normal

Procedure Menu Box

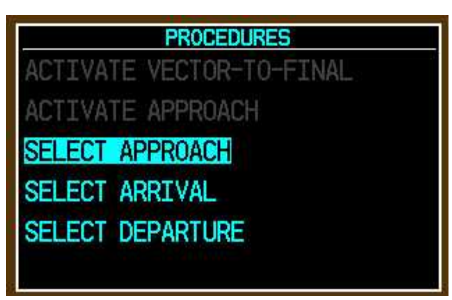

Figure 5.45 – Procedure menu box

Figure 5.46 – Procedure menu selection key

This menu box calls up the approaches, arrival procedures, and departure procedures for a particular airport designated in the Flightplan or Direct-to flight plan as a destination
This also allows you to activate an approach and to activate vector to final.

Crew Alert Box

Figure 5.47 – Crew Alert Menu box

- ❑ The far right softkey on the PFD is the warning or alerts key.
- ❑ When it flashes "warning", "alert", or "caution", that softkey must be pressed and an alerts window will appear on the lower right hand side of the PFD that will describe what the alert is about.
- ❑ This is covered in more detail in study unit 6

Note: Because this alert box can hide important information that you need and there is no audible alert callout to catch your attention, you must keep this area of the screen in your scan flow.

Nearest Menu Box

Figure 5.48 – Nearest Menu Box

Figure 5.49 – NRST selection softkey

- NRST allows you to select the nearest 25 airports (based upon parameters you can control)
- You can also select the frequency and send this to the standby COM highlighted with the blue box by highlighting the frequency and pressing ENT
  - NRST Softkey will create a box which displays the 25 nearest airports to the current position.
  - Move the curser to the desired airport with the large knob. Press the Direct-to→ button and press ENT.

The Transponder Control Box

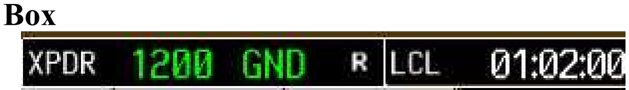

Figure 5.50 – Transponder display box on PFD

This area is described more thoroughly in study unit 7.

- A small box located on the bottom right side of the PFD shows the code and the status of the transponder
- The XPNDR softkey on the bottom of the PFD gives access to change the transponder code.
- The code can then be entered manually. If 1200 is desired the VFR key may be pressed.
- Additional modes can also be accessed from this menu.
- IDENT Softkey can be pressed as requested by ATC.

Note: Double pressing the XPDR key automatically takes you to the CODE softkey set

Data Fields at top of PFD

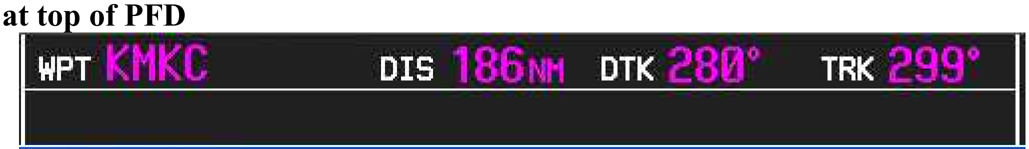

Figure 5.51 – Current waypoint data strip on top of PFD

- Center-Top of PFD screen and always depicted in Magenta indicating GPS derived
- Above the flight instruments, the strip box in the top-center of the screen has information concerning your current course. They are fixed items, they cannot be changed.
- They always tell you where the G1000 thinks it is going to and when it will get there

Conclusion

In this study unit, we looked at the main functions of the Primary Flight Display and how it helps you to manage the flight aspects of the G1000 equipped aircraft. By knowing the functions of many of these menus, buttons, knobs, and controls, you can more efficiently maintain a good scan flow and safely operate your TAA aircraft.

Most of the flight instruments that we have come to know and love in our traditional paneled aircraft have been replaced by more efficient and scan friendly portrayals of flight information. By placing information where we need it when we need it, this allows us to more safely operate these aircraft while at the same time improving our situational awareness. This may take some getting used to, but once we have mastered it, you will find that it is truly a pleasure to fly this new glass cockpit aircraft.

Remember

- ❑ Most of the primary flight instruments work the way that you would expect them to except for some logical portrayal improvements
- ❑ The PFD should always be kept in your primary scan to catch anomalies
- ❑ Keep an eye on the Alert area waiting for messages that may have no audible tone to catch your attention
- ❑ Set HDG and ALT bugs as reference for all your activities
- ❑ Watch DBAR in HSI as a reference to where your desired course is
- ❑ Most of the information that will change during your flight will be in the HSI as this provides all lateral guidance to the autopilot in terms of both HDG and NAV reference

FITS Study Unit Debriefing:

You have now covered the area of the Garmin G1000 Primary Flight Display and along with the knowledge of knobs, buttons, and controls learned in study unit 2, you should have a good idea how to operate the most functions of the system using the PFD.

- ❑ If you now understand that the G1000 knobs, buttons, and controls of the Primary Flight Display are the primary way for the pilot to control various instruments, menu, submenus, and functions, then you should see that the PFD is a very capable unit providing much more integration info than traditional instruments!
- ❑ If you now understand that the PFD is a very powerful tool for maintaining safe flight, then you will also understand that many times there is more than one way to accomplish a desired task on the PFD.
- ❑ If you now understand that this system offers you a way to integrate your flying tasks with your navigation tasks, then you will also understand that knowing how to get the advanced features out of the system quickly will prevent you from becoming fixated on the display screens and keep your operations safe.

If you not only understand these three areas, but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a “Correlate” level of FITS accomplishment! It’s time take the quiz and then to move to study unit six!

Study Unit 5: Primary Flight Display Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin G1000 system Primary Flight Display (PFD) on a flight from Kansas City Downtown airport (KMKC) at an altitude of 2500 feet VFR with ATC flight following to Roosterville, Missouri (0N0), a non-tower controlled airport. You enter this information into the PFD Flightplan menu box. Consider the following questions about this scenario:

Figure 5.52 – Study unit 5 quiz scenario

Question 1: While enroute to your destination, ATC advises you to make a 30 degree heading change to the right. How would you complete the operation on your G1000 aircraft, if the auto pilot was being used?

- **a) You would use the CRS/BARO knob to set in the new heading in CRS mode**
- **b) You would turn the HDG Heading knob right 30 degrees and make sure the autopilot was set to HDG mode**
- **c) You would change the heading of the aircraft while carefully scanning for traffic, then you would make the change on the HDG bug on the autopilot**

Question 2: Upon receiving your clearance, ATC gives you a squawk code of 4632 and asks you to IDENT. How would you complete this operation on the G1000 transponder?

a) **On the MFD, press the XPNDR softkey twice, Press 4632 softkeys, then press ENT**

b) **On the PFD, press the XPNDR softkey, press the CODE softkey, Press 4632 softkeys, then press IDENT**

c) **Use the FMS knob to navigate to the transponder page and enter the requested information**

Question 3: As you continue the flight to your destination, ATC advises you to "remain clear of Class B airspace ahead". Which procedure is correct on how to use the G1000 PFD to help you?

a) **On the PFD, activate the INSET MAP, adjust the range scale to show the Class B airspace, then use the OBS key with the CRS knob to create an offset course around the airspace**

b) **On the PFD, activate the INSET MAP, adjust the range scale to show the Class B airspace, then add another waypoint to the Flightplan creating a diversion around the airspace**

c) **Both A and B are correct**

Question 4: As you continue the flight to your destination, you see an airport ahead. Which procedure is correct on how to use the G1000 PFD to help you identify this airport?

a) **On the PFD, activate the INSET MAP, press in the RANGE knob and activate the joystick pointer and move the pointer until the airport highlights on the INSET and then press enter to read WPT information**

b) **On the PFD, press the NRST softkey on the PFD and look find the airport on the NRST Menu box**

c) **Both A and B are correct**

Question 5: As you continue the flight to your destination, you decide to dial up a VIH VOR to watch your progress along the route of flight. How can you do this and not lose the NAV lock on the autopilot that is set to tracking the GPS course in your flight plan?

a) **Key in the frequency of the VOR using the NAV frequency selection knob, press the toggle key to make it active in NAV1 or NAV2, then on the PFD, press the CDI softkey to read the course in the HSI**

b) Key in the frequency of the VOR using the NAV frequency selection knob, press the toggle key to make it active in NAV1 or NAV2, then on the PFD, press OBS and turn the CRS knob to see what radial you are on

c) Key in the frequency of the VOR using the NAV frequency selection knob, press the toggle key to make it active in NAV1 or NAV2, then on the PFD, press the PFD softkey and then activate BRG pointer 1 to create another pointer on the on the HSI

Question 6: As you arrive at the halfway point to KCOU, you decide to start to see what approaches are available in case the weather deteriorates. What is the best way to so this on the PFD?

a) Press MENU and select ACTIVATE APPROACH

b) PRESS PROC and select APPROACH

c) Press the APPROACH softkey

Question 7: The weather finally deteriorates and you decide to proceed to the nearest alternate airport to land and wait. What is the best way to so this on the PFD?

a) Press NRST softkey and select the closest suitable airport using PROC

b) Press NRST softkey and select the closest suitable airport using MENU

c) Press the DIRECT-to softkey, bump the curser, scroll down to the NRST field and press ENT-ENT

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will offer a link back to the appropriate reference area in the study unit. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

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Study Unit 6- Crew Alerting System

Study Unit Objectives:
The objective of this Study Unit is for you to move from the "Perception" level to the "Understand" level of FITS accomplishment regarding the Crew Alerting System and how it is important to you for monitoring the status of the G1000 systems.

Completion Standards:
You will be able to describe and explain the features of the Crew Alerting System and can explain the differences between Warnings, Cautions, and Alerts and how to acknowledge each of them.

You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

Crew Alerting System

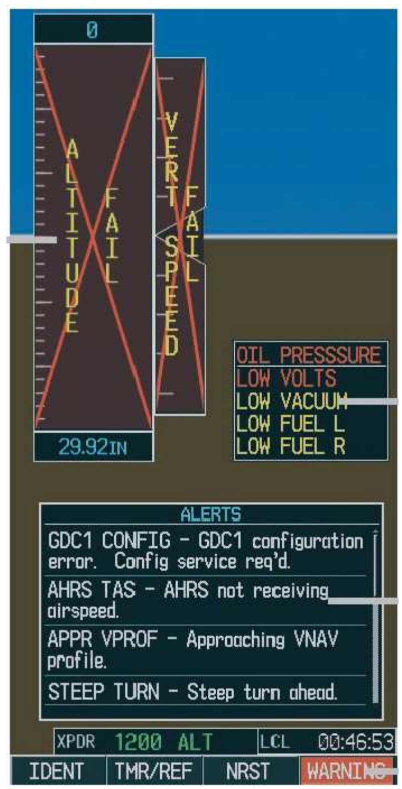

Figure 6.1 – The PFD Crew alerting system

The G1000 equipped aircraft is equipped with a system which monitors the LRUs and the systems of the airframe and the powerplant and provides real time information regarding the status of these systems to you. This allows you to make informed decisions about how to cope with a system loss or degradation. Many times, this is the difference of survival and disaster for you in an emergency because dealing with a pending emergency is always better with time on your side. The screen shown above shows the MFD with multiple problems being depicted all at the same time.

G1000 Faults and Warnings

The G1000 system displays alerts to you in the following ways:

Annunciation window

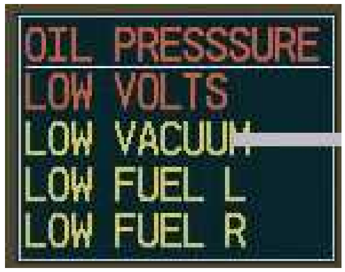

Figure 6.2 – The PFD annunciation window

This window displays text about the annunciation. The system uses three different colors, which will be discussed later. The annunciation window is located on the right side of the display, to the right of the vertical speed and altitude tape. There is room for up to 12 annunciators to be displayed at any one time. There is a white horizontal line the separates the annunciators that are acknowledged from those that are not. Also, the higher the priority of the alert will be the higher the position on the screen.

Alerts Window

Figure 6.3 – The PFD alerts window

The Alerts window displays text alert messages. There is room for up to 64 messages to be displayed in the window. To display the alerts window the pilot must press the ALERTS softkey. Pressing the ALERTS softkey a second time removes the alerts window. When the window is displayed pilots may use the large FMS knob to scroll through the list of alerts that are displayed.

Softkey Annunciation

Figure 6.4 – The PFD Crew alerting system

For new alerts, a softkey message will appear and will **blink** to catch your attention. This softkey assumes that something has changed that requires your attention. The label indicates the level of the alert (WARNING, CAUTION, and ADVISORY). When the pilot presses the softkey, they are acknowledging the alert. The softkey then returns to the previous label from the last alert. If the alert softkey is pressed second time the text of the message appears.

System Annunciations

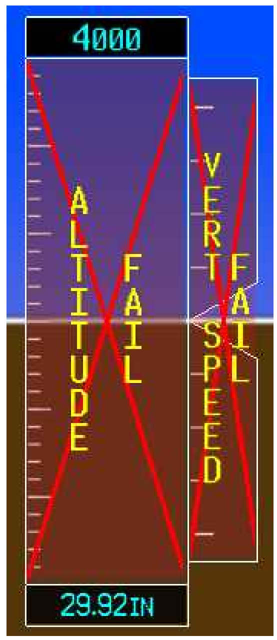

Figure 6.5 – The PFD system annunciation

Usually, a large red X appears in windows when a failure of the LRU that provides information to that window. These will be discussed more in detail later in this section and in the emergency study unit 14.

The G1000 system uses three alerting systems to warn pilots of failures or to provide information. These levels of alerting are: WARNING, CAUTION, and ADVISORY.

Figure 6.6 – The warning

Definition: <u>Warning</u> *An aircraft condition which requires the immediate attention of the pilot and if left unresolved, may cause a serious breach in operational safety.*

WARNING Alerts

Annunciation Window Text	Alerts Window Message	Audio Alert
OIL PRES LO	Oil pressure is below 25 psi.	Continuous Aural Tone
FUEL PRES LO *	Fuel pressure is below 14 psi.	Continuous Aural Tone
FUEL PRES HI *	Fuel pressure is greater than 35 psi.	Continuous Aural Tone
ALTERNATOR	Alternator failed. Battery is only electrical source.	Continuous Aural Tone
STARTER ENGD	Starter is engaged.	Continuous Aural Tone
DOOR OPEN	Canopy and/or rear door is not closed and locked.	Continuous Aural Tone
TRIM FAIL	Autopilot automatic trim is inoperative.	Continuous Aural Tone

Figure 6.7 – Warning examples

The warning level of alert is something that requires immediate attention from you, the pilot. The warning alert is also accompanied by an annunciation in the annunciation text window in the lower right portion of the PFD display. The text that appears in these windows is RED for a warning. If the pilot presses the WARNING softkey it acknowledges the presence of the warning and also silences the aural tone if applicable.

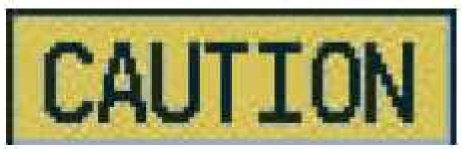

Figure 6.8 –The caution advisory

Definition: <u>Caution</u> *An aircraft condition which requires the imminent attention of the pilot and if left unresolved, may develop into a warning which could cause a serious breach in operational safety.*

CAUTION Alerts

Annunciation Window Text	Alerts Window Message	Audio Alert
L FUEL LOW	Left fuel quantity is less than 3 gallons.	Single Aural Tone
R FUEL LOW	Right fuel quantity is less than 3 gallons.	Single Aural Tone
LOW VOLTS	On-board voltage is below 24 Volts	Single Aural Tone
PITOT FAIL	Pitot heat is inoperative.	Single Aural Tone
PITOT OFF	Pitot heat is off.	Single Aural Tone

Figure 6.9 – Caution examples

The caution level of alert indicates that an abnormal condition exists on the aircraft that may require the pilot to intervene. The caution alert is also accompanied by an annunciation in the annunciation text window, which appears in the color yellow. Also for a caution the pilot will see a flashing caution softkey. Pressing the softkey acknowledges the caution alert.

Figure 6.10 – The Advisory

Definition: <u>Advisory</u> *An aircraft condition which requires the attention of the pilot whose action is left to their own discretion.*

Message Advisory Alerts

Alerts Window Message	Audio Alert
PFD FAN FAIL – The cooling fan for the PFD is inoperative.	None
MFD FAN FAIL – The cooling fan for the MFD is inoperative.	None
GIA FAN FAIL – The cooling fan for the GIAs is inoperative.	None

Figure 6.10 – Alert examples

The advisory alert level is used to provide general information to you. An advisory alert does not show up in the text annunciation window, but do show up as a softkey that flashes ADVISORY. When the pilot presses the ADVISORY softkey it acknowledges the presence of advisory and displays the text message in the Alerts window.

Note: Cooling fan advisories have been known to occur when operating at high altitudes or high density altitudes or when cooling vents have impeded airflow.

Safe operating Annunciation

Annunciation Window Text	Audio Alert
PROP HEAT	No Tone

Figure 6.11 – Safe annunciation examples

Some aircraft use this to inform you that a system or systems is operation within the safe limitations. These only appear in the annunciation window in green text.

G1000 SYSTEM ANUNCIATIONS

This diagram will describe the annunciations when an LRU or a function of an LRU fails. Typically a large red “X” is displayed on the windows that are associated with the failed data. Please refer to study unit 14 for a more specific description on how to deal with these situations.

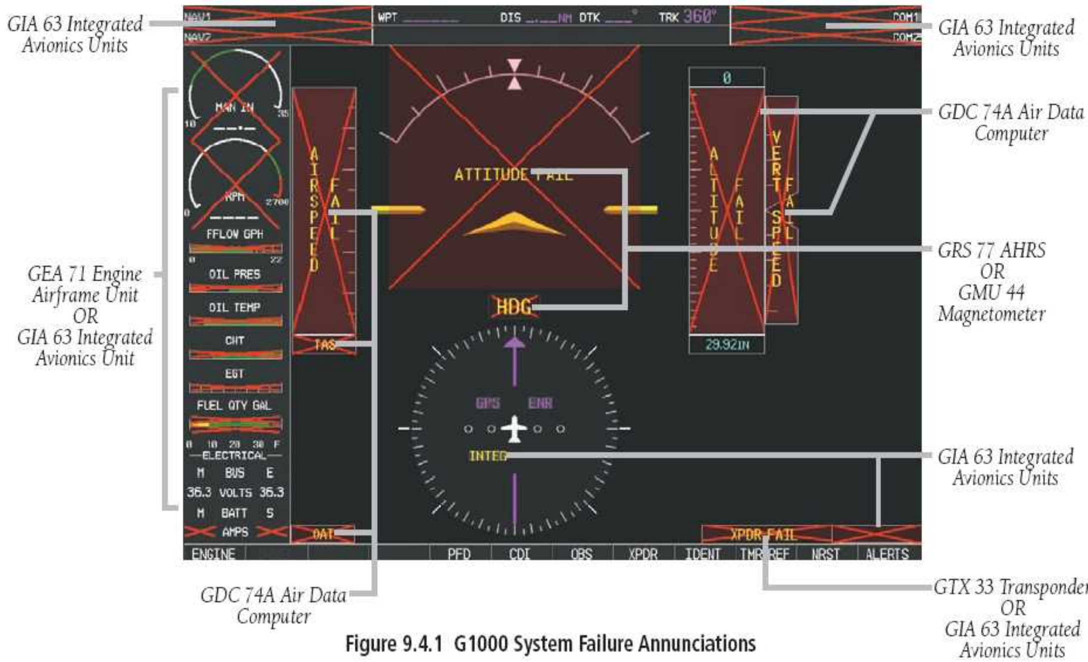

Figure 6.12 – Complete failure annunciation description diagram

Conclusion

In this study unit, we looked at the crew alerting system as a way for you to understand whether the G1000 system is operating correctly and to what extent you might have to deal with system degradation. An important point to be made to you is always keeps the crew alerting panel within your scan flow. Too many pilots have fallen victim to the trap that a message light is blinking and they choose to ignore it giving up the precious time they may have needed to execute a viable option. When a system fails such as a cooling fan, pull the circuit breaker and wait for 1 minute and retry the circuit breaker to see if the system resets.

Remember

- ❑ A **blinking** message light must be acknowledged by the pilot.
- ❑ **Green** messages are usually good and are just to tell you that something is operating normally.
- ❑ **White Alert** messages contain information that you probably need to know.
- ❑ **Yellow caution** messages imply a degrading condition and if not dealt with may eventually lead to a red warning.
- ❑ **Red Warnings** mean that something has failed that you need to address immediately.

FITS Study Unit Debriefing:

You have now covered the area of the Garmin G1000 crew alerting system and should now see that a technically advanced aircraft (TAA) such as the Garmin G1000 requires a thorough knowledge of the alerts cautions, and advisories in order to properly detect and respond to system annunciations before they turn into a safety or operational issue for you.

- ❑ If you now understand that the G1000 uses crew alerting system uses a variety of message boxes and colors to tell you about system status, then you will now understand why it is so important to keep this area of the PFD in your scan flow.
- ❑ If you now understand that the differences between the colors of messages indicate the level of severity, then you will also understand that addressing a problem when it first appears as an alert is a far safer technique than waiting until it is a warning.
- ❑ If you now understand that the G1000 uses an information monitoring system to determine whether data is valid before displaying it on the screen, then you will also understand that the system automatically removes invalid or suspect data from the screen to prevent you from using the data until it is deemed accurate.

If you not only understand these three areas, but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a "Correlate" level of FITS accomplishment! It's time take the quiz and then to move to study unit seven!

Study Unit 6: Crew Alerting System Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin G1000 system crew alerting system on a flight from Roosterville, Missouri airport (0N0) to Clay County airport (KGPH), a tower controlled airport. Consider the following questions about this scenario:

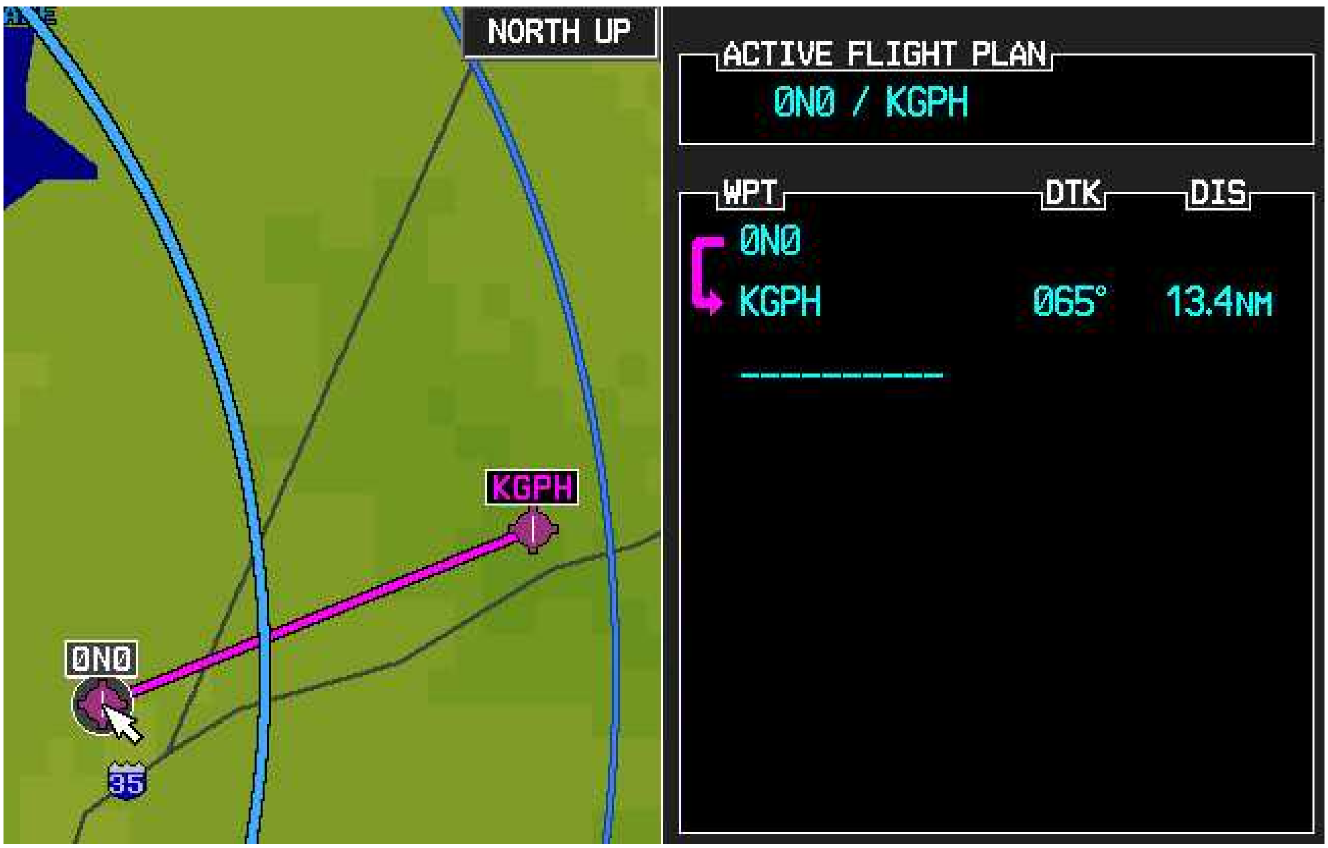

Figure 6.13 – Study unit 6 quiz scenario diagram

Question 1: While flying enroute, you notice a red flashing softkey in the bottom right corner of the PFD. What level of alert is being displayed?

- **a) CAUTION**
- **b) WARNING**
- **c) ADVISORY**

Question 2: What should you do next with the red flashing softkey in order to determine your options?

a) **Press the CLR button to see if the system resets**

b) **Look on the PFD next to the Vertical Speed indicator to see what system has failed**

c) **Press the ADVISORY button on the MFD to get a status of LRUs**

Question 3: What are the three levels of ALERTS used in the G1000 system?

a) **CAUTION, DANGER, ALERT**

b) **WARNING, ADVISORY, CAUTION**

c) **ALERT, ADVISORY, CAUTION**

Question 4: How is a WARNING acknowledged by the pilot?

a) **Looking at the screen and pressing enter**

b) **Pointing at the WARNING alert with the RNG knob pointer**

c) **Pressing the WARNING softkey**

Question 5: How will the G1000 system display the information when a system or component fails?

a) **A red X over the failed component removing all information from the item deemed inaccurate**

b) **Removing the component from the display**

c) **There is no warning of this**

Grading Criteria

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will offer a link back to the appropriate reference area in the study unit. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

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Study Unit 7: G1000 Transponder

Study Unit Objectives:
The objective of this software Study Unit is for you to move from the "Perception" level to the "Understand" level of FITS accomplishment regarding the basics of the integrated GTX 33 transponder and its use within the Garmin G1000 system. You will become familiar with all of its functions including the use of its code settings and the way in which it encodes Traffic information from the Air Traffic Control mode S transponder signal.

Completion Standards:
You will be able to describe and explain the features of the Garmin G1000 GTX33 Transponder and demonstrate an understanding of the use of the transponder controls from located on the Primary Flight Display.

The GTX 33 Digital Mode S Transponder

Figure 7.1 – Garmin GTX33 transponder LRU control box

The GTX33 Transponder functions from within the confines of the Primary Flight Display. It has no separate control box or knobs within the cockpit other than on the PFD. In addition to the basic transponder functions, the Mode S transponder has traffic information system (TIS).

Transponder Functions and Support

Mode A
This is referred to as 4096 support. This means that the transponder allows for the processing of 4 digits ranging from the numbers 0 to 7 and has 4096 possible combinations of codes. The VFR squawk code of 1200 is an example of a 4096 code. This information is encoded on the radar signal and sent back to ATC as a reply to their radar system interrogation signal. This discrete code will appear on the ATC radar scope to help distinguish your aircraft from others. When ATC gives you a special code to put into your transponder, it is imperative that you do this in accordance with their instructions.

Mode C

This allows for the automatic encoding of altitude information calibrated to a pressure altitude setting of 29.92. This information is sent back to ATC radar for display on their radar screens so they can distinguish your aircraft altitude from other aircraft around you.

Mode S

Mode S transponder only works with special Mode S radar equipment at ATC. Many TRACON radar facilities have Mode S equipment, but there are still some who do not. Canadian facilities do not have Mode S support at this time. Traffic Information Service (TIS) provides traffic information within a maximum range of 55 nautical miles of a terminal area with Mode S equipment installed and properly operating. The Mode S transponder receives information from a terminal radar facility and only displays targets that are shown on the terminal radar. The mode S receiver in the GTX33 transponder can track up to 8 targets within 12 nm of your aircraft. Some pilots have reported more targets being displayed than 8 but this has not been verified by Garmin.

Note: Only those aircraft with an operating Mode A and Mode C transponder will be encoded by ATC Mode S equipment and sent to your Mode S receiver for processing. Pilots should not rely on this system for definitive Traffic information reporting in the vicinity of their aircraft.

Transponder Display

Figure 7.2 – Garmin GTX33 transponder display on PFD

The Transponder status is located in the bottom right corner of the PFD. The squawk code and the status of the transponder is shown. GND will be shown if the transponder is in ground mode, and ALT will automatically appear when the aircraft exceeds 30 KTS of ground speed. If the transponder does not switch to altitude encoding, then it can be turned on from the transponder softkeys depicted in figure 7.3.

Note: Transponder always starts up squawking code from the last flight

Transponder Operating Modes

Figure 7.3 – Garmin GTX33 transponder PFD softkeys

Standby Mode

Figure 7.4 – Garmin GTX33 transponder in standby mode

Standby – Transponder is not sending or receiving any information to ATC. It is disabled.

ON Mode

Figure 7.5 – Garmin GTX33 transponder squawking 1200

On – Transponder is operating, but is not sending Mode C information so ATC is not receiving any altitude information.

ALT Mode

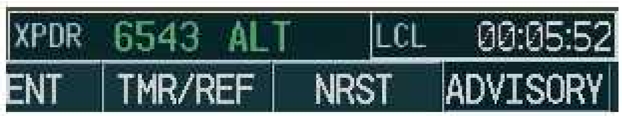


Figure 7.5 – Garmin GTX33 transponder squawking 6543 in ALT mode

Alt - Transponder is operating, and is sending Mode C information to ATC. ALT is automatically selected as soon as the aircraft is operating at a GS of greater than 30 knots. If it is operating at less than 30 knots GS, then the aircraft remain invisible to airborne radar and aircraft operating TCAS.

GROUND Mode

Figure 7.6 – Garmin GTX33 transponder squawking 6543 in GROUND mode

Ground - Transponder is operating, and is sending GROUND tag Mode C information to ATC. This tells the ATC equipment that you are still on the ground and reduces radar screen clutter and controller workload by not mixing traffic alerts with other aircraft that may already be airborne above you. Special GROUND CONTROL radar at certain facilities will be able to paint your aircraft in the taxiway system so that they can schedule and sequence traffic releases to departure control based upon terminal release of pending traffic.

Main Transponder Softkey Control Buttons

Figure 7.7 – Garmin GTX33 transponder squawking VFR in GROUND mode

This is the screen that we see as a default on all PFD softkey selection options. This is the main point of entry into all other transponder functions.

Figure 7.8 – Garmin GTX33XPDR softkey

Once we press XPDR, we get the following screen.

Figure 7.9 – Garmin GTX33 transponder set 2 softkeys

In order to squaw the universal **VFR code 1200**, we press the following VFR softkey.

Figure 7.10 – Garmin GTX33 transponder VFR softkey

If we want to enter a specific code assigned by ATC, then we press the CODE softkey.

Figure 7.11 – Garmin GTX33 transponder CODE softkey

- ❑ The XPNDR softkey on the bottom of the PFD gives access to change the transponder code and changing the status of the transponder. The VFR softkey will automatically change the squawk code to 1200.
- ❑ Pressing the CODE softkey will display the corresponding numbers to enter a different squawk code.

Note: Pressing XPDR twice (double pressing) is a shortcut straight to the code softkey set

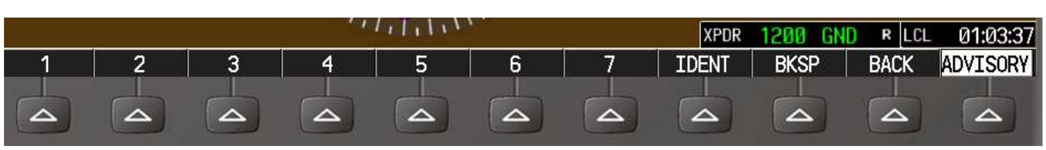


Figure 7.12 – Garmin GTX33 transponder code softkey set

Figure 7.13 – Garmin GTX33BKSPC softkey

The code can then be entered manually. The BKSP softkey will clear any mistakes made on the code. Make sure you press the final of the 4 digit codes.

Note: Failure to enter the final digit within a reasonable timeframe may result in a function timeout and the system will revert back to the original code.

Figure 7.14 – Garmin GTX33 transponder code softkey set

The BACK softkey will return to the regular PFD menu softkey set.

Figure 7.15 – Garmin GTX33 transponder IDENT softkey

The IDENT softkey can be pressed as requested by ATC. The IDENT softkey is also displayed on the default PFD menu.

Conclusion

In this study unit, we looked at the operation of the G1000 transponder with its controls on the PFD. You will find that operating this unit is essentially the same as the transponders on traditional aircraft with the exception that many of the functions are automatic. The operation of the TIS traffic reporting system is self contained within the system, but the display of that information is spread out across the rest of the system. We will cover this in much more depth in study unit 10.

Remember

- The transponder functions exclusively on the PFD and is driven solely by the softkeys

- The mode S features of the transponder function only when the ATC radar facility provides mode S signal support
- Pressing the XPDR key twice in a row takes you straight to the CODE softkey set
- Pressing IDENT acknowledges all button pushes and takes you back to the home PFD softkey set
- The transponder always starts up with the squawk code from the last flight – always check this in your startup flow!

FITS Study Unit Debriefing

You have now covered the area of the G1000 transponder system and should have a good understanding of its operation modes and how they are different from a traditional transponder.

- If you now understand that the G1000 transponder operates like other traditional transponders, you will understand that it is easy to use and very flexible!
- If you now understand that the G1000 transponder offers mode S functionality that depends upon special equipment at the ground radar facility, you will also understand that this mode S can create a false sense of security for you who relies on it too much.
- If you now understand that this transponder is controlled exclusively from the PFD, then you will also understand why knowing that the XPDR and IDENT softkeys are available in nearly every PFD screen so that you have ready access to its controls regardless of where your are in the PFD operation.

If you not only understand these three areas, but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a “Correlate” level of FITS accomplishment! It’s time take the quiz and then to move to study unit eight!

Study Unit 7: GTX 33 Transponder Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study quiz, imagine that you are flying on a VFR flight plan on a cross country from Clay County Regional airport (KGPH) airport back to Kansas City International Airport (KMCI). Consider the following questions about this scenario:

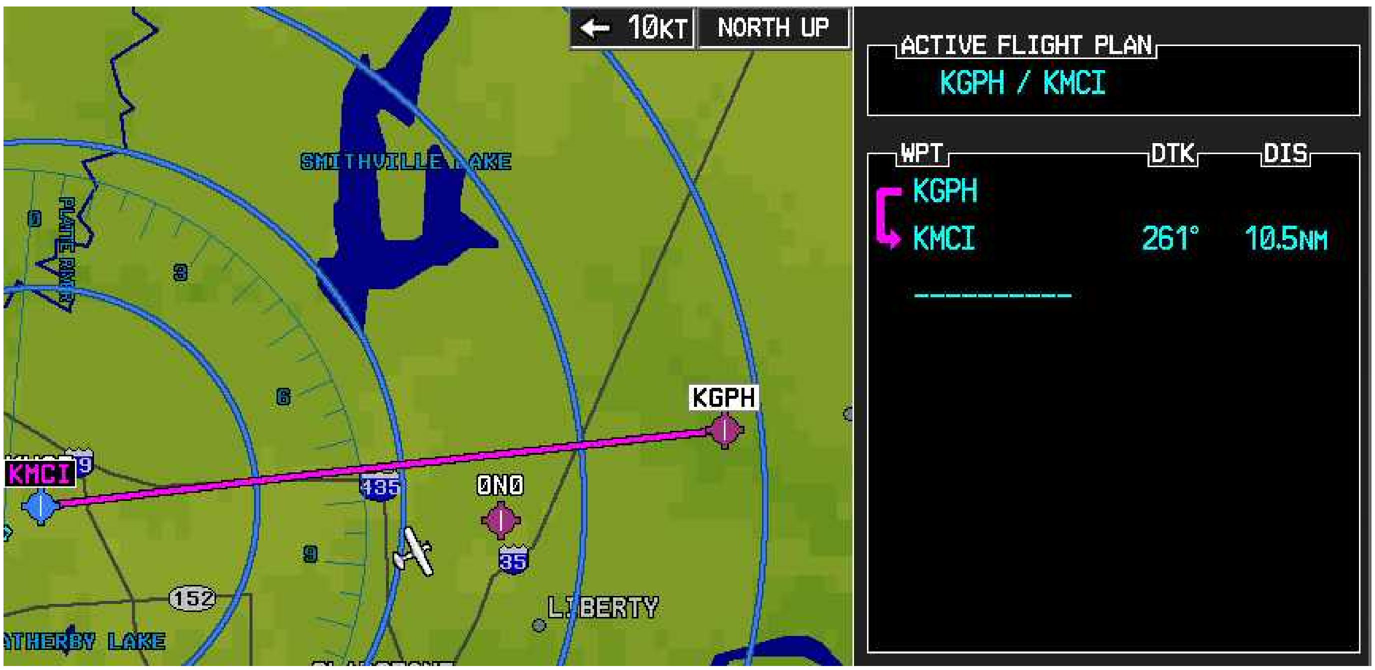


Figure 7.16 – Study unit 7 quiz scenario diagram

Question 1: How do you activate the ALT mode after takeoff and how do you verify that it is properly sending mode C Altitude to ATC?

a) Activate ALT by pressing XPDR and CODE prior to takeoff

b) The G1000 will automatically turn the ALT on after liftoff and the ALT readout will appear in the transponder status window

c) We can check ALT readout on the airspeed tape on the PFD screen to make sure that ALT was turned on at 30 knots

Question 2: During your flight you are requested to press IDENT by ATC. What do you have to do?

a) Press the IDENT button on the PFD softkey menu that is available in all modes of PFD operation

b) Press the XPNDR button on the MFD

c) Press the XPNDR button then the IDENT button on the MFD

Question 3: When you contact ATC, you request flight following and you are instructed to squawk 2146. How do you comply with ATC instructions?

a) Press XPDR and then the IDENT button twice

b) Press the XPNDR softkey on the PFD twice and enter the proper code followed by pressing BACK

c) Press the MAN SQ button on the audio panel and turn the FMS knob to enter the proper code.

Question 4: How far away from the terminal area will the Mode S transponder give traffic information?

a) 100 nautical miles

b) 55 nautical miles

c) The traffic information works anywhere there are operating transponders

Question 5: When you first start the aircraft and power on the avionics master switch, what code will come up in the transponder display window?

a) A blank code

b) A code of 1200

c) The last code that was used from the last flight

Grading Criteria

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will offer a link back to the appropriate reference area in the study unit. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 8: G1000 Audio Panel (GMA 1347)

Study Unit Objectives:
The objective of this software Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the basics of the GMA 1347 Audio Panel and how it interoperates with the audio management of the entire G1000 system.

Completion Standards:
When this study unit is complete, you will be able to describe and explain the features of the Garmin G1000 glass cockpit system GMA1347 Audio Panel and you will be able to show an understanding of its various components, how it interoperates with the other LRUs, and how you control it from the PFD and MFD.

You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

The Audio Panel

Figure 8.1 – The GMA350C Audio Panel functional overview

GMA250C Control Groups

This digital audio panel is similar to many modern audio panels except that it controls digital signal communications between the PFD and the MFD display units and it features a Bluetooth controlled audio system for digital streaming. When a selection is made, the light above that option will illuminate in the shape of a triangle ▼ pointing at the function. When a particular function is active, that light blinks ▼.

The Audio Panel is divided into several groups depending upon the functions that it performs.

Communication (COM) Audio Controls

Figure 8.2 – The GMA1347 Audio Panel COM control key group

This control group allows you to direct the operations of COM1, COM2, the combination of both in split com mode, and controls which COM radio is active on the microphone.

- ❑ • Transceiver audio selector keys (COM1, COM2, COM3) - These keys select the desired transceiver audio. More than one radio may be monitored at one time. The ▼ light above the active source will be illuminated.
- ❑ • Transmitter (AUDIO/MIC) selection keys (COM1 MIC, COM2 MIC, COM3 MIC) - These keys select the desired transmitter AND the receive audio for that transceiver. The audio is automatically selected for the appropriate transmitter when the button is depressed. There is no need to depress the audio button for the selected transmitter. Only one transmitter can be selected at any one time (exception: COM ½)
- ❑ • Split COM key (COM 1/2) -Pressing the COM 1/2 key selects the split COM function. During split COM operation, the COM1, COM1 MIC, COM2 and COM2 MIC keys are active. When the COM 1/2 key is selected, COM1 is used by the pilot for transmission and COM2 is used by the copilot. The COM1 MIC ▼ annunciator blinks when the pilot's microphone is keyed and the COM2 MIC annunciator blinks when the copilot's microphone is keyed. In this mode, both the pilot and the copilot can transmit simultaneously over separate radios. The pilot can still monitor COM3, NAV1, NAV2, DME, ADF, AUX and MKR audio as selected, but the copilot is only able to monitor COM2. Split COM mode is cancelled by pressing the COM ½ key again.
- ❑ • Dedicated telephone interface key (TEL) - The GMA 1347 contains a dedicated telephone interface. It is controlled by the TEL key but only works if an "Air to Ground" telephone system is installed

Navigation (NAV) Audio Controls

Figure 8.4– The GMA1347 Audio Panel NAV control key group

This control group allows you to direct the operations of NAV1, NAV2, DME, ADF, and Auxiliary audio that might be connected to the system separately from the G1000. The ▼ light above the active source will be illuminated.

- ❑ • Aircraft radio audio selector keys (NAV1, NAV2, ADF, DME, AUX) - By pressing the DME, ADF, AUX, NAV1, or NAV2 one can select and deselect the radio source. Selected audio can be heard over the headset and or speakers. These audio keys can be selected individually or together in any combination.
- ❑ • Passenger address key (PA) - By pressing the PA key the passenger address function is activated. When the PA function is activated the Push-to-talk (PTT) must be used to deliver PA announcements over the headsets.
- ❑ • Speaker key (SPKR) - Speaker audio is selected by the pilot by pressing the SPKR key. The speaker audio is automatically muted when the PTT switch is keyed. Adjustment of the speaker volume by the pilot is not available.

Intercom Controls including Cockpit Recorder

Figure 8.5 – The GMA1347 Audio Panel COM control key group

This control group allows you to direct the operations of the cockpit intercom, the isolation of the pilot and the co-pilot from the rest o the passengers, and the cockpit voice recorder which automatically records all incoming communication transmissions in discrete memory blocks for a total of up to 2 ½ minutes.

Figure 8.6– The GMA1347 Audio Panel VOL/SQ knob

- ❑ • Volume/squelch knob (VOL/SQ) - Intercom volume can be adjusted by turning one of the concentric knobs located near the bottom of the audio panel. The small knob adjusts the pilot’s ICS volume. The large knob adjusts the ICS volume for the co-pilot and passengers. Pressing the VOL/SQ knob switches between volume and squelch adjustment (after pressing the MAN SQ button). When the unit is in volume adjustment mode, the VOL indicator on the lower left of the VOL/SQ knob is lit and volume can be adjusted. When the unit is in squelch mode, the SQ indicator on the lower right of the VOL/SQ knob is lit and squelch level can be adjusted.

- • Intercom manual squelch key (MAN SQ) - Manual Squelch mode can be activated by pressing the MAN SQ button. This allows the listener to override the automatic squelch system. Pressing the VOL/SQ knob toggles between volume and squelch adjustment. When the unit is in squelch mode, the SQ indicator on the lower right of the VOL/SQ knob is lit and squelch threshold level can be adjusted. The small knob adjusts the pilot's squelch level, the large knob adjusts the co-pilot and passenger squelch level.

Additional Options Available

- • AUX - The GMA 1347 provides for an entertainment input which allows audio from outside sources to be played over the intercom system. There are two types of playback: Muted music and Un-muted music. (note: Requires a CD input jack installed in the aircraft to function independent of the GDL69 datalink)
    - Muted music is available to you and copilot during normal intercom operations. It is muted anytime there is audio from the aircraft radio, marker beacons, or intercom system. - Un-muted music is available only to the passengers and is never muted.
- Diamond aircraft has announced that they will install a passenger music volume control
- • Digital recording playback key (PLAY) - The GMA 1347 provides a digital clearance recorder with playback capability. The length of playback is up to 2.5 minutes of COM signal recording. Each separate com radio transmission is recorded in separate memory positions. Signals from all of the selected COM radios are recorded and can be played back. After the recording time limit is reached, the recorder begins recording over the stored memory positions, starting from the oldest one. These positions are automatically cleared upon power off.
    - Each time the play button is pressed the next oldest recording position will be played until the 2.5 minute limit is reached. While in playback mode the annunciator is illuminated above the PLAY button.
    - The ▼ light above the active source will flash during playback
    - Pressing the Marker Mute button stops playback
    - Any new incoming COM transmissions automatically stops playback and recording starts again
    - All recorded data is lost after shut down and power is turned off to the system

Figure 8.7– The GMA1347 intercom isolation keys

- Intercom system (ICS) isolation keys (PILOT, COPLT) - Four isolation modes are available: ALL, PILOT, COPILOT and CREW.
    - When only the PILOT key is selected: The pilot can hear the selected radios, and muted music. The passengers can hear un-muted music, and the copilot and passengers can communicate with each other.
    - When only the COPLT key is selected: The copilot is isolated from everyone else. The pilot and passengers can hear the selected radios and communicate with each other. In this mode, the pilot can hear muted music, and the passengers can hear un-muted music.

- ❑ When both the PILOT and COPLT keys are selected: Both the pilot and copilot can hear the selected radios and communicate with each other, while the passengers can only communicate with each other and hear un-muted music.

Reversionary Backup Controls

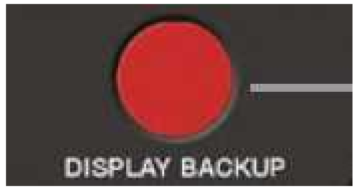


Figure 8.8– The GMA1347 Reversionary mode button

Figure 8.9 – The G1000 in reversionary mode

Reversionary mode button (DISPLAY BACKUP) - This control button is located on the bottom of the display and controls the operation of the G1000 Display Units from either normal mode or reversionary mode. In reversionary mode, the screens display identical information. This includes engine instrumentation but forces the removal of the moving map display on the MFD and the inset display on the PFD.

In case of a display failure the Reversionary mode can be activated by pressing the DISPLAY BACKUP located at the bottom of the audio panel. The Reversionary mode operation displays important flight and engine information on both the PFD and MFD. While in reversionary mode, the inset map cannot be displayed. Additionally, the MFD will not function in moving map mode.

Note: In case of power loss to one of the GDU1040 display units, the remaining GDU will automatically default to reversionary mode.

Operating the screens in this mode occurs in the following circumstances:

- Automatic reversion by the G1000 computer when it senses that the PFD is not in service or has suffered a power loss.
- Manually, by pressing the red button when you determine that something is wrong with the PFD display and the computer did not detect it.
- Manually, by pressing the red button when you determine removing the MFD information enhances flight safety such as operating in the traffic pattern with a flight instructor, etc.
- During takeoff and landing so the engine instrumentation is in front of you

Marker Beacon Controls

Figure 8.8 – The GMA1347 Audio Panel COM control key group

This control group allows you to operate the audio portion of the marker beacon receiver.

- • Marker beacon receiver audio select/mute key (MKR/MUTE) - The receiver detects the three (3) marker tones, outer, middle and inner, and illuminates the appropriate marker beacon indicators located on the upper left of the altimeter tape on the PFD. The outer marker is indicated with a blue indicator, the middle marker with an amber indicator and the inner marker with a white indicator. When the MKR/MUTE key is selected, the annunciator light illuminates and the audio signal can be heard over the speaker or headsets during marker reception.
- The GMA 1347 provides a marker audio muting capability. When the MKR/MUTE key is annunciated and a marker beacon tone is received, pressing the MKR/MUTE key mutes the audio but does not affect the annunciators. The audio returns when the next marker signal is received.
- • Marker beacon receiver high sensitivity key (HI SENS) - The HI SENS function is used to receive a weak or earlier indication of the marker beacon during an approach. HI SENS can be pressed for increased marker beacon signal sensitivity.
- The marker beacon display light on the PFD cannot be turned off

Conclusion

In this study unit, we looked at the functions of the GMA1347 Audio Panel and how it controls the communications of the Audio system in the aircraft and directs the audio of the NAV and COM system. We also learned about the Reversionary Display button which controls the display unit behavior in the event of an emergency or any time you want to limit the information on the screen, such as when entering the traffic pattern or when you are with your flight instructor.

Remember

- ❑ Autopilot cannot be used if the GMA1347 is disabled or turned off due to FAA requirement to hear audible alarms
- ❑ The ▼ light above an item indicates that it is active
- ❑ The ▼ light blinking above an item indicates that it is operating
- ❑ The Reversionary display button is an important part of your emergency response to display failures

FITS Study Unit Debriefing:

You have now covered the area of the GMA1347 Audio Panel and should now understand how this system controls the audio of the entire G1000 system.

- ❑ If you now understand that the G1000 uses the GMA1347 as a control of digital audio information flow between the display units, then you will also understand that knowing the main groups of buttons on the audio panel can make sure that you do not accidentally disable a radio that you really meant to listen to.
- ❑ If you now understand why the reversionary button is your first line of defense in reducing distracting information in the cockpit when you do not need it, then you should also understand that the system can do the same thing to you automatically if it detects a display unit LRU failure.
- ❑ If you now understand that the cockpit voice recorder records all incoming radio transmissions then you should also understand that by pressing the PLAY button repeatedly will allow you to move backwards to review a previous ATC transmission.

If you not only understand these three areas, but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a "Correlate" level of FITS accomplishment! It's time take the quiz and then to move to study unit nine!

Study Unit 8: GMA1347 Audio Panel Quiz

The Quiz Session Scenario
The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. Audio Panel to determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft. .

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin GMA 1347 Audio Panel and the role it plays in a typical flight scenario from Kansas City International Airport (KMCI) to Kansas City Downtown airport (KMKC). Consider the following questions about this scenario:

Figure 8.9 – Study unit 8 quiz scenario diagram

Question 1: As you approach your destination airport, you want to listen to the ATIS while maintaining contact with approach control. How is the second frequency selected on the audio panel?

- ***a) Pressing the COM/MIC key for the other radio***
- ***b) Pressing the COM button for the radio tuned to ATIS***
- ***c) Pressing the MKR/MUTE button***

Question 2: Before your flight, you are in your airplane and you want to listen to ATIS on the speaker. How is this accomplished?

a) ***Pressing the COM button***
b) ***Pressing the ADF button***
c) ***Pressing the SPKR button on the GMA1347***

Question 3: During your flight, you need to isolate your passengers so they can talk uninterrupted, how is this accomplished on the audio panel?

a) ***Pressing the MKR/MUTE button***
b) ***Pressing the PILOT key in the intercom section of the GMA1347***
c) ***Pressing the PLAY button***

Question 4: During your operation in the destination terminal area, you desire to reduce the distraction caused by the MFD. How do you change the MFD into the PFD?

a) ***Using the PA button***
b) ***Using the HI SENS button***
c) ***Pressing the Display backup button***

Question 5: You received ATIS information on your COM radio a moment ago, but neglected to make a note of the wind speed. Other than tuning the frequency back in again, how else can you get this information

a) ***Press the PLAY button on your portable voice recorder***
b) ***Using the HI SENS button to listen to the ATIS more clearly***
c) ***Pressing the PLAY button repeatedly until you hear the ATIS in playback mode, them press MKR MUTE when you have heard what you need***

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will offer a link back to the appropriate reference area in the study unit. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 9: Engine Indications and Engine Management

Study Unit Objectives:
The objective of this software Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the basics of the engine indications and engine management instrumentation and controls.

Completion Standards:
You will be able to describe and explain the features of the Garmin G1000 glass cockpit system and demonstrate an understanding of the engine indications and engine management instrumentation and controls from the perspective of the pilot who must manage all the automation in the cockpit while maintaining a scan flow to keep situational awareness at its maximum effectiveness.

You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

The Engine Management and Monitoring System

The engine indicators are stacked on the left hand side of the MFD, and also appear on the PFD any time the system is operating in reversionary or emergency backup mode. These gauges have the same basic look and feel of their traditional counterparts, but are organized to optimize space and take advantage of the crew alerting system on the PFD.

The G1000 always uses the color paradigm

GREEN means things are good or within an acceptable range
Yellow requires investigation and could go either way – but don't ignore it
RED means trouble and requires immediate decision making on your part

or 

where the triangle turns yellow or red means a parameter is out of normal range and needs your attention – do not ignore!

The engine Monitoring quadrant can take several different views:

ENGINE or normal mode using color banded slider gauges to show current relative operating parameters for each gauge using the color codes shown above and the sliding triangle pointer which shows where the reading falls within the colored arc. When something is out of the green range, the triangle pointer turns a color as noted above and it may place the cylinder number in the triangle, as well. When something such as the triangle pointer blinks, it needs attention.

SYSTEM or detailed view changes many of the sliding colored scale pointers into numeric displays telling you exactly what the reading is. When something is out of the green range, the triangle pointer turns a color as noted above and if it refers to a particular cylinder of the engine, it may place the cylinder number in the triangle, as well. When something such as the triangle pointer blinks, it needs attention.

Figure 9.1 – System softkey

Figure 9.2–Engine softkey

Figure 9.3–Lean softkey

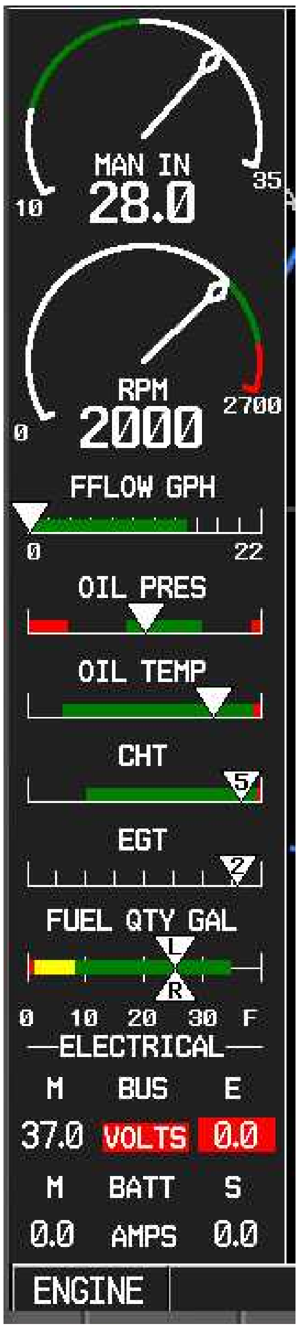


Figure 9.4 – System display

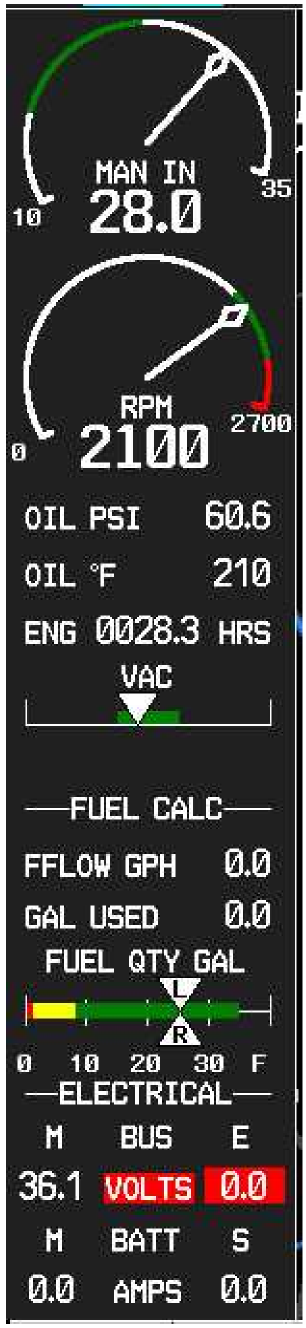


Figure 9.5 – Engine display

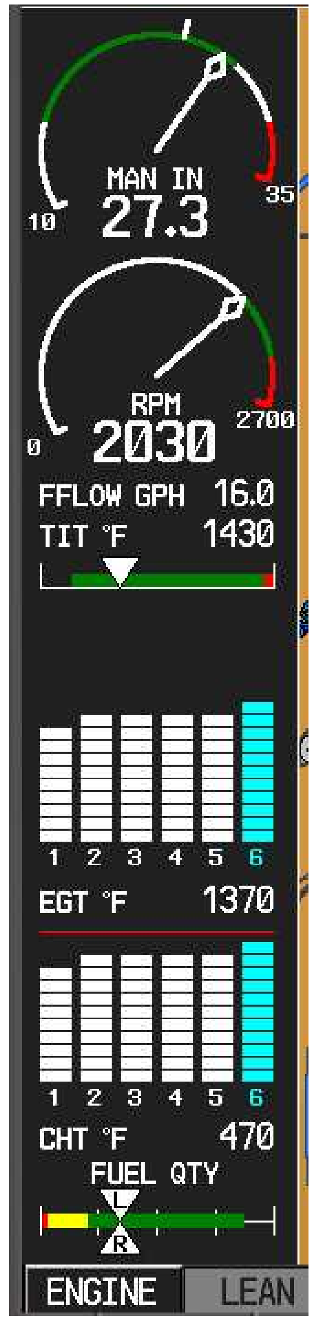


Figure 9.6 – Engine display

This engine monitoring system can be broken into several information groups

Engine Performance

Figure 9.7 – Engine performance group

This portion of the monitoring system can vary from aircraft model to aircraft model depending upon if there is a constant pitch propeller or even single engine versus multiengine.

- Manifold pressure (where applicable) in In/Hg – This is the primary way we set power with the throttle on a constant speed propeller equipped aircraft such as Mooney, Beechcraft, higher horsepower Cessna, and Diamond aircraft.
- Engine speed in RPM – All the aircraft mentioned above will set this value using the Propeller control. Aircraft with a fixed pitch propeller will not have a Manifold Pressure gauge and throttle settings will be set with this indicator. Examples of this type of aircraft would be Cessna 172.
- Fuel Flow - Shown in Gal/Hr of the G1000 aircraft will have this feature driven by a fuel flow transducer to help the pilot control his fuel burn and control the aircraft range
- Turbocharged aircraft may have an extra fuel flow setting which helps control engine temperature to avoid over heating

Internal Engine Operating Parameter

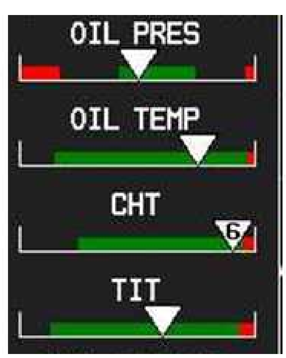


Figure 9.8 – Internal engine parameters

This portion of the monitoring system can vary from aircraft model to aircraft model depending upon if there is a turbocharger, a vacuum pump and other factors.

- ❑ Oil Pressure - shows whether value is in yellow, green, or red range
- ❑ Oil temp - shows whether value is in yellow, green, or red range
- ❑ CHT indicating hottest cylinder with the triangle shows whether value is in yellow, green, or red range
- ❑ Exhaust Gas Temperature (EGT) - indicating hottest cylinder with the triangle – Usually for non-turbocharged aircraft - shows whether value is in yellow, green, or red range
- ❑ Turbine Inlet Temperature (TIT) – Only for Turbocharged aircraft to help avoid over temping by setting mixture to achieve right operating temperature- shows whether value is in yellow, green, or red range

Fuel Quantity Monitoring

Figure 9.9 – Fuel quantity gauges

This portion of the monitoring system can vary from aircraft model to aircraft model depending upon if there are auxiliary fuel tanks, and other factors.

- ❑ Fuel quantity in Gallons from each measurable tank

Notice: Area above top of green on fuel gauges indicates unreadable fuel above top of fuel indication sending unit in fuel tanks

On some aircraft the following are available:
- ❑ Gallons Remaining
- ❑ Endurance
- ❑ Range

Caution: This measurement system is only required to be accurate when the gauges are empty.

Fuel Range Ring Management

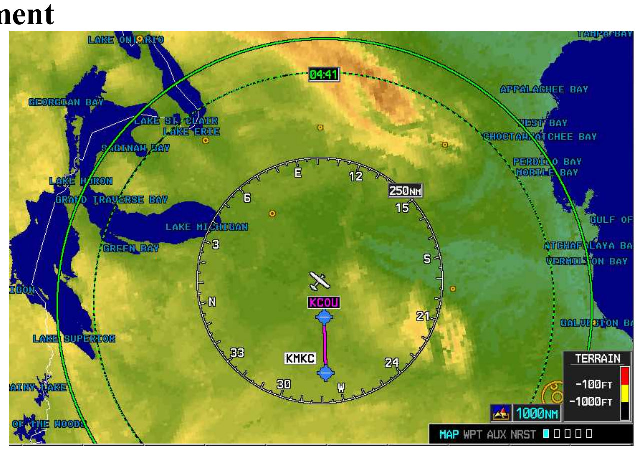


Figure 9.10 – Fuel range ring

These softkeys allow the fuel on board total to be modified to match the actual Fuel load on the aircraft

- INCR FUEL – increase fuel for purposes of measurement on the Fuel Range ring on the MFD
- DEC FUEL – decrease fuel for purposes of measurement on the Fuel Range ring on the MFD
- RST USD – reset fuel used for purposes of measurement on the Fuel Range ring on the MFD

Caution: The Fuel Range Ring measurement system is not in any way connected to how much fuel is in the fuel tanks. Only press reset when you actually have verified that the tanks are full. If the manufacturer provides for an INC and DEC function, then adjust fuel after verifying exact amount in tank.

Electrical System Monitoring

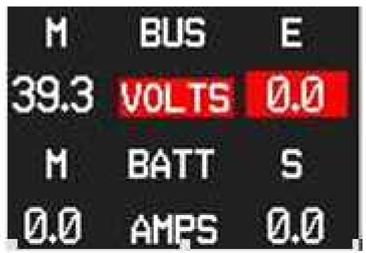


Figure 9.11 – Fuel quantity gauges

This portion of the monitoring system can vary from aircraft model to aircraft model depending upon if there is a standby battery or even multiple batteries and other factors.

- Main (M) and Essential (E) bus Voltages – relative to a 24 volt battery and a targeted 28 volt charging voltage – Note Maximum voltage is 32 volts – Anything higher than this and the G1000 system components may sustain heat damage internally
- Main (M) and Essential (E) Bus Amperage or current – Positive charging is good. Too much is not good.
- The two of these together represent the whole story about the integrity of your electrical system

Definition: **Critical Idle Speed** – The speed at which when idling with electrical equipment on, the alternator and the charging system provides a positive current charge as reflected by the Ammeter.

- Every aircraft has a critical idle speed. Determine the critical idling speed for your aircraft and try not to let it idle below that.
- Cessna critical idling speed is 950RPM (give or take)
- Diamond DA40 critical idle speed is 1100RPM (give or take)

Important: Never attempt takeoff with a battery voltage less than 28 volts or with a battery that has not had a chance to operate at or above the critical idle speed for a period of time enough to regain pre-starting capacity

Engine Leaning

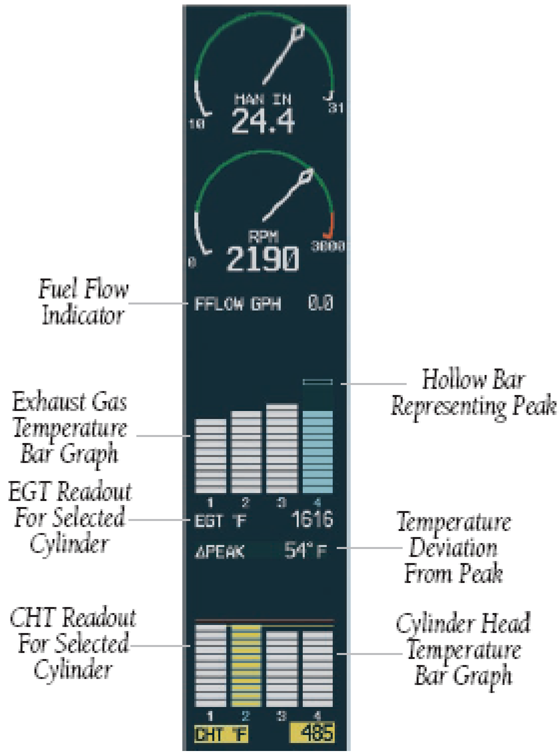


Figure 9.12 – Fuel leaning screen

Figure 9.13 – Engine lean softkey

Pressing the LEAN softkey accesses additional functions as follows:

CYL SLCT – allows display of the absolute value of the cylinder head and exhaust gas temperatures for the selected cylinder indicated by a blue numeral above that cyclinder

ASSIST – enables the lean assist function. As the mixture is leaned the exhaust gas temperatures will be shown to increase. The hottest cylinder is displayed in blue. The first cylinder that decreases in EGT is the leanest cylinder. Once this peak is reached a hollow blue box will be displayed on the graph. At that time the temperature differential will be displayed below the graph with the peak temperature as the zero degree reference point. Richen the mixture to the value recommended by the engine manufacturer.

Example: You level off in cruise and start the leaning process. The recommended cruise mixture is 50deg. F rich of peak EGT. Press the ENGINE, LEAN, and ASSIST softkeys. Start reducing the mixture slowly. As the leanest cylinder reaches peak EGT the hollow box will appear along with the temperature differential. Now richen the mixture until the temperature differential reaches the proper value (-50deg F).

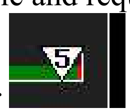
- The fuel gauges show the quantity of fuel in each tank. If one tank becomes low, and amber warning will appear. If one tank becomes empty, the fuel gauge will flash red.
- If the MFD were to fail, the engine stack will be shown on the left side of the PFD.
- The engine indicators will change color if there is an alert or warning with a particular system. For example, if the oil pressure was too low or too high, the indicator will begin to flash with a yellow color.

Conclusion

In this study unit, we looked at the engine monitoring and management systems in order to help you more thoroughly understand the features available that were not on traditional aircraft. Follow the color coding literally and relate them to a traffic light. Red is never good and you should be prepared to take immediate decision making action when it appears on critical engine monitoring equipment.

Remember

- ❑ Engine Gauge color shading legend:
  - ❑ **GREEN** means things are good or within an acceptable range
  - ❑ Yellow requires investigation and could go either way – but don't ignore it
  - ❑ RED means trouble and requires immediate decision making on your part
  - ❑ 

or 

where the triangle turns yellow or red means a parameter is out of normal range and needs your attention – do not ignore!
- ❑ Fuel gauges do not match the fuel range ring unless they are properly calibrated and verified
- ❑ Take care of your aircraft battery and charging system by obeying the critical idle speed
- ❑ Never attempt takeoff with an operating parameter in the red range or when an indication is out of limits or has a red X
- ❑ Keep the engine instrumentation within your scan flow

FITS Study Unit Debriefing:

You have now covered the area of the G1000 engine monitoring and control screens and should now have a much better understanding about how the G1000 actually puts information on the screen and how it uses colors to represent concepts of normal and not normal engine and operating indications.

- ❑ If you now understand that the G1000 color coding to represent normal and abnormal parameter indications, you probably should also understand that you can use the SYSTEM softkey to drive into indications and get the system to produce more information about the indication in question.
- ❑ If you now understand that a yellow or red indication on a monitoring system indicates that there may be a problem, you should also understand that not always does this mean it is a dire

emergency and that you may have options to diagnose a bad sending unit sensor by cross checking other indicators and see if the problem that you appear to have is real.

- ❑ If you now understand that this system is a digital system featuring many systems which are driven by software and computers, then you will also understand that software updates may come along in the form of service bulletins that may change the way these systems operate, requiring you to stay on top of updates, completely understanding them and how they inter-relate to your aircraft systems

If you not only understand these three areas, but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a "Correlate" level of FITS accomplishment! It's time take the quiz and then to move to study unit ten!

Study Unit 9: Engine Indications and Engine Management Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin engine monitoring system and some of the chores that you may have to perform using its information in a typical flight scenario between Kansas City Downtown airport (KMKC) to Cedar airport in Olathe, Kansas (51K), a non-tower controlled airport. Consider the following questions about this scenario:

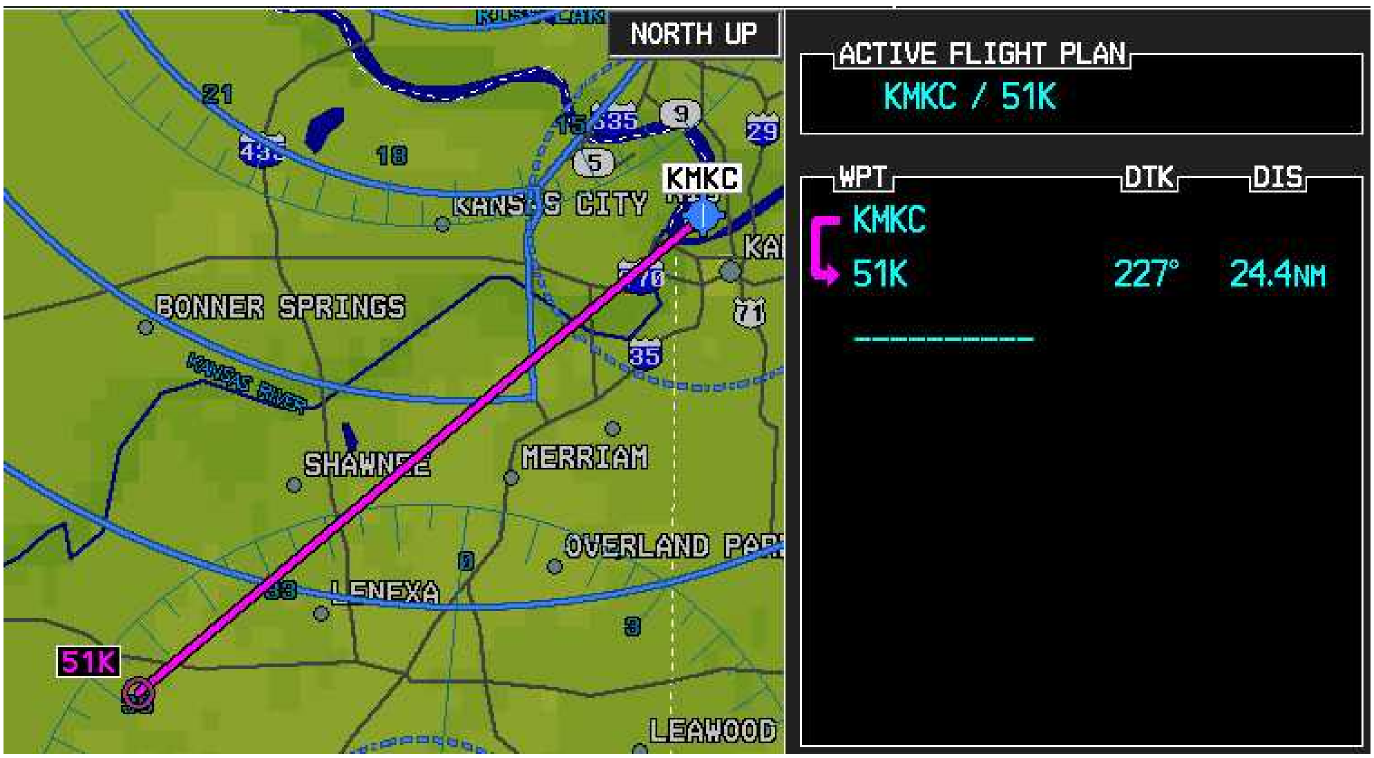


Figure 9.14 – Study unit 9 quiz scenario diagram

Question 1: During your flight the MFD display unit fails. Where will you be able to view your engine indicators?

- ***a) They will be displayed on the left side of the PFD***
- ***b) They will not be visible unless you press the Display Backup button on the GMA1347***
- ***c) They will be on map page 3***

Question 2: While enroute you want to look at the fuel remaining in a numeric format. What softkey will give you this information?

- ***a) Press the FMS cursor and move it onto the fuel gauges***
- ***b) Press the ENGINE softkey and then the SYSTEM softkey***
- ***c) Press the INSET softkey on the PFD to display the information in the PIP screen***

Question 3: During your engine run-up you need to look more specifically at the EGT gauge to make sure that it is working when you lean the mixture. How is this done?

- ***a) Pressing the ENGINE softkey, and then the SYSTEM softkey***
- ***b) Moving to AUX page 5***
- ***c) Pressing the CODE softkey***

Question 4: When using the lean assist function, which softkeys do you press to navigate to the correct screen?

- ***a) ENGINE then SYSTEM***
- ***b) LEAN then ENGINE***
- ***c) ENGINE then LEAN then ASSIST***

Question 5: As you approach the destination, you notice that the fuel range ring only shows 15 minutes of fuel remaining, but your fuel gauges still show fuel. What could have caused this disparity in the two systems?

- ***a) The fuel gauge sending unit has developed a problem***
- ***b) The fuel range ring reset button was not pressed the last time that the aircraft was fueled***
- ***c) The fuel flow transducer has developed a sending fault and should be followed by a caution on the PFD crew alert system***

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will offer a link back to the appropriate reference area in the study unit. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 10: Multi-Function Display

Study Unit Objectives:
The objective of this software Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the basics of the Primary Flight Display and the interoperability of the Line Replaceable Units (LRU) the G1000's main features, including instrumentation and controls.

Completion Standards:
You will be able to describe and explain the features of the Garmin G1000 glass cockpit system and demonstrate and understanding of the Multi Function Display and all of its robust functions, pages, screens, and menus. You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

The Multi Function Display (MFD) uses the right GDU 1040 and displays the most thorough information in the entire system. The information is separated into page groups that can be navigated through easily once you understand how to use the FMS knob.

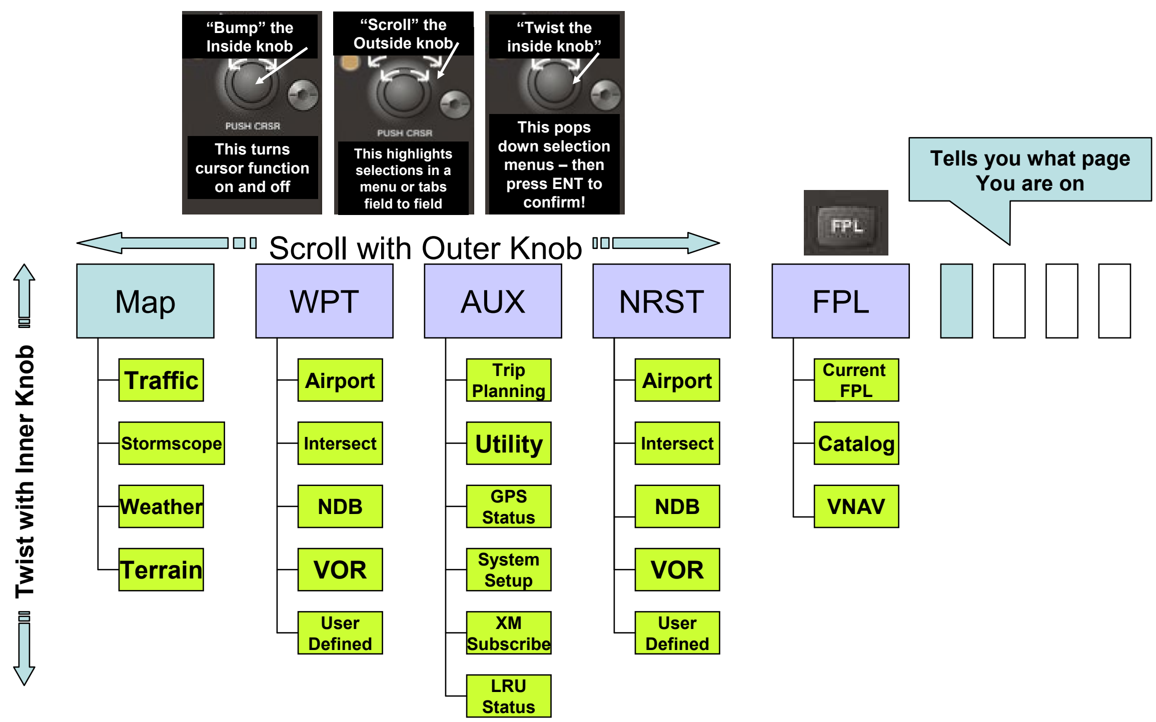


Figure 10.1 Multi-function display Menu Navigation

Page Groups

Page groups are shown in the bottom right hand corner of the MFD. You can also think of these page groups as "chapters" with "pages" within the chapters. The different page groups are labeled as:

1. MAP

The moving map shows the flight plan and additional information including aeronautical data, traffic, topography, terrain, and the capability for weather data.

2. WPT (Waypoint)

    Shows information on the current waypoint the active flight plan

3. AUX (Auxiliary)

    Provides for many auxiliary functions including GPS system status, RAIM, trip statistics, programmed events and timers

4. NRST (Nearest)

    Shows information on the nearest airport, VOR, NDB, Intersection, user waypoint, ARTCC, Center, and FSS

MAP page group

Figure 10.2 Map group page 1

Use the large FMS Knob to select the page group you want, use the small FMS knob to select the page you want within the group.

Figure 10.3 FMS knob

Map 1 **Moving Map**

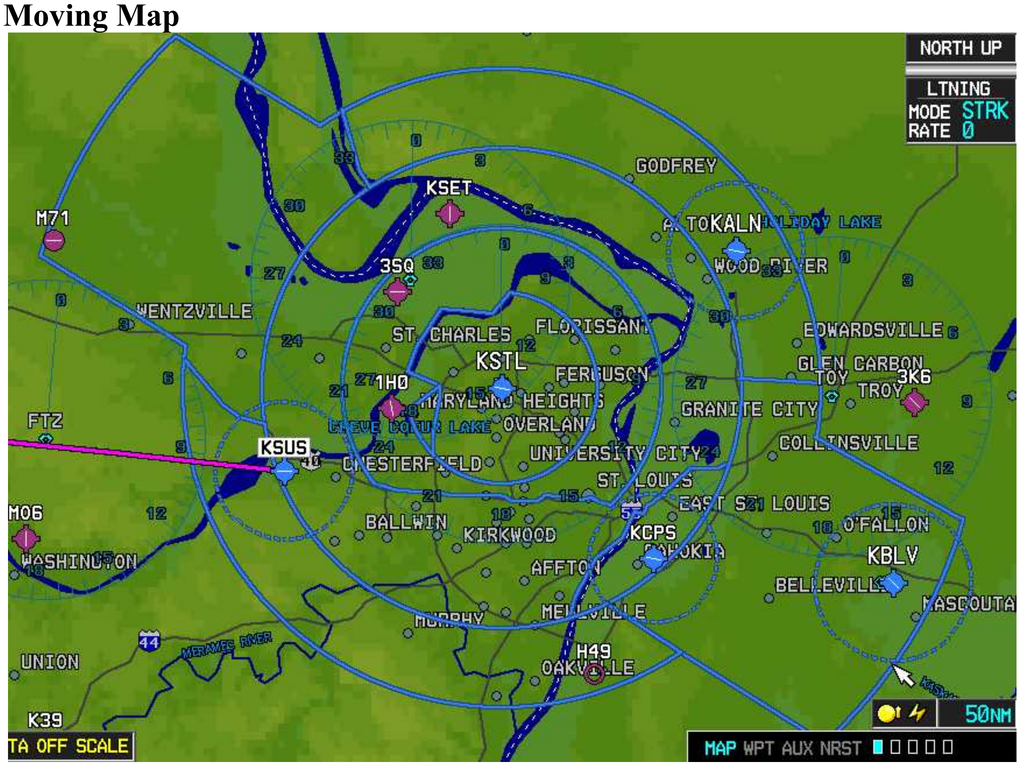


Figure 10.4 Map display page 1

The moving map on the MFD will give the pilot the most information in one screen. The map will be centered on the airplane icon.
All the available items shown on the moving map are:

- Navigation map display
- Airports
- Airspace
- NAVAIDS
- Land data Icons for map overlay functions
- Names of cities, facilities, airports, airspace, water features, highways etc
- Zoom range legend (lower right corner above page group icon)
  - To change the range of the navigation map turn the range knob to the right or left to display the range desired as indicated in the zoom range legend
- Wind Vector shown in upper right corner (Optional)
- Map Orientation (North up or Track up)
- Track vector (optional)
- Topography scale (optional)

To clear up the screen when there is too much information displayed, press the de-clutter soft key.

Figure 10.5 De clutter softkey

To return to the previous menu, press the BACK soft key.

Figure 10.6 Back softkey

To change any of the features of the map, press the MAP soft key at the bottom of the screen.

Figure 10.7 Map softkey

When you press this button, a new set of soft keys are displayed

Figure 10.8 Map overlay softkey selections

TOPO

The TOPO soft key will turn on the topographical information, the map above shows topographical information. To turn TOPO on or off, Press MAP.

Figure 10.9 Map softkey

Then press the TOPO soft key. When it is on, the TOPO box will be grey

Figure 10.10 TOPO softkey

When TOPO is turned off, the moving map display will look like this:

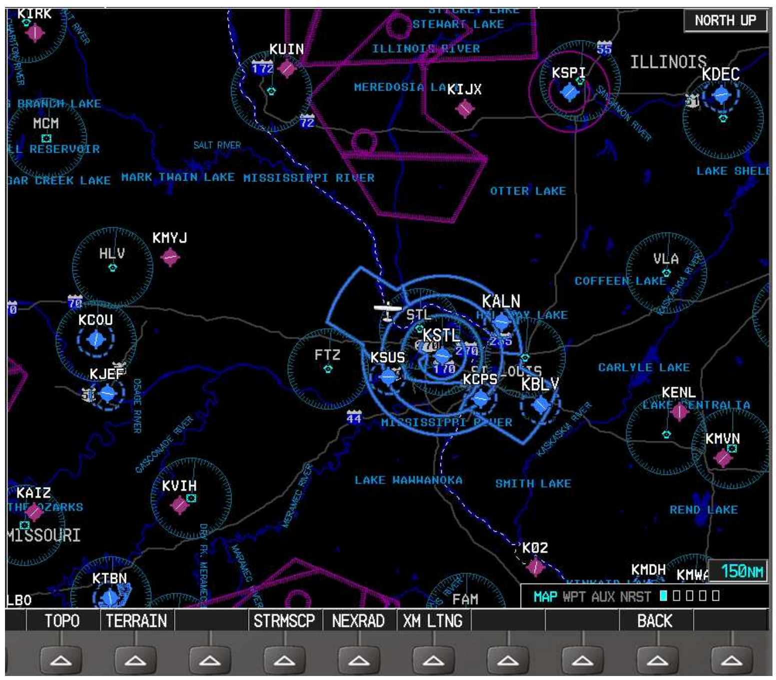


Figure 10.11 TOPO off map display

TERRAIN

A terrain awareness display showing terrain features and highlighting those within both 100'(red) and 1000'(yellow) of the aircrafts current altitude. Turn this function on and off the same way as TRAFFIC AND TOPO with the TERRAIN soft key.

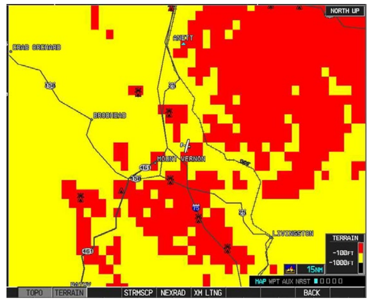


Figure 10.12 Terrain on map display

TRAFFIC

Figure 10.13 Map overlay softkeys

The TRAFFIC soft key will turn on the TIS overlay on the moving map. Traffic will be shown on the Map 1 page. You can turn the overlay on or off by pressing the MAP soft key, then the TRAFFIC soft key. When the TRAFFIC box is grey, the overlay is turned on.

STRMSCP

Press the STRMSCP soft key to turn the overlay of Stormscope on or off. If it is on, the STRMSCP box will be grey.

Figure 10.14 STRMSCP softkey

At the top right side of the MFD on the moving map, a lightning strike box will appear when Stormscope is activated.

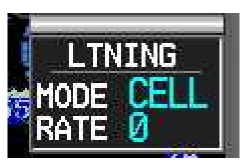


Figure 10.15 LTNING mode display

This box will give information on the rate of the lightning strikes, current lightning mode, current strike rate and fault messages.

NEXRAD

Press the NEXRAD soft key to activate the overlay of NEXRAD weather on the moving map. Doing this, however, will turn off TOPO, STRMSCP, and XM LTNG.

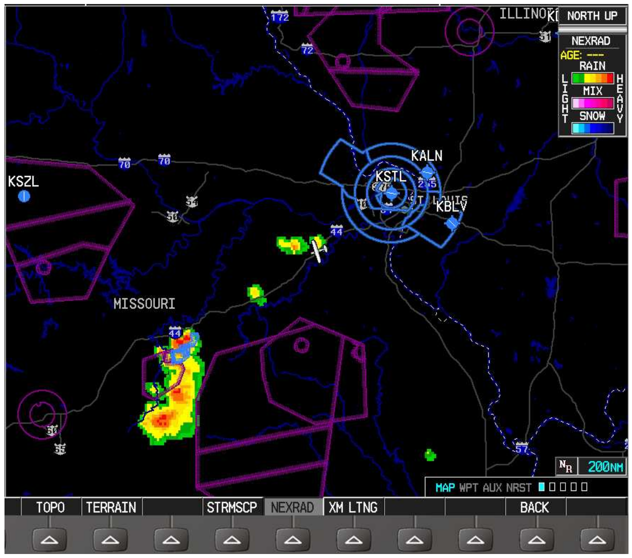


Figure 10.16 NEXRAD radar overlay

XM LTNG

The XM LTNG mode will turn off storm scope and use the XM system to overlay lightning strikes.

MAP 2 **Traffic**

Figure 10.17 MAP group page 2

A display showing TIS traffic information

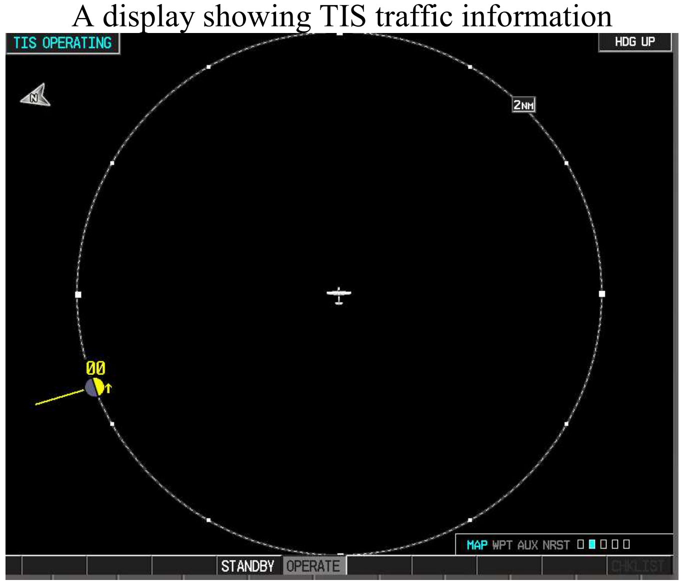


Figure 10.18 TIS display screen

The traffic alert can be turned on and off by turning the small knob to MAP page 2 and pressing the soft keys at the bottom of the screen. Press the OPERATE soft key to turn on the TIS or press STANDBY to turn off the TIS. The ring shows the range in which traffic is shown, use the range knob to zoom in or out.

Figure 10.19 Range knob

MAP 3 **Stormscope**

Figure 10.20 MAP group page 3

Figure 10.21 Stormscope display page

The Storm Scope can be adjusted on MAP page 3 by changing the mode from CELL mode to STRIKE mode. The view can also be changed by pressing the VIEW soft key from a 360 degree view to an ARC view.

Figure 10.22 Stormscope ARC view

You can also zoom in and out by turning the range knob.

MAP 4 **NEXRAD RADAR DEPICTION**

Figure 10.23 MAP group page 4

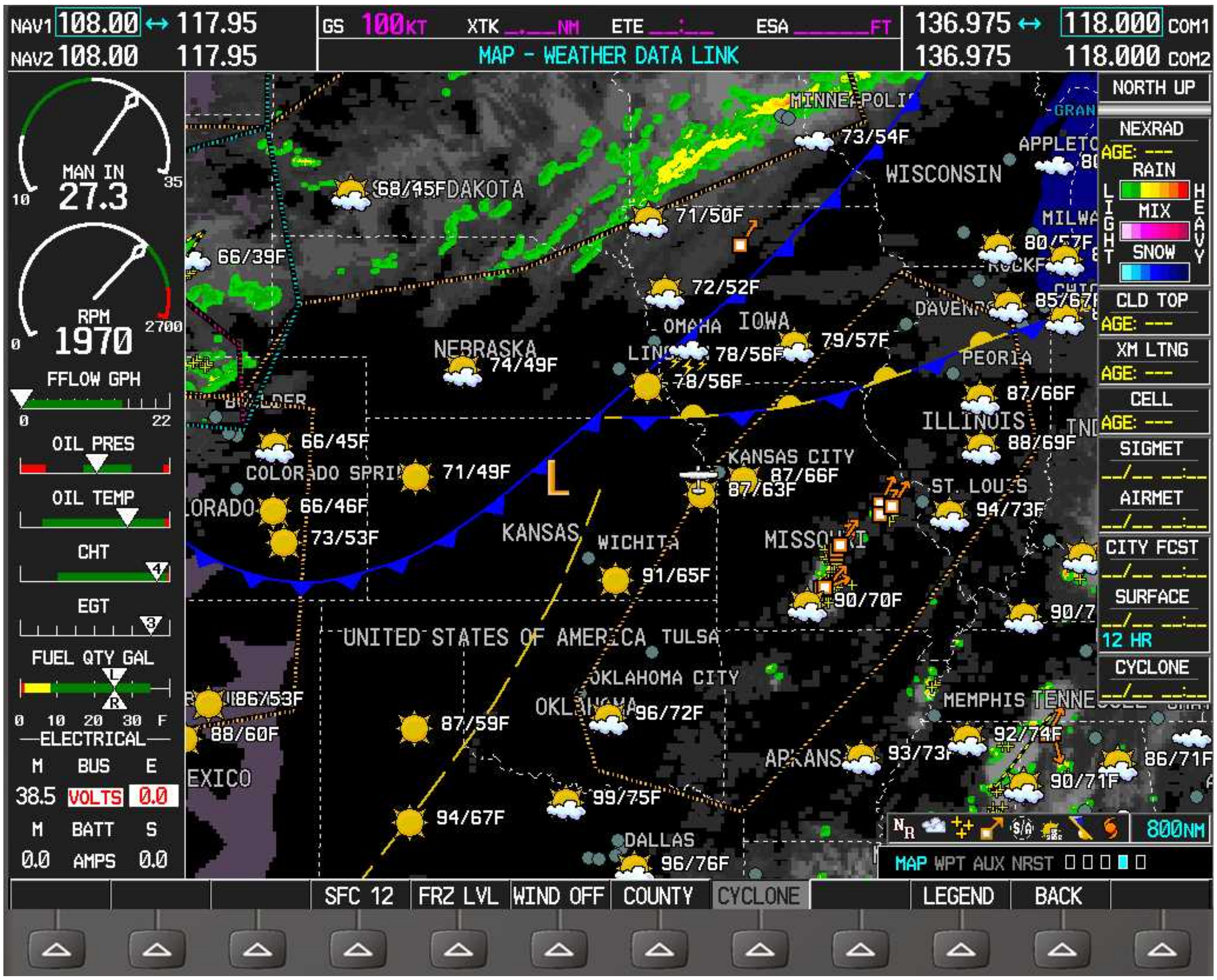


Figure 10.24 Weather Data link display

NEXRAD Weather uses XM Satellite service to download weather information such as radar, cell movement, storm tops, cloud tops, lightning, Sigmets and Airmets, METARS, surface analysis charts, freezing levels, winds aloft from 3000 feet to FL420, flood warnings and cyclones. There's also a legend to decode all of the symbols on the map. The pilot can bump the range button and use the joystick to find all of the weather information on the map. If the information is selected on indicated by the gray highlight then it can be viewed by the pilot in this manner. This example will use the METAR and TAF information for SPI (Springfield, IL).

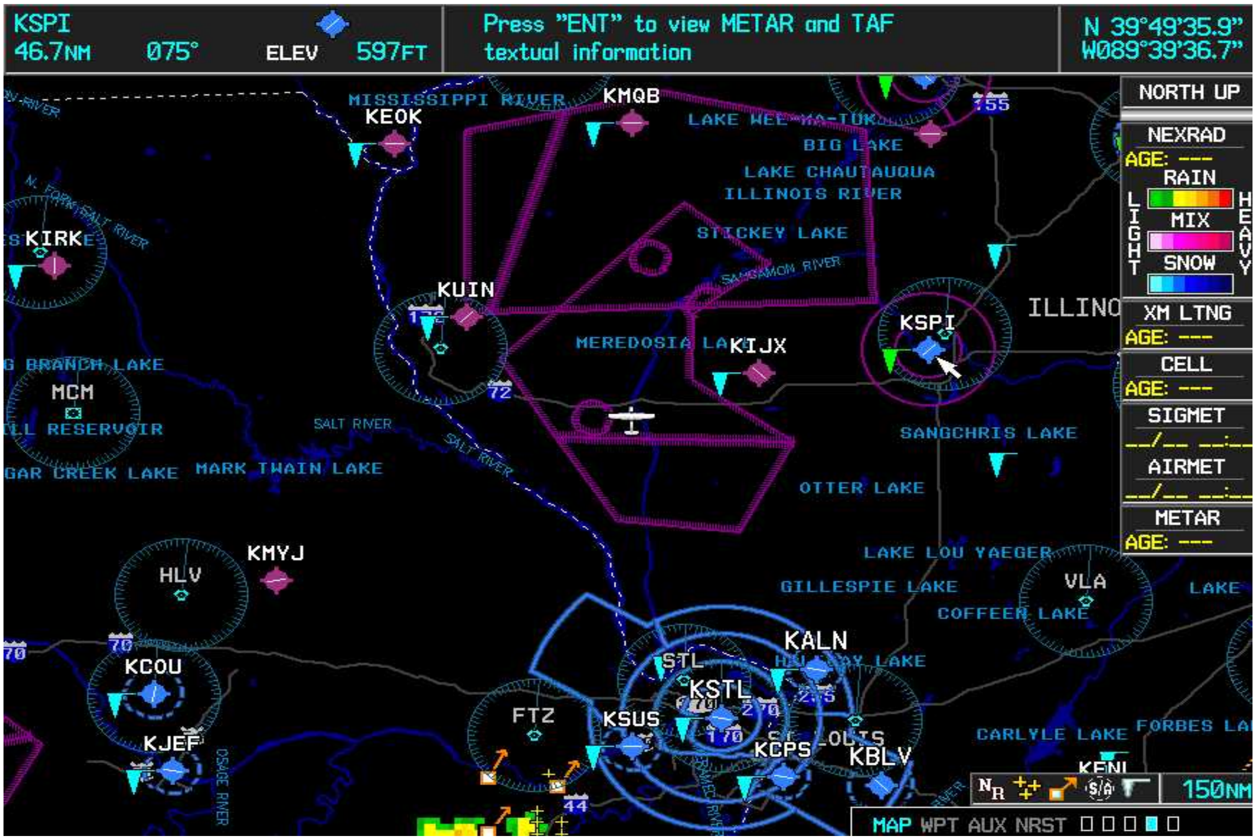


Figure 10.25 METAR and TAF stations

Notice the arrow on the airport symbol for SPI. At the top of the page you can see where it says Press "ENT" to view METAR and TAF textual information. At this time press the ENT key to view the information.

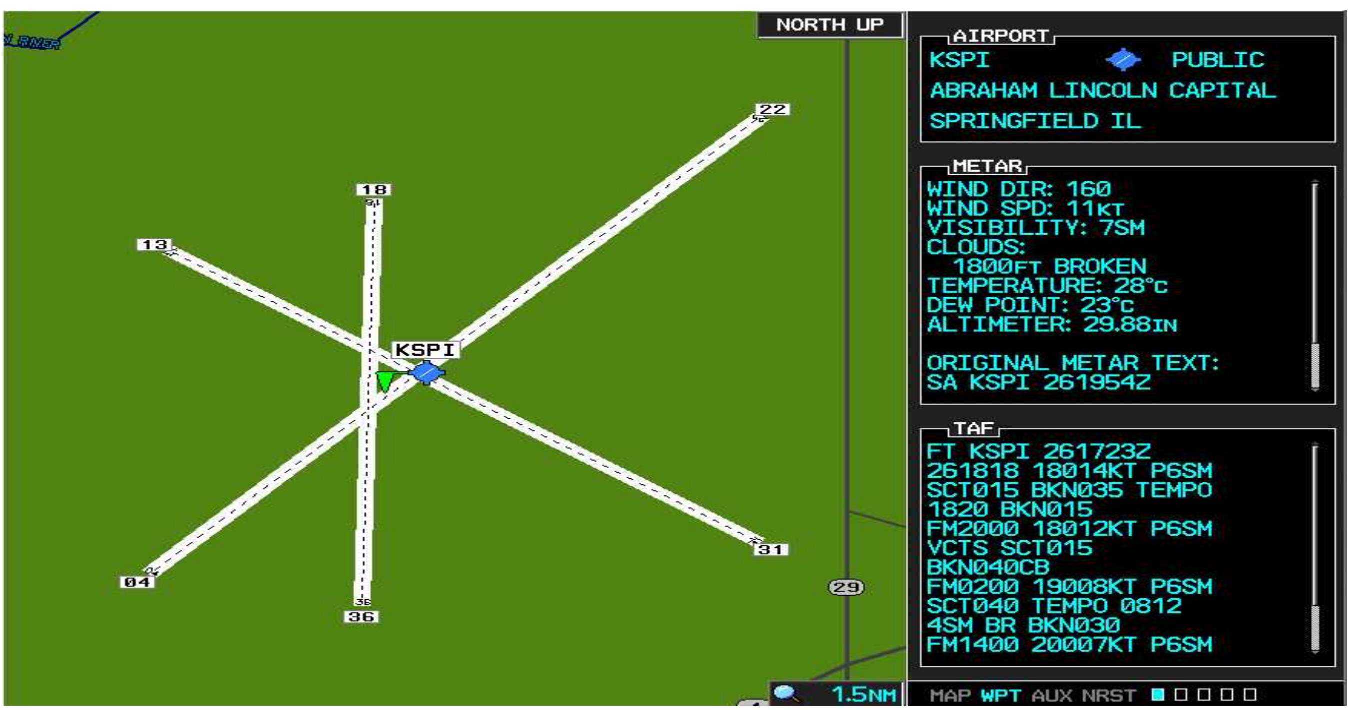


Figure 10.26 METAR and TAF text information

Another example of some of the information that is provided is AIRMET information. As in the previous example, the pilot bumps the range button, and then uses the joystick to move the pointer over an area that contains an AIRMET. You can see in the figure the large area that the aircraft is in is outlined with an AIRMET.

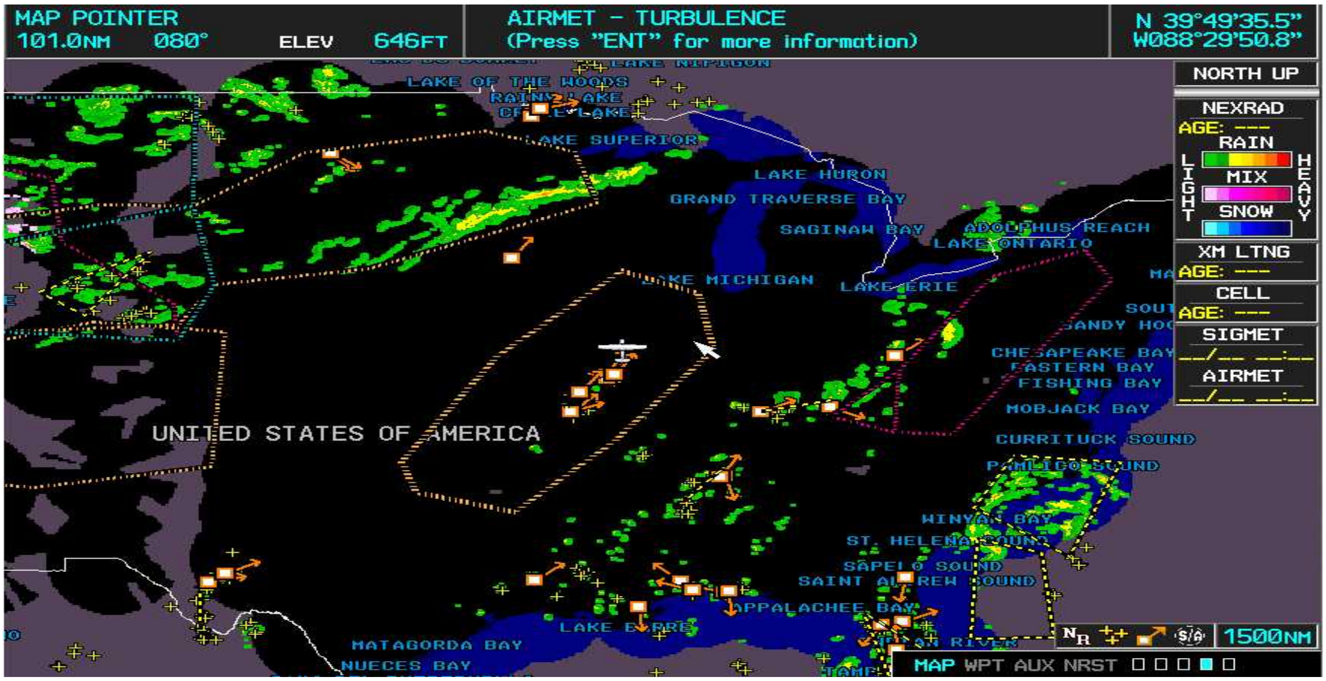


Figure 10.27 AIRMET area display

By pressing ENT they pilot can view the textural description of the AIRMET.

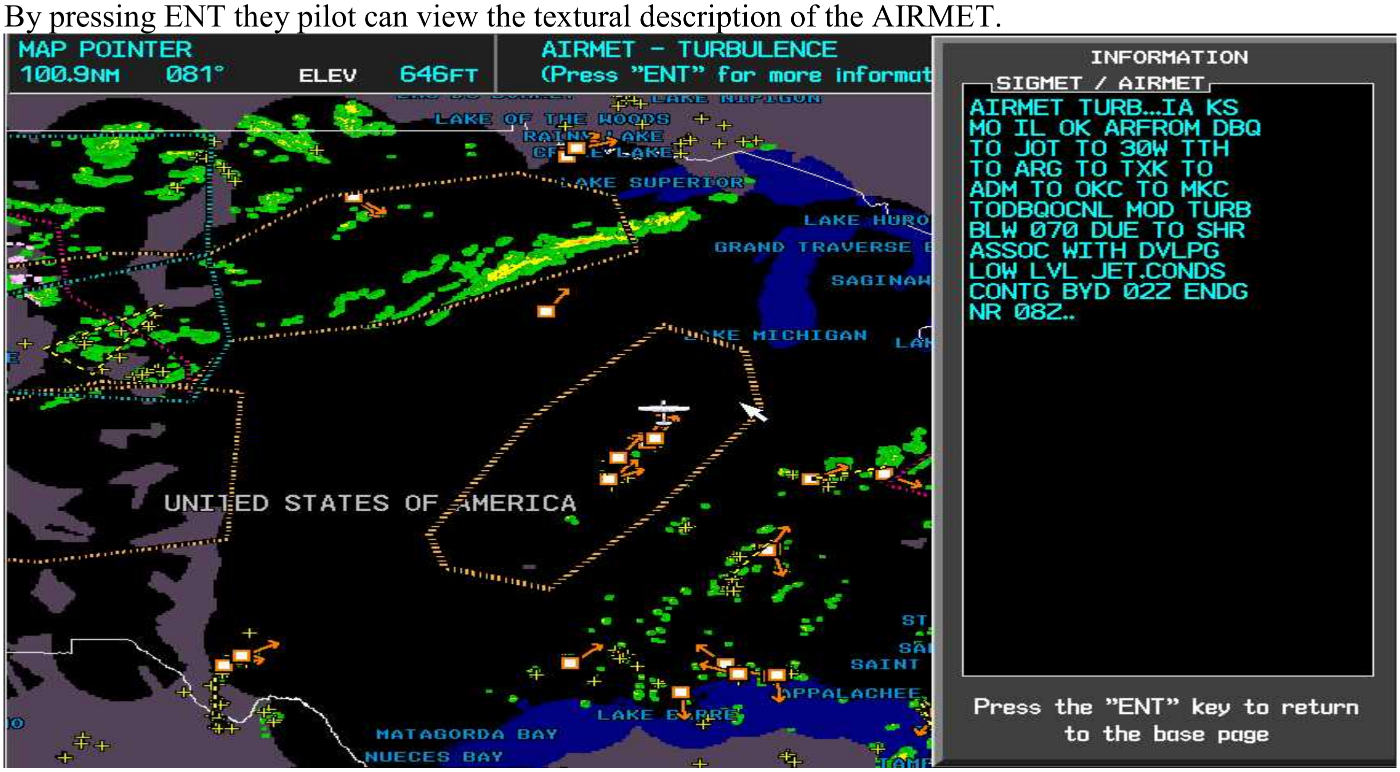


Figure 10.28 AIRMET text information

MAP 5 **TERRAIN**
The Map page 5 shows terrain within 1000 ft of the aircrafts current altitude which is shown in yellow and terrain within 100 ft shown in red.

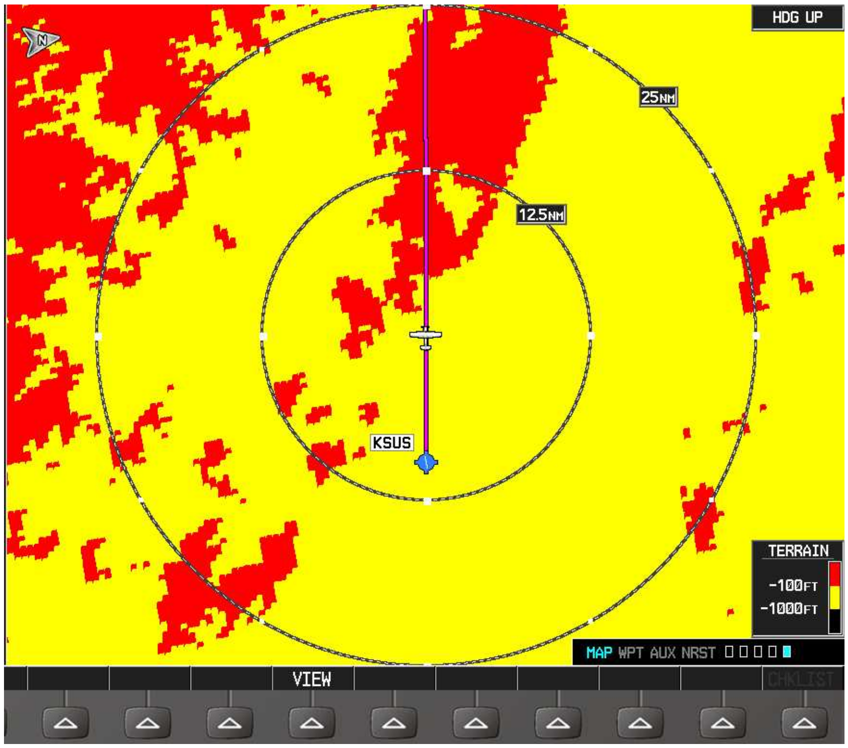


Figure 10.29 Terrain display page

The view format is selected by using the soft keys. Press VIEW, then select 360 or ARC view. The range can be changed up to 200 NM by turning the RANGE knob.

Map showing surrounding terrain
Current aircraft location
Range rings
Color scale

Additional Information
By pressing the range knob you enable the pointer.

Figure 10.30 Range knob

The pointer can be moved around the navigation map by pushing the range "joystick" in the desired direction of movement. The map will automatically pan to display the area of the map around the pointer. The pointer can be used to select most nav map features. In the example below, once an airport is selected by the pointer, the airport type, services available, elevation, distance and bearing to the station are displayed. Additional information is available such as:

Traffic map display

- o Displays traffic information from the TIS system
- o Shows:
  - o Surrounding traffic, current aircraft location and range markings
  - o Current traffic mode
  - o Traffic alert messages

Figure 10.31 WPT selection with pointer

Waypoint Menu Group

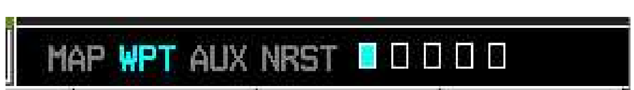


Figure 10.32 WPT group page 1

The waypoint chapter is the second chapter in the MFD. The waypoint chapter will display information on the current destination airport, intersection, NDB, VOR, and user waypoint.

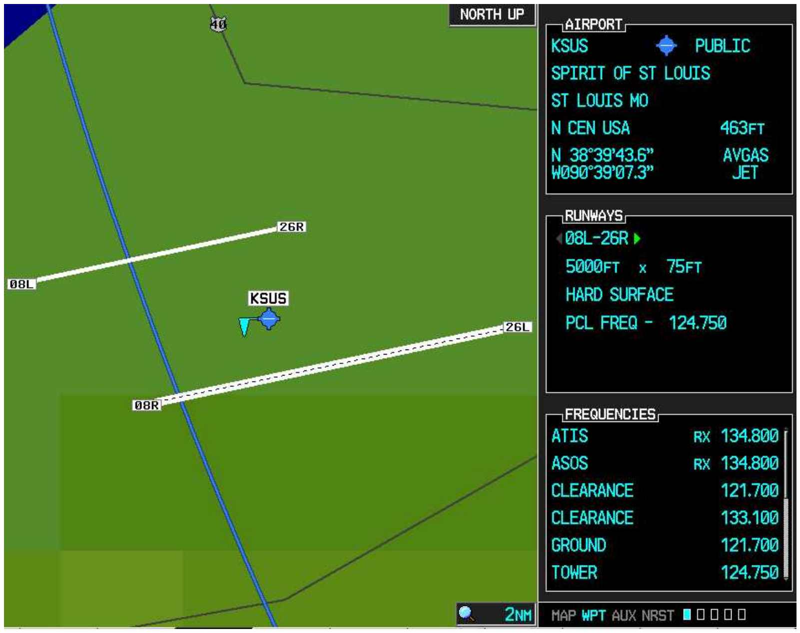


Figure 10.33 Display of selected waypoint

Waypoint Page 1: Airport

Figure 10.34 Airport information page

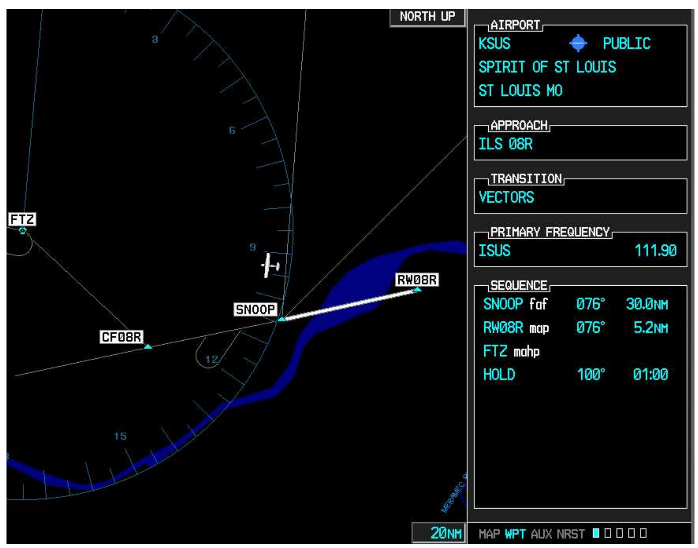


Figure 10.35 Waypoint display after pressing APR softkey

The airport page will list information on the last airport selected as a destination or the departure airport can be listed. It will be displayed on the right-hand side of the MFD screen and a map of the runway layout is displayed.

The top box will display the airport name, location, elevation and type of airport. (public, controlled, fuel services)
Information on the different runways such as length, hard surface, and orientation is listed.
The list of frequencies includes ATIS, ASOS, Clearance, etc.

Figure 10.36 Airport text information

The Softkeys on WPT Page 1 can be selected to provide other information such as Departure procedures (DP), Arrivals (STAR), and Instrument Approaches (APR)

Waypoint Page 2: Intersections

Figure 10.37 WPT page 2 Intersection

The second page displays intersection information such as LAT/LONG, Nearest VOR radial and distance

Waypoint Page 3: NDB

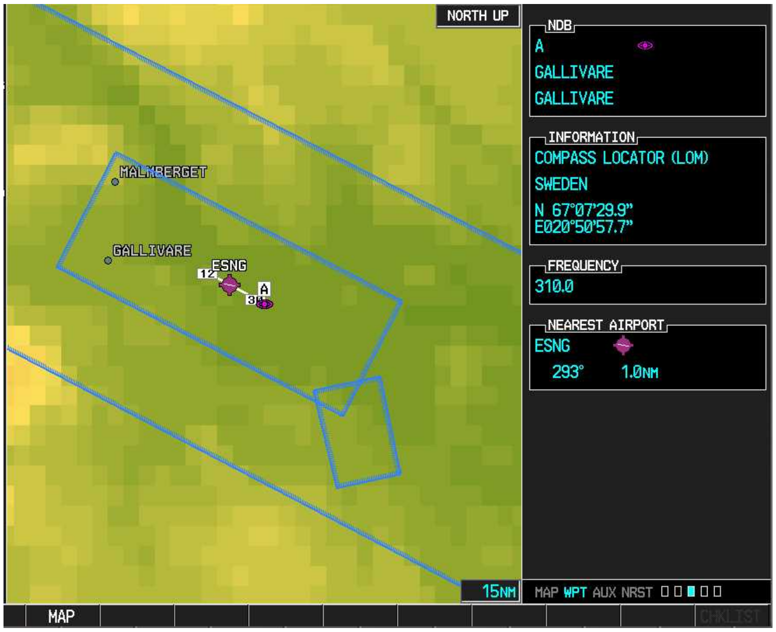


Figure 10.38 NDB waypoint page

NDB information, type, location, frequency and nearest airport.

Waypoint Page 4

Figure 10.39 VOR waypoint page

VOR type (VORTAC), low altitude, frequency and nearest airport.

Waypoint Page 5: User Defined

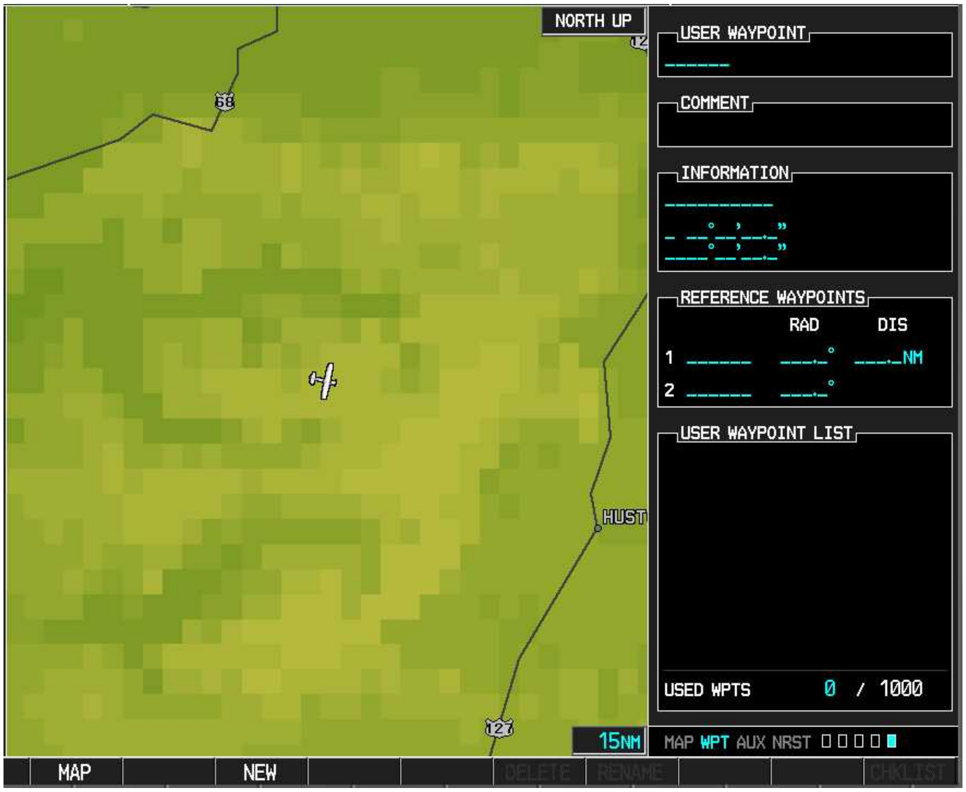


Figure 10.40 User defined waypoint page

User Waypoint allows a specified point to be created anywhere using lat/long or VOR radials and distance. The waypoint list displays all of the user waypoint that have been created and stored.

Softkeys are: NEW, DELETE, and RENAME to make changes to waypoints.

Auxiliary Page Group

Figure 10.41 AUX group page 6

Aux page 1

Figure 10.42 AUX page 1 Trip stats

Aux page 1 is the trip planning page. On this page the user can calculate trip statistics for direct to, point to point or flight plan navigation. This page allows the user to view DTK, DIS, ETE, ETA, and ESA for the selected type of navigation. For normal calculations the user should press the AUTO softkey so that the calculations can be made for the particular type of navigation. If the MAN softkey is pressed the system clears all of the data and the screen can be used as an in flight electronic flight computer. Two other softkeys are present on the trip planning page. The FPL softkey is used when the user wants to calculate trip data for a stored flight plan. The WPTS softkey is used for either direct to or point to point navigation.

Aux page 2

Figure 10.43 AUX page 2 Utility page

The utility page is used to set and display three items. These are the timers, trip statistics, and the scheduler. There are three windows separating this data. The scheduler is used to set reminders about anything the pilot wants to be reminded of, such as switching fuel tanks. There are no softkeys associated with this page.

Aux page 3 – GPS Status

Figure 10.44 Aux page 3 GPS status

GPS status page includes information about the GPS. Included on this page are satellite status, RAIM prediction, and signal strength. RAIM prediction can be used to determine if RAIM will be available at the time of arrival or for a future trip. There are two softkeys associated with this page, allowing the selection of GPS 1 or GPS 2.

Aux page 4 – System Setup

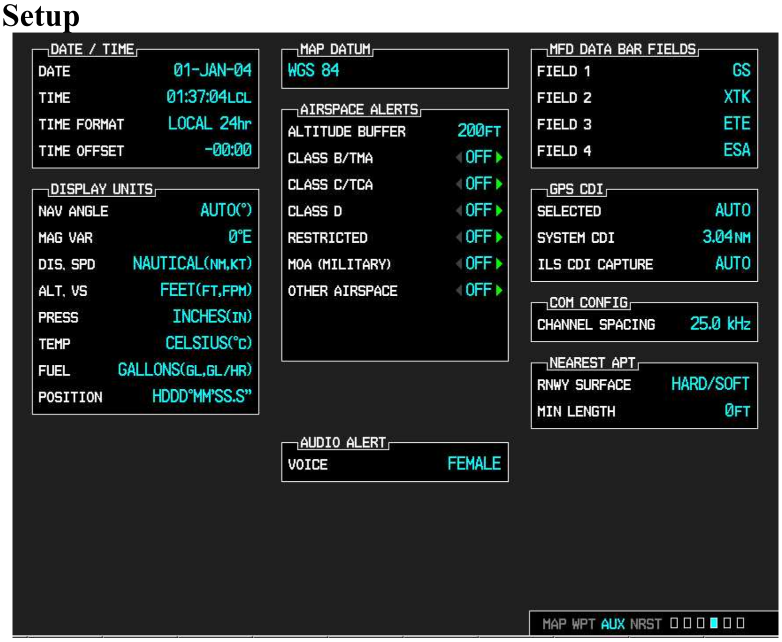


Figure 10.45 Aux page 4 System setup

The system setup page displays information about the setup of the system. This includes the system Date/Time, the display units, map datum, airspace alerts, audio alerts, the MFD data bar fields, GPS CDI, communication channel spacing, and nearest airport. This page allows the pilot to set up this information to customize it to display the type of information that they desire. Keep in mind that although the pilot may select the MFD data bar fields, the fields in the PFD data bar are not changeable. There are no softkeys displayed on this page.

Aux page 5 – Weather and XM Data Subscription Status

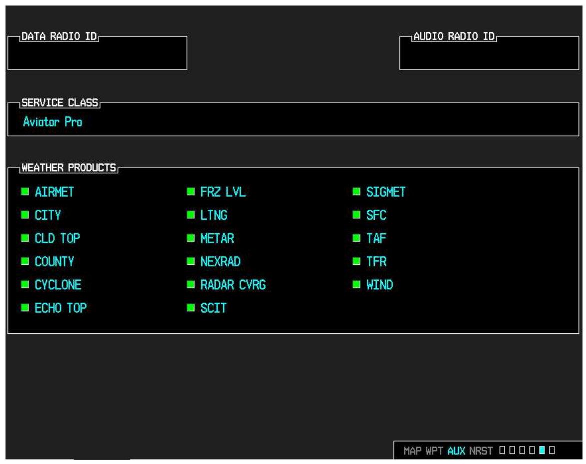


Figure 10.46 Aux page 5 XM subscription status

The XM entertainment page is displayed here if the aircraft is equipped. On this page the pilot can select the any of the XM radio stations for in flight entertainment. There are softkeys for RADIO and INFO. The INFO softkey is used to display what type of XM information is available including the weather features. This is also a volume softkey, which when pressed brings up softkeys displaying a +, - and MUTE. This is where the volume for the XM radio is set. When the radio is on the system plays the audio until either a radio transmission or an intercom transmission interrupts the signal. At no time will radio take priority over any ATC transmission.

Aux page 6 – LRU Status

Figure 10.47 Aux page 6 LRU status

The System Status page displays the status of each LRU in the system. Either a check mark for operational or a red x for non operational can be seen on this page. Also displayed on the page is the serial number and software version of each component. There are two softkeys present on this screen. The LRU softkey is used when viewing the component status box. There is also a DBASE softkey for viewing the status of the database information, including expiration dates.

Nearest Menu

Figure 10.48 NRST group page 5

Nearest Page Group

Nearest Page 1: Airports

Figure 10.49 Nearest Airport page

The NRST airport page will list the nearest 25 airports to the aircrafts current position. The aircraft are listed by identifier, type of airport and whether or not it has fuel available, the bearing to the airport and the distance. Information list will give lat/long, field elevation and location of the airport. Runway information includes type of surface, length and width. Frequencies listed include ATIS or ASOS, clearance, approach, ground tower, etc. Approaches can be view for the airports as well.

The Softkeys will allow the pilot to select APT, RNWY, FREQ, APR. You must select the appropriate Softkey if you want to select a specific frequency, look at another runway, or to view instrument approaches.

Intersection

Figure 10.50 Nearest Intersection page

The list of nearest intersections will be listed with the name of the intersection, the bearing to it, and the distance from it. Information will be lat/long reference VOR will give the information on the VOR that identifies the particular intersection.

Nearest Page 2: NDB

Figure 10.51 Nearest NDB page

Nearest NDB lists the closest NDBs to the aircrafts current position.
The name and type of NDB and the frequency is given.

Nearest Page 3: VOR

Figure 10.52 Nearest VOR page

The nearest VORs are listed by identifier, type, bearing to station, and distance.
Lat/long information and the area in which it is located is given in the information box.
The frequency for the VOR and can selected by press the FREQ softkey and the pressing ENT when the frequency is highlighted. The frequency will then appear in the standby blue box the NAV frequency.

Nearest Page 4: USER WAYPOINT
The nearest user waypoints will be listed by name, bearing and distance to the station.
The VOR reference information will be the identifier for the VOR, the radial and distance from the VOR.

Nearest Page 5: FREQUENCIES

Figure 10.53 Nearest frequencies page

The nearest ARTCC will give information on the closest frequency to get the air route traffic control center. FSS frequencies are shown with the name of the Flight Service Station, the distance and bearing from it and the frequencies available at your present position. Nearest weather frequencies can be selected to listen to local airport conditions from ATIS, ASOS, and AWOS. The Softkeys, ARTCC, FSS, and WX allow the pilot to choose which type of frequency he/she would like to select.

Nearest Page 6: AIRSPACES

Figure 10.54 Nearest Airspace

The nearest airspace will show alerts will for the closest airspaces that could be of concern to you. The alerts, controlling agency, vertical limits and frequencies are provided. The Softkey for ALERTS and FREQ allow the pilot to select the alert or the frequencies of the controlling agency for that airspace.

Map Setup

On the MFD display, many features can be changed, such as the orientation of the moving map display. Press the MENU button on the MFD,

and select Map Setup.

Figure 10.55 Map setup menu

Use the FMS knob and cursor to tab and select different menu items

Figure 10.56 FMS knob

Turn the large knob to select what item you would like to change, then press ENT 

The groups that can be changes are:

MAP

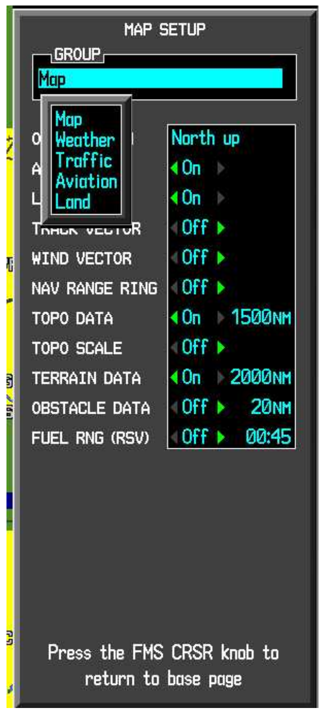


Figure 10.57 Map setup menu

Orientation of the map

North Up, Track Up, DTK Up

Figure 10.58 Map orientation setup

Figure 10.59 FMS knob

These features can either be turned on or off using the FMS knob:

- Auto Zoom
- Land Data
- Track Vectors
- Wind Vectors
- Nav Range Ring
- Fuel Range Ring Reserve

  The reserve ring can be set for any amount of reserve. The dashed line will show the range with reserve left. The solid green circle will show the range with the amount of fuel left.

WEATHER

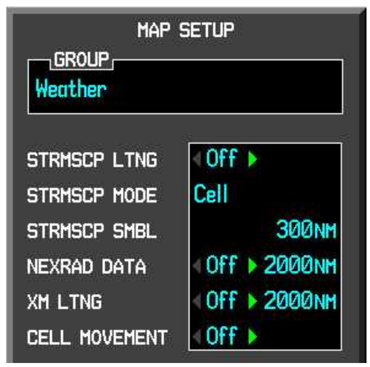


Figure 10.60 MAP setup weather group

Storm scope can be turned on or off as well as, Range of the storm scope, Cell Movement, and NEXRAD radar depiction.

TRAFFIC

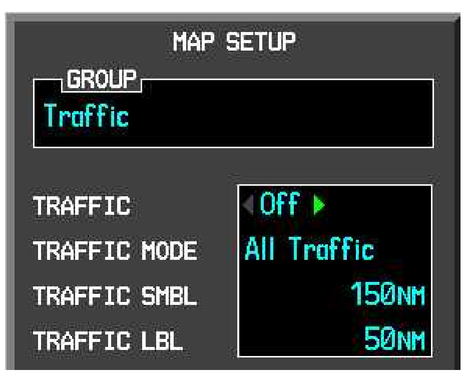


Figure 10.61 MAP setup traffic group

Turn the traffic on or off

Range can be changed

AVIATION

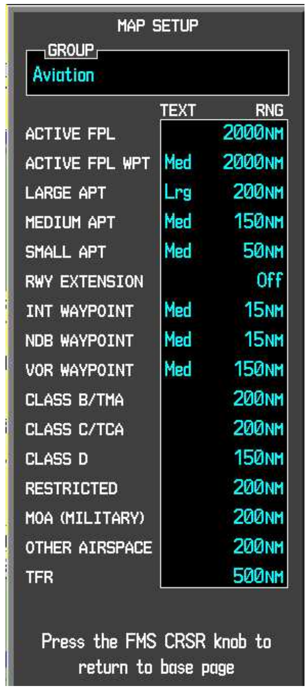


Figure 10.62 MAP setup aviation group

Range of small and large airports shown on map or they can be turned off completely. Airspaces, waypoints, and runways can also be changed.

LAND

Figure 10.63 MAP setup land group

Items that can be turned on or off:

Freeway, National and Local Highways, local roads, Railroads, cities, states, river and lakes

Communication and Navigation radio settings

Com Radio Control Summary

Figure 10.649 – COM radio control group

- The COM 1 and COM 2 are located on the upper right hand corner of the GDU 1040.
- To change the frequency, turn the COM knobs on the right hand side of the GDU 1040 above the BARO and CRS selector. Use the large knob to change MHz and the small knob to change kHz.
- The top row will display the active and standby frequencies for COM 1. The bottom row will display the active and standby frequency for COM 2.
- The standby frequency is located on the right and can be changed by pushing in the COM frequency selector knob and moving the blue box over standby frequency on either COM 1 or 2.
- Once you have change the frequency and would like to make it the active frequency, press the flip switch just below the volume control.
- The Active frequency that the pilot is transmitting and receiving on will be green. All inactive frequencies will be white.
- To adjust the volume for COM 1, the blue box must be on the standby frequency in COM1. The turn the volume control knob on the very top right of the GDU 140 to adjust the volume. A percentage of volume level will appear between the Active and standby frequencies.
- To adjust the volume for COM 2, you must press in the frequency selector knob to move the blue box down to the standby frequency on COM 2. Then use the volume control just like with COM 1.
- Push the volume control knob in to hear the squelch.

NAV Radio Control Summary

Figure 10.65 – NAV frequency controls

- ❑ The NAV 1 and NAV 2 controls are located on the upper left hand corner of the screen. NAV 1 is located and the top row and NAV 2 on the bottom. The active NAV frequencies will be on the right (closest to screen) and standby on the left (farthest from the screen).
- ❑ To change the frequency, the blue box has to be around the frequency you wish to change. To move the box from NAV 1 to NAV 2, push the NAV frequency selector knob in.
- ❑ The NAV frequency selector is located on the left hand side of the GDU 1040, the larger knob controls MHz and the smaller knob controls kHz.
- ❑ To identify a VOR or LOC, make sure the appropriate NAV 1 or 2 is selected on the audio panel. Then press the NAV volume control "in" on the upper left hand side of the GDU 1040. "ID" will appear in between the standby and active frequency position.
- ❑ The VOR or LOC identifier will also be displayed to the right of the active NAV frequency. For example "STL" will appear if St. Louis VOR is in the active frequency.
- ❑ The color of the active NAV frequency depends on what is selected as the current CDI needle on the heading indicator. If VOR or LOC 1 is selected, then the active frequency in NAV 1 will be green. And if VOR or LOC 2 is selected as the CDI, the active NAV 2 will be green.

Conclusion

In this study unit, we looked at the features and functions of the Multi Function Display. It is the most robust section of the system and contains the most number of menus, options, and softkeys. It also produces the most colorful display and that while the color provides you with very important and relevant information, it is not always your first priority to stare at it instead of doing other things you should be doing to maintain control of your flight.

Remember

- ❑ Map page 1 is the default map page. Anytime it is desired to return to that page simply press and hold the CLR button and the system will automatically return to that page.
- ❑ The vast number of functions that can be used in the MFD can create a distraction for the pilot. Remember not to spend too much time looking at or using the many features of the MFD.
- ❑ Use the MFD pages is you need to view the status of the system, change your XM radio station, view weather reports and NEXRAD radar.
- ❑ Some pages on the MFD require the use of softkeys to navigate between the information boxes presented on the screen.

FITS Study Unit Debriefing:

You have now covered the area of the Garmin G1000 system modules and the concept of using the MFD to aid in your situational awareness by providing information grouped in a high level then broken down by categories of logical information.

- ❑ If you now understand that the G1000 uses the Multi Function Display (MFD) to perform most of the electronic situational awareness from your scan flow, you will also understand how distracting the device can be to your overall safe operation of the aircraft if you don't keep your eyes moving!
- ❑ If you now understand why knowing the functions of the MFD and where to find certain menus is so important, then you will also realize that if you ever get lost in a menu or a function screen and you quickly need to get back to the top you can just press and hold the CLR clear button and the system will immediately go back to MAP Page 1.
- ❑ If you now understand that this system is a digital system featuring many systems which are driven by software and computers, then you will realize the importance of keeping the software and the databases which drive it current and up to date as that software releases may come out which change some of your basic functions without you knowing it.

If you not only understand these three areas but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a "Correlate" level of FITS accomplishment! It is time for you to move on to study unit eleven!

Study Unit 10: Multi Function Display Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you “understand” and can even “correlate” the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin engine monitoring system and some of the chores that you may have to perform using its information in a mountainous terrain flight scenario between Denver, Colorado (KDEN) and Meek County, Colorado (KEEO), a non-tower controlled airport. Consider the following questions about this scenario:

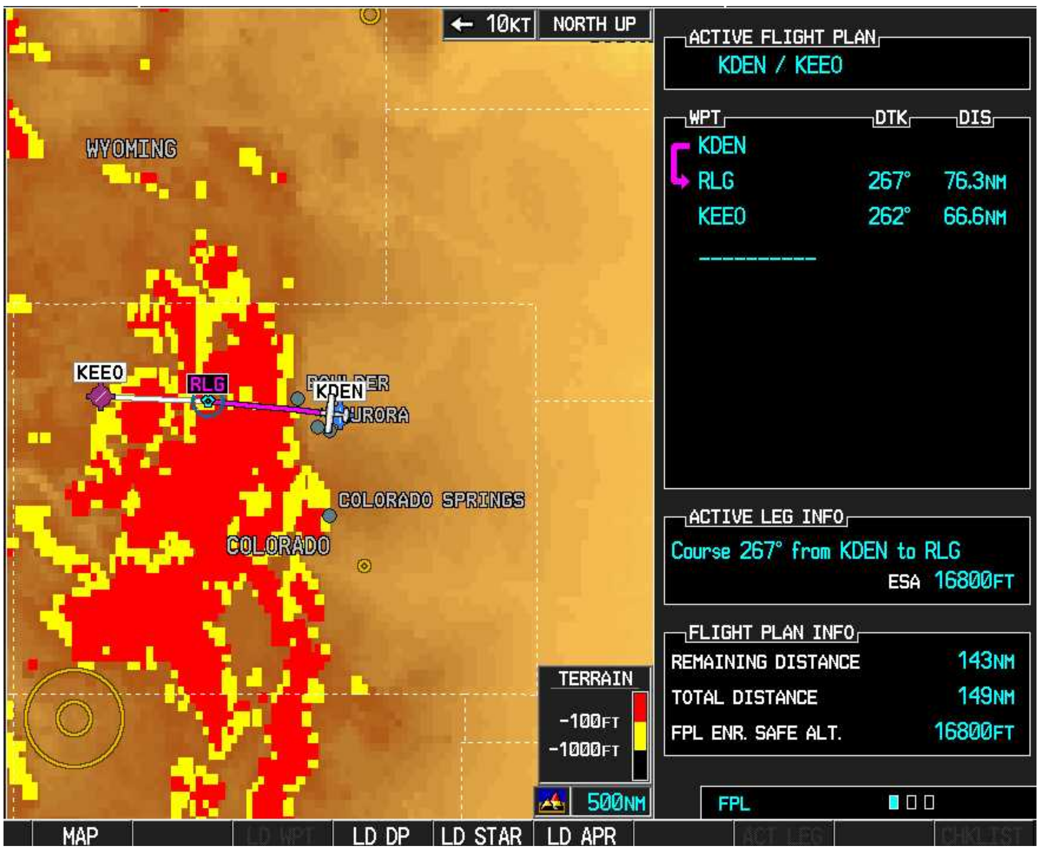


Figure 10.66 – Study unit 10 quiz scenario diagram

Question 1: During your flight, you want to find the nearest airport on the MFD. How is this information retrieved?

- **a) Using the FMS large knob, scroll to NRST page group**
- **b) Using the FMS small knob and moving to map page 4**
- **c) Pressing the Direct to key**

Question 2: As you are flying, traffic information appears on your moving map, how do you find a page that will allow to you to get a closer look at the traffic?

a) **Pressing the FMS knob**

b) **Turn the small FMS knob once to the right to get to the TIS page (MAP page 2)**

c) **Pressing the FPL button**

Question 3: How many airports does the NRST function display at one time?

a) **10**

b) **50**

c) **25**

Question 4: If you want to change the MFD map display default information, what screen will allow you to change this information?

a) **pressing the MENU key while on MAP page 1**

b) **Pressing the INSET softkey**

c) **Selecting AUX page 3**

Question 5: You are flying in the departure terminal area of Denver and you want to turn on the traffic overlay on the moving map display. How do you do this?

a) **Press MENU to select TRAFFIC ON**

b) **Press the MAP Soft Key on MAP page 1, then press the TRAFFIC soft key**

c) **Select the FPL key and select scroll to TRAFFIC on the menu.**

Question 6: You are exiting the departure terminal area of Denver and you want to see the NEXRAD weather ahead along your route. How do you do this?

a) **Press MENU to select NEXRAD ON**

b) **Scroll the FMS knob to MAP Page 1, twist the inside FMS knob to WX, select the NEXRAD softkey on the bottom of the MFD to activate the weather**

c) **Scroll the FMS knob to MAP Page 1, twist the inside FMS knob to WPT, Twist the inside knob to highlight, weather and select NEXRAD**

Question 7: You are now enroute to Meek (KEEO) and you want to see TAF and METAR text weather for the destination airport. How do you do this?

a) **Press MENU to select TAF ON**

b) **Scroll the FMS knob to MAP Page 1, twist the inside FMS knob to WX, select the TAF/METAR softkey on the bottom of the MFD to activate the weather**

c) **Scroll the outside FMS knob to view WPT. If there is weather available for your destination, there will be a WX softkey illuminated. Press that key.**

Question 8: You are now approaching Meek (KEEO) and you see the red and yellow areas displayed on the screen such as shown on the scenario diagram above. What does this mean and what should you do?

a) NEXRAD weather is being used and there is a thunderstorm and heavy rain showers ahead

b) The MAP terrain feature is being used and the terrain ahead is higher than the aircraft requiring the pilot to climb before continuing

c) The NEXRAD and the TERRAIN features are both in use and there are both weather cells and terrain ahead and you should turn around and return to Denver or another alternate airport

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Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will point you back to the appropriate reference area in the chapter. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 11- Flight Planning

Study Unit Objectives:
The objective of this Study Unit is for you to move from the "Perception" level to the "Understand" level of FITS accomplishment regarding the basics of the Flight Planning functions of the G1000 and how this is one of the more important aspects of enhancing electronic situational awareness and integrating these functions with autopilot management.

Completion Standards:
You will be able to describe and explain the features of the Garmin G1000 Flight Planning procedures from both the PFD and the MFD and how to use these two views of the flight plan to manage the track of the aircraft efficiently and effectively.

You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

Basic Concepts of Flight Planning on the G1000

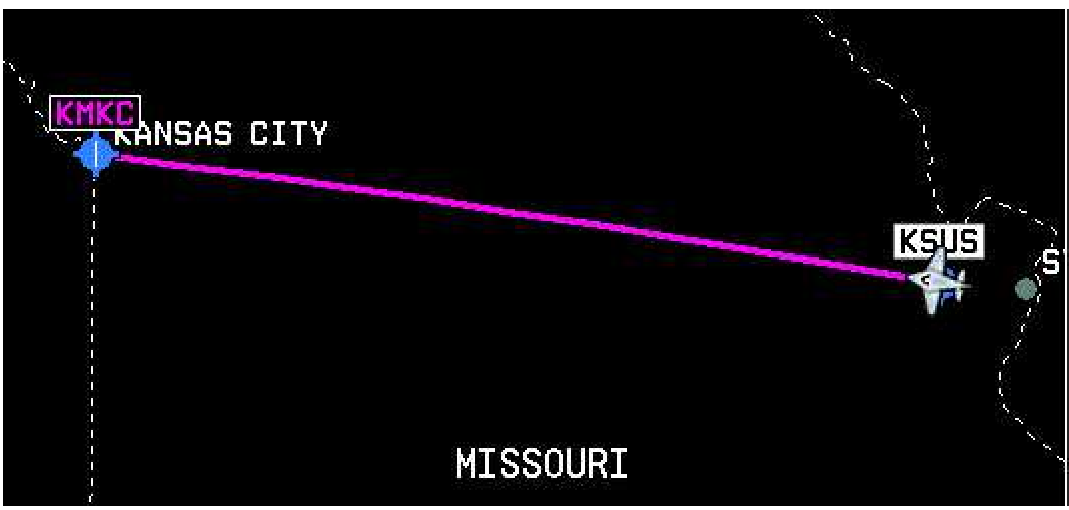

Figure 11.1 – Flight Plan – SUS to MKC

Definition: <u>Flight Plan</u> *A sequence of defined waypoints which when connected with lines on a chart constitute a plan of intended action which leads from a point in space (departure point) to another point in space (a destination).*

One of the key advantages of using an integrated system like the G1000 is that information from a variety of sources can be combined together to create a logical script of known waypoints to help layout trips with ease. What is even better is that the autopilot can fly this script of waypoints perfectly just like it was a computer running a computer program. When you think about, it is.

Figure 11.2 – Flight plan page 1

A flight plan, as defined above implies that a flight plan consists of at least two known waypoint. Many flight plans could consist of many more waypoints. In fact the G1000 allows up to 99 flight plans to be stored in its database for future use and each of these can contain up to 31 waypoints each. In this case, we have entered a flight plan which goes from the geographical center of Spirit of St. Louis Airport, KSUS, to the geographical center of Kansas City Downtown/Wheeler, KMKC. Once we were airborne and engaged the autopilot in NAV mode, the autopilot would track this path correcting for winds and would attempt to fly to the destination keeping the CDI needle on the HSI centered at all times.

Figure 11.3 – Flight Plan key

You can enter the flight planning menu on the PFD using the FPL key. You are limited as to what you can do from the smaller menu box on the PFD, but in general, you can create, edit, and save flight plans from the PFD but you cannot call-up flight plans from the flight plan catalog, nor can you see the specifics of the flight plan on a map as you do these things. You get much more flexibility and powerful functions when you do this type of programming on the MFD.

Direct-To Flight Plan

Figure 11.4 – Direct-To menu

A Direct to flight plan is what many pilots have been doing for several years since the advent of LORAN and early GPS models. They did this because the small screens of the earlier models made doing point to point or multiple point flight plans too cumbersome to learn or remember from flight to flight.

Figure 11.5 – Direct-To key

In order to do a Direct-To flight plan, we use the Direct-To button. The differences are subtle, but the amount of information the system can offer you about the departure point and the arrival point becomes limited with this type of Flight Plan. We advise you to always use the FPL button to create a point to point Flight plan and then press the Direct-to button only when you are off course from an ATC deviation and they then clear you to the destination.

Figure 11.6 – Direct-To a waypoint in active flight plan

Flight Plan Menu in MFD

Figure 11.7 – Flight plan page 1

Figure 11.8 – Flight plan key

The flight plan menu group is accessed by pressing the FPL button on the MFD. This button brings up flight plan page 1 as the default page.

Figure 11.9 – Flight plan page 1, active flight plan

Flight plan page 1
This is the active flight plan page. This page is used for viewing or editing the current flight plan. Once a flight plan is activated the Active Flight Plan page shows all the waypoints stored for a flight plan. Also displayed on this page is the distance and desired track to the waypoint for each leg of the flight plan. The active leg is identified by a magenta line on the map and a magenta arrow on the waypoint list. This arrow points from the previous waypoint to the next waypoint. When the active leg is complete the line then moved to the next leg of the flight plan. The active flight plan page shows the estimated enroute safe altitude for the selected leg and or the whole flight plan. The active flight plan page also shows the total remaining distance for the entire flight plan. There are three softkeys associated with the active flight plan page:

Figure 11.10 – Active flight plan softkeys

LD DP – use to load a Standard Instrument Departure Procedure (SID) for the flight planned destination airport

LD STAR – use to load a Standard Arrival Procedure (STAR) for the departure airport

LD APPR – use to load an instrument approach procedure (IAP) for the destination airport

These can be selected if the pilot needs to load departures, arrivals or approaches.

Flight plan page 2: Flight Plan Catalog

Figure 11.11 – Flight plan page 2, Flight plan catalog

This is the catalog page. This page displays stored flight plan information and when the cursor is active, provides softkeys for the following functions:

Figure 11.12 – Flight plan catalog softkeys

NEW – use to create a new flight plan
ACTIVE – use to activate a specific flight plan (the one currently displayed/selected)
INVERT – use to invert the sequence of waypoints, often used for the return trip on a specific flight plan
EDIT – use to edit the current or selected flight plan
COPY – copies a portion of or complete flight plan
DELETE – use to delete the selected flight plan

By using these keys the pilot can create or edit all of the flight plans in the catalog.

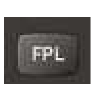

Figure 11.13 – Flight plan key

Figure 11.14 – Flight plan page 2 menu

Figure 11.15 – Empty flight plan catalog

- To enter a flight plan press the FPL key and use the small FMS knob to display the flight plan Catalog (Flight plan page 2). Press menu to display the catalog options. Use the large FMS knob to highlight 'Create new flight plan' and press enter. A blank page now appears that will allow the pilot to select waypoints by using the small and large FMS knobs and the enter key. Repeat the previous step until all the waypoints are entered for the plan. When finished press the small FMS knob to return to the flight plan catalog.

Figure 11.16 – Flight plan key

Figure 11.17 – Flight plan catalog, stored

Figure 11.18 – Menu key

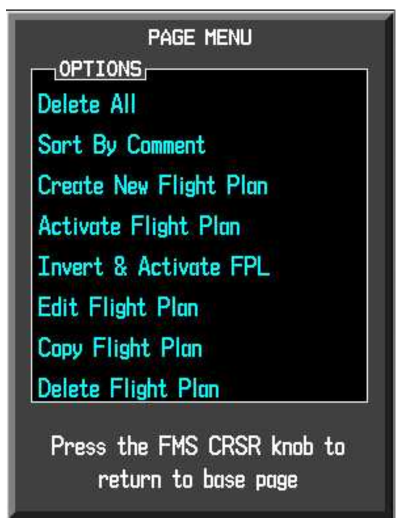

Figure 11.19 – Complete flight plan catalog

Figure 11.20 – Activate flight plan softkey

Figure 11.21 – Activation Confirmation

- To navigate a flight plan press the FPL key and use the small FMS knob to display the flight plan catalog. Press the small FMS knob to activate the cursor. Use the large FMS knob to highlight the desired flight plan and then press MENU to display the catalog options. Use the large FMS knob to highlight 'active flight plan' and press ENT. Press the ENT again to confirm. A second way to accomplish the same function is to press the softkey which appears once the cursor is activated

Flight plan page 3 – Vertical Navigation

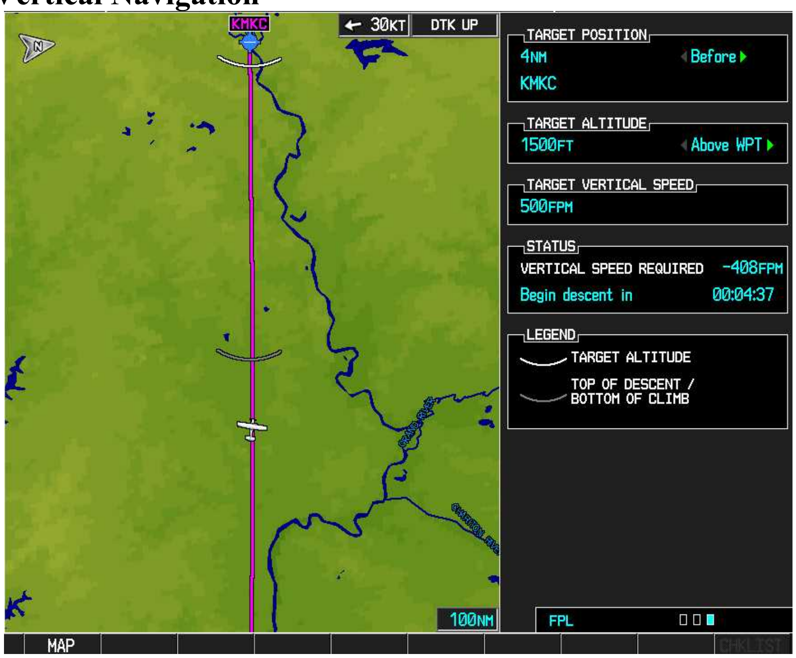

Figure 11.22 – Flight plan page 3, vertical navigation

This is the vertical navigation page. This page displays information about vertical climb/descent planning and the features related to it. By activating the cursor the pilot can adjust the following criteria:

Target altitude selectable in 100 foot increments in reference to either AGL or MSL altitudes
Distance in nautical miles from the selected waypoint
Selected waypoint
Rate of descent desired in feet per minute

Figure 11.23 – Flight plan page 3, Vertical speed required

Also displayed is the vertical speed required to achieve the planned descent/climb

Figure 11.24 – Flight plan page 3, Top of climb, Bottom of descent

Two arcs will be displayed on the map shown on this page only. The first arc (dark grey color) is the top of descent/climb point. The second arc (white color) is the programmed target altitude point.

Figure 11.25 – Aux page 1, trip statistics

Additional information valuable to flight planning can be found in the AUX page group on the AUX page 1.

Direct to page

Figure 11.26 – Direct-To key

Although the G1000 is designed to best be utilized with flight plans, there is the need to sometimes use the Direct-to navigation function. This is a stand alone button which has many different uses. The main purpose is to navigate directly to any point in the internal or user defined database.

By pressing the "Direct-To" key you may select a waypoint by specifying the identifier, name or location. Bump the FMS knob and scroll to the appropriate field, then select the identifier you would like to go direct-to.

You can also select waypoints that are part of a flight plan, selecting from a list of nearest airports, Specifying a course to fly to the waypoint, and activating direct to navigation to the nearest waypoint.

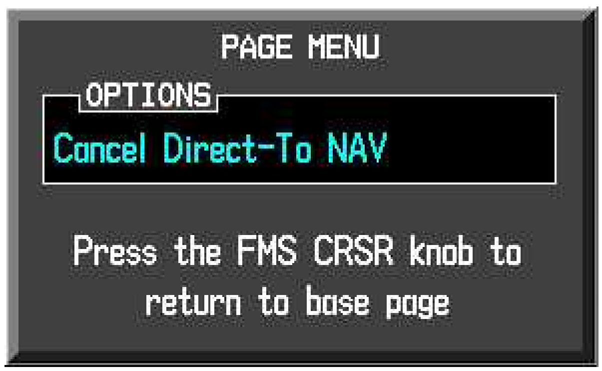

Figure 11.27 – Direct-To

Figure 11.28 – Enter key

If you are navigating with the direct to function you can cancel the operation by pressing the Direct key and then pressing the menu key. Highlight 'Cancel Direct-to NAV' and press the ENT key.

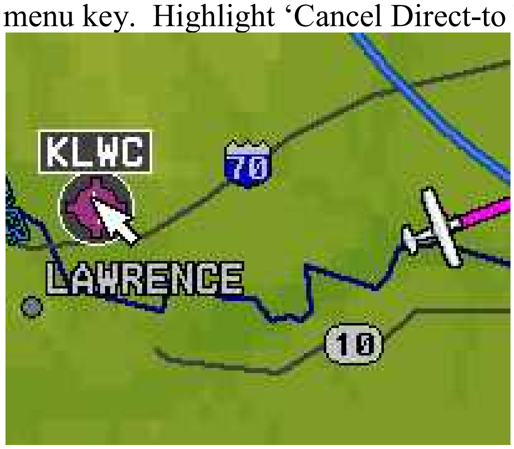

Figure 11.29 – Cursor Direct-To

Figure 11.30 – Direct-To menu

Figure 11.31 – Direct-To MapWpt menu

Figure 11.32 – Direct-to MapWpt

Direct to can also be selected by using the Navigation Map page. Select the navigation map page (Map page 1). Press the JOYSTICK to display the panning arrow. Move the JOYSTICK over to a point that you would like to proceed direct to. When the waypoint is highlighted press the Direct-To button and then press ENT twice. If you do this operation in an open area a waypoint called MAPWPT is created and the GPS will navigate to that point. If it so desired, the MAPWPT can be renamed to suit your purpose.

To use the Direct to function from the active flight plan press the FPL button. Next, press the small FMS knob to activate the cursor. Now turn the large FMS knob to select the desired waypoint. Press the "Direct-To" button and then press the ENT button twice in order to select and confirm your choice.

Flight Planning Scenario for the G1000

For this scenario we are going to plan a flight from Spirit of St. Louis (KSUS) to Kansas City Downtown Airport (KMKC).

For the sake of training this flight will use a Departure, Airway routing and Arrival to better describe all the planning capabilities of the G1000 system.

To begin:

Figure 11.33 – Flight plan key on the MFD

Figure 11.34 – Flight plan catalog, stored flight plans

Figure 11.35 – Flight plan menu options

Figure 11.36 – Create new Flight plan

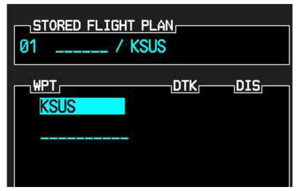

Figure 11.37 – Enter waypoints

Press the FPL button on the MFD. Pressing this key brings up the Flight Planning page 1. Turn the small FMS knob to display the catalog (flight plan page 2). Press the menu key to bring up the flight plan catalog options. Turn the large FMS knob to highlight 'create new flight plan' and then press the ENT key. A blank flight plan page will appear for the first available storage location. Use the small and large FMS knobs to enter the first waypoint identifier and then press the ENT key. The other waypoints are entered in the same fashion

Figure 11.38 – Menu key

Figure 11.39 – Store flight plan

Our departure airport will be Spirit of St. Louis Airport (KSUS). Our next point will be the Macon VOR (MCM), and then for our last waypoint it will be our destination (KMKC). At this point the small FMS knob should be used to move to the flight plan catalog page. Press the FMS knob to activate the cursor. Then use the large FMS knob to highlight the flight plan that you created. Press the MENU key and select "Store flight plan. The flight plan will be stored in the first empty slot in the flight plan catalog. Press ENT to confirm that you want to store the flight plan.

Figure 11.40 – Flight plan key

Figure 11.41 – Flight plan catalog

Figure 11.42 – Menu key

Figure 11.43 – Flight planning menu options

Figure 11.44 – Acknowledge activate flight plan

When it is time to begin navigating a flight plan, press the FPL button and use the small FMS knob to display the flight plan catalog page. Press the FMS knob to activate the cursor. Use the large knob to highlight the flight plan that you want to use. Press the MENU key and highlight 'Activate flight plan' and then press the ENT key. Confirm this action by making sure that OK is highlighted and then press the ENT key. The flight plan is now active and is now displayed in the active flight plan page.

Figure 11.45 – Flight planning softkeys

Now that the flight plan is active, we can load Departure and Arrival procedures that may be a part of the clearance/flight plan. The easiest way to accomplish this is to use the softkeys that will be displayed on the bottom of the active flight plan page. The task can also be accomplished by using the menu button from the flight plan page 1. Select the appropriate key for either the DP or the STAR. The system will prompt you for some additional information such as which runway you will be landing on.

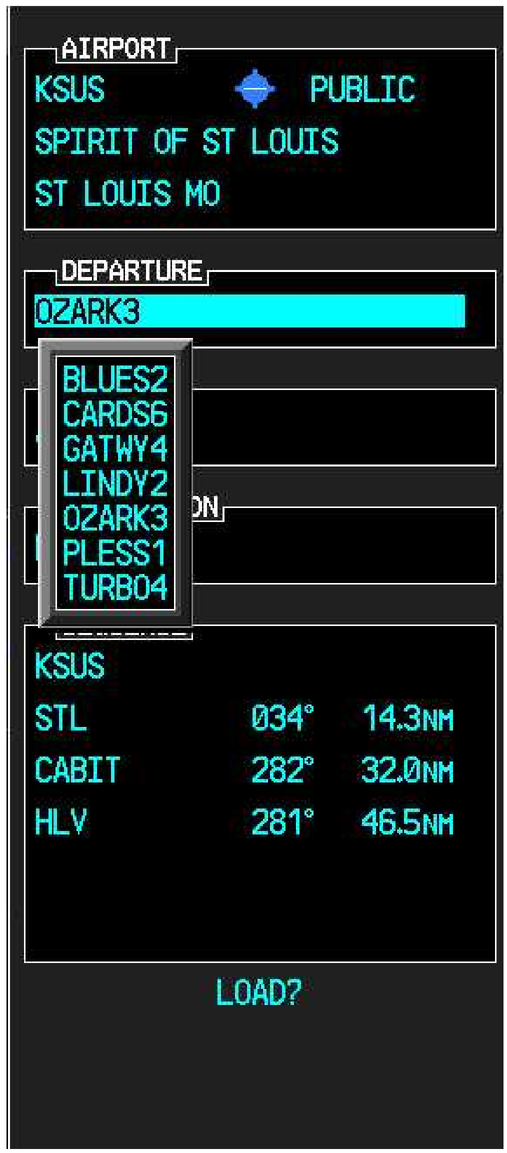

Figure 11.46 – SID selection

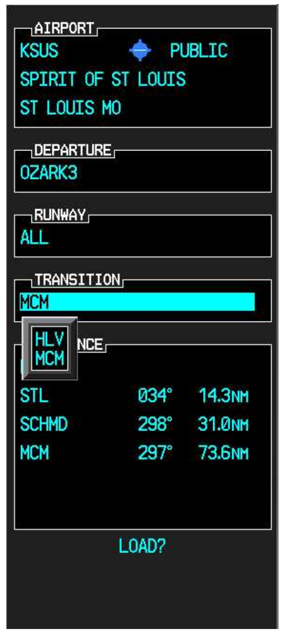

Figure 11.47 – Transition selection

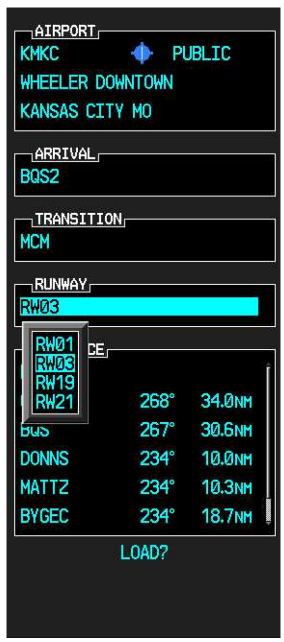

Figure 11.48 – Runway selection

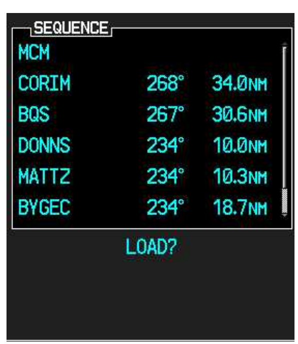

Figure 11.49 – Waypoint sequence

For our example we will load the OZARK3 departure out of KSUS using the MCM transition. Next we will load the Braymer Two Arrival. We are given choices for which transition and which runway we were expecting to land on. Once entry is complete you can check the sequence of waypoints in both the procedure page and also in the active flight plan page.

While using the "active flight plan" page there are many actions that can be accomplished. Some of the features are as follows:

Figure 11.50 – Flight planning menu options

Changing the flight plan title
Inverting the flight plan
Deleting the flight plan
Getting information on the closest waypoint in the flight plan
Activating a selected leg of the flight plan
Loading and deleting Approaches, Departures, and arrivals

Note: Selection of approach procedures will be covered in detail in the Instrument Procedures section.

Conclusion

In this study unit, we looked the Flight Planning functions from within the Multi Function Display and how you can use them to customize the trip planning that you are going to do. Once the flight plan is entered, the autopilot will fly the Flightplan like a script. You can monitor the status of your flight plan on the MFD or the PFD.

FITS Study Unit Debriefing:

You have now covered the area of flight planning with the Garmin G1000 and you should now understand how to develop, store, retrieve, and work with flight plans and how they are operated differently than traditional aircraft.

- ❑ If you now understand that the G1000 flight planning to create a customized agenda for your proposed flight, then you should also understand that you can create, edit, save, retrieve, and invert those flight plans to give you flexibility and save key strokes
- ❑ If you now understand when it makes sense to use a point to point flight plan and when it makes sense to use a Direct-to flight plan, then you will also understand that entering a flight plan from the MFD makes sense when you have time to deal with the deeper level of menus and entering the flight plan from the PFD makes more sense when you are operating on the fly.
- ❑ If you now understand that this system of interoperating menus can lead to a distracting time for the unprepared pilot, then you will understand that planning ahead and using the enroute phases of the trip is the best time to plan for the pending arrival at your destination.

If you not only understand these three areas but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a “Correlate” level of FITS accomplishment! It is time for you to move on to study unit twelve!

Study Unit 11: Flight Planning Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin engine monitoring system and some of the chores that you may have to perform using its information in a typical flight scenario between Johnson County airport (KOJC) to New Century airport in Olathe Kansas (KIXD), a tower controlled airport. Consider the following questions about this scenario:

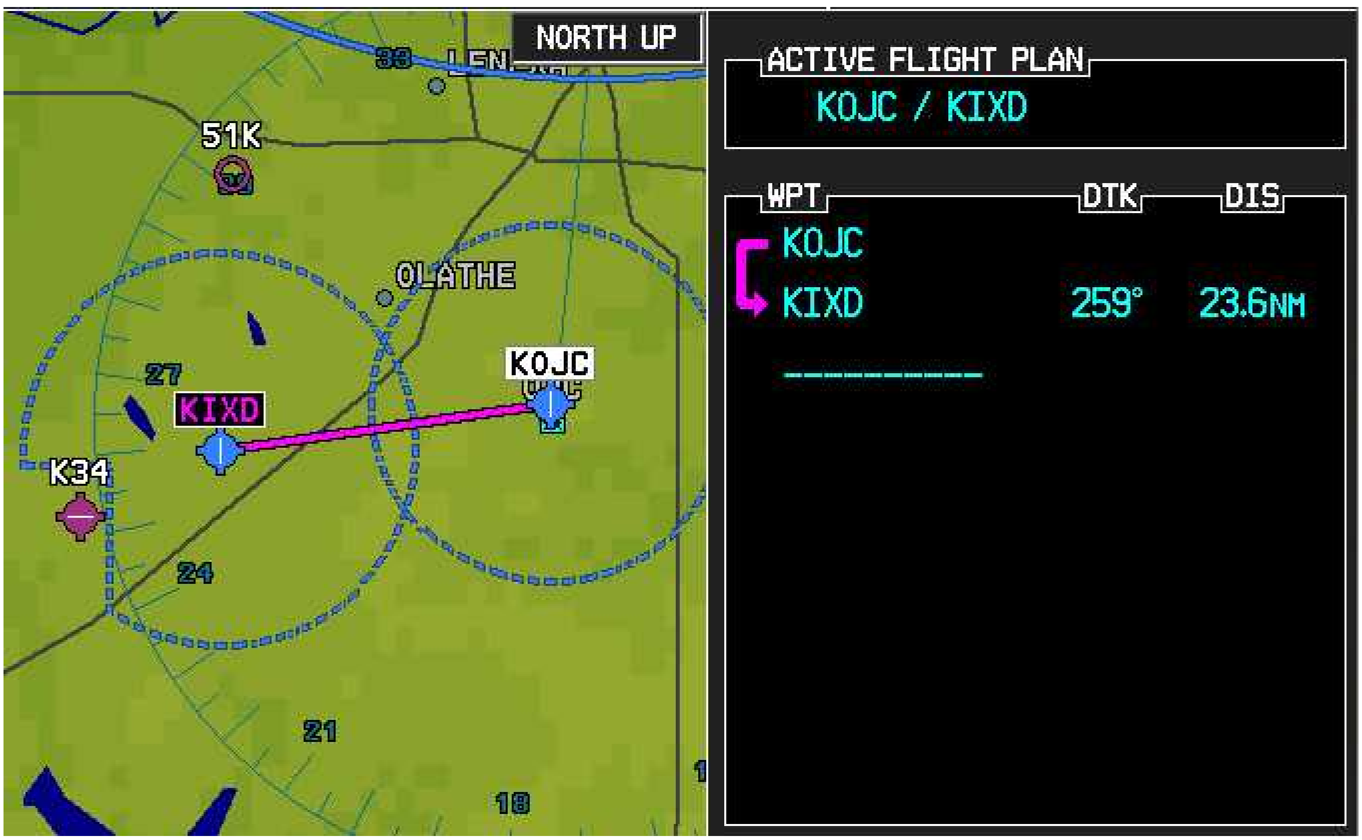

Figure 11.51 – Study unit 11 quiz scenario diagram

Question 1: If you wanted to create a flight plan for the trip suggested in this scenario, what would be the first button to push?

- **a) MENU**
- **b) FPL**
- **c) Direct to**

Question 2: What page of the FPL menu group is the catalog located on?

a) **Flight plan page 5**

b) **Flight plan page 3**

c) **Flight plan page 2**

Question 3: To cancel a fight plan that has already been activated, what is the sequence to accomplish it?

a) **Press the FPL key, Press the MENU key, highlight 'delete flight plan', press the ENT key twice**

b) **Press the FPL key and then pressing ENT key**

c) **Hold down the CLR key**

Question 4: How can you use the JOYSTICK to navigate direct to a waypoint?

a) **Pressing the FMS knob and then the JOYSTICK**

b) **Pressing the JOYSTICK, then moving the cursor to highlight the desired waypoint, then pressing ENT, naming the waypoint and pressing ENT again**

c) **Pressing the Direct to button and then the JOYSTICK button**

Question 5: How would you load a STAR procedure into the current flight plan?

a) **By pressing the FPL key, then the LD STAR softkey, selecting the procedure, and then the assigned transition**

b) **By going to the active flight plan page and adding each individual waypoint to the flight plan**

d) **Press the Direct-To key and enter the first waypoint of the STAR, the GPS will auto sequence from there.**

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will point you back to the appropriate reference area in the chapter. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 12- Autopilot Integration with the Garmin G1000

Study Unit Objectives:
The objective of this Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the basics of autopilot integration with the G1000 and how you must understand and properly correlate the safe operating practices for the particular autopilot model that is installed in your aircraft. Most G1000 equipped aircraft have the KAP 140 autopilot model. However, consult your POH for specifics for your aircraft.

Completion Standards:
You will be able to describe and explain the features of the autopilot and how that the proper utilization of the autopilot installed in your aircraft will ultimately define your ability to operate a Technically Advanced Aircraft.

You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

Autopilot Concepts

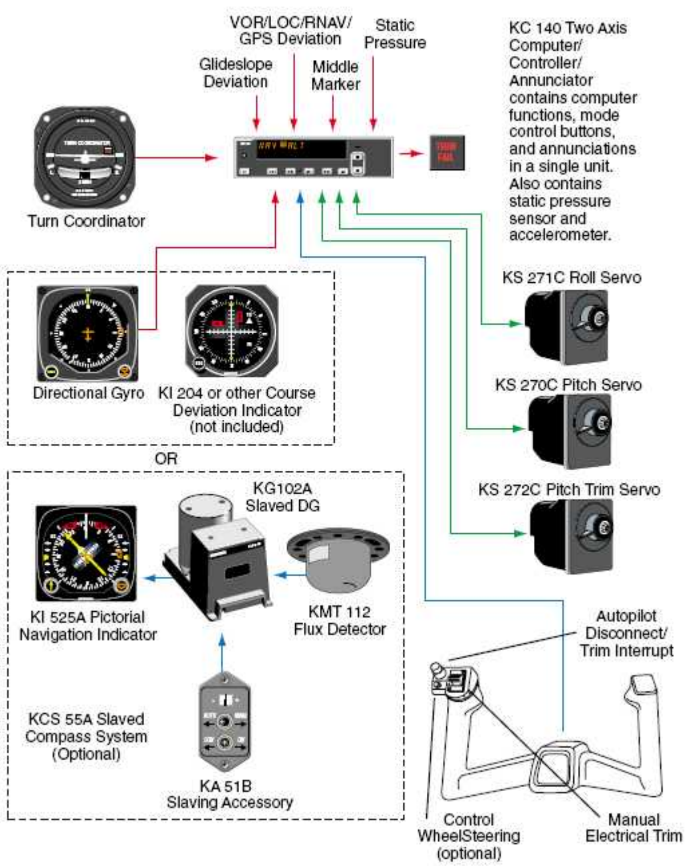

Figure 12.1 Autopilot diagram for KAP 140 autopilot system

There are a number of different configurations of autopilots that could be installed in a TAA aircraft. Typically with the Garmin G1000, there have only been 2 major types of autopilots approved for installation in these aircraft.

Definition: **Autopilot** -An integrated mechanical, electrical, or hydraulic system developed to control a vehicle with little or no intervention from a human controller.

2 Axis Autopilot:

A two axis autopilot such as the Bendix/King Honeywell KAP 140 autopilot installed in the Cessna and Diamond aircraft delivered during 2004 and 2005. This system controls the aircraft on the pitch axis through electromechanical servo control over the elevator using the trim system. It controls the aircraft on the roll axis through electromechanical servo control over the aileron system. The two-axis autopilot allows the pilot to fly an aircraft virtually hands-free, with sole input on the rudder pedals.

3 Axis Autopilot:

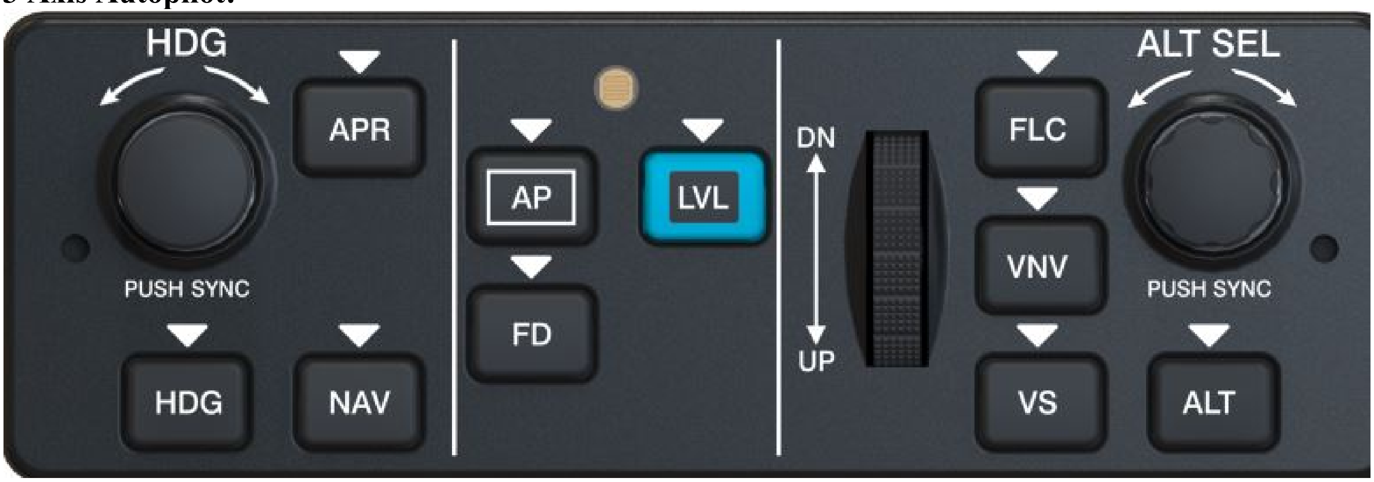

Figure 12.2 Integrated Garmin Perspective Plus Autopilot Control Panel

A three- axis autopilot such as the Garmin autopilot that is being certified and installed in Beech Bonanza and Beech Baron aircraft delivered at the end of 2005 and beyond. This system controls the aircraft on the pitch axis through electromechanical servo control over the elevator using the trim system. It controls the aircraft on the roll axis through electromechanical servo control over the aileron system. It controls the aircraft on the yaw axis through electromechanical servo control over the rudder system and may introduce a yaw damper mechanism to dampen oscillations that may occur through the vertical axis of the aircraft. By introducing a yaw damper, these aircraft truly allow you to be a flight systems manager and eliminates problems with external autopilots by ensuring the complete exchange of all digital information between the G1000 and the autopilot.

An autopilot may be analog, digital, or it may be a combination. Depending upon its level of digital integration will depend upon how well it integrates with the G1000 and its digital LRUs and systems.

Autopilot Roll Channel

An autopilot that controls the aircraft along the longitudinal axis usually has three different operational modes; ROLL, HDG, and NAV.

Roll Mode:

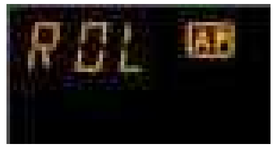

Figure 12.3

In this mode, the autopilot simply captures the amount of bank the pilot has induced on the wings and does not attempt to maintain any other reference parameter. This is useful as a temporary mode for the pilot to address cockpit chores or address a temporary distraction or situation. If the aircraft wings are level when the roll mode is captured, the auto-pilot will continue to hold the wings level. This is also considered the default mode since when an autopilot is activated, there is no immediate confirmation that either the HDG or the NAV inputs are valid.

Heading Mode

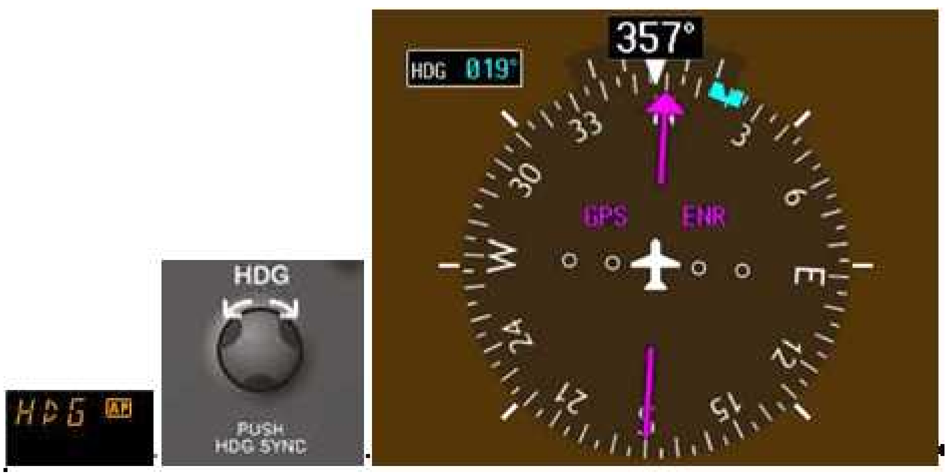

Figure 12.4 The autopilot in HDG mode

The heading bug selector will select the desired heading that the pilot wished to hold in flight. Turn the knob right or left to select a heading. If the current heading is desired, just push in the heading selector knob and the bug will center on the current heading. When engaging the autopilot in the heading mode, first center the heading bug on your current heading, then press the HDG button on the autopilot so it will capture the heading bug. Once the heading mode is active, the autopilot will turn the aircraft to desired headings by twisting the HDG knob and moving the heading bug. Keep in mind that the autopilot will be able to turn to any desired heading , but keep the heading bug within approximately 150 degrees, or the autopilot will not be able to compute whether or not the operator desires a left or right turn. The heading that the heading bug is on will also be shown in a HDG box to the left of the heading indicator.

NAV Mode

Figure 12.5 Autopilot in NAV mode

The NAV mode is when the autopilot is set to follow a particular course from a CDI needle. In the case of the G1000, it is following whatever NAV mode is primary in the center of the CDI. If the NAV signal is interrupted, or is deemed not dependable, the NAV mode will automatically by shutdown returning the unit to ROLL mode. Notice in the second diagram above that there is no DEVIATION BAR needle in the center of the HSI. This indicates that there is no dependable signal and the autopilot would either not engage in the NAV mode, or if it already was, it fall out of NAV mode back to ROLL mode

Autopilot PITCH Channel:
An autopilot that controls the aircraft along the PITCH channel usually has three different operational modes:

Altitude Hold Mode

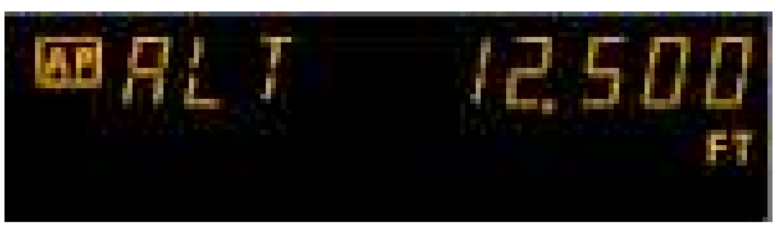

Figure 12.6 Autopilot in ALT mode holding 12,500 feet

The Altitude hold mode on the KAP 140 allows the pilot to select the altitude they are flying simply by pressing the ALT button. The autopilot will capture and hold the altitude the aircraft is flying at that moment by adjusting the elevator trim of the aircraft.

Vertical Speed Mode

Figure 12.7 Autopilot in ROLL mode with 500 feet per minute climb set in vertical speed

The Vertical Speed (VS) mode is what automatically initializes when the KAP 140 is engaged. In this mode, the autopilot captures the feet per minute the aircraft is climbing or descending and adjusts the elevator trim to maintain that climb or decent. Another function of the VS mode is to initialize a climb or decent from straight and level flight. If the autopilot is in the VS mode and your Vertical Speed is set to zero, you can start a climb simply by pressing the ‘UP’ button. Each time you press this button, your vertical speed will increase by one-hundred feet per minute. For example, if you wanted to initiate a climb at 500 Feet Per Minute, you would press the ‘UP’ button five times and the autopilot display screen would show a climb at 100, 200, 300, 400, and then 500 feet per minute and the aircraft will hold 500 FPM until it is told to level off, or it reaches an altitude at which it can no longer climb.

Altitude Capture Mode:

Figure 12.8 Autopilot in vertical speed mode with ALT ARMED for level-off at 12,500 feet

The Altitude Capture mode on the KAP 140 is what the pilot engages when they are climbing or descending and selects an altitude for the autopilot to level off and capture. This is accomplished by starting from the ALT hold mode, and first selecting a new altitude on the autopilot using the large knob for thousands of feet and the small knob for hundreds of feet. When a new altitude is selected, the altitude capture will be armed reflected by “ALT ARM” on the KAP 140. At this point the autopilot is ready to capture an altitude once the aircraft reaches that altitude, but you are not going anywhere until you initiate a climb or decent. To initiate a climb or decent, press the ALT button again, and the VS mode becomes active again. Once in the VS mode, press UP or DOWN to select an appropriate climb or decent rate. Once in a climb or decent, going in the direction of your selected altitude, and you also have “ALT ARM” in the KAP 140 display window, the autopilot will level off and hold your newly selected altitude when reached.

Note: If the ALT is not armed, the autopilot will continue to climb or descend at the vertical speed selected. This situation can immediately become hazardous; always verify that the ALT is ARMED. Also verify that the autopilot capture upon reaching the desired altitude.

Figure 12.9 Using the ALT knob to set a reference altitude of 3000 feet

The altitude selector knob allows the pilot to select an altitude that will be displayed on the top of the altitude indicator and an altitude bug will appear next to the selected altitude in the indicator box. The larger knob will change the altitude in thousands of feet and the small knob will change hundreds of feet.

NAV Mode

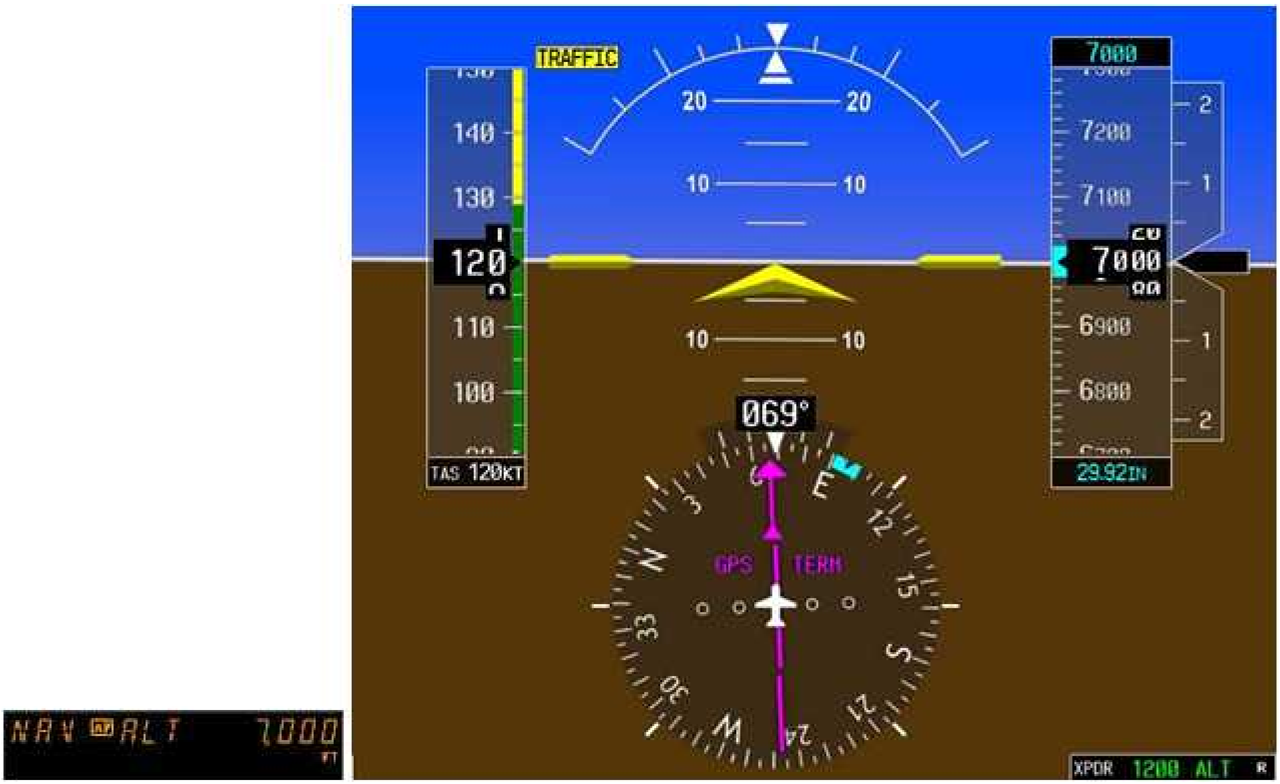

Figure 12.10 Autopilot in NAV mode tracking GPS needle in GPS

The autopilot will track whatever course is shown on the CDI. Depending on what course you want the autopilot to track, the correct source must be shown on the HSI. To change the NAV function, press the CDI softkey. A magenta needle will be a GPS course, a solid green needle will be NAV 1 and double lined green needle will indicate NAV 2. So if you are tracking a radial to a VOR that is entered into NAV 1, you should not be displaying a magenta needle on the HSI.

Approach Mode:

The Approach mode(APR) allows the KAP 140 to maintain closer to the centerline of the course than in the NAV mode while using NAV 1, NAV 2, or the GPS CDI needles. If shooting an approach, make sure the appropriate NAV function is selected in the CDI display. For example, if an ILS overlay approach is selected in the GPS for situational awareness, and the CDI is selected on GPS, it will appear

Figure 12.11 The Bendix/King KAP 140 autopilot

The KAP 140 is the model autopilot that most aircraft equipped with the G1000 have.
The autopilot is capable of holding heading, altitude, NAV courses, flying instrument approaches and holding climb and descent rates.

Operating the KAP 140

- The only way to turn the autopilot on is to press the AP button on the lower left-hand corner.
- When you turn on the autopilot, it automatically captures the vertical speed (VS) of the aircraft at that moment and engages roll (ROL) mode which holds the wings level.
- To hold the current heading, press the heading bug selector on the G100 display to center the bug. To change heading using the autopilot, turn the bug on the G1000 and the autopilot will turn the aircraft at standard rate to the desired heading.

Figure 12.12 The HDG knob is used to set the HDG mode of the autopilot

Then press the HDG button on the autopilot and "HDG" will replace "ROL" on the left hand side of the autopilot screen.

- When the autopilot is turned on and the vertical speed is captured, it is very important that the pilot makes a note of what vertical speed was captured. When the AP button is pressed and the autopilot is engaged, the vertical speed rate will flash momentarily on the right hand side of the autopilot screen. If the rate is too high or too low, press the UP and DN buttons until an appropriate rate is reached.
- To have the aircraft climb and level off at a specified altitude after takeoff, select the altitude before takeoff by turning the altitude selector knob on the bottom right hand corner of the KAP 140, the altitude pre-select will be shown on the right hand side of the autopilot screen. After the aircraft reaches 800 feet AGL, press the AP button to turn the autopilot on. Immediately verify the climb rate that the autopilot has captured and make any adjustments with the UP and DN buttons. Verify that the altitude is armed; you should see the word ARM next the ALT on the display.

Note: If the altitude is not armed, the aircraft will only continue to climb or descend through the selected altitude

- To hold the current altitude, press the ALT button at any time to make the aircraft level off at the current altitude. This include during a climb or a descent. If you set a VS of 500 fpm and are

climbing, if ALT is pressed, the aircraft will stop climbing and level off at the altitude you were at when you pushed ALT.
- To operate the NAV function, the desired course must be showing on the HSI. For example, you are tracking the 270 radial TO a VOR. The desired VOR is tuned into NAV 1. The HSI should be displaying a green needle on and reading VOR 1. If the course is within one dot of center when you press the NAV button on the autopilot, then the autopilot will begin tracking that specific course. On the HSI, if the KAP 140 is armed in the NAV mode on NAV 1, and the CDI button is pressed to change the HSI display to NAV 2, the autopilot will default into the ROLL mode. Keep in mind now the KAP 140 is no longer locked on NAV 1 (verified by NAV flashing in the KAP 140 display). If NAV 2 happens to be centered or within one dot on the HSI, the NAV will arm itself again to capture NAV 2. If the autopilot does not arm itself, press the NAV button again to manually arm the KAP 140.
- APR works similarly to NAV, however it will capture a glide slope on an ILS and track the localizer.

KAP 140 Quick Reference:

1. Using the knobs on the autopilot, select the altitude you would like to hold, and twist the green heading bug on the HSI to your current heading.
2. Turn the autopilot on by pressing the AP button, then immediately press the HDG and ALT buttons.(Now your autopilot is holding heading and altitude)
3. **Climb or Decent:** Set your new altitude in the altitude window. Press ALT and set your VS appropriately by pressing UP or DOWN to set the climb rate in hundreds of feet per minute.
4. <u>Using the autopilot for an approach</u>.
   For straight in approach:
   Once you have been cleared for the approach, press the APR button. (HDG will flash for five seconds reminding you to turn your heading bug to the approach course) The autopilot will automatically set up an intercept angle.
   For full approach:
   Press the APR button when you are within a couple miles of the IAF and turn the heading bug to the first heading.
5. <u>Descent</u>
   For non-precision approaches:
   Upon reaching the final approach fix, you must initiate a decent by pulling your power back and set your new altitude in the altitude window, then setting the Vertical speed at -800 FPM
   For precision approaches:
   When the autopilot is established in APR mode, GS arm will appear below ALT until the glide slope is intercepted. The autopilot will control the rate of descent depending on the power setting. Power must be controlled as to not allow airspeed to get too high. (If approach flaps are desired, they must be put in very slowly or the autopilot will deactivate. 1° per second should be slow enough)(AP can't intercept GS from above)

Autopilot Disconnect

There are six ways to disconnect the autopilot

1. The autopilot disconnect is a red switch on the left side of the pilot's yoke

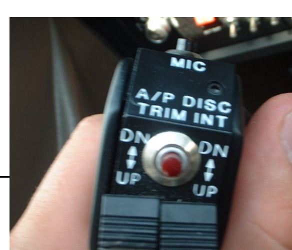

Figure 12.13 The yoke mounted autopilot quick disconnect button

2. Engage the electric trim on the left hand side of the pilot's yoke
3. Press the AP button on the KAP 140

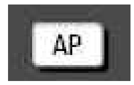

Figure 12.14 The autopilot AP switch can be used to turn on and off the autopilot

4. Pull the autopilot circuit breaker
5. Turn the Avionics Master switch off
6. Turn the red Master switch off

The TRIM System

The trim system in integrated with the autopilot. If the trim were to become inoperative, the autopilot would also be inoperative. The electric trim works by adjusting elevator trim to reach a desired altitude. If there was not sufficient power, and a vertical speed was selected that was too high, the aircraft would lose airspeed and eventually stall. If the airplane is trying to climb, and the pilot pushed against the yoke, the trim will counteract the forward pressure and continue trimming, which can create a dangerous situation.

The electric trim switch has two separate switches located on the yoke that must be moved together either forward or aft depending upon whether you are looking for trim nose up or down. One activates the Trim Servo. The other tells the Trim Servo whether to spin clockwise or counterclockwise. Without both of these switches engaged, the system could not operate. This is a safety feature and prevents the trim from entering a runaway condition.

Conclusion

In this study unit, we have covered autopilot operation in a G1000 cockpit. This study unit also has described and given examples of how to operate the KAP 140 both in basic VFR conditions as well as during IFR flight including instrument approaches.

Remember

- ❑ Set your heading and altitude before you turn the KAP 140 on, otherwise, when you attempt to capture HDG and ALT, the autopilot may go to a heading that is undesirable.
- ❑ Whenever you are in a climb or decent, make sure the altitude is ARMED, verified by the KAP 140 display window showing "ALT ARM." Otherwise, the autopilot will not recognize the desired altitude when it is reached.

- ❑ If the KAP 140 is captured in NAV mode, and you want to reference another NAV CDI needle, when you switch from one NAV to another the autopilot defaults to the ROLL mode and you must push NAV again to ARM the autopilot.

FITS Study Unit Debriefing:

You have now covered the area of the Garmin G1000 system integration with an autopilot system. In order to fully appreciate the power of the system and to fully use its capabilities, you must have a thorough working knowledge of the autopilot and how to use it to reduce your cockpit workload.

- ❑ If you now understand that the G1000 uses the autopilot as an integral part of the G1000 system then you will also understand that with an external autopilot such as the Bendix/King KAP 140, there are going to be some pieces of data that just don't integrate very well
- ❑ If you now understand that some autopilots integrated with the G1000 are analog units with a digital face, you will see that the autopilot must be a primary portion of your scan flow to make sure that the autopilot is doing what you think it is.
- ❑ If you now understand that the Garmin autopilot that is scheduled for introduction on Beech and other aircraft starting in December 2005 will integrate better the autopilot functions with those of the G1000, you will also understand the importance of reviewing all supplement materials that comes out with those autopilots to ensure a thorough working knowledge of the new integrated systems.

If you not only understand these three areas but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a "Correlate" level of FITS accomplishment! It's time take the quiz and then to move to study unit thirteen!

Study Unit 12: Autopilot Integration Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin engine monitoring system and some of the chores that you may have to perform using its information in a typical flight scenario between Kansas City Downtown airport (KMKC) to Columbia, Missouri (KCOU), a tower controlled airport. Consider the following questions about this scenario:

Figure 12.15 – Study unit 12 quiz scenario diagram

Study Unit 12: Autopilot integration Quiz

Question 1: On the above flight scenario, you decide to engage the autopilot to use it to reduce cockpit workload. When the autopilot is first powered on, what modes are active?

- ***a) HDG and ALT modes***
- ***b) ROLL and VS modes***
- ***c) NAV and GS modes***

Question 2: After takeoff and during your climb, you engage the autopilot. When the autopilot is first powered on, what is the vertical speed that is selected by the system automatically?

a) The vertical speed at the instant the AP is powered on
b) 500 FPM
c) Whatever vertical speed is selected by the pilot

Question 3: You receive a heading vector from approach control. When the autopilot is in heading mode, what controls the heading that the autopilot follows?

a) The HDG button on the PFD display only
b) The ALT knob on the G1000 display
c) The HDG knob on either G1000 display

Question 4: When changing altitudes, what is the proper procedure if the autopilot is in ALT hold mode?

a) First select the new ALT in the ALT selector window, press ALT arm, press ALT and select the vertical speed desired
b) Press the ALT button and then press ALT at the new altitude
c) Press the ALT arm button

Question 5: Which answer is true regarding the electric trim system of the G1000 equipped aircraft with a coupled autopilot?

a) It has a separate on/off switch that must be engaged after takeoff
b) It has a split toggle switch in order to prevent runaway trim system failures
c) It can be used when the autopilot circuit breaker is pulled out

Question 6: Which answer is NOT true regarding the pitch channel of the G1000 equipped aircraft with a coupled KAP140 autopilot?

a) Engaging the flaps during a coupled instrument approach may cause a pitch trim failure in the autopilot because the 1.5G trim limit may be exceeded
b) The autopilot will automatically shut-off when the pilot starts to flare the aircraft for landing
c) The airplane should be stabilized in a landing configuration prior to finalizing the autopilot approach coupling

Question 7: Where would you be able to find information regarding the minimum altitudes that the autopilot can be used on climb-out and approach?

a) The approved POH supplement that covers the autopilot
b) A placard that might is printed and displayed on the instrument panel

c) ***Both a and b are correct***

Question 8: When you are approaching your destination, you decide to couple the autopilot to the instrument approach. Which of the following is NOT correct regarding using an autopilot in coupled mode?

a) ***The autopilot automatically captures the localizer course on an ILS when properly armed***
b) ***The autopilot automatically captures the glideslope when it is below you***
c) ***The autopilot will not proceed past the missed approach decision point without the pilot pressing SUSP to continue to the missed approach holding fix***

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will point you back to the appropriate reference area in the chapter. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

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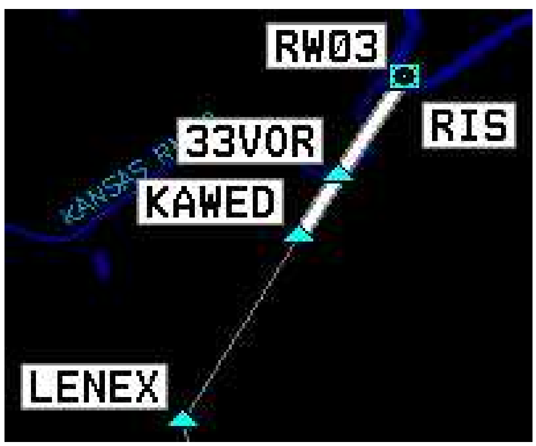
Study Unit 13- Instrument Procedures

Study Unit Objectives:
The objective of this Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding the basics of Instrument Procedures in the G1000 cockpit by reviewing the content of this study unit and then taking the study unit quiz which will ask you some questions about the material that you covered.

Completion Standards:
You will be able to describe and explain the functions of the G-1000 throughout different stages of an IFR flight that will include selecting approaches, (full procedure and vectors to final) flying the missed approach, and executing a hold.

You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

Instrument Procedures



Note: For information on how to select a SID or STAR see the section on flight planning.

First, make sure you have an active waypoint
On the MFD, press the PROC softkey to get to the Procedures Menu.

Figure 13.1 - Procedure key

Next activate the cursor by bumping in the small FMS knob.

Figure 13.2 - FMS knobs

Now use the outer FMS knob to scroll through the following choices:

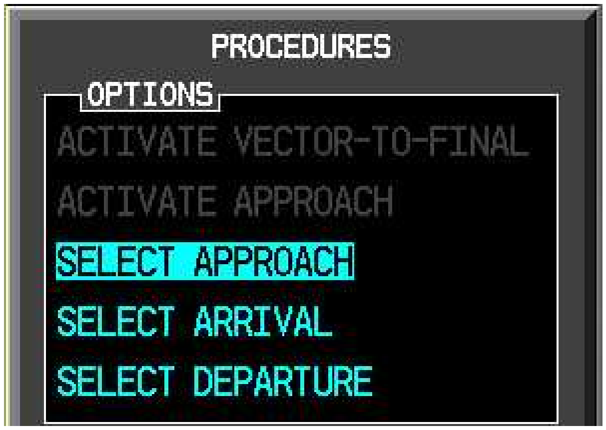


Figure 13.3 – Selecting an approach after selecting the PROC key

Figure 13.4 – Use FMS knobs to select option

Figure 13.5 – Press the enter key

Pressing enter selects the highlighted choice.

Next select the appropriate procedure. In this case, Kansas City Downtown KMKC is our active waypoint and so far we have pressed the PROC button, highlighted 'SELECT APPROACH', and pressed ENT. If you have no active waypoint, or if the one you have selected does not have an Instrument Approach, the G-1000 will prompt you to enter a waypoint that has an instrument procedure. The procedures for that airport will be listed, scroll to the desired approach and press ENT.

Figure 13.6 – Selecting an approach

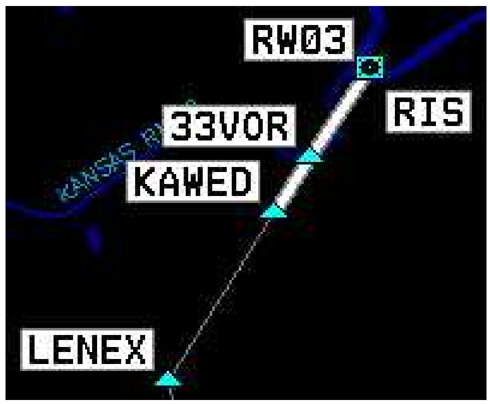


Figure 13.7 - Plan view of the approach

Figure 13.8 – Enter key

The plan view of the procedure, including transition, can be viewed on the map display while scrolling through the available transitions. In this case, as you scroll you see a plan view of all of the Instrument Approaches for KMKC. Pressing enter selects the highlighted choice.

At this point the G-1000 will prompt you to select an IAF or Vectors to Final.

Figure 13.9 – Selecting a transition

You will now be asked to “Load” or “Activate” the procedure.

Figure 13.10 – Loading the procedure

Selecting "Load" puts the procedure and any associated waypoints into the current flight plan after the destination waypoint. Selecting "Activate" both loads the waypoints and activates "Direct To" the first waypoint on the procedure.

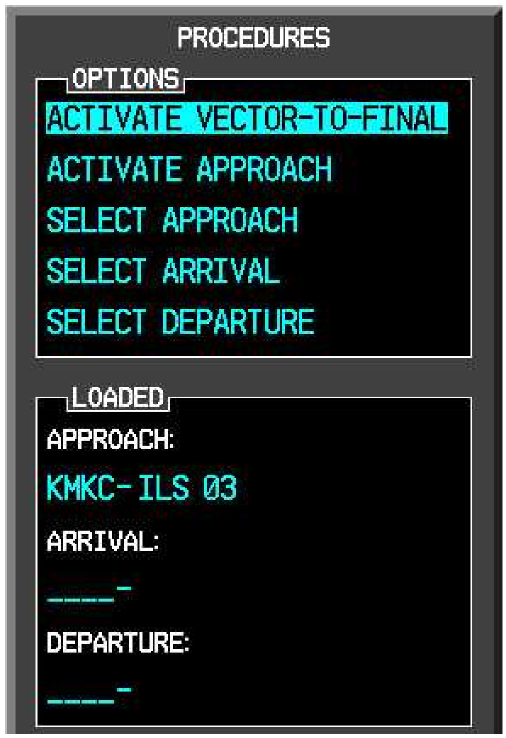


Figure 13.11 – Activate vectors to final

Once an approach is loaded one can activate that approach at any time by again pressing the PROC key and selecting the choice for "Activate Approach", or "Activate Vector-to-final" (if VECTORS transition has been selected).

Figure 13.12 – PFD flight plan window

Procedures can be loaded, activated and modified in the small flight plan window on the PFD as well. When using the PFD window the plan view of the procedure will not be shown.

Figure 13.13 – An approach loaded into the active flight plan

The GPS will automatically sequence to the next waypoint on an activated approach procedure.

Figure 13.14 – SUSP Mode and softkey available at the missed approach waypoint

Missed approaches

The GPS will NOT auto-sequence past a missed approach point until the SUSP (suspend) softkey located on the bottom of the PFD is pressed. In order to access this softkey you will have to press the CDI softkey to select the GPS mode. If a missed approach is desired after reaching the missed approach point the SUSP softkey must be pressed in order to activate missed approach course guidance. At this point the GPS will plot a direct-to course to the missed approach holding pattern.

Figure 13.15 – An active hold, in suspend mode

Figure 13.16 – Suspend softkey

Holds

When entering a hold that is part of an instrument procedure the GPS will again go into suspend mode and the SUSP softkey will appear in the softkey list at the bottom of the PFD. The course guidance will be provided only for the inbound leg of the hold. The holding pattern will show on the map in magenta as the current flight plan leg. The pilot must fly the aircraft through the turns and the outbound leg of the hold. Once it is desired to leave the hold the SUSP key must be pressed in order to sequence to the next waypoint of the approach procedure loaded in the flight plan.

Figure 13.17 – Suggested hold entry

The recommended hold entry type will be displayed in the data strip, at the top of the PFD, shortly before reaching the holding fix.

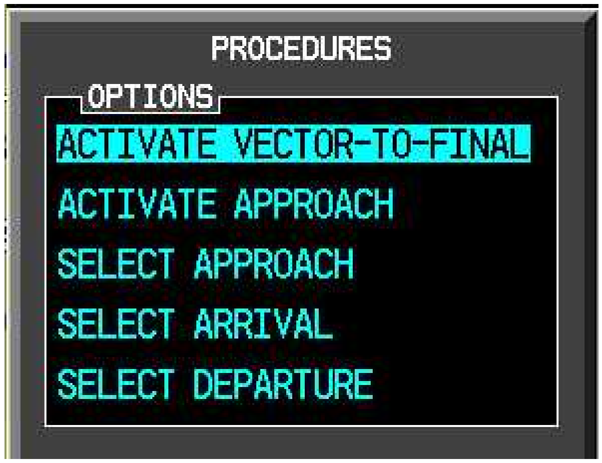


Figure 13.18 – Activating vectors to final

Figure 13.19 – Vectors to final active

Radar Vectors

When Vectors to Final are expected for the approach selected the Activate Vectors to Final option can be activated in the Procedure menu. This option should not be selected/activated until ATC starts vectoring the aircraft for the approach. Once activated the approach course extended centerline will be shown in magenta as the active leg and the GPS CDI will auto slew to the inbound final approach course.

Conclusion

In this study unit, we looked at how to use the G1000 to load and activate instrument procedures into the flight plan so that the autopilot is prepared to fly the various components of those instrument procedures in an orderly and precise fashion. By taking this approach to your instrument flying, you can spend your time as a cockpit manager making sure the system is doing its job. The same procedures can be used to enhance the safety of IFR operations.

FITS Study Unit Debriefing:

You have now covered the area of the Garmin G1000 instrument approach procedures and how to effectively integrate this with the use of the autopilot.

- ❑ If you now understand that the G1000 uses the databases to generate the electronic versions of the instrument procedures, you will also understand why a thorough understand of the autopilot and the coupling of the systems can greatly enhance system safety
- ❑ If you now understand why knowing how to effectively add, delete, and edit instrument approach procedures in the flight plan, then you will also understand how to use the Direct-to key and the MENU key to proceed to specific fixes within the procedure as directed by ATC.
- ❑ If you now understand that this system is a digital system featuring many systems which are driven by software and computers, then you will realize the importance of keeping the aviation databases current and up to date and will never fly IFR without the most current information.

If you not only understand these three areas but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a "Correlate" level of FITS accomplishment! It is time for you to move on to study unit fourteen!

Study Unit 13: Instrument Procedures and Operations Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to key in and safely operate a TAA aircraft equipped with cockpit automation equipment such as the Garmin G1000. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way which will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin Instrument procedures on the G1000 and some of the chores that you may have to perform using its functions. This scenario is based upon a typical IFR flight scenario between Kansas City Downtown airport (KMKC) and Columbia, Missouri (KCOU), a tower controlled airport.

Consider the following questions about this scenario:

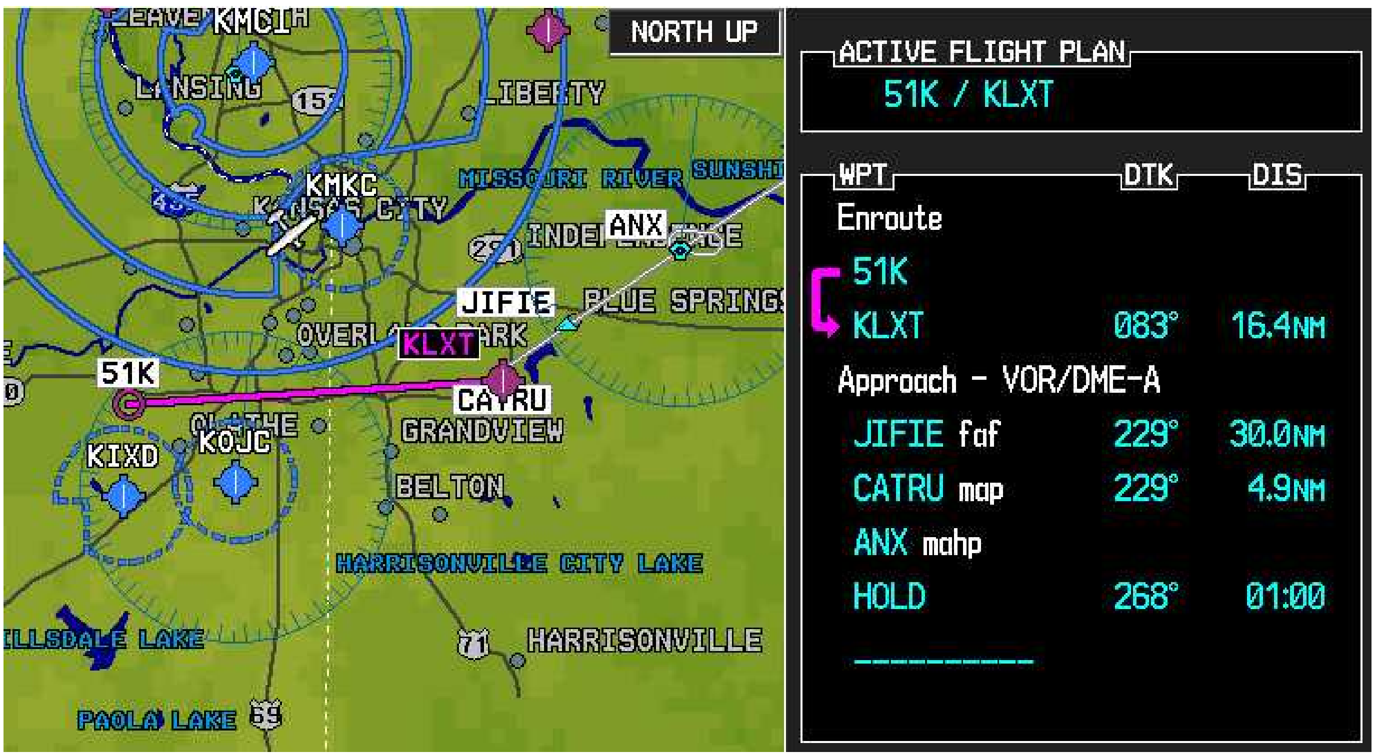


Figure 13.20 – Study unit Sample flight plan

Question 1: When the PROC button is first pushed, what choices are offered to you?

- ***a) Select Approach, select radar vectors, select type of approach***
- ***b) Select Approach, Select Arrival, Select Departure***
- ***c) Select Airport, Select Approach, Select type of approach***

Question 2: If the approach is loaded, how does the pilot activate the approach?

- ***a) Press the FPL button***
- ***b) Press the Direct to button***
- ***c) Press the PROC button and then select activate approach***

Question 3: If you are receiving radar vectors to final, what must be selected for the approach to be properly activated?

- ***a) Activate approach***
- ***b) Activate Vector to Final***
- ***c) Activate Waypoint***

Question 4: When entering a hold for a missed approach what mode will the G1000 revert into?

- ***a) HOLD***
- ***b) DIRECT TO***
- ***c) SUSPEND***

Question 5: In order to proceed beyond a hold what action must be taken by the pilot?

- ***a) Activate the approach again***
- ***b) Press the SUSP softkey to take the GPS out of Suspend mode***
- ***c) Press the PROC key and select continue from the menu***

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will point you back to the appropriate reference area in the chapter. Once you have achieved all the correct answers, you may proceed on to the next study unit. You can come back to items in this study unit at any time.

Study Unit 14- Emergencies and Emergency Management

Study Unit Objectives:
The objective of this Study Unit is for you to move from the "Perceive" level to the "Understand" level of FITS accomplishment regarding component failure recognition. In addition, you will understand the course of action to follow when experiencing an emergency situation while operating the G1000 and its subsystems.

Completion Standards:
You will be able to describe and explain how to diagnose that your G-1000 is having a AHRS failure, a PFD failure, and an alternator failure. You will also be able to describe and explain load-shedding and the usage of your auto-pilot while experiencing component failure.

You will know you have met the completion standards of the study unit when you have correctly answered all the quiz questions at the end of this section. If you get any answer incorrect, the system will coach you on that particular topic and will offer you a link to go back to the reference material. When you have correctly answered all the study unit quiz questions, then you may proceed to the next study unit.

Emergency Management

Figure 14.1 – PFD with multiple failed LRUs

Although complex, the Garmin G1000 system provides many sources of information to help you manage in flight emergencies. The crew alerting system discussed in detail earlier in this program outlines every type of alert that is provided to a pilot. In this chapter we will discuss how the pilot can actually recognize and effectively manage different types of emergency situations. We will begin a discussion covering some of the system failures. In addition, this section will show how to recognize system failure by the indications given on the PFD and MFD, the appropriate pilot actions to take, and also discuss other G1000 related emergencies.

Alternator failure

The Garmin G1000 system is electrically based and therefore it is very dependent upon electrical power and the alternator to keep the battery(s) charged. The alternator is an electro-mechanical device and is therefore susceptible to internal failures, external control failures such as control units, relays, and circuit breakers; and incidental failures such as broken belts, shorted wires, and broken mounts or pulleys. It is essential that you do everything required on the preflight and during the engine run-up to make sure that the alternator is providing proper charging voltage, the battery is properly charged, and the engine is operated above the critical idle speed for that aircraft installation. You must ensure that flight is not initiated if any portion of that system is showing signs of failure or degradation. One common area that is overlooked by many pilots is the condition of the battery itself. The battery is a consumable item and degrades its ability to perform with time, number of charge/discharge cycles, and with temperature. A battery is rated in terms of "Amp Hour" capacity. That is how many amps a battery can put out for 1 hour before becoming exhausted. A battery is severely limited in its storage capacity in low temperatures. That is why a worn out battery tends to fail or run down quickly during starting in the cold temperatures.

You should be very wary of jump starting an aircraft with a dead battery. If there was no real reason for the battery to fail (such as the master switch being left on), one should immediately have the system troubleshot and/or the battery replaced prior to attempting flight. Jumpstarting the battery for engine start can lead to operating the aircraft in a jeopardized condition. The best case is that the battery will again be dead for the next start, and the worse case could be electrical system failure in flight due to insufficient residual voltage left at low power settings to keep the alternator charged and primed with an "exciter" voltage.

In the event that a "Low Voltage" caution or "Failed Alternator" warning appears during flight, you must take immediate action to conserve power. We call this electrical load shedding.

Definition: **Electrical Load Shedding** –The process of reducing system electrical appliance demand to extend the finite capacity remaining of an electrical power source after a system failure or degradation.

Just like the real life story of Apollo 13 and its dramatic return to earth with catastrophic power system failures, you must learn to systematically reduce the power consumption of your systems based upon a prioritization of system or appliance need. The Garmin G1000 has some internal automatic load shedding that it performs, especially when system voltage drops below 22 volts. In this case, you will see screens dim, and COM radio transmitter output wattage will be reduced. You must be proactive. The highest power consumption appliances will be those that "heat, light, and spin." This means that items such as landing lights, taxi lights, Pitot heaters, fuel pumps, and flap motors are the first items that must be eliminated in order to extend the longevity of a battery.

AHRS failure

If the AHRS system fails, the pilot will see red "X's" over the Attitude Indicator and the H S I. Once the AHRS has failed, an ALERT will flash and when prompted will tell the pilot there is a HDG Fault and a Magnetometer fault.

The pilot at this point must use the standby attitude indicator and the magnetic compass for primary attitude and heading information. Provided the auto-pilot it has its own rate of turn gyro, the autopilot may still be used, but this will only work in roll mode and nav mode. When experiencing an AHRS failure, The MFD screen will appear normal and the pilot will continue to utilize all functions of the MFD.

Figure 14.2 – GRS77 AHRS failure

ADC failure:
If the ADC fails, the pilot will lose Airspeed and Altitude information indicated by red "X's" in place of the Airspeed and Altitude tapes. In addition, the G-1000 will no longer be able to compute and display VSI, Outside Air Temp, and TAS information indicated also by red "X's" in their place. An ALERT will begin to flash telling the pilot the G-1000 is not receiving Airspeed information. The Mode C operation of the transponder will also be lost, as the ADC is where the transponder gets its pressure altitude information.

The pilot will have to use the standby airspeed and altimeter to control the aircraft. During an ADC failure, the MFD will continue to operate without losing any components. Also, while flying with a ADC failure, the pilot may continue to use the Auto-Pilot. However, the Altitude hold function of the Auto-pilot will not be operational.

Figure 14.3 – ADC failure

Magnetometer failure:

If the magnetometer fails the pilot will lose heading information from the system. A red "x" will be displayed over the letters HDG on the top of the HSI presentation. Heading functions from the autopilot will become inoperable. Component failures of this type are indicated to the pilot by the red "X" and the pilot will also receive an advisory for each system or component failure. This is the case for all engine instrumentation.

During a Magnetometer failure, the pilot will obtain heading information using the magnetic compass. The MFD is still operable, however the pilot will notice they will no longer be able to use the "Track Up" mode on the moving map.

Figure 14.4 – GMU 44 Magnetometer failure

PFD failure:

If the Primary Flight Display fails, the pilot will lose PFD information displayed on the left of the two displays. The system may automatically switch into the reversionary back up mode. In this mode, the PFD information is transferred to the right side display where the MFD information is normally displayed. When in the reversionary mode, the PFD information, coupled with the engine instrument indications are shown on the MFD display. The engine indications will be displayed on the left side of the screen as they normally appear on the MFD. With a PFD failure, the pilot will lose COM 1 and NAV 1 information (not pictured) and all moving map references. The pilot will receive ALERTS notifying there is a Cross-Talk Error, the Audio Panel, EIS, Air Data, and the AHRS will all be using Back-up Paths.

If the system does not automatically switch into the reversionary mode, there has not been a true PFD failure, but the screen itself is malfunctioning or has failed. The G-1000 may not recognize a problem with the display screen so if there is any problem with the PFD display screen, the pilot should press the RED display backup button located on the bottom of the audio panel. This will manually turn the right side display into PFD information.

Figure 14.5 – Using the reversionary button to recover a failed PFD

MFD Failure:

If the MFD fails, the pilot will lose all information on the right of the two display screens. In this case, the right screen will go blank, and the system will once again go into the reversionary mode, but this time the engine information will automatically cycle over to the left side of the PFD display screen. The pilot will receive an ALERT that there is a Cross-Talk Error, and will lose some flight planning information, but will still be able to pull up the current flight plan information on the PFD. Another component that will fail with the MFD is COM 2 and NAV 2.

If the system does not automatically switch into the reversionary mode, there has not been a true MFD failure, but the screen itself is malfunctioning or has failed. The G-1000 may not recognize a problem with the display screen so if there is any problem with the MFD display screen, the pilot should press the RED display backup button located on the bottom of the audio panel. This will bring the engine information that was previously on the MFD side over to the left side of the PFD display screen.

Figure 14.6 Using the reversionary backup button to recover from a failed MFD

Now that we have covered what happens when some of the various systems and components fail, we will examine some specific electrical system problems. Being that the entire system is predominantly electric it is imperative that you know how to manage alternator and battery problems.

All aircraft that are G1000 equipped have a standby battery. The different manufacturers have given their standby batteries different capabilities. Examples of this are the Cessna and the Diamond. The Diamond uses 12 lithium manganese batteries that are 3 volts and 1300mAh each. This battery pack is specifically designed to power the stand by attitude indicator and the flood light. Although other manufacturers allow other electrical components to be operated on their standby systems, the Diamond standby system will last for up to 90 minutes, but this could degrade over time because it does not take any type of trickle charge from the alternator. There is a requirement to replace these batteries every 24 months, but Diamond believes that this will soon be extended to 36 months. The battery pack is located behind the instrument panel.

Figure 14.7 – The power distribution bus and backup battery switch on a Diamond DA40 aircraft

The Cessna has two 12 volt batteries wired in series for a total of 24 volts as its backup battery. This system is capable of powering the items that are part of the Essential Bus on the system. The Cessna system is also capable of monitoring the stand by battery system voltage. There is a test before engine starting for the Cessna to test the Standby battery making sure that is has sufficient power to operate the items on the essential bus should the alternator fail. Deciding how much time you have remaining before your battery fails an important factor. Although the standby battery system will not last as long as the Diamond's, you can operate more components to assist in navigation as well as monitor the standby bus system to determine how much power the standby batteries have remaining

Figure 14.8 The power distribution panel of a Cessna aircraft

The condition of the battery prior to alternator failure plays a big role in how long it will last after an alternator failure. A battery in new condition may function for 45 minutes, but a battery not in perfect condition might only last 10 to 30 minutes. The standby battery pack in the Diamond should last 1 hour and 30 minutes, but if the alternator failure is recognized early, the useful life of the aircraft's standard battery can be extended by load shedding. Looking at the Circuit Breaker panel can provide very useful information as to load shedding the system to most effectively utilize the battery power that remains. Determining which items to turn off is very important to saving as much power as possible. Take into account that a good rule of thumb is that items that heat, spin or light take up the most energy. Items like pitot heat and landing lights take a large amount of energy to operate. When the standard battery has been drained, the pilot will engage the emergency standby battery, which will power the standby attitude indicator and the panel light.

To simulate failures in the Cessna system the following table can be useful. Something of note, that on Cessna models the CB for the AHRS and ADC are the same and they cannot be failed separately. On the diamond model it is possible to simulate AHRS and ADC failures separately.

Failure to simulate	Examiner action	Applicant action
Loss of AHRS and ADC* (simulates loss of all primary flight instrumentation)	Pull AHRS and ADC circuit breakers	Control the aircraft by reference to the backup attitude, altitude and airspeed indicators, engage the autopilot if it is rate based and has its own gyro source in roll mode
Loss of AHRS (attitude and heading)	Pull AHRS circuit breaker	Control the aircraft by reference to the backup attitude indicator, engage the autopilot if it is rate based and has its own gyro source in roll mode
Loss of ADC (airspeed, altitude and vertical speed)*	Pull ADC circuit breaker	Control the aircraft by reference to PFD attitude presentation and the backup airspeed and altitude indicators, (engage the autopilot in roll, HDG, or NAV mode)
Loss of PFD	Pull PFD circuit breakers – *note: this action will not allow the tuning of the COM 1/NAV 1 radio, COM 2 must tuned to the proper frequency and in use*	Control the aircraft by reference to the MFD in reversionary mode (this mode also removes all moving map presentations)

**Note: When the ADC is failed, pressure altitude data is no longer available to the transponder. This will result in the transponder only being capable of Mode A (no altitude reporting) capability. Therefore, failing the ADC should be avoided in Class B and C airspace or within the Mode C veil of Class B airspace, without the required coordination with the appropriate air traffic control facility.*

Figure 14.9 The failure mode chart provided by Garmin

Conclusion

In this study unit, we looked at the emergency operations aspects of the Garmin G1000 system. Because the system is so complex in terms of interoperating systems, it stands to reason that if something fails, there will be a cascading effect of that failure. The G1000 system has been designed with dependability in mind and the ways that system failure are detected are used to alert you as soon as possible to give you the most amount of time to diagnose and plan for the proper response to that failure.

Remember

- System and system component failures can be very distracting. Keep in mind that you can still use the autopilot even though you may lose some of the functions
- During a PFD or MFD failure or anytime the reversionary backup screen mode is selected, you will not be able to use the inset map, but may still use the flight plan function on the unit that is still operable.
- During an alternator failure, you can extend the useful life of your battery by pulling circuit breakers of non-essential items.

FITS Study Unit Debriefing:

You have now covered the area of the Garmin G1000 system emergencies management and you should now understand how the system detects, displays, and resolves emergencies. You must have a thorough working knowledge of this area in order to safely operate the G1000 glass cockpit.

- If you now understand that the G1000 monitors the status of all the LRUs so that it never displays invalid data, then you will also understand that anytime data is not considered accurate or reliable by the system, it is covered with a red X.
- If you now understand why knowing how to deal with system outages and know how the system will produce various annunciations to help you make the correct response to each situation, then you will also understand that the backup instruments are very important to cross checking the failed instruments to ensure a complete picture is obtained..
- If you now understand that this system is a digital system featuring many systems that are driven by software and computers, then you will realize the importance of keeping the software and the databases that drive it current and up to date.

If you not only understand these three areas but also can correlate these three major points into your everyday flying skills and apply these skills to the operation of your Garmin G1000 aircraft, then you are already ahead of the curve. You are operating at a "Correlate" level of FITS accomplishment! It is time for you to take the study unit quiz and then move on to the final exam!

Study Unit 14: Emergencies and Emergency Management Quiz

The Quiz Session Scenario

The Quiz Session Scenario (QSS) is designed to take real world flight situations and utilize it in the flow of the software so that you can participate in the decisions about how to safely operate a TAA aircraft equipped with Garmin G1000 cockpit automation. You can then determine whether you "understand" and can even "correlate" the material you have covered with your existing aeronautical knowledge and are prepared to use this information in a way that will enhance your operational safety while using the G1000 equipped aircraft.

In this study unit quiz, you are asked to demonstrate an understanding of the Garmin engine monitoring system and some of the chores that you may have to perform using its information in a typical flight scenario between Lexington, Missouri and 3GV and Kansas City International airport (KMCI). Consider the following questions about this scenario:

Figure 14.10 – Study unit 14 quiz scenario diagram

Question 1: If the pilot experiences a loss of the PFD, what would the proper course of action be?

- **a) Push the Red Display Backup button if the system does not automatically switch to reversionary backup mode**
- **b) Push the MENU button and seek the display options**
- **c) Try pulling and resetting the PFD circuit breaker**

Question 2: If the LOW VOLTS warning is displayed, what has happened?

a) **The standby battery has been activated**
b) **The ALT volts are low and the system needs to be troubleshot**
c) **The ALT may have failed or the idle is set below the critical idle speed and the pilot should raise the power setting if at idle or begin load shedding**

Question 3: In a scenario with a suspected failed alternator, what type of electrical items should you load shed first as you start to diagnose the problem and respond?

a) **PFD and MFD**
b) **Lights, pitot heat and fuel pumps**
c) **Everything except standby instruments**

Question 4: Can the autopilot still be of use to you experiencing an AHRS failure?

a) **YES, but only in ROLL or NAV mode**
b) **Yes, all functions operate normally**
c) **NO**

Question 5: You are flying the scenario above in IFR conditions and you encounter a red X on the face of the airspeed indicator, altimeter, and vertical speed indicator. What should you do?

a) **Attempt troubleshooting and start load shedding**
b) **Ignore the red indications and attempt to fly the aircraft with the backup AHRS unit**
c) **Assume that you have had a LRU failure and immediately begin reference to the standby instruments**

Grading Criteria:

You will know when you have completed this study unit when you get all the answers correct. When you complete the exam, the system will grade your answers and let you know which ones were correct. Incorrect answers will generate a prompt for you to retry the question and will point you back to the appropriate reference area in the chapter. Once you have achieved all the correct answers, you may proceed on to the final exam. You can come back to items in this study unit at any time.

Final Exam and FITS Certification

Study Unit Objectives:
The objective of this Study Unit is for you to demonstrate your knowledge of the Garmin G1000 system by completing this final exam and achieving a final score of at least 80% which we will define as an "understand" level of FITS accomplishment. A grade of 90% or greater indicates that you have achieved a correlate" level of FITS accomplishment.

Study Unit Objectives:
The objective of this Study Unit is for you to demonstrate your knowledge of the Garmin G1000 system by completing this final exam and achieving a final score of at least 80% which we will define as an "understand" level of FITS accomplishment. A grade of 90% or greater indicates that you have achieved a correlate" level of FITS accomplishment.

Completion Standards:
When you complete the final exam, the system will grade it for you and will give you an option to review each area missed in the exam. Any questions which you incorrectly answer will offer you some coaching on that question and offer you

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The Final Exam Scenario
The final exam is based upon a Knowledge Exam Scenario (KES) designed to take real a world flight situation and utilize it in the flow of the software so that a pilot can participate in the decisions about how to safely operate the TAA aircraft equipped with Garmin G1000 cockpit automation.

In this study unit quiz, the pilot is asked to demonstrate a comprehensive understanding of the Garmin G1000 system using its information in a flight scenario as follows:

The pilot is going on a two leg flight between Sand Point, ID (KSZT) and Deer Park, WA airport (KDEW) then back to Sand Point International airport (KSZT), both non-tower controlled airports.

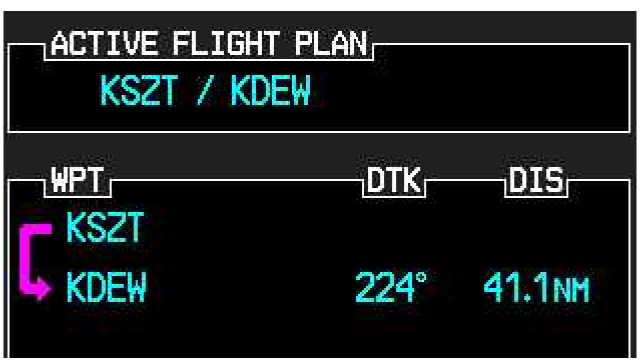

Figure FE.1 – Knowledge exam scenario reference diagram for G1000 Active Flight Plan

Figure FE.2 – Knowledge exam scenario reference diagram for G1000 PFD

Figure FE.3 – Knowledge exam scenario diagram for G1000 MFD

Figure FE.4 – Knowledge exam scenario diagram Garmin Perspective Plus in a Cirrus

1. **How do you distinguish that you are flying a TAA aircraft?**
    a) **The aircraft has a GPS with a color map and weather**
    b) **The aircraft has a Primary Flight Display (PFD) and a Multifunction Display (MFD), a flight management system to control them, and an integrated auto pilot that can couple to that system**
    c) **The aircraft has an autopilot with altitude hold**

2. **Why is the scan flow different for TAA aircraft than for traditional aircraft?**
    a) **The pilot must look inside the aircraft more**
    b) **The pilot has an extra item in the scan, usually a MFD**
    c) **There is no difference is the scan flow**

3. **What are some of the hazards associated with the TAA scan flow as the pilot approaches the destination airport in this scenario?**
    a) **Fixation on one area of the scan flow for too long of a period**
    b) **Too many items to scan**
    c) **System is too complicated to use and should be turned off**

4. **What statement is true regarding the use of an aircraft checklist in the TAA cockpit for this flight?**
    a) **The checklist is not as important on such a short flight**
    b) **The on-screen checklist will completely eliminate the need for a handheld checklist**
    c) **The on-screen checklist once activated will help reduce cockpit workload, but may not include all items of importance to the pilot**

5. **You are flying your local flight to the destination airport and your magnetometer fails. What information will you lose?**
    a. **Altitude information**
    b. **GPS and course guidance information**
    c. **Heading information as reported on the HSI**

6. **What does the GRS 77 AHRS control for the Garmin Perspective Plus system?**
    a) **Reference information such as Attitude, Heading, and turn rate**
    b) **Engine temperature information**
    c) **Altitude and Airspeed information**

7. You are preparing to depart and are getting your weather from the local AWOS at your airport. Where do you put the altimeter information into the Garmin Perspective Plus equipped aircraft?

a) Through the Autopilot BARO button and this sets the entire aircraft

b) You put it into the Garmin Perspective Plus using the BARO knob, and into the standby altimeter using the Kolsman knob

c) You put it into the GPS database using the ALT knob on the GDU1040

8. You have completed your departure and you want to place the arrival CTAF frequency into your number 2 COM. How do you do this and make it active?

a) You press the COM key in the frequency with the GCU keypad

b) You use the inner and outer knobs of the COM knob to select the frequency and then press the toggle frequency button to make it active

c) Both A & B are correct

9. You are now airborne and want to center the heading bug and the Altitude bug at your current heading and altitude. How do you do this?

a) Press the Direct-to button and then select HDG and ALT

b) Turn the ALT and the HDG knob counterclockwise until they are centered

c) Press in ("bump") on the HDG and ALT knobs on the autopilot control panel to center these settings

10. You are trying to tune in ATIS on COM2 to get the weather at the destination airport and you find that you are a little far away and hear nothing in your headset. What can you do with the Garmin Perspective Plus radios to help you?

a) Turn the volume up on the GMA1347 Audio Panel

b) Make sure the blue box is around the active frequency and then turn up the volume control using the VOL/SQ knob

c) Pressing the VOL/SQ button in will turn off the squelch and allow you to hear the station at an increased distance

11. If you were on the trip half way to your destination and you wanted to hear the NAV radio identifier for an upcoming VOR and did not see the station identifier show up next to the frequency, how would you increase the sensitivity of the NAV radio that you were listening to?

a) turn the volume up more using the NAV VOL/ID knob

b) make sure the blue box is around the active frequency and then turn up the VOL/ID volume control knob

c) press the NAV button on the Audio Panel and by pressing the NAV VOL/ID knob in to amplify the Morse code of the identifier

12. How do you use the FMS selection Knob to retrieve information from menus within the Garmin Perspective Plus?

- **a) Twist the knobs to select automatic search and then press ENT to make your final selection**
- **b) Turn the inner knob and outer knobs to alphabetically spell station names and then press ENT for Entering the selection**
- **c) Bump the inner knob to activate cursor, scroll with the outer knob to move to the correct field and twist the inner knob to select your choice in the drop-down box followed by pressing ENT**

13. Before your flight today, how is the best way to make sure that your databases are current for IFR Flight??

- **a) Pull out the SD Card from the MFD and read the expiration date off the label of the SD card**
- **b) Start the Garmin Perspective Plus MFD using the master switch and read the expiration date on the flight planning screen**
- **c) Start the Garmin Perspective Plus MFD using the master switch and avionics switch if necessary and read the expiration dates on the initiation screen**

14. You have just completed the startup sequence for your flight in your Garmin Perspective Plus aircraft and notice your COM2 and NAV2 frequency boxes still have a red X through them. What should you do?

- **a) Check to see that your avionics master switch is on and that no circuit breakers are popped**
- **b) Shut the system down right away because it has developed a malfunction**
- **c) Reach over and press the COM and NAV buttons to turn on the radio with the blue box pointer**

15. You are taxiing to your departure runway to do your pre-departure checks and autopilot and trim system checks and you receive a call from ground control amending your departure clearance. What should you do?

- **a) Stop the aircraft on the taxiway and input the changes after acknowledging the clearance route change**
- **b) Reach over and twist in the changes to the flight plan as it is only a small change**
- **c) Acknowledge the change and wait until the aircraft is at stopped at the run-up area to input the change into the Garmin Perspective Plus**

16. While enroute to your destination, ATC advises you to make a 30-degree heading change to the right. How would you complete the operation on your Garmin Perspective Plus aircraft, if the auto pilot was being used?

a) You would use the CRS/BARO knob to set in the new heading in CRS mode

b) You would turn the GMC707 Autopilot HDG knob right 30 degrees and make sure the autopilot was set to HDG mode

c) You would change the heading of the aircraft while carefully scanning for traffic, then you would make the change on the HDG bug on the MFD

17. Upon receiving your clearance, ATC gives you a squawk code of 4632 and asks you to IDENT. How would you complete this operation on the Garmin Perspective Plus transponder?

a) On the PFD, press the XPNDR softkey twice, Press 4632 softkeys, then press IDENT

b) On the GCU, press the XPNDR softkey, press 4632 softkeys, then press IDENT

c) A & B are correct

18. As you continue the flight to your destination, ATC advises you to "remain clear of Class B airspace ahead". Which procedure is correct on how to use the Garmin Perspective Plus to help you?

a) On the MFD, activate the RANGE ring using the GCU RANGE knob, adjust the range scale to show the Class B airspace, then use the FPL key with the OBS softkey to create an offset course around the airspace

b) On the PFD, activate the INSET MAP, adjust the range scale to show the Class B airspace, then add another waypoint to the Flightplan creating a diversion around the airspace

c) Both A and B are correct

19. As you continue the flight to your destination, you see an airport ahead. Which procedure is correct on how to use the Garmin Perspective Plus to help you identify this airport?

a) On the GCU, press in the RANGE knob and activate the joystick pointer and move the pointer until the airport highlights on the MFD Home map and then press enter to read WPT information

b) On the PFD, press the NRST softkey on the PFD and find the airport on the NRST Menu box

c) Both A and B are correct

20. As you continue the flight to your destination, you decide to dial up a VIH VOR to watch your progress along the route of flight. How can you do this and not lose the NAV lock on the autopilot that is set to tracking the GPS course in your flight plan?

a) Key in the frequency of the VOR using the NAV frequency selection knob, press the toggle key to make it active in NAV1 or NAV2, then on the PFD, press the CDI softkey to read the course in the HSI

b) Key in the frequency of the VOR using the NAV frequency selection knob, press the toggle key to make it active in NAV1 or NAV2, then on the PFD, press OBS and turn the CRS knob to see what radial you are on

c) Key in the frequency of the VOR using the NAV frequency selection knob, press the toggle key to make it active in NAV1 or NAV2, then on the PFD, press the PFD softkey and then activate BRG pointer 1 to create another pointer on the on the HSI

21. As you arrive at the halfway point to KCOU, you decide to start to see what approaches are available in case the weather deteriorates. What is the best way to so this on the PFD?

a) Press MENU and select ACTIVATE APPROACH

b) PRESS PROC and select APPROACH

c) Press the APPROACH softkey

22. The weather finally deteriorates and you decide to proceed to the nearest alternate airport to land and wait. What is the best way to so this?

a) Press NRST softkey and select the closest suitable airport using DIRECT (D->) key

b) Press NRST softkey and select the closest suitable airport using MENU

c) Press the DIRECT (D->) softkey, bump the curser, scroll down to the NRST field and press ENT-ENT

23. On the Cirrus Garmin Perspective System, the PFD has a menu key in the FMS. What does this menu button do?

a) Sets global System parameters for the GCU

b) Allows the pilot to set the Transponder controls

c) Allows the pilot to control the screen brightness of the PFD and MFD

24. One the Cirrus Garmin Perspective system, what does the GCU do?

a) Allows the pilot to control the AHRS

b) Allows the pilot to control the functions and menus of the MFD

c) Allows the pilot to control the Alternator Control Unit (ACU)

25. As the pilot conducts this flight to the destination, they wish to avoid the terrain ahead. Which procedure is correct on how to use the Garmin Perspective Plus to help accomplish this?

a) On the MFD, set the MAP softkey to show TOPO and Terrain and use the color coding of the MAP to fly an altitude higher than the terrain ahead

b) On the MFD, add a waypoint to the Flight plan creating a diversion around the obstacle you wish to avoid

c) Both a and b are correct

26. How does the Garmin Perspective Plus system display information when a system or component fails?

a) A red X over the failed component removing all information

b) Removing the component from the display

c) There is no warning of this

27. During operation in the departure terminal area, the pilot desires to reduce the distraction caused by the MFD. How can the MFD be changed into the PFD?

a) Using the PA button

b) Using the HI SENS button

c) Pressing the display backup button between the PFD and MFD to duplicate the displays to avoid distractions in busy areas

28. As the pilot is flying this scenario, "Traffic" appears on the PFD and also as an aural callout, how does the pilot find a page that will allow a closer look at the traffic?

a) Pressing the FMS knob

b) Press and hold CLR to get to the main MAP (home) page 1 of the MFD.

c) Pressing the FPL button

29. To cancel a fight plan that has already been activated, what is the key sequence to accomplish this?

a) Press the FPL key on either PFD or the GCU; Press the MENU key; highlight 'delete flight plan', press the ENT key twice

b) Press the FPL key and then pressing the ENT key

c) Hold down the CLR key

30. When the Garmin Perspective Plus autopilot is in heading (HDG) mode, what controls the heading that the autopilot follows?

a) The HDG knob on the autopilot

b) The ALT knob on the Garmin Perspective Plus display
c) The HDG knob on either Garmin Perspective Plus PFD or the MFD display

31. If the pilot is receiving radar vectors to final approach into Deer Park airport and has selected an instrument approach for that airport, what must be selected for the approach to be properly executed?
a) Activate Approach using the PROC button
b) Activate Vector to Final using the MENU button
c) Activate Waypoint using the FPL button

32. The pilot is now getting close to Deer Park (KDEW) and wants to double-check the runway length available on the longest runway. This is accomplished by:
a) Scrolling the MFD to WPT and twisting in the airport identifier to look at runways available.
b) Pressing FPL, Scrolling to the airport in the Flightplan, then pressing enter to look at runways available.
c) Both of these are correct.

33. If the pilot wanted to create a flight plan for the trip suggested in this scenario, what would be the first button to push?
a) MENU
b) FPL
c) DIRECT TO

34. The pilot has loaded the flightplan for this scenario and decides to try to load the instrument approach early in the flight to stay ahead of the aircraft. What statement is true regarding this decision?
a) The pilot should "Activate" the approach using the PROC key so that the autopilot will sequence directly to the Initial Approach waypoint at the appropriate time.
b) The pilot should never load an approach early in a flight because the GPS must be in either the enroute mode or the approach mode.
c) The pilot should "Load" the approach using the PROC key during the enroute phase of the trip and then "Activate" the approach once they are ready to proceed directly to a published leg of the approach.

35. How does the pilot activate the Transponder ALT mode after takeoff and how is it verified to be properly sending mode C altitude to ATC?
a) Activate ALT by pressing the ALT button prior to takeoff.
b) The Garmin Garmin Perspective Plus will automatically turn the ALT on after airborne and the ALT readout will appear in green on the transponder display of the PFD.
c) The pilot can check ALT readout on the airspeed tape on the PFD screen to make sure that ALT was turned on at 35 knots.

36. When the pilot first starts the aircraft and powers on the avionics master switch, what code will come up in the transponder display window?
a) A blank code.
b) A code of 1200.
c) The code that was used on the last flight.

37. While being vectored for a Visual Approach at KDEW, ATC advises the pilot to make a 30-degree heading change to the right from the pilot's current heading. How would the pilot complete the operation on the pilot's Garmin Perspective Plus aircraft, if the autopilot were being used in heading mode?

a) The pilot would first bump the CRS knob to make sure that it was centered on the current heading, then use the CRS knob of the PFD to set in the new heading.

b) The pilot would first bump the HDG knob to make sure that it was centered on the current heading, then turn the HDG (Heading bug control knob) right 30 degrees and make sure the autopilot was set to HDG mode.

c) The pilot would change the heading of the aircraft by carefully scanning for traffic, and then would make the change on the HDG bug on the autopilot.

38. During the flight, the pilot wants to identify the nearest airport. What is the most direct way to retrieve this information from the MFD?

a) Scroll the outside of the GCU FMS knob to the NRST page group.

b) Twist the inside of the GCU FMS knob to the NRST page group.

c) Pressing the NRST softkey on the PFD.

39. If the pilot wants to proceed to a specific waypoint in the flightplan as instructed by ATC, what needs to be done?

a) On the Garmin Perspective Plus, press the FPL key, bump the cursor to make sure that the cursor is on, then scroll to the waypoint, press DIRECT TO, and press CLR.

b) On the Garmin Perspective Plus, press the PROC key, scroll to the waypoint, press FPL, and press ENT twice.

c) On the Garmin Perspective Plus, press the FPL key, bump the FMS knob to ensure the cursor is on, then scroll to the waypoint, press DIRECT TO, and press ENT twice.

40. During flight the MFD display unit fails. Where will the pilot be able to view the engine indications?

a) They will be displayed on the left side of the PFD.

b) They will not be visible unless the pilot presses the red Display Backup button on the MFD.

c) They will be on ENG Information page three.

41. On the leg between KSZT and KDEW, the pilot decides to check the status of the autopilot as part of the cockpit scanflow. What statement is true regarding the status and operation of the autopilot?

a) The autopilot and trim system preflight operational check must have been performed on the first flight of the day in order to use the autopilot on that flight.

b) No active modes are engaged but the autopilot is ready to engage if the green RDY indications on the PFD is illuminated.

c) Both a and b are correct.

42. As the pilot is being vectored for an approach into Deer Park (KDEW), it is noticed that although the fuel range ring only shows 15 minutes of fuel remaining, the fuel gauges still show plenty of fuel. What could have caused this disparity in the two systems?

a) The fuel storage sending unit has developed a problem.

b) The fuel range initialization was not performed the last time that the aircraft was fueled.

c) The fuel flow transducer has developed a sending fault and will be followed by a yellow Low Fuel caution on the crew annunciation panel.

43. On approach to KDEW, the pilot wants to listen to the AWOS while maintaining contact with the local frequency. The second frequency may be monitored on the GMA450C audio panel by:
a) Pressing the COM/MIC key for the other radio.
b) Pressing the COM button on the GMA450C audio panel for the radio tuned to ATIS.
c) Pressing the MKR/MUTE button.

44. The pilot needs to add a waypoint to an existing flightplan on the Garmin Perspective Plus. How is this accomplished?
a) Pressing the FMS knob and then the ENT button.
b) Press FPL, press Menu, Scroll or twist down the menu until the add waypoint selection choice is highlighted, then press ENT.
c) Press FPL, press the cursor, twist down to highlight the waypoint in the flightplan where the new waypoint is to be inserted, twist the FMS knob, scroll and twist to add the entire identifier and then press ENT.

45. Which answer is true regarding the electric trim system of the Garmin Perspective Plus equipped aircraft with a GMC707 autopilot?
a) Trim and autopilot are not on the same circuit breaker.
b) It has an autopilot disconnect button located near the trim switch to stop trim runaways.
c) Both a and b are correct

46. Where would the pilot be able to find information regarding the minimum altitudes and speeds which the autopilot can be used on climb-out and approach?
a) The approved AFM Chapter 9 supplement that covers the autopilot.
b) There are no such limits published
c) The emergency portion of the AFM manual

47. What is true regarding the use of sectional charts while operating the Garmin Perspective Plus equipped aircraft?
a) Sectional charts and AFDs are not required because all necessary information to operate into airports are included on the Garmin Perspective Plus waypoint screens.
b) Sectional charts are only required in case the MFD develops a failure.
c) A source of current airport facility database information such as charts or Foreflight (AFD) should be carried onboard at all times because certain information about airports such as pattern altitudes and non-standard pattern directions are not reported on the Garmin Perspective Plus.

48. For flight-planning in the Garmin Perspective Plus, which method is the preferred way to set up the avionics for a trip between two locations?
a) Press the Direct-to key on the PFD or MFD and "bump scroll and twist" in the destination airport identifier.
b) Press the FPL key and "Bump scroll and twist" in the airport identifier of the destination airport.
c) Press the FPL key and "Bump scroll and twist" in the airport identifier of the current airport and then do the same for the destination airport.

49. If the pilot wants to start a timer to count down 5 minutes until a future event, what is the easiest way that this is accomplished on the Garmin Perspective Plus?
a) On the MFD, scroll the FMS knob to the AUX page group, twist the FMS knob to AUX page 5, and set up a one time event.
b) Use the chronograph installed on the panel.
c) Press the TMR/REF softkey on the PFD and set the counter to countdown and press ENT to start down from a predetermined time.

50. If the pilot wants to look at the runway diagram for the destination runway to determine the best runway for wind conditions, how is this done?
a) On the MFD, select Airport Diagram from the Menu.
b) On the PFD, use the inset map and map pointer to point the joystick at the desired airport and press ENT.
c) On the MFD, press the FPL key, press the FMS knob to turn the cursor on, Scroll down the list of waypoints in the flightplan, highlight the desired airport and then press ENT.

51. At the beginning of the flight, the pilot wants to reset the fuel ranging computer to show that fuel was added to the aircraft. How is this accomplished?
a) On the PFD, press menu, scroll down until the fuel reset option is highlighted and press ENT.
b) On the MFD, press menu, scroll down until the fuel reset option is highlighted and press ENT.
c) Using the GCU controlling the MFD, select the AUX menu, press FUEL and then press RESET FUEL.

52. During this flight, the pilot suddenly received red Xs on the PFD covering the Airspeed indicator, Altimeter, and Vertical Speed tapes. What is the best procedure to try to remedy this situation?
a) Press the red display backup button between the PFD and the MFD.
b) Cycle the Master Switch to reboot the Air Data Computer.
c) Refer to the backup instruments and fly the aircraft first.

53. When using the GMC707 autopilot for an instrument approach into an airport, what is the proper way to ensure the autopilot has been disengaged prior to landing?
a) Press the yoke disconnect button while crossing the runway threshold and look to make sure that the green RDY light is illuminated on the PFD.
b) Use the Before Landing Checklist and a Before Landing flow while descending towards the runway to make sure that the autopilot is disconnected while doing other before landing duties.
c) Turn off the autopilot using the autopilot power switch when the aircraft is on a 5-mile final.

Grading Criteria:

The pilot in training should get all answers correct in order to have accomplished an “Understand” level of FITS accomplishment. Incorrect answers will generate a prompt for you to retry the question and will point them back to the appropriate reference area in the chapter. Once the pilot in training as achieved all correct answers, they may proceed on to the next study unit as they understand the basic tenets of that study unit and can correlate the information with other aspects of their aeronautical knowledge and knowledge gained from other study units of this software training system.

Completion Certificate

This is to certify that

____

Has successfully completed all course requirements of this

Compliant Checkout Course

Entitled

The Complete Garmin G1000

Signed

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Aviation Consulting, LLC

Glossary

Aircraft Automation Management - The ability to control and navigate an aircraft by means of the automated systems installed in the aircraft.

Automation Competence - The demonstrated ability to understand and operate the automated systems installed in the aircraft.

Automation Cross-filling A process where data entered on one display unit is simultaneously updated on the other unit to avoid conflicting data that could lead to errors in the system.

Autopilot -An integrated mechanical, electrical, or hydraulic system developed to control a vehicle with little or no intervention from a human controller

Automated Navigation Leg - A flight of 30 minutes or more conducted between two separate airports in which the aircraft is controlled primarily by the autopilot and the on board navigation systems.

Automation Surprise - The characteristic of an automated system to provide different types and varieties of cues to pilots than the analog systems they replace, especially in time-critical situations.

Automation Bias - The relative willingness of the pilot to trust and utilize automated systems in the cockpit.

Crew Resource Management(CRM) A methodical process used in the cockpit piloted by coordinated actions of multiple crew members to ensure that all procedures are adhered to, vigilance is maintained, aeronautical decision making is optimized, and safety is enhanced.

Critical Idle Speed – The speed at which when the aircraft is idling with electrical equipment on, the alternator and the charging system provides a positive current charge as reflected by the Ammeter.

Critical Safety Tasks / Event - Those mission related tasks / events that, if not accomplished quickly and accurately, may result in injury or substantial aircraft damage.

Data-link Situational Awareness Systems - Systems that feed real-time information to the cockpit on weather, traffic, terrain and flight planning. This information may be displayed on the PFD, MFD or on other related cockpit displays.

Electrical Load Shedding –The process of reducing system electrical appliance demand to extend the finite capacity remaining of an electrical power source after a system failure or degradation.

Emergency Escape Maneuver - A maneuver (or series of maneuvers) performed manually or with the aid of the aircraft's automated systems that will allow the pilot to successfully escape from an inadvertent encounter with Instrument Meteorological Conditions (IMC) or other life-threatening situations.

FAA/Industry Training Standard (FITS) A training methodology and accompanying set of training standards which uses a student-centric, scenario-based approach to teach complex procedures to reduce the total number of general aviation accidents by integrating risk management, aeronautical decision making, situational awareness, and single pilot resource management into every flight operation.

- **Perceive** –at the completion of the software study unit, the pilot will be able to describe the scenario activity and understand some underlying concepts, principles, and procedures that comprise the topic, but may not yet understand how this fits in the grand scheme. *Progression to the next scenario should not be attempted until the pilot can function at the Understand level.*
- **Understand**– at the completion of the software study unit the pilot will be able to describe the classroom scenario topic in terms of definitions, basic usage, and applicability, and can start to demonstrate those topics in lab sessions or in a study unit exam. *Note: This is the minimum grading level that the pilot can be considered at in order to complete the study unit and move on to the next study unit.*
- **Correlate** – at the completion of the software study unit, the pilot is able to thoroughly understand the topic without referring back to the reference material in the study unit and can correlate this topic with other topics and can properly integrate those topics with *risk management, aeronautical decision making, situational awareness, and single pilot resource management into the pilot's flight operations. Note: This grading level would be considered above average for the pilot to complete the study unit and move on to the next area.*

Avidyne ENTEGRA Equipped Aircraft *An aircraft which has an integrated glass cockpit model Entegra manufactured by Avidyne Corporation of Lincoln, Massachusetts installed in place of the traditional aircraft instruments and radios.*

IFR Automated Navigation Leg A route segment flown on autopilot from 800 ft AGL (unless the limitations of the autopilot require a higher altitude, then from that altitude) on departure until reaching the decision altitude (coupled ILS approach) or missed approach point (autopilot aided non-precision approach) on the instrument approach. If a missed approach is flown it will be flown using the autopilot and on-board navigation systems.

Line Replaceable Unit (LRU) A modular aircraft equipment design started in the late 1960s which consolidates parts of a common system or components of a system into a common aircraft location such as an equipment box, tray, or circuit board, facilitating ease of aircraft or system maintenance and troubleshooting.

Mission Related Tasks - Those tasks required for the safe and effective accomplishment of the mission(s) that the aircraft is capable of and required to conduct**.**

Multifunction Flight Display MFD - Any display that combines navigation, aircraft systems, and situational awareness information onto a single electronic display.

Primary Flight Display (PFD) - Any display that combines the primary six flight instruments, plus other related navigation and situational awareness information, into a single electronic display.

Proficiency - The ability to accurately perform a task within a reasonable amount of time. The outcome of the task is never seriously in doubt.

Scan Flow The order used by the pilot or crew of an aircraft when monitoring the various components of the flight deck, the systems, the electronics and radios, while at the same time maintaining situational awareness outside of the aircraft.

Scenario Based Training (SBT) - A training system that uses a highly structured script of real-world experiences to address flight training objectives in an operational environment. Such training can include initial training, transition training, upgrade training, recurrent training, and special training. The appropriate term should appear with the term "Scenario Based," (ex. “Scenario Based Transition Training") to reflect the specific application.

Simulation - Any use of animation and/or actual representations of aircraft systems to simulate the flight environment. Pilot interaction with the simulation and task fidelity for the task to be performed are considered the requirements for effective simulation.

Single Pilot Resource Management (SRM) A methodical process used in the cockpit piloted by a single crew member to ensure that all procedures are adhered to, vigilance is maintained, aeronautical decision making is optimized, and safety is enhanced. This can also be considered the process of managing all the resources (both on-board the aircraft and from outside sources) available to a single-pilot (prior and during flight) to ensure the successful outcome of the flight is never in doubt.

TAA An aircraft which has an integrated GPS or like guidance system, an autopilot which can couple to that guidance system, and a Flight Management System (FMS) which provides for a way to enter information or retrieve information from a database and submit it to this integrated suite of aircraft systems.

VFR Automated Navigation Leg A route segment flown on autopilot from 800 ft AGL on the departure until entry to the 45-degree leg in the VFR pattern.

Garmin G1000 Equipped Aircraft *An aircraft which has an integrated glass cockpit model G1000 manufactured by Garmin Corporation of Olathe, Kansas installed in place of the traditional aircraft instruments and radios.*

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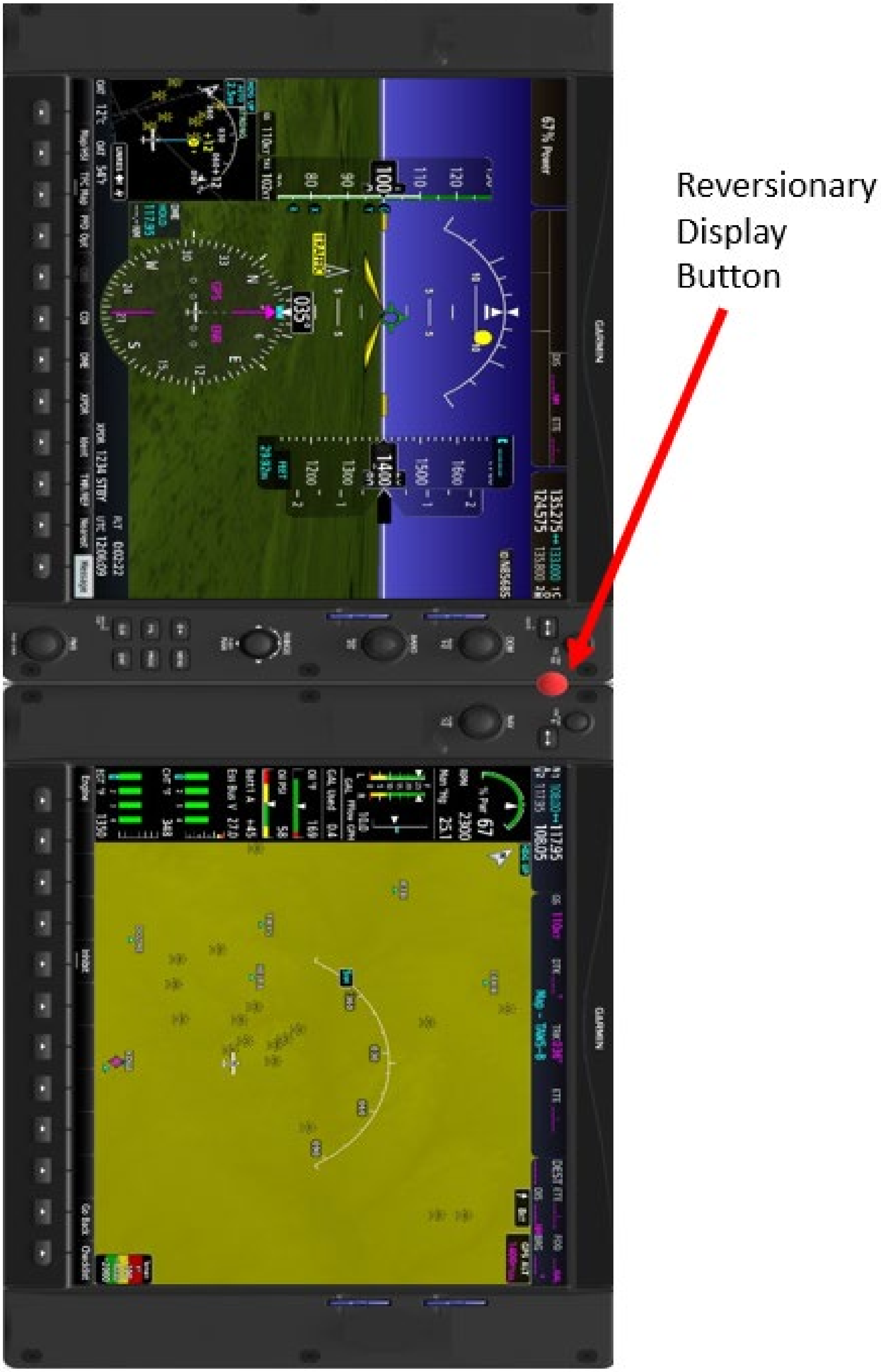
Cirrus SR20 Aircraft Study Guide

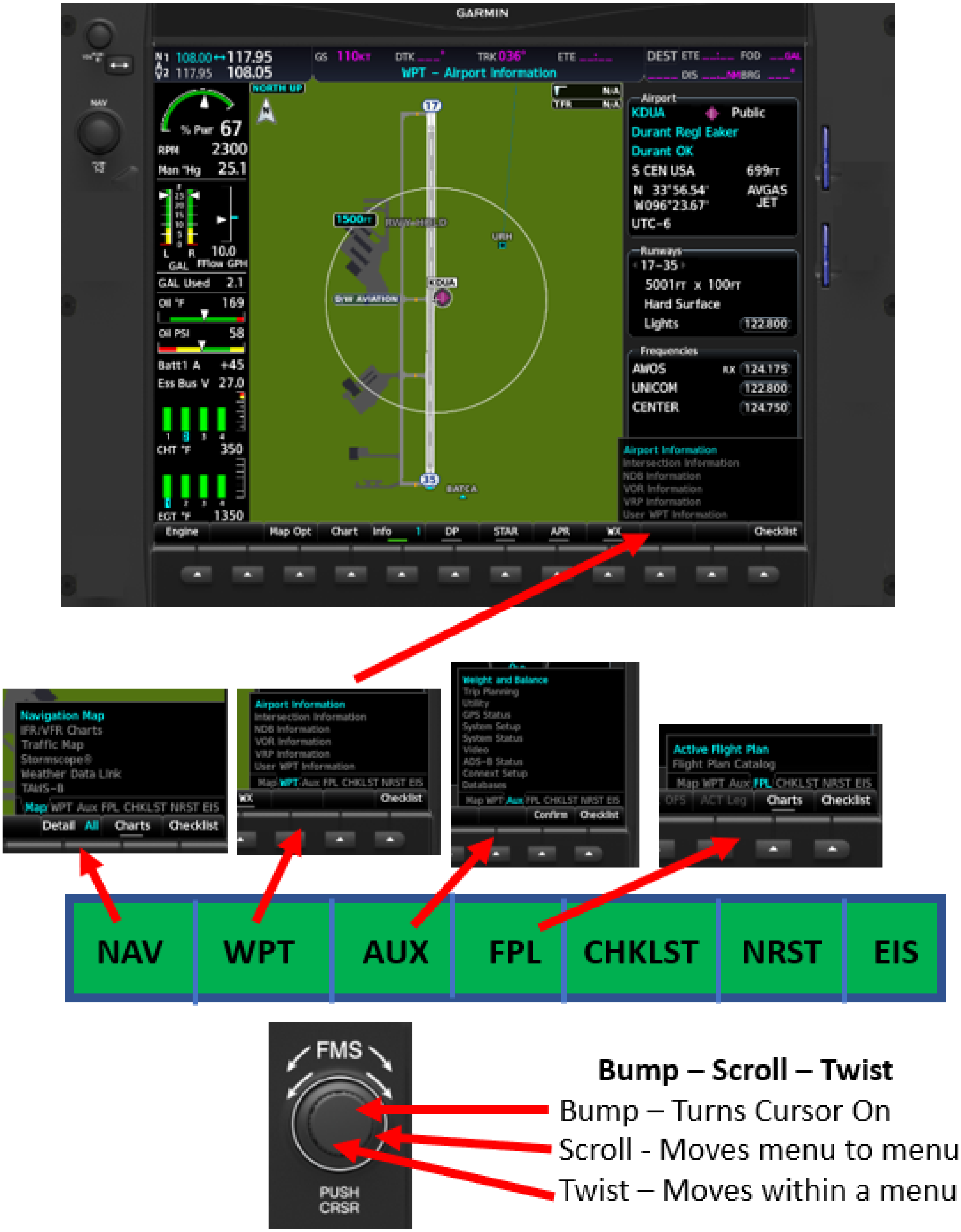
Garmin Perspective Plus – Cirrus SR20 TRAC

Garmin Perspective Plus
Cirrus SR20 TRAC

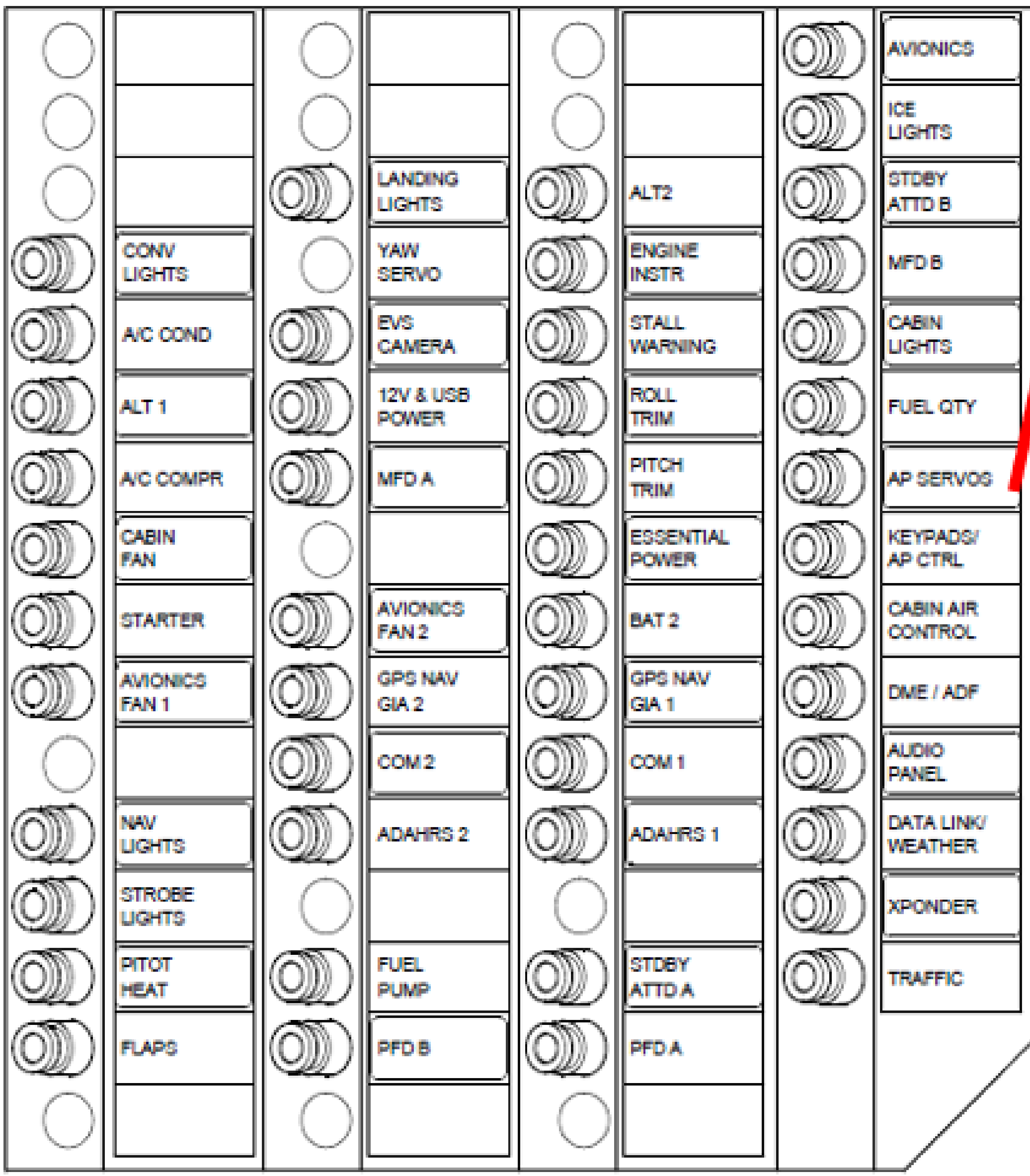
GDU Display Units



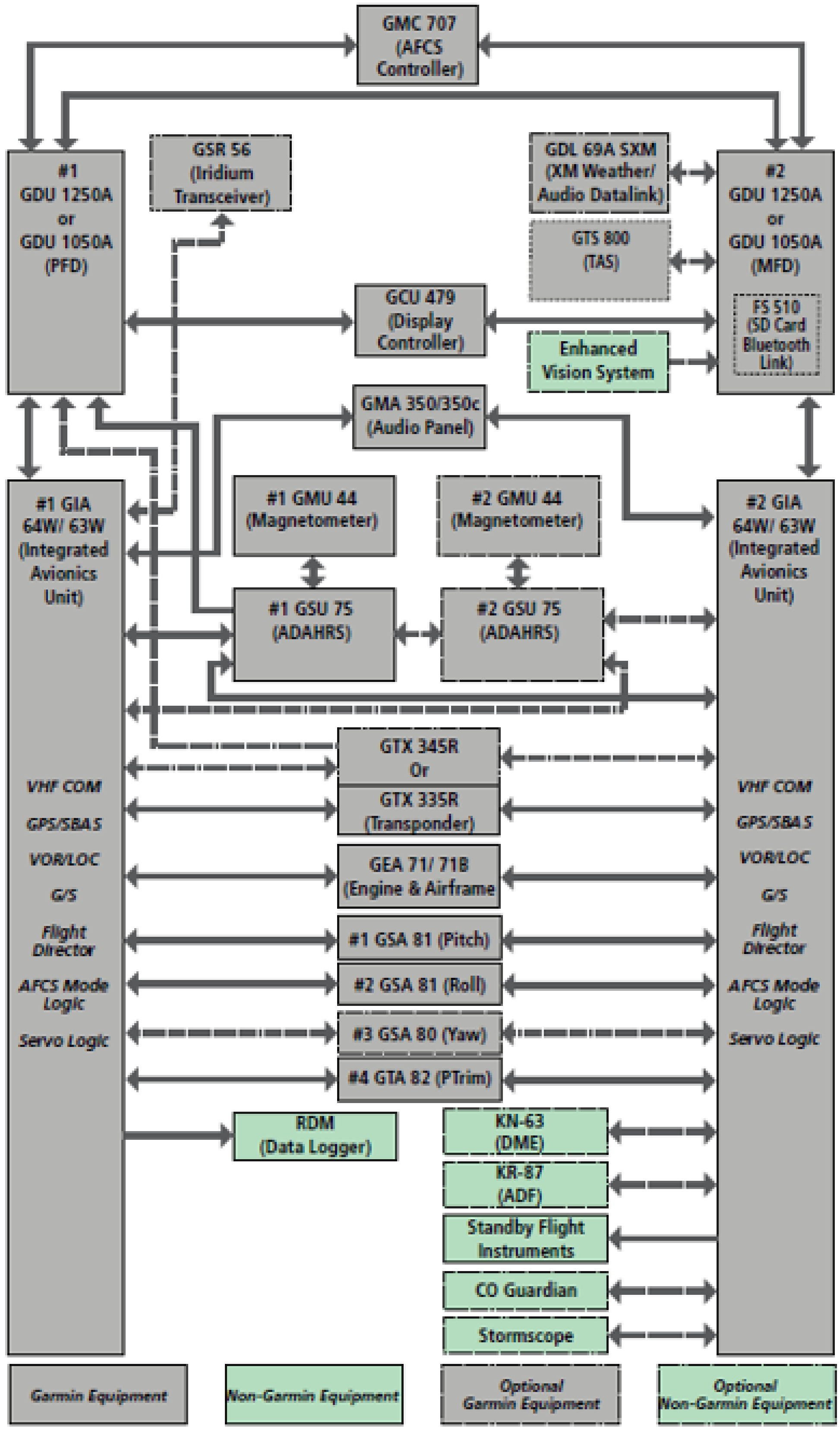
MFD Menu System



Other Cirrus Panels



LRUS


GMC 707
(AFCS
Controller)
#1
GDU 1250A
or
GDU 1050A
(PFD)
GSR 56
(Iridium
Transceiver)
GDL 69A SXM
(XM Weather/
Audio Datalink)
GTS 800
(TAS)
#2
GDU 1250A
or
GDU 1050A
(MFD)
FS 510
(SD Card
Bluetooth
Link)
GCU 479
(Display
Controller)
Enhanced
Vision System
GMA 350/350c
(Audio Panel)
#1 GIA
64W/ 63W
(Integrated
Avionics
Unit)
#1 GMU 44
(Magnetometer)
#2 GMU 44
(Magnetometer)
#2 GIA
64W/ 63W
(Integrated
Avionics
Unit)
#1 GSU 75
(ADAHRS)
#2 GSU 75
(ADAHRS)
GTX 345R
Or
GTX 335R
(Transponder)
GEA 71/ 71B
(Engine & Airframe
#1 GSA 81 (Pitch)
#2 GSA 81 (Roll)
#3 GSA 80 (Yaw)
#4 GTA 82 (PTrim)
VHF COM
GPS/SBAS
VOR/LOC
G/S
Flight
Director
AFCS Mode
Logic
Servo Logic
RDM
(Data Logger)
KN-63
(DME)
KR-87
(ADF)
Standby Flight
Instruments
CO Guardian
Stormscope
Garmin Equipment
Non-Garmin Equipment
Optional
Garmin Equipment
Optional
Non-Garmin Equipment

Quiz Answer Key

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Principal Consultant

Mike Gaffney is the Department Chair of Aviation at Southeastern Oklahoma State University in Durant, Oklahoma. He has become a leader in the area of Technically Advanced Aircraft (TAA) and is a nationally recognized speaker, author, and lecturer in the area of glass cockpit integration and Scenario Based Instruction techniques for general aviation aircraft. The Federal Aviation Administration has awarded in him with five FAA/Industry Training Standard (FITS) course approvals making him the first FAA certified CFR Part 141 Flight School in the US to receive such a designation. Mr. Gaffney, the 2007 National Flight Instructor of the Year, a FAAST Team Lead Rep, ATP rated Pilot, A&P Mechanic, Certified Flight Instructor, a Master Instructor and Master Ground Instructor with nearly 4,500 flight hours in a wide variety of aircraft. His articles on Technically Advanced Aircraft have appeared in many publications including FAA News and AOPA Flight Training and he is the author of "Complete Avidyne Entegra Software".

He is a published author frequently contributing to FAA News, Diamond Quarterly magazine, Avemco On-Approach, and American Cessna Club Newsletter and has been quoted a number of times in Flight Training magazine and Avionics News. He was selected as the FAA National Flight Instructor of the Year for 2007. He can be reached at Flightlogics@gmail.com

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