

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT
or
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL

for the
Garmin GTN 625, 635, 650, 725, or 750 GPS/SBAS Navigation System
as installed in

Cessna 414A

Make and Model Airplane

Registration Number: N78DG Serial Number: 414A-0641

This document serves as an Airplane Flight Manual Supplement or as a Supplemental Airplane Flight Manual when the aircraft is equipped in accordance with Supplemental Type Certificate SA02019SE-D for the installation and operation of the Garmin GTN 625, 635, 650, 725, or 750 GPS/SBAS Navigation System. This document must be carried in the airplane at all times.

The information contained herein supplements or supersedes the information made available to the operator by the aircraft manufacturer in the form of clearly stated placards or markings, or in the form of an FAA approved Airplane Flight Manual, only in those areas listed herein. For limitations, procedures and performance information not contained in this document, consult the basic placards or markings, or the basic FAA approved Airplane Flight Manual.

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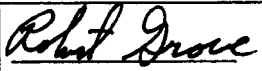
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Section 1. GENERAL

1.1 Garmin GTN Navigators

The Garmin GTN navigation system is a GPS system with a Satellite Based Augmentation System (SBAS), comprised of one or more Garmin TSO-C146c GTN 625, 635, 650, 725, or 750 navigator(s) and one or more Garmin approved GPS/SBAS antenna(s).

GTN navigation system functions are shown in Table 1.

	GTN 625	GTN 635	GTN 650	GTN 725	GTN 750
GPS SBAS Navigation: <ul style="list-style-type: none"> Oceanic, enroute, terminal, and non-precision approach guidance Precision approach guidance (LP, LPV) 	X	X	X	X	X
VHF Com Radio, 118.00 to 136.990, MHz, 8.33 or 25 kHz increments		X	X		X
VHF Nav Radio, 108.00 to 117.95 MHz, 50 kHz increments			X		X
LOC and Glideslope non-precision and precision approach guidance for Cat 1 minimums, 328.6 to 335.4 MHz tuning range			X		X
Moving map including topographic, terrain, aviation, and geopolitical data	X	X	X	X	X
Display of datalink weather products (optional)	X	X	X	X	X
Display of terminal procedures data (optional)				X	X
Display of traffic data (optional)	X	X	X	X	X
Display of StormScope® data (optional)	X	X	X	X	X
Display of marker beacon annunciators				X	X
Remote audio panel control				X	X
Remote transponder control	X	X	X	X	X
Remote audio entertainment datalink control	X	X	X	X	X
TSO-C151b Class B TAWS	X	X	X	X	X
Supplemental calculators and timers	X	X	X	X	X

Table 1 – GTN Functions

The GPS navigation functions and optional VHF communication and navigation radio functions are operated by dedicated hard keys, a dual concentric rotary knob, or the touchscreen.

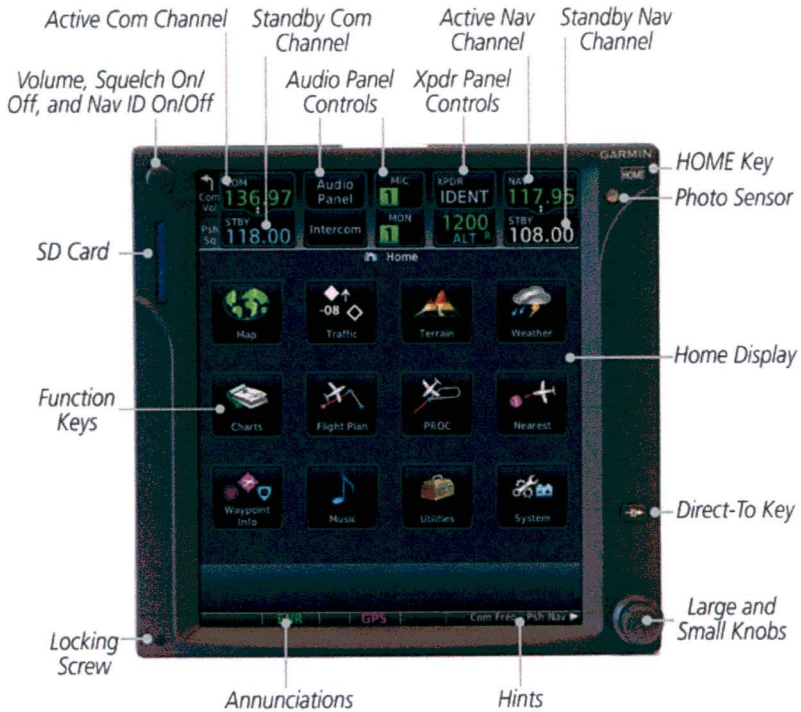


Figure 1 - GTN 750 Control and Display Layout

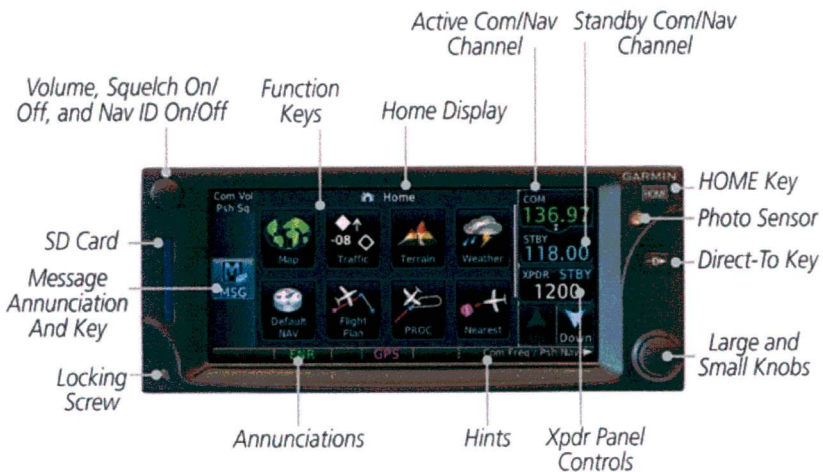


Figure 2 - GTN 635/650 Control and Display Layout

1.2 Capabilities

GPS/SBAS TSO-C146c Class 3 Operation:

The GTN, when installed in accordance with STC SA02019SE-D, has airworthiness approval for navigation using GPS and SBAS (within the coverage of a Satellite Based Augmentation System complying with ICAO Annex 10) for IFR en route, terminal area, and non-precision approach operations (including those approaches titled “GPS”, “or GPS”, and “RNAV (GPS)” approaches). The Garmin GNSS navigation system is composed of the GTN navigator and antenna, and is approved for approach procedures with vertical guidance including “LPV” and “LNAV/VNAV”, within the U.S. National Airspace System.

The Garmin GNSS navigation system as installed in this aircraft, complies with the equipment requirements of AC 90-105 and meets the equipment performance and functional requirements to conduct RNP terminal departure and arrival procedures and RNP approach procedures without RF (radius to fix) legs. Part 91 subpart K, 121, 125, 129, and 135 operators require operational approval from the FAA.

The Garmin GNSS navigation system as installed in this aircraft complies with the equipment requirements of AC 90-100A for RNAV 2 and RNAV 1 operations. In accordance with AC 90-100A, Part 91 operators (except subpart K) following the aircraft and training guidance in AC 90-100A are authorized to fly RNAV 2 and RNAV 1 procedures. Part 91 subpart K, 121, 125, 129, and 135 operators require operational approval from the FAA.

Applicable to dual installations consisting of two GTNs: The Garmin GNSS navigation system, as installed in this aircraft, has been found to comply with the requirements for GPS Class II oceanic and remote navigation (RNP-10) without time limitations in accordance with AC 20-138A and FAA Order 8400.12A. The Garmin GNSS navigation system can be used without reliance on other long-range navigation systems. This does not constitute an operational approval.

Applicable to dual installations consisting of two GTNs: The Garmin GNSS navigation system, as installed in this aircraft, has been found to comply with the navigation requirements for GPS Class II oceanic and remote navigation (RNP-4) in accordance with AC 20-138A and FAA Order 8400.33. The Garmin GNSS navigation system can be used without reliance on other long-range navigation systems. Additional equipment may be required to obtain operational approval to utilize RNP-4 performance. This does not constitute an operational approval.

The Garmin GNSS navigation system, as installed in this aircraft, complies with the accuracy, integrity, and continuity of function, and contains the minimum system functions required for P-RNAV operations in accordance with JAA Administrative & Guidance Material Section One: General Part 3: Temporary Guidance Leaflets, Leaflet No 10 (JAA TGL-10 Rev 1). The GNSS navigation system has [one or more] TSO-C146c Class 3 approved Garmin GTN Navigation Systems. The Garmin GNSS navigation system as installed in this aircraft complies with the equipment requirements for P-RNAV and B-RNAV/RNAV 5 operations in accordance with AC 90-96A CHG 1 and JAA TGL-10 Rev 1. This does not constitute an operational approval.

Garmin International holds an FAA Type 2 Letter of Acceptance (LOA) in accordance with AC 20-153 for database integrity, quality, and database management practices for the Navigation database. Flight crew and operators can view the LOA status at FlyGarmin.com then select "Type 2 LOA Status." Navigation information is referenced to WGS-84 reference system.

Note that for some types of aircraft operation and for operation in non-U.S. airspace, separate operational approval(s) may be required in addition to equipment installation and airworthiness approval.

1.3 Electronic Flight Bag

The GTN as installed in this aircraft supports approval of AC 120-76A Hardware Class 3, Software Type C Electronic Flight Bag (EFB) electronic aeronautical chart applications when using current FliteChart or ChartView data. Additional operational approvals may be required. For operations under 14 CFR Part 91, Garmin suggests that a secondary or back up source of aeronautical information necessary for the flight be available to the pilot in the airplane. The secondary or backup information may be either traditional paper-based material or displayed electronically. If the source of aeronautical information is in electronic format, operators must determine non-interference with the GTN system and existing aircraft systems for all flight phases.

1.4 Definitions

The following terminology is used within this document:

ADF:	Automatic Direction Finder
APR:	Approach
CDI:	Course Deviation Indicator
DME:	Distance Measuring Equipment
EFB:	Electronic Flight Bag
EHSI:	Electronic Horizontal Situation Indicator
GNSS:	Global Navigation Satellite System
GPS:	Global Positioning System
GPSS:	GPS Roll Steering
GTN:	Garmin Touchscreen Navigator
HSI:	Horizontal Situation Indicator
IAP:	Instrument Approach Procedure
IFR:	Instrument Flight Rules
ILS:	Instrument Landing System
IMC:	Instrument Meteorological Conditions
LDA:	Localizer Directional Aid
LNAV:	Lateral Navigation
LNAV+V:	Lateral Navigation with advisory Vertical Guidance
L/VNAV:	Lateral/Vertical Navigation
LOC:	Localizer
LOC-BC:	Localizer Backcourse
LP:	Localizer Performance
LPV:	Localizer Performance with Vertical Guidance
MLS:	Microwave Landing System
OBS:	Omnibearing Select
RAIM:	Receiver Autonomous Integrity Monitoring
RMT:	Remote
RNAV:	Area Navigation
RNP:	Required Navigational Performance
SBAS:	Satellite Based Augmentation System
SD:	Secure Digital

SDF:	Simplified Directional Facility
SUSP:	Suspend
TACAN:	Tactical Air Navigation System
TAS:	Traffic Awareness System
TAWS:	Terrain Awareness and Warning System
TCAS:	Traffic Collision Avoidance System
TIS:	Traffic Information Service
VHF:	Very High Frequency
VFR:	Visual Flight Rules
VLOC:	VOR/Localizer
VMC:	Visual Meteorological Conditions
VOR:	VHF Omnidirectional Range
WAAS:	Wide Area Augmentation System
WFDE:	WAAS Fault Data Exclusion
XFR:	Transfer

Section 2. LIMITATIONS

2.1 Cockpit Reference Guide

The Garmin GTN 6XX or GTN 7XX Cockpit Reference Guide, part number and revision listed below (or later revisions), *must* be immediately available to the flight crew whenever navigation is predicated on the use of the GTN.

- GTN 6XX Cockpit Reference Guide P/N 190-01004-04 Rev A
- GTN 7XX Cockpit Reference Guide P/N 190-01007-04 Rev A

2.2 Kinds of Operation

This AFM supplement does not grant approval for IFR operations to aircraft limited to VFR operations.

IFR approved aircraft may have a GTN installed that is limited to VFR operations only. GTN installations limited to VFR are placarded in close proximity to the GTN: “GPS LIMITED TO VFR USE ONLY”. Systems with this placard are not approved for GPS navigation during IFR operations.

2.3 Minimum Equipment

If the installation of the GTN is not limited to VFR, the GTN must have the following system interfaces fully functional in order to be used for IFR operations:

Interfaced Equipment	Number installed	Number Required for IFR
External HSI/CDI/EHSI	1 or more	1
External GPS Annunciator	See Note 1	1

Table 1 – Required Equipment

Note 1: Certain installations require an external GPS annunciator panel. If installed, this annunciator must be fully functional to use the GTN for IFR operations.

Single engine piston aircraft under 6,000 lbs maximum takeoff weight:

Required Equipment for IFR operations: Single GTN Navigator

Single engine turbine aircraft or multi-engine piston aircraft under 6,000 lbs maximum takeoff weight:

Required Equipment for IFR operations: Single GTN Navigator plus a second source of GPS navigation or a separate source of VHF navigation.

Operation in remote or oceanic operation requires two sources of GPS navigation.

Aircraft over 6,000 lbs maximum takeoff weight:

Required Equipment for IFR operations: Single GTN Navigator plus a second source of GPS navigation or a separate source of VHF navigation.

Operation in remote or oceanic operation requires two sources of GPS navigation.

2.4 Flight Planning

For flight planning purposes, in areas where SBAS coverage is not available, the pilot must check RAIM availability. Within the United States, RAIM availability can be determined using the Garmin WFDE Prediction program, Garmin part number 006-A0154-04 (included in GTN trainer) software version 3.00 or later approved version with Garmin approved antennas or the FAA's en route and terminal RAIM prediction website: www.raimprediction.net, or by contacting a Flight Service Station. Within Europe, RAIM availability can be determined using the Garmin WFDE Prediction program or Europe's AUGER GPS RAIM Prediction Tool at <http://augur.ecacnav.com/augur/app/home>. For other areas, use the Garmin WFDE Prediction program. This requirement is not necessary if SBAS coverage is confirmed to be available along the entire route of flight. The route planning and WFDE prediction program may be downloaded from the Garmin website on the internet. For information on using the WFDE Prediction Program, refer to Garmin WAAS FDE Prediction Program, part number 190-00643-01, 'WFDE Prediction Program Instructions'.

For flight planning purposes, operations within the U.S. National Airspace System on RNP and RNAV procedures when SBAS signals are not available, the availability of GPS RAIM shall be confirmed for the intended route of flight. In the event of a predicted continuous loss of RAIM of more than five minutes for any part of the intended route of flight, the flight should be delayed, canceled, or rerouted on a track where RAIM requirements can be met. The flight may also be re-planned using non-GPS based navigational capabilities.

For flight planning purposes for operations within European B-RNAV/RNAV 5 and P-RNAV airspace, if more than one satellite is scheduled to be out of service, then the availability of GPS RAIM shall be confirmed for the intended flight (route and time). In the event of a predicted continuous loss of RAIM of more than five minutes for any part of the intended flight, the flight should be delayed, canceled, or rerouted on a track where RAIM requirements can be met.

Applicable to installations consisting of two GTNs: For flight planning purposes, operations where the route requires Class II navigation the aircraft's operator or pilot-in-command must use the Garmin WFDE Prediction program to demonstrate that there are no outages on the specified route that would prevent the Garmin GNSS navigation system to provide GPS Class II navigation in oceanic and remote areas of operation that requires (RNP-10 or RNP-4) capability. If the Garmin WFDE Prediction program indicates fault exclusion (FDE) availability will exceed 34 minutes in accordance with FAA Order 8400.12A for RNP-10 requirements, or 25 minutes in accordance with FAA Order 8400.33 for RNP-4 requirements, then the operation must be rescheduled when FDE is available.

Both Garmin GPS navigation receivers must be operating and providing GPS navigation guidance for operations requiring RNP-4 performance.

Applicable to installations consisting of two GTNs: North Atlantic (NAT) Minimum Navigational Performance Specifications (MNPS) Airspace operations per AC 91-49 and AC 120-33 require both GPS/SBAS receivers to be operating and receiving usable signals except for routes requiring only one Long Range Navigation sensor. Each display computes an independent navigation solution based on its GPS sensor.

Whenever possible, RNP and RNAV routes including Standard Instrument Departures (SIDs) and Obstacle Departure Procedures (ODPs), Standard Terminal Arrival (STAR), and enroute RNAV “Q” and RNAV “T” routes should be loaded into the flight plan from the database in their entirety, rather than loading route waypoints from the database into the flight plan individually. Selecting and inserting individual named fixes from the database is permitted, provided all fixes along the published route to be flown are inserted. Manual entry of waypoints using latitude/longitude or place/bearing is prohibited.

It is not acceptable to flight plan a required alternate airport based on RNAV(GPS) LP/LPV or LNAV/VNAV approach minimums. The required alternate airport must be flight planned using an LNAV approach minimums or available ground-based approach aid.

Navigation information is referenced to the WGS-84 reference system, and should only be used where the Aeronautical Information Publication (including electronic data and aeronautical charts) conform to WGS-84 or equivalent.

2.5 System Use

In installations with two GTNs and an external GPS annunciator (See Table 1) the GTN connected to the external GPS annunciator must be used as the navigation source for all operations.

The only approved sources of course guidance are on the external CDI, HSI, or EHSI display. The moving map and CDI depiction on the GTN display are for situational awareness only and are not approved for course guidance.

2.6 Applicable System Software

This AFMS/AFM is applicable to the software versions shown in Table 2.

The Main and GPS software versions are displayed on the start-up page immediately after power-on. All software versions displayed in Table 2 can be viewed on the System – System Status page.

Software Item	Software Version <i>(or later FAA Approved versions for this STC)</i>
Main SW Version	2.00
GPS SW Version	4.0
Com SW Version	2.00
Nav SW Version	6.01

Table 2 - Software Versions

2.7 SD Card

Proper function of the unit is predicated on the SD card being present. Garmin cannot assure functionality if the SD card is inserted or removed while the unit is powered on.

2.8 Navigation Database

GPS/SBAS based IFR enroute, oceanic, and terminal navigation is prohibited unless the pilot verifies and uses a valid, compatible, and current Navigation database or verifies each waypoint for accuracy by reference to current approved data.

“GPS”, “or GPS”, and “RNAV (GPS)” instrument approaches using the Garmin navigation system are prohibited unless the pilot verifies and uses the current Navigation database. GPS based instrument approaches must be flown in accordance with an approved instrument approach procedure that is loaded from the Navigation database.

Discrepancies that invalidate a procedure should be reported to Garmin International. The affected procedure is prohibited from being flown using data from the Navigation database until a new Navigation database is installed in the aircraft and verified that the discrepancy has been corrected. Navigation database discrepancies can be reported at FlyGarmin.com by selecting “Aviation Data Error Report.” Flight crew and operators can view Navigation database alerts at FlyGarmin.com then select “NavData Alerts.”

If the Navigation database cycle will change during flight, the pilot must ensure the accuracy of navigation data, including suitability of navigation facilities used

to define the routes and procedures for flight. If an amended chart affecting navigation data is published for the procedure, the database must not be used to conduct the procedure.

2.9 Ground Operations

Do not use SafeTaxi or Chartview functions as the basis for ground maneuvering. SafeTaxi and Chartview functions do not comply with the requirements of AC 20-159 and are not qualified to be used as an airport moving map display (AMMD). SafeTaxi and Chartview are to be used by the flight crew to orient themselves on the airport surface to improve pilot situational awareness during ground operations.

2.10 Approaches

- a) Instrument approaches using GPS guidance may only be conducted when the GTN is operating in the approach mode. (LNAV, LNAV+V, L/VNAV, LPV, or LP)
- b) When conducting instrument approaches referenced to true North, the NAV Angle on the System -Units page must be set to **True**.
- c) The navigation equipment required to join and fly an instrument approach procedure is indicated by the title of the procedure and notes on the IAP chart. Navigating the final approach segment (that segment from the final approach fix to the missed approach point) of an ILS, LOC, LOC-BC, LDA, SDF, MLS, VOR, TACAN approach, or any other type of approach not approved for GPS, is not authorized with GPS navigation guidance. GPS guidance can only be used for approach procedures with GPS or RNAV in the procedure title. When using the Garmin VOR/LOC/GS receivers to fly the final approach segment, VOR/LOC/GS navigation data must be selected and presented on the CDI of the pilot flying.
- d) Advisory vertical guidance deviation is provided when the GTN annunciates LNAV + V. Vertical guidance information displayed on the VDI in this mode is only an aid to help pilots comply with altitude restrictions. When using advisory vertical guidance, the pilot must use the primary barometric altimeter to ensure compliance with all altitude restrictions.
- e) Not all published Instrument Approach Procedures (IAP) are in the Navigation database. Pilots planning to fly an RNAV instrument approach must ensure that the Navigation database contains the planned RNAV Instrument Approach Procedure and that approach procedure must be loaded from the Navigation database into the GTN system flight plan by its name. Users are prohibited from flying any approach path that contains manually entered waypoints.

- f) IFR approaches are prohibited whenever any physical or visual obstruction (such as a throw-over yoke) restricts pilot view or access to the GTN and/or the CDI.

2.11 Autopilot Coupling

IFR installations of a GTN allow the pilot to fly all phases of flight based on the navigation information presented to the pilot; however, not all modes may be coupled to the autopilot. All autopilots may be coupled in Oceanic (OCN), Enroute (ENR), and Terminal (TERM) modes.

This installation is limited to:

- Lateral coupling only for GPS approaches. Coupling to the vertical path for GPS approaches is not authorized.

2.12 Terrain Proximity Function (All Units)

Terrain and obstacle information appears on the map and terrain display pages as red and yellow tiles or towers, and is depicted for advisory use only. Aircraft maneuvers and navigation must not be predicated upon the use of the terrain display. Terrain and obstacle information is advisory only and is not equivalent to warnings provided by TAWS.

The terrain display is intended to serve as a situational awareness tool only. By itself, it may not provide either the accuracy or the fidelity on which to base decisions and plan maneuvers to avoid terrain or obstacles.

NOTE

Terrain and TAWS are separate features and mutually exclusive. If “TAWS B” is shown on the bottom right of the dedicated terrain page, then TAWS is installed.

2.13 TAWS Function (Optional)

Pilots are authorized to deviate from their current ATC clearance to the extent necessary to comply with TAWS warnings. Navigation must not be predicated upon the use of TAWS.

If an external TAWS annunciator panel is installed in the aircraft, this annunciator panel must be fully functional in order to use the TAWS system.

NOTE

Terrain and TAWS are separate features and mutually exclusive. If “TAWS B” is shown on the bottom right of the dedicated terrain page, then TAWS is installed.

2.14 Datalinked Weather Display (XM Weather, Optional)

Datalink weather data is provided by an optional GDL 69 or 69A interface. The weather information display on the GTN is a supplementary weather product for enhanced situational awareness only and may not be used in lieu of an official weather data source. Use of the datalink weather display for hazardous weather (e.g. thunderstorm) penetration is prohibited.

2.15 Traffic Display (Optional)

Traffic may be displayed on the GTN when connected to an approved optional TCAS I, TAS, or TIS traffic device. These systems are capable of providing traffic monitoring and alerting to the pilot. Traffic shown on the display may or may not have traffic alerting available. The display of traffic is an aid to visual acquisition and may not be utilized solely for aircraft maneuvering.

2.16 StormScope[®] Display (Optional)

StormScope[®] lightning information displayed by the GTN is limited to supplemental use only. The use of the StormScope[®] lightning data on the display for hazardous weather (thunderstorm) penetration is prohibited. StormScope[®] lightning data on the display is intended only as an aid to enhance situational awareness of hazardous weather, not penetration. It is the pilot's responsibility to avoid hazardous weather using official weather data sources.

When the GTN StormScope[®] page is operating in track up mode as indicated by the "TRK UP" label at the upper right corner of the StormScope[®] page, use of the GTN to display StormScope[®] information is prohibited while on the ground.

2.17 Flight Planner/Calculator Functions

When using the calculator/planner pages data must be entered into all data fields and verified by the pilot prior to use of the data. Depending on system configuration, the "Use Sensor Data" button may populate the Indicated ALT window with indicated altitude or pressure altitude. The pilot must verify the desired altitude and appropriate barometric pressure setting to ensure valid calculations. Aircraft performance or fuel loading must not be predicated upon the use of data derived from these functions.

2.18 Glove Use / Covered Fingers

No device may be used to cover fingers used to operate the GTN unless the Glove Qualification Procedure located in the Pilot's Guide has been successfully completed. The Glove Qualification Procedure is specific to a pilot / glove / GTN 725, 750 or GTN 625, 635, 650 combination.

2.19 Demo Mode

Demo mode may not be used in flight under any circumstances.

Section 3. EMERGENCY PROCEDURES

3.1 Emergency Procedures

3.1.1 TAWS WARNING

Red annunciator and aural “PULL UP”:

Autopilot **DISCONNECT**
Aircraft Controls **INITIATE MAXIMUM POWER CLIMB**
Airspeed **BEST ANGLE OF CLIMB SPEED**

After Warning Ceases:

Power **MAXIMUM CONTINUOUS**
Altitude **CLIMB AND MAINTAIN SAFE ALTITUDE**
Advise ATC of Altitude Deviation, if appropriate.

NOTE

Only vertical maneuvers are recommended, unless either operating in visual meteorological conditions (VMC), or the pilot determines, based on all available information, that turning in addition to the escape maneuver is the safest course of action, or both.

3.2 Abnormal Procedures

3.2.1 LOSS OF GPS/SBAS NAVIGATION DATA

When the GPS/SBAS receiver is inoperative or GPS navigation information is not available or invalid, the GTN will enter one of two modes: Dead Reckoning mode (DR) or Loss Of Integrity mode (LOI). The mode is indicated on the GTN by an amber “DR” or “LOI”.

If the Loss Of Integrity annunciation is displayed, revert to an alternate means of navigation appropriate to the route and phase of flight.

If the Dead Reckoning annunciation is displayed, the map will continue to be displayed with an amber ‘DR’ overwriting the ownship icon. Course guidance will be removed on the CDI. Aircraft position will be based upon the last valid GPS position, then estimated by Dead Reckoning methods. Changes in true airspeed, altitude, heading, or winds aloft can affect the estimated position substantially. Dead Reckoning is only available in Enroute and Oceanic modes. Terminal and Approach modes do not support Dead Reckoning.

If Alternate Navigation Sources (ILS, LOC, VOR, DME, ADF) Are Available:

Navigation..... **USE ALTERNATE SOURCES**

If No Alternate Navigation Sources Are Available:

DEAD RECKONING (DR) MODE:

Navigation..... **USE GTN**

NOTE

- All information normally derived from GPS will become less accurate over time.

LOSS OF INTEGRITY (LOI) MODE:

Navigation..... **FLY TOWARDS KNOWN VISUAL CONDITIONS**

NOTE

- All information derived from GPS will be removed.
- The airplane symbol is removed from all maps. The map will remain centered at the last known position. “NO GPS POSITION” will be annunciated in the center of the map.

3.2.2 GPS APPROACH DOWNGRADE

During a GPS LPV, LNAV/VNAV, or LNAV+V approach, if GPS accuracy requirements cannot be met by the GPS receiver, the GTN will downgrade the approach. The downgrade will remove vertical deviation indication from the VDI and change the approach annunciation accordingly from LPV, L/VNAV, or LNAV+V to LNAV. The approach may be continued using the LNAV only minimums.

During a GPS approach in which GPS accuracy requirements cannot be met by the GPS receiver for any GPS approach type, the GTN will flag all CDI guidance and display a system message “ABORT APPROACH-GPS approach no longer available”. Immediately upon viewing the message, the unit will revert to Terminal navigation mode alarm limits. If the position integrity is within these limits lateral guidance will be restored and the GPS may be used to execute the missed approach, otherwise alternate means of navigation must be utilized.

3.2.3 LOSS OF COM RADIO TUNING FUNCTIONS

If alternate COM is available:

Communications **USE ALTERNATE COM**

If no alternate COM is available:

COM RMT XFR key (if installed)..... **PRESS AND HOLD FOR 2 SECONDS**

NOTE

This procedure will tune the active COM radio the emergency frequency 121.5, regardless of what frequency is displayed on the GTN. Certain failures of the tuning system will automatically tune 121.5 without pilot action.

3.2.4 LOSS OF AUDIO PANEL FUNCTIONS (GMA 35 Only)

Audio Panel Circuit Breaker **PULL**

NOTE

This procedure will force the audio panel to provide the pilot only with communications on the Non-GTN 750 radio. If only a GTN 750 is installed in the aircraft, then the pilot will have communications on the GTN 750. The crew and passenger intercom will not function.

3.2.5 TAWS CAUTION (Terrain or Obstacle Ahead, Sink Rate, Don't Sink)

When a TAWS CAUTION occurs, take corrective action until the alert ceases. Stop descending or initiate either a climb or a turn, or both as necessary, based on analysis of all available instruments and information.

3.2.6 TAWS INHIBIT

The TAWS Forward Looking Terrain Avoidance (FLTA) and Premature Descent Alerts (PDA) functions may be inhibited to prevent alerting, if desired. Refer to GTN Cockpit Reference Guide for additional information.

To Inhibit TAWS:

Home HardkeyPRESS
Terrain Button.....PRESS
Menu ButtonPRESS
TAWS Inhibit Button PRESS TO ACTIVATE

3.2.7 TER N/A and TER FAIL

If the amber **TER N/A** or **TER FAIL** status annunciator is displayed, the system will no longer provide TAWS alerting or display relative terrain and obstacle elevations. The crew must maintain compliance with procedures that ensure minimum terrain and obstacle separation.

3.2.8 HEADING DATA SOURCE FAILURE

Without a heading source to the GTN, the following features will not operate:

- GPSS will not be provided to the autopilot for heading legs. The autopilot must be placed in HDG mode for heading legs.
- Map cannot be oriented to Heading Up.
- All overlaying traffic data from a TAS/TCAS I system on the main map display. The pilot must use the dedicated traffic page on the GTN system to display TAS/TCAS I data.
- All overlaying StormScope® data on the main map display. The pilot must use the dedicated StormScope® page on the GTN system to display StormScope® data.

StormScope® must be operated in accordance with Section 7.8 when no heading is available.

3.2.9 PRESSURE ALTITUDE DATA SOURCE FAILURE

Without a pressure altitude source to the GTN, the following features will not operate:

- Automatic leg sequencing of legs requiring an altitude source. The pilot must manually sequence altitude legs, as prompted by the system.

Section 4. NORMAL PROCEDURES

Refer to the Cockpit Reference Guide defined in Section 2.1 of this document or the Pilot's Guide defined in Section 7.1 for normal operating procedures and a complete list of system messages and associated pilot actions. This includes all GPS operations, VHF communication and navigation, traffic, data linked weather, StormScope[®], TAWS, and Multi-Function Display information.

The GTN requires a reasonable degree of familiarity to prevent operations without becoming too engrossed at the expense of basic instrument flying in IMC and basic see-and-avoid in VMC. Garmin provides training tools with the Pilot's Guide and PC based simulator. Pilots should take full advantage of these training tools to enhance system familiarization.

4.1 Unit Power On

Database **REVIEW EFFECTIVE DATES**

Self Test **VERIFY OUTPUTS TO NAV INDICATORS**

Self Test - TAWS Remote Annunciator:

PULL UP **ILLUMINATED**

TERR **ILLUMINATED**

TERR N/A **ILLUMINATED**

TERR INHB **ILLUMINATED**

Self Test - GPS Remote Annunciator:

VLOC **ILLUMINATED**

GPS **ILLUMINATED**

LOI or INTG..... **ILLUMINATED**

TERM **ILLUMINATED**

WPT..... **ILLUMINATED**

APR **ILLUMINATED**

MSG..... **ILLUMINATED**

SUSP or OBS..... **ILLUMINATED**

4.2 Before Takeoff

System Messages and Annunciators **CONSIDERED**

4.3 HSI and EHSI Operation

If an HSI is used to display navigation data from the GTN the pilot should rotate the course pointer as prompted on the GTN.

If an EHSI is used to display navigation data from the GTN the course pointer may autoslew to the correct course when using GPS navigation. When using

VLOC navigation the course pointer will not autoslew and must be rotated to the correct course by the pilot. For detailed information about the functionality of the EHSI system, refer to the FAA approved Flight Manual or Flight Manual Supplement for that system.

CAUTION

The pilot must verify proper course selection each time the CDI source is changed from GPS to VLOC.

4.4 Autopilot Operation

The GTN may be coupled to an optional autopilot, if installed in the aircraft, when operating as prescribed in the LIMITATIONS section of this manual.

Autopilots coupled to the GTN system in an analog (NAV) mode will follow GPS or VHF navigation guidance as they would with existing VOR receivers.

Autopilots that support GPSS or GPS Roll Steering in addition to the analog course guidance will lead course changes, fly arcing procedures, procedure turns, and holding patterns if coupled in GPSS mode.

For autopilot operating instructions, refer to the FAA approved Flight Manual or Flight Manual Supplement for the autopilot.

4.5 Coupling the Autopilot during approaches

CAUTION

When the CDI source is changed on the GTN, autopilot mode may change. Confirm autopilot mode selection after CDI source change on the GTN. Refer to the FAA approved Flight Manual or Flight Manual Supplement for the autopilot.

- This installation prompts the pilot and requires the pilot to enable the approach outputs just prior to engaging the autopilot in APR mode.

To couple an approach:

Once established on the final approach course with the final approach fix as the active waypoint, the GTN will issue a flashing message indication.

Flashing Message Button **PRESS**
“Enable APR Output” Button **PRESS**

If coupled, Autopilot will revert to ROL mode at this time.

Autopilot **ENGAGE APPROACH MODE**

- This installation supports coupling to the autopilot in approach mode once vertical guidance is available.

To couple an approach:

Once established on the final approach course with the final approach fix as the active waypoint, the GTN will enable vertical guidance.

Vertical Guidance **CONFIRM AVAILABLE**
Autopilot **ENGAGE APPROACH MODE**

- The autopilot does not support any vertical capture or tracking in this installation.

Analog only autopilots should use APR mode for coupling to LNAV approaches. Autopilots which support digital roll steering commands (GPSS) may utilize NAV mode and take advantage of the digital tracking during LNAV only approaches.

Section 5. PERFORMANCE

No change.

Section 6. WEIGHT AND BALANCE

See current weight and balance data.

Section 7. SYSTEM DESCRIPTIONS

7.1 Pilot's Guide

The Garmin GTN 6XX or GTN 7XX Pilot's Guide, part number and revision listed below, contain additional information regarding GTN system description, control and function. The Pilot's Guides *do not* need to be immediately available to the flight crew.

- GTN 6XX Pilot's Guide P/N 190-01004-03 Rev A or later
- GTN 7XX Pilot's Guide P/N 190-01007-03 Rev A or later

7.2 Leg Sequencing

The GTN supports all ARINC 424 leg types. Certain leg types require altitude input in order to sequence (course to altitude, for example). If a barometric corrected altitude source is not interfaced to the GTN, a popup will appear prompting the pilot to manually sequence the leg once the altitude prescribed in the procedure is reached.

- This installation *has* a barometric corrected altitude source. The GTN will automatically sequence altitude legs.
- This installation *does not have* a barometric corrected altitude source. The pilot will be prompted to manually sequence altitude legs.'

7.3 Auto ILS CDI Capture

Auto ILS CDI Capture will not automatically switch from GPS to VLOC for LOC-BC or VOR approaches.

7.4 Activate GPS Missed Approach

If the GTN displays a CDI key on the Map Page (GTN 750) or Default Nav Page (GTN 650) the GTN *will* autoswitch from VLOC to GPS when the “Activate GPS Missed Approach” button is pressed.

If the GTN *does not* display a CDI key on the Map Page (GTN 750) or Default Nav Page (GTN 650) the GTN *will not* autoswitch from VLOC to GPS when the “Activate GPS Missed Approach” button is pressed. The pilot must manually switch from VLOC to GPS if GPS guidance is desired after the missed approach point.

7.5 Terrain Proximity and TAWS

- The Terrain Database has an area of coverage from North 75° Latitude to South 60° Latitude in all longitudes.
- The Obstacle Database has an area of coverage that includes the United States and Europe, and is updated as frequently as every 56 days.
- To avoid unwanted alerts, TAWS may be inhibited when landing at an airport that is not included in the airport database.

NOTE

The area of coverage may be modified as additional terrain data sources become available.

- This installation supports *Terrain Proximity*. *No aural or visual alerts* for terrain or obstacles are provided. Terrain Proximity *does not* satisfy the TAWS requirement of 91.223.
- This installation supports *TAWS B*. Aural and visual alerts *will be* provided. This installation *does* support the TAWS requirement of 91.223.

7.6 GMA 35 Audio Panel (Optional)

The GTN 725 and 750 can interface to a GMA 35 remotely mounted audio panel and marker beacon receiver. Controls for listening to various radios, activating the cabin speaker, clearance playback control, and marker beacon are accessed by pressing the “Audio Panel” button on the GTN display screen. Volume controls for the audio panel are accessed by pressing the “Intercom” button on the GTN display screen.

7.7 Traffic System (Optional)

This system is configured for the following type of traffic system. The Garmin GTN 6XX or GTN 7XX Cockpit Reference Guide or Garmin GTN 6XX or GTN 7XX Pilot's Guide provides additional information regarding the functionality of the traffic device.

- No traffic system is interfaced to the GTN.
- A TAS/TCAS I traffic system is interfaced to the GTN.
- A TIS traffic system is interfaced to the GTN.

7.8 StormScope® (Optional)

When optionally interfaced to a StormScope® weather detection system, the GTN may be used to display the StormScope® information. Weather information supplied by the StormScope® will be displayed on the StormScope® page of the GTN system. For detailed information about the capabilities and limitations of the StormScope® system, refer to the documentation provided with that system.

Heading Up mode:

If the GTN system is receiving valid heading information, the StormScope® page will operate in the heading up mode as indicated by the label "HDG UP" presented at the upper right corner of the display. In this mode, information provided by the StormScope® system is displayed relative to the nose of the aircraft and is automatically rotated to the correct relative position as the aircraft turns.

Track Up mode:

If the GTN system is not receiving valid heading information, either because a compatible heading system is not installed, or the interfaced heading system has malfunctioned, the StormScope® page will operate in the track up mode as indicated by the label "TRK UP" in the upper right corner of the display. When operating in the track up mode, StormScope® information is displayed relative to the current GPS track of the aircraft and is automatically rotated as the aircraft turns. In track up mode, the pilot must be aware that, if the combination of aircraft speed and crosswind results in a crab angle to maintain the track, the relative bearing of StormScope® information on the GTN display will be offset by an amount equal to the aircraft crab angle. Because the difference between GPS track and aircraft heading can be very large when on the ground, use of the GTN to display StormScope® information in TRK UP mode is prohibited while on the ground.

7.9 Power

- Power to the GTN is provided through a circuit breaker labeled NAV/GPS (1/2).
- Power to the optional GTN COM is provided through a circuit breaker labeled COMM (1/2)
- Power to the optional GMA 35 is powered through a circuit breaker labeled AUDIO.

7.10 Databases

Database versions and effective dates are displayed on the start-up page immediately after power-on. Database information can also be viewed on the System – System Status page.

The Obstacle Database coverage area includes the United States and Europe.

7.11 External Switches

External switches may be installed and interfaced to the GTN. These switches may be stand alone, or integrated with a TAWS or GPS annunciator. Table 3 lists the switches and function they perform:

Switch Label	Function
CDI	Toggles between GPS / VLOC sources. This switch may be part of an external annunciator panel.
COM CHAN DN	Toggles down through the preset com frequencies.
COM CHAN UP	Toggles up through the preset com frequencies.
COM RMT XFR	Transfers the com active / standby frequencies.
NAV RMT XFR	Transfers the nav active / standby frequencies.
OBS	Performs an OBS or SUSP function. This switch is part of an external annunciator panel and is placarded with the following: “Green OBS indicates OBS or SUSP mode – GTN annunciator bar indicates which is active. Push OBS button to change OBS or SUSP mode.”
OBS/SUSP	Performs an OBS or SUSP function.
TERR INHB	Toggles the TAWS Inhibit function on/off. This switch is part of an external annunciator panel. The terrain display is still presented if TAWS is Inhibited.

Table 3 – External Switches

Garmin International, Inc.
1200 E. 151st Street
Olathe, Kansas 66062 U.S.A.

FAA Approved

AIRPLANE FLIGHT MANUAL SUPPLEMENT

or

SUPPLEMENTAL AIRPLANE FLIGHT MANUAL

Garmin GTX 330/33 with ADS-B Out

Dwg. Number: 190-00734-15 Rev. 1

This document serves as an FAA Approved Airplane Flight Manual Supplement or Supplemental Airplane Flight Manual when the GTX 330/33 with ADS-B Out is installed in accordance with Supplemental Type Certificate SA01714WI. This document must be incorporated into the FAA Approved Airplane Flight Manual or provided as an FAA Approved Supplemental Airplane Flight Manual.

The information contained herein supplements the FAA approved Airplane Flight Manual. For limitations, procedures, loading and performance information not contained in this document, refer to the FAA approved Airplane Flight Manual, markings, or placards.

Make and Model Airplane:

Cessna 414A

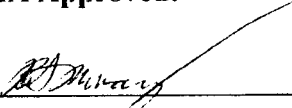
Airplane Serial Number:

414A-0641

Airplane Registration Number:

N78DG

FAA Approved:


Robert Murray
ODA STC Unit Administrator
Garmin International, Inc
ODA-240087-CE

Date: 5/1/2013

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Garmin International, Inc.

FAA Approved Airplane Flight Manual Supplement or

Supplemental Airplane Flight Manual

for

Garmin GTX 330/33 with ADS-B Out

Log of Revisions

REV NO.	PAGE NO(S)	DESCRIPTION	DATE OF APPROVAL	FAA APPROVED
1	ALL	Original Issue	See Cover	See Cover

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Section 1. General

1.1 GTX 330/33 ES

The Garmin GTX family consists of the GTX 330 and GTX 33 (Non-Diversity Mode S Transponders) and the GTX 330D and GTX 33D (Diversity Mode S Transponders). The ES option of any of the transponders provides ADS-B extended Squitter functionality.

All Garmin GTX transponders are a radio transmitter/receiver that operates on radar frequencies, receiving ground radar or TCAS interrogations at 1030 MHz and transmitting a coded response of pulses to ground-based radar on a frequency of 1090 MHz. Each unit is equipped with IDENT capability and will reply to ATRCBS Mode A, Mode C and Mode S All-Call interrogation. Interfaces to the GTX 330/33 are shown in the following block diagrams.

Figure 1. GTX 330 or GTX 330D Interface Summary

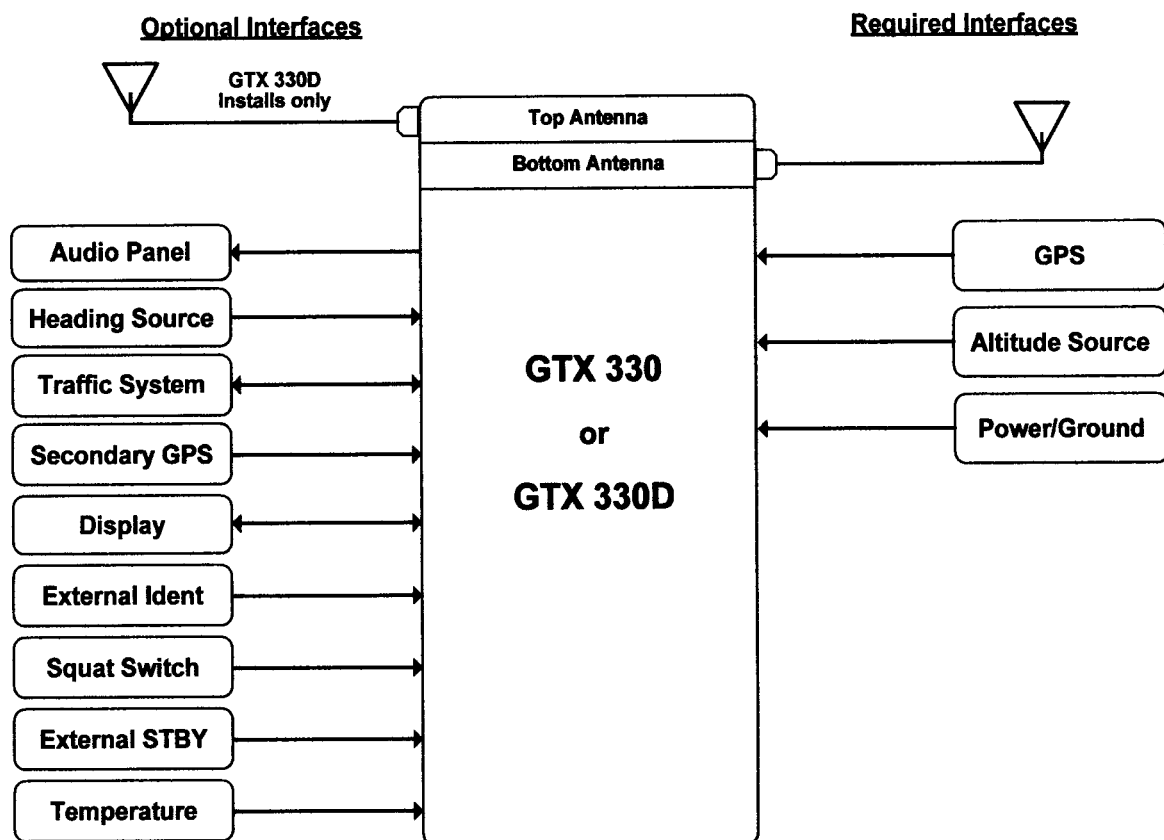
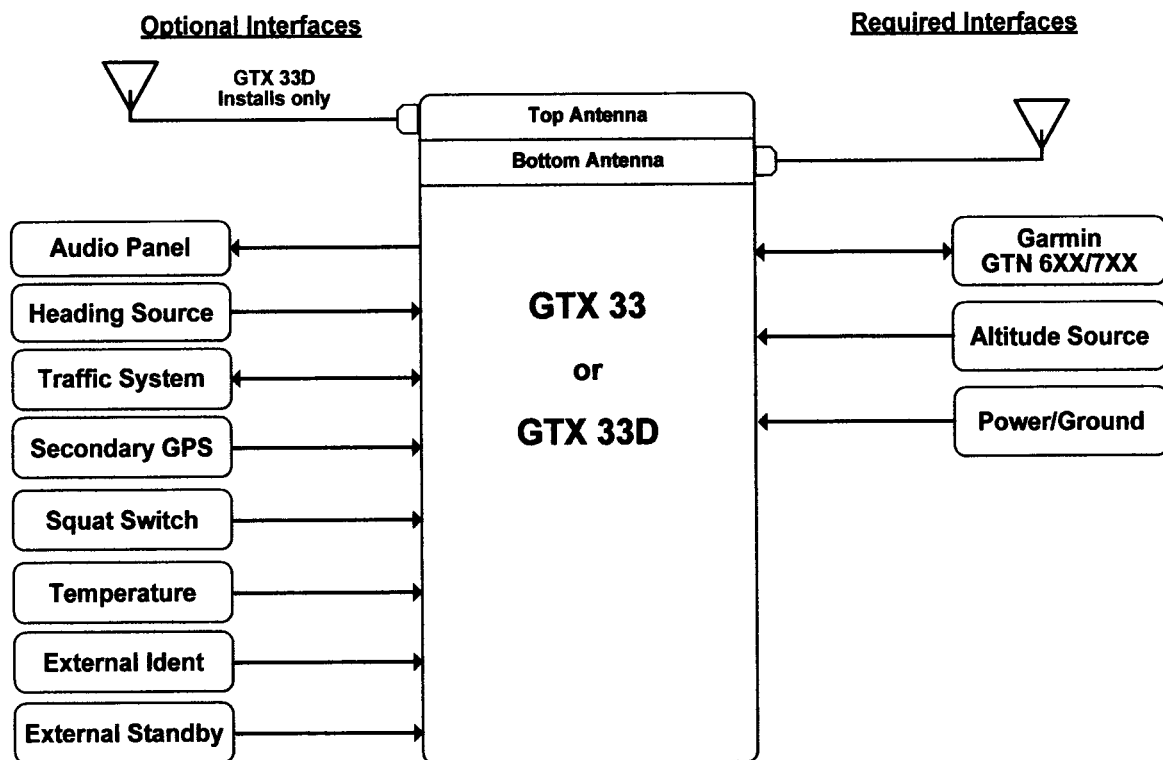


Figure 2. GTX 33 or GTX 33D Interface Summary



The GTX 330/33 performs the following ADS-B Out functions:

- Transmission of ADS-B out data on 1090 extended squitter (1090ES) (1090 MHz)
- Integration of data from internal and external sources to transmit the following data per 14 CFR 91.227:
 - GPS Position, Altitude, and Position Integrity
 - Ground Track and/or Heading, Ground Speed, and Velocity Integrity
 - Air Ground Status
 - Flight ID, Call Sign, ICAO Registration Number
 - Capability and Status Information
 - Transponder squawk code, IDENT, and emergency status
- Pressure Altitude Broadcast Inhibit

1.2 Capabilities

The Garmin GTX 330/33 with ADS-B Out functionality as installed in this aircraft has been shown to meet the equipment requirements of 14 CFR § 91.227.

1.3 Installation Configuration

This aircraft is equipped with a GTX 330/33 with ADS-B Out system with the following interfaces/features:

Equipment Installed:

- | | |
|--------------------------------------|-------------------------------------|
| <input type="checkbox"/> #1 GTX 330 | <input type="checkbox"/> #1 GTX 33 |
| <input type="checkbox"/> #1 GTX 330D | <input type="checkbox"/> #1 GTX 33D |
| <input type="checkbox"/> #2 GTX 330 | <input type="checkbox"/> #2 GTX 33 |
| <input type="checkbox"/> #2 GTX 330D | <input type="checkbox"/> #2 GTX 33D |

Interfaced GTN 6XX/7XX or GNS 4XX/5XX Position Source(s):

	Transponder (#1 or #2)		Transponder (#1 or #2)		Transponder (#1 or #2)
<input type="checkbox"/> GTN 725	_____	<input type="checkbox"/> GNS 430AW	_____	<input type="checkbox"/> GNS 530AW	_____
<input type="checkbox"/> GTN 750	_____	<input type="checkbox"/> GNS 430W	_____	<input type="checkbox"/> GNS 530W	_____
<input type="checkbox"/> GTN 625	_____	<input type="checkbox"/> GNC 420AW	_____	<input type="checkbox"/> GPS 500W	_____
<input type="checkbox"/> GTN 635	_____	<input type="checkbox"/> GNC 420W	_____		
<input type="checkbox"/> GTN 650	_____	<input type="checkbox"/> GPS 400W	_____		

1.4 Definitions

The following terminology is used within this document:

ADS-B: Automatic Dependent Surveillance-Broadcast

AFM: Airplane Flight Manual

AFMS: Airplane Flight Manual Supplement

ATCRBS: Air Traffic Control Radar Beacon System

CFR: Code of Federal Regulations

ES: Extended Squitter

GNSS: Global Navigation Satellite System

GNS: Garmin Navigation System

GPS: Global Positioning System

GTX: Garmin Transponder

GTN: Garmin Touchscreen Navigator

ICAO: International Civil Aviation Organization

LRU: Line Replaceable Unit

PABI: Pressure Altitude Broadcast Inhibit

POH: Pilot Operating Handbook

SBAS: Satellite-Based Augmentation System

SW: Software

TCAS: Traffic Collision Avoidance System

TX: Transmit

Section 2. Limitations

2.1 Minimum Equipment

The GTX 330/33 with ADS-B Out must have the following system interfaces fully functional in order to be compliant with the requirements for 14 CFR 91.227 ADS-B Out operations:

Table 1. Required Equipment

Interfaced Equipment	Number Installed	Number Required
Uncorrected Pressure Altitude Source	1	1
GPS SBAS Position Source	1 or more	1
GTN series navigator (for aircraft equipped with GTX 33/33D only)	1 or more	1

2.2 ADS-B Out

The GTX 330/33 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational. When the system is not operational, ADS-B Out transmit failure messages will be present on the GTN control interface, or GTX 330 display.

2.3 Applicable System Software

This AFMS/AFM is applicable to the software versions shown in Table 2.

The Main GTX software version is displayed on the splash screen during start up, for the GTX 330, and the external LRU page on the GTN for the GTX 33.

Table 2. Software Versions

Software Item	Software Version <i>(or later FAA Approved versions for this STC)</i>
Main SW Version	7.02

2.4 Pressure Altitude Broadcast Inhibit (PABI)

Pressure Altitude Broadcast Inhibit shall only be enabled when requested by Air Traffic Control while operating within airspace requiring an ADS-B Out compliant transmitter, per 14 CFR 91.227. PABI is enabled by selecting the GTX to ON mode.

Section 3. Emergency Procedures

3.1 Emergency Procedures

None

3.2 Abnormal Procedures

3.2.1 Abnormal Indications

The loss of an interfaced input to the GTX 330/33 may cause the transponder to stop transmitting ADS-B Out data. Depending on the nature of the fault or failure, the GTX may no longer be transmitting all of the required data in the ADS-B Out messages.

For GTX 330 installations:

If the GTX 330 detects any internal faults or failures with the ADS-B Out functionality, the GTX 330 will annunciate this event via the NO ADSB annunciator on the GTX 330 display screen. When the GTX 330 annunciates the NO ADSB annunciation, one of the following failures or faults have occurred:

- Loss of adequate GPS position data
- ADS-B TX (transmit) is selected OFF

When the GTX 330 annunciates FAIL to the flight crew, the GTX 330 has detected an internal failure and no transponder data is transmitted.

When a GTX 330 NO ADSB, or FAIL annunciation is received, verify proper operation of all interfaced equipment (refer to Section 1.3) as the failure of one of these devices could be the cause of the abnormal indication.

For GTX 33 installations:

Reference Display Device documentation for applicable annunciations.

3.2.2 Loss of Aircraft Electrical Power Generation

Loss of electrical power generation **REMOVE POWER FROM GTX**

If the GTX should be load shed due to a loss of electrical power generation, ADS-B Out data will no longer be available.

NOTE

This guidance is supplementary to any guidance provided in the POH or AFM for the installed aircraft for loss of power generation.

3.2.3 Loss of GPS/SBAS Navigation Data

When the GPS/SBAS receiver is inoperative or GPS position information is not available or invalid, the GTX will no longer be transmitting ADS-B Out data.

For GTX 330 installations:

NO ADSB annunciator illuminated:

Interfaced GPS position sources.....**VERIFY VALID POSITION**

For GTX 33 installations:

Reference Display Device documentation for applicable annunciation:

Interfaced GPS position sources.....**VERIFY VALID POSITION**

Section 4. Normal Procedures

The procedures described below are specific only to the GTX 330. Cockpit Reference Guides and Pilot Guides for interfaced displays will provide additional operating information specific to the displays or other traffic systems.

ADS-B Out functionality resides within the GTX transponders thereby providing a single point of entry for Mode 3/A code, Flight ID, IDENT functionality and activating or deactivating emergency status for both transponder and ADS-B Out functions. Details on performing these procedures are located in the GTX 330/330D Pilot's Guide.

4.1 Unit Power On

NO ADSB **CONSIDERED**

NOTE

The NO ADS-B Annunciation (or associated display annunciations) may illuminate as the unit powers on and begins to receive input from external systems, to include the SBAS position source.

4.2 Before Takeoff

NO ADSB **EXTINGUISHED**

NOTE

The NO ADS-B Annunciation (or associated display annunciations) must be **EXTINGUISHED** for the system to meet the requirements specified in 14 CFR 91.227. This system must be operational (NO ADSB annunciator **EXTINGUISHED**) in certain airspaces after January 1, 2020 as specified by 14 CFR 91.225.

Section 5. Performance

No Change

Section 6. Weight and Balance

See current Weight and Balance data

Section 7. Systems Description

The Garmin GTX 330 Pilot's Guide, part number and revision listed below, contain additional information regarding GTX system description, control, and function. Pilots Guides for interfaced displays, part number and revision listed below, provide additional operating information for the Garmin GTX 33.

Garmin GTX 330/33 with ADS-B Out

190-00734-15

Rev. 1

FAA Approved

<u>Title</u>	<u>Part Number</u>	<u>Revision</u>
GTX 330 Pilot's Guide	190-00207-00	Rev G (or later)
Garmin GTN 725/750 Pilot's Guide	190-01007-03	Rev. E (or later)
Garmin GTN 625/635/650 Pilot's Guide	190-01004-03	Rev. E (or later)

Section 8. Handling, Service, and Maintenance

No Change

FAA APPROVED

AIRPLANE FLIGHT MANUAL SUPPLEMENT
or
SUPPLEMENTAL AIRPLANE FLIGHT MANUAL
for the
Garmin GDL 88 ADS-B Transceiver
as installed in

Cessna 414A

Make and Model Airplane

Registration Number: N78DG Serial Number: 414A-0641

This document serves as an Airplane Flight Manual Supplement or as a Supplemental Airplane Flight Manual when the aircraft is equipped in accordance with Supplemental Type Certificate SA02119SE for the installation and operation of the Garmin GDL 88 ADS-B Transceiver. This document must be incorporated into the FAA Approved Airplane Flight Manual or provided as an FAA Approved Supplemental Airplane Flight Manual.

The information contained herein supplements the information in the FAA Approved Airplane Flight Manual. For limitations, procedures, loading and performance information not contained in this document, refer to the FAA Approved Airplane Flight Manual, markings, or placards.

FAA APPROVED 28-DEC-2012



Robert Grove
ODA STC Unit Administrator
GARMIN International, Inc
ODA-240087-CE

LOG OF REVISIONS		
Revision Number	Date	Description
1	12/18/2012	Complete Supplement

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Section 1. GENERAL

1.1 Garmin GDL 88 UAT Transceiver

The Garmin GDL 88 UAT Transceiver is an ADS-B system comprised of a Garmin TSO-C154c GDL 88, one or two UAT/1090 antenna(s), optional Garmin approved GPS/SBAS antenna, optional Garmin GPS/SBAS position source, and other interfaces as shown in the following block diagram.

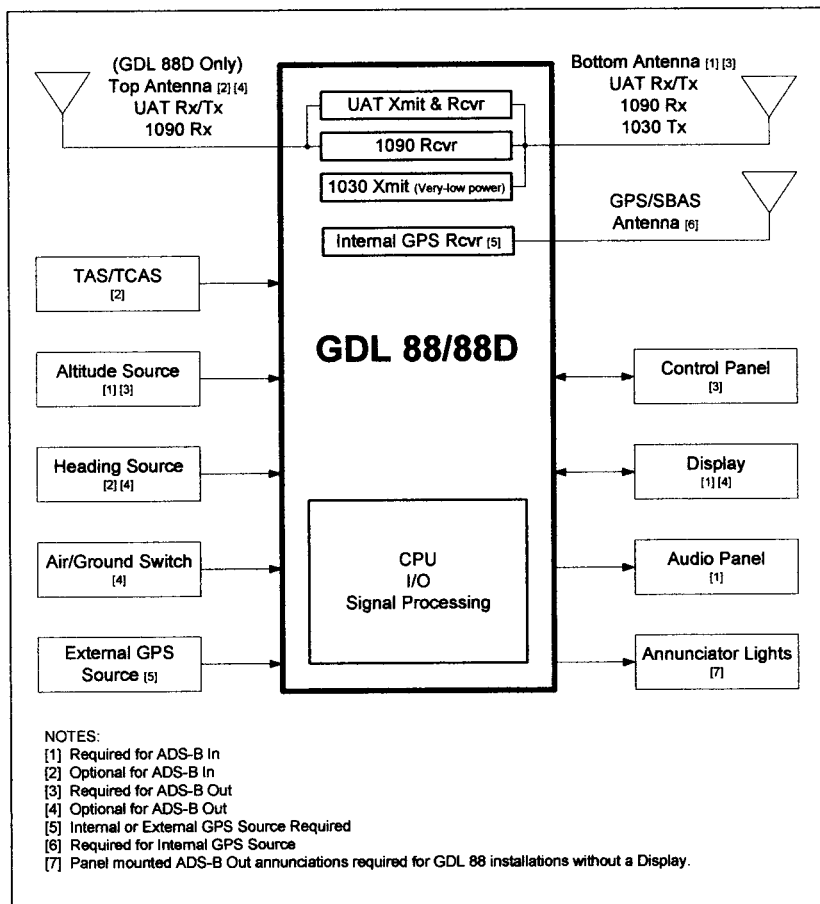


Figure 1 – GDL 88 Block Diagram

The GDL 88 system performs following functions:

- Transmission of ADS-B out data on UAT (978 MHz)
 - Integration of data from internal and external sources to transmit the following data per 14 CFR 91.227
 - GPS Position, Altitude, and Position Integrity
 - Ground Track and/or Heading, Ground Speed, and Velocity Integrity
 - Air Ground Status
 - Flight ID, Call Sign, ICAO Registration Number
 - Capability and Status Information
 - Transponder squawk code, IDENT, and emergency status
 - Anonymous Mode
 - Pressure Altitude Broadcast Inhibit
- Reception of ADS-B In data on UAT (978 MHz)
 - ADS-B (Data directly from another transmitting aircraft)
 - ADS-R (Rebroadcast of ADS-B data from a ground station)
 - TIS-B (Broadcast of secondary surveillance radar (SSR)-derived traffic information from a ground station)
 - FIS-B (Broadcast of aviation data from a ground station)
- Reception of ADS-B In data on 1090 MHz
 - ADS-B (Data directly from another transmitting aircraft)
 - ADS-R (Rebroadcast of ADS-B data from a ground station)
- Provide traffic information and alerting to the pilot via an optional display or annunciator lamp.
 - Correlation and consolidation of traffic data from multiple traffic sources
 - Output of traffic data to an external display
 - Aural and visual traffic alerting
- Provide FIS-B data to the pilot via an optional display
 - Processing and output of FIS-B data to an external display
 - Graphical and textual weather products
 - NEXRAD
 - PIREPs
 - AIRMET/SIGMETs
 - METARs
 - TAFs
 - Winds Aloft
 - Aviation Data
 - TFRs
 - NOTAMs

The GDL 88 may be installed as a stand-alone ADS-B system or, optionally, integrated with a compatible display for the display and control of traffic, FIS-B weather, and aviation data.

1.2 Capabilities

As installed in this aircraft, the Garmin GDL 88 system complies with the requirements of AC 20-165 and meets the equipment performance and functional requirements to comply with 14 CFR 91.227.

The GDL 88 meets the requirements of TSO-C154c for ADS-B Out operation.

Applicable to installations consisting of a GDL 88 interfaced with one or more GTNs with software version 3.00 or later:

The GDL 88 meets the requirements of TSO-C195a Class C1, C2, C3, C5, TIS-B Services TSO-C166b Class A1, and FIS-B TSO-C157a for ADS-B In Operation and AC 20-172A for Airworthiness Approval for ADS-B In Systems and Applications

1.3 Installation Configuration

This aircraft is equipped with a GDL 88 system with the following interfaces/features:

Equipment Installed:

- GDL 88
- GDL 88D with dual antennas
- GDL 88 with internal GPS/SBAS position source
- GDL 88D with dual antennas and internal GPS/SBAS position source

Interfaced Active Traffic System:

- None
- TCAD
- TAS/TCAS I

Interfaced Transponder(s):

- Single Transponder serially interfaced to the GDL 88
- Dual Transponders serially interfaced to the GDL 88
- Single Transponder interfaced to the GDL 88 via self-interrogation

Interfaced Radio Altimeter(s):

- Yes
- No

Interfaced GPS/SBAS Position Source(s):

GPS #1:

- GNS 4XXW/5XXW
- GTN 6XX/7XX
- None

GPS #2:

- GNS 4XXW/5XXW
- GTN 6XX/7XX
- None

Definitions

The following terminology is used within this document:

ADS-B:	Automatic Dependent Surveillance-Broadcast
ADS-R:	Automatic Dependent Surveillance-Rebroadcast
CSA:	Conflict Situational Awareness
FIS-B:	Flight Information Service-Broadcast
GDL:	Garmin Datalink
GPS:	Global Positioning System
GTN:	Garmin Touchscreen Navigator
LRU:	Line Replaceable Unit
PABI:	Pressure Altitude Broadcast Inhibit
SBAS:	Satellite-Based Augmentation System
TAS:	Traffic Awareness System
TCAD:	Traffic Collision Avoidance Device
TCAS:	Traffic Collision Avoidance System
TIS-B:	Traffic Information Service-Broadcast
UAT:	Universal Access Transceiver
VFR:	Visual Flight Rules

Section 2. LIMITATIONS

2.1 Minimum Equipment

The GDL 88 must have the following system interfaces fully functional in order to be compliant with the requirements for 14 CFR 91.227 ADS-B Out operations:

	Interfaced Equipment	Number Installed	Number Required
O R	External ADS-B Annunciators	2 lamps	2 lamps (NO POSN and FAULT)
	Interfaced Display	1	1
	GPS SBAS Position Source	1 or more	1
	Transponder	1 or more	1

Table 1 – Required Equipment

2.2 ADS-B Out

The GDL 88 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational as indicated by external annunciators not illuminated or interfaced display ADS-B messages not being present.

2.3 Anonymous Mode

Anonymous Mode must only be operated while operating under VFR while squawking a VFR code. If requested by Air Traffic Control, Anonymous Mode must be turned off.

2.4 Applicable System Software

This AFMS/SAFM is applicable to the software versions shown in Table 2.

The Main software version is displayed on the External LRU page available on some interfaced display devices.

Software Item	Software Version (or later FAA Approved versions for this STC)
Main SW Version	2.01

Table 2 - Software Versions

2.5 Pressure Altitude Broadcast Inhibit (PABI)

While operating within airspace requiring an ADS-B Out compliant transmitter, per 14 CFR 91.227, Pressure Altitude Broadcast Inhibit shall only be enabled when requested by Air Traffic Control.

2.6 Traffic Alerting

Traffic alerting is an aid to visual acquisition and may not be used as the sole basis for aircraft maneuvering.

Section 3. EMERGENCY PROCEDURES

3.1 Emergency Procedures

None.

3.2 Abnormal Procedures

3.2.1 Abnormal Indications

The loss of an interfaced input GDL 88 may cause the GDL 88 to stop transmitting ADS-B Out data or providing ADS-B In function.

Depending on the nature of the fault or failure, the GDL 88 may no longer be transmitting all of the required data in the ADS-B Out messages and Traffic Alerts may not be provided by the system.

- For No Display installations:

If the GDL 88 detects any internal faults or failures, the GDL 88 will annunciate this event via the two external annunciators on the ADS-B annunciator panel. Using these two lights, three messages/states are capable of being conveyed to the flight crew: NO POSN, FAULT, and TX FAIL.

When the GDL 88 annunciates NO POSN, the GDL 88 has detected that it does not have a valid position from the internal or any of the external GPS/SBAS sources. (See Section 3.2.3 for further information.)

When the GDL 88 annunciates FAULT to the flight crew, the GDL 88 has detected a loss of an input or internal fault resulting in the GDL 88 not transmitting full ADS-B information or degradation in performance.

When both annunciator lights on the ADS-B annunciator panel are illuminated, the GDL 88 is annunciating TX FAIL. When the GDL 88 annunciates TX FAIL to the flight crew, the GDL 88 has detected a loss of required input or an internal failure resulting in the GDL 88 being unable to either transmit or receive ADS-B data.

When a GDL 88 NO POSN, FAULT, or TX FAIL annunciation is received, verify proper operation of all interfaced equipment (refer to Section 1.3) as the failure of one of these devices could be the cause of the abnormal indication.

When the GDL 88 is interfaced to a transponder via self-interrogation, the FAULT annunciator will illuminate if the GDL 88 has not received communication from the transponder when the aircraft transitions from on the ground to airborne.

- For Display Installations:

Reference Display Device documentation for applicable annunciators.

3.2.2 LOSS OF AIRCRAFT ELECTRICAL POWER GENERATION

Loss of electrical power generation.....**REMOVE POWER FROM GDL 88**

If the GDL 88 is load shed due to a loss of electrical power generation, ADS-B Out, ADS-B In, and the display of interfaced traffic system data will no longer be available.

NOTE

This guidance is supplementary to any guidance provided in the POH or AFM for the installed aircraft for loss of power generation.

3.2.3 LOSS OF GPS/SBAS NAVIGATION DATA

When the GPS/SBAS receiver is inoperative or GPS position information is not available or invalid, the GDL 88 will no longer be transmitting ADS-B Out data and ADS-B traffic alerting functions will be unavailable.

- For No Display installations:

NO POSN annunciator illuminated:

Interfaced GPS position sources.....**VERIFY VALID POSITION**

- For Display Installations:

**Reference Display Device documentation for applicable
annunciation:**

Interfaced GPS position sources.....**VERIFY VALID POSITION**

3.2.4 VISUAL/AURAL TRAFFIC ALERT

Traffic Alert Annunciation and Aural

Traffic.....**VISUALLY ACQUIRE**

Section 4. NORMAL PROCEDURES

The procedures described below are specific only to the GDL 88. Cockpit Reference Guides and Pilot Guides for interfaced displays will provide additional operating information specific to the displays or other traffic systems.

4.1 Unit Power On

GDL 88 Annunciations **CONSIDERED**

NOTE

The GDL 88 Annunciators (or associated display annunciations) may illuminate as the unit powers on and begins to receive input from external systems, to include the SBAS position source.

The GDL 88 only complies with 14 CFR 91.227 for ADS-B Out when all required functions are operational as indicated by external annunciators not illuminated.

4.2 Before Takeoff

GDL 88 Annunciations **CONSIDERED**

Section 5. PERFORMANCE

No change.

Section 6. WEIGHT AND BALANCE

See current weight and balance data.

Section 7. SYSTEM DESCRIPTIONS

7.1 Pilot's Guide

The Garmin GDL 88 Pilot's Guide, part number and revision listed below, contain additional information regarding GDL 88 system description, control, and function. Cockpit Reference Guides and Pilot Guides for interfaced displays provide additional operating information.

- GDL 88 Pilot's Guide P/N 190-01122-03 Rev A or later

7.2 Traffic Sources and Alerting

The GDL 88 is capable of receiving ADS-B, ADS-R, and TIS-B traffic reports in order to track traffic around the aircraft and provide alerts to the flight crew to aid in visual acquisition and avoidance.

Traffic alerting is provided via an installed visual annunciator and audio callouts for these alerts. The audio callout will include any available information regarding the intruder, to include direction, range, and relative altitude (high, low, same altitude).

Due to the nature of TIS-B, its service volumes, and incomplete equipage/adoption of ADS-B Out equipment, not all traffic will be tracked by the GDL 88. This is much like an active traffic system and does not track non-transponder equipped aircraft. The flight crew must use "see and avoid" procedures to visually acquire and avoid other aircraft.

7.3 Interfaced Active Traffic System (Optional)

When an active traffic system is interfaced with a GDL 88, the GDL 88 receives traffic from the active traffic system and attempts to correlate – or match – this traffic with ADS-B traffic the GDL 88 has received and is already tracking. When a correlation is made, the active traffic system or ADS-B target with the most accurate information is displayed to the flight crew. Any active traffic system or ADS-B traffic that is not correlated will also be displayed for the flight crew. The correlation of traffic by the GDL 88 ensures that only the most accurate, and no duplicate, traffic targets are displayed for the flight crew's situational awareness.

In addition, the GDL 88 will use its air-ground logic or inputs to automatically switch the active traffic from Standby to Operate when transitioning from ground to air, and from Operate to Standby when transitioning from air to ground.

If the GDL 88 fails then external traffic device data is no longer sent to the display, however aural traffic alerts from these traffic systems may continue to be received.

When interfaced to an active traffic system, traffic alerts are provided as follows:

TCAS Target Correlated With ADS-B Target	TAS/TCAS Alert Active?	CSA Alert Active?	Aural Alert Source	Visual Alert Source
Yes	Yes	N/A	TCAS/TAS	TCAS/TAS
Yes	No	N/A	None	None
No	Yes	Yes	TCAS/TAS (prioritized) GDL 88	TCAS/TAS GDL 88
No	No	Yes	GDL 88	GDL 88

Table 3 – GDL 88 Traffic Alerting with Interfaced Active Traffic System

The optional interfaced display’s Pilot’s Guides and supplements provide additional information regarding the functionality and control of the traffic device.

7.4 Power

Power to the GDL 88 is provided through a circuit breaker labeled “ADS-B.”

7.5 External Switches

External switches may be installed in conjunction with the GDL 88. Table 4 lists the switches and function they perform:

Switch Label	Function
ALTITUDE REPORTING	Enables and disables Pressure Altitude Broadcast Inhibit functionality.
ANONYMOUS	Enables and disables Anonymous Mode functionality.
TRAFFIC MUTE	Acknowledges and mutes a currently playing aural Traffic Alert.
BRT/DIM	Enables GDL 88 annunciators to be dimmed appropriately for lighting conditions.

Table 4 – External Switches