

GDU 1500

Installation Manual



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RECORD OF REVISIONS

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DOCUMENT PAGINATION

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This manual reflects the operation of software version 8.00. Some differences in operation may be observed when comparing the information in this manual to earlier or later software versions.

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WARNING

This product, its packaging, and its components contain chemicals known to the State of California to cause cancer, birth defects, or reproductive harm. This Notice is being provided in accordance with California's Proposition 65. If you have any questions or would like additional information, please refer to our web site at www.garmin.com/prop65.

CAUTION

The GDU 1500 lens is coated with a special anti-reflective coating which is very sensitive to skin oils, waxes and abrasive cleaners. **CLEANERS CONTAINING AMMONIA WILL HARM THE ANTI-REFLECTIVE COATING.** It is very important to clean the lens using a clean, lint-free cloth and an eyeglass lens cleaner that is specified as safe for anti-reflective coatings.

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GDU 1500 HARDWARE MOD LEVEL HISTORY

The following table identifies hardware modification (Mod) Levels for the GDU 1500. Mod Levels are listed with the associated service bulletin number, service bulletin date, and the purpose of the modification. The table is current at the time of publication of this manual (see date on front cover) and is subject to change without notice. Authorized Garmin Sales and Service Centers are encouraged to access the most up-to-date bulletin and advisory information on the Garmin Dealer Resource web site at www.garmin.com using their Garmin-provided user name and password.

MOD LEVEL	SERVICE BULLETIN NUMBER	SERVICE BULLETIN DATE	PURPOSE OF MODIFICATION

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1 GENERAL DESCRIPTION

1.1 Introduction

This manual presents mechanical and electrical installation requirements for installing the GDU 1500 as part of the G1000 Integrated Cockpit System. The GDU 1500 can be integrated into a variety of airframes under an appropriate TC or STC. Each airframe installation may vary. Use only approved (type or supplemental type) data for specific installation instructions in a particular aircraft.

1.2 Equipment Description

The GDU 1500 provides a central display and user interface for the G1000 Integrated Cockpit System. The display is mounted flush to the aircraft instrument panel using six ¼ turn fasteners. A GDU 1500 can be configured as either a Multi Function Display (MFD) or Primary Flight Display (PFD). The GDU 1500 provides the following functions:

1.2.1 Flight Instrument Functions

- Display of attitude (pitch and roll), rate of turn, slip/skid, heading, airspeed, altitude, and vertical speed information (PFD or reversionary modes only)
- Display of engine and airframe instrumentation (MFD or reversionary modes only)
- Display of the AFCS flight director command bars and modes (PFD or reversionary modes only)

1.2.2 Navigation Instrument Functions

- Display of position and ground speed for use by the pilot/flight crew
- Display of stored navigation and map databases for use by the pilot/flight crew
- Display of the HSI, Selected Heading and Selected Course (PFD or reversionary modes only)
- Area navigation functions using the determined position/velocity and stored navigation data
- Approach navigation functions and associated databases
- Baro-altitude Vertical Navigation

1.2.3 System Interface Functions

- Interfacing with the GCU 475, GMC 710, GDL 69/69A, and GDU 104Xs
- Display of dual communications transceivers operating in the 118.00 to 136.975 MHz range in 8.33 kHz or 25 kHz frequency spacing
- Control and display of weather information along with satellite radio audio channel and volume
- Display of dual VOR/ILS receivers tuning from 108.00 to 117.95 MHz in 50 kHz increments
- Control and display of transponder(s) GTX 32 or 33

1.3 Interface Summary

The GDU 1500 is designed as an open architecture system that uses typical ARINC 429, RS-232, and Ethernet communications interfaces. The GDU 1500 communicates with the following G1000 LRUs:

- GDU 104Xs
- GMA 1347/1347D Audio Panel
- GCU 47X
- GMC 710
- GDL 69/69A Data Link
- GIA 63/63W IAU

1.4 Technical Specifications

1.4.1 Environmental Qualification Form

It is the responsibility of the installing agency to obtain the latest revision of the GDU 1500 Environmental Qualification Form. This form is available directly from Garmin under the following part number:

GDU 1500 Environmental Qualification Form, Garmin part number 005-00150-21

To obtain a copy of this form, see the dealer/OEM portion of the Garmin web site (www.garmin.com).

1.4.2 Physical Characteristics

Characteristics	Specifications
Width	14.90 inches (37.85)
Height	10.74 inches (27.28 cm)
Depth from front of panel to connector	4.11 inches (10.44 cm)
Unit Weight w/out Connector Kit	8.40 lbs. (3.8 kg)
Unit Weight with Connector Kit	8.61 lbs. (3.9 kg)

1.4.3 General Specifications

The table below contains general environmental specifications. For detailed specifications, see the Environmental Qualification Form.

Characteristics	Specifications
Operating Temperature Range	-40°C to +55°C.
Humidity	95% non-condensing
Altitude Range	-1,500 ft to 55,000 ft
Software Compliance	RTCA/DO-178B levels B, C, and D
Hardware Compliance	RTCA/DO-254 Level B
Environmental Compliance	RTCA/DO-160E
Power Requirements	28 Vdc. See the Environmental Qualification Form for details on surge ratings and minimum/maximum operating voltages.

1.4.4 Power Consumption

Ambient temperature above -15°C:

	28V (Maximum)	28V (Typical)
GDU 1500	55W	50W

Ambient temperature at or below -15°C:

	28V (Maximum)	28V (Typical)
GDU 1500	90W	85W

The GDU 1500 includes an internal heater, the heater will be on for approximately 15 minutes in air at -40°C that is circulated by a typical avionics fan across the units heat sink.

1.5 Certification

The conditions and tests required for TSO approval of this article are minimum performance standards. It is the responsibility of those installing this article either on or within a specific type or class of aircraft to determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only if performed under 14 CFR part 43 or the applicable airworthiness requirements. At the time of publication, installations of this TSO approved article are only approved when installed in an aircraft as part of a Garmin G1000 integrated cockpit system.

The following table provides a list of applicable TSO/ETSOs for the GDU 1500.

1.5.1 TSO/ETSO Compliance

Function	TSO/ETSO/SAE/ RTCA/EUROCAE	Category	Applicable LRU SW Part Numbers	Applicable Custom Logic Device Part Numbers
Airborne Multipurpose Electronic Displays	TSO-C113† SAE AS8034	Type I, II, and III	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Airspeed Instruments	TSO-C2d SAE AS8019A	Type C Range : 20 to 999 kts	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Turn and Slip Instrument	TSO-C3d SAE AS8004	Type II	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Bank and Pitch Instruments	TSO-C4c SAE AS8001	Turn Error, Category B	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Direction (Heading) Instrument, Magnetic	TSO-C6d SAE AS8013A		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Vertical Velocity Instruments (Rate-Of-Climb)	TSO-C8d SAE AS8016A	Type C Range : -9950 to 9950 ft/min	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Automatic Pilots	TSO-C9c SAE AS402B		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Altimeter, Pressure Actuated, Sensitive Type	TSO-C10b SAE AS8009A	Range : -1000 to 99,980 ft	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
ILS Glide Slope Receiving Equipment Operating Within The Radio Frequency Range of 328.6-335.4 Megahertz (MHz)	TSO-C34e RTCA DO-192		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()

TSO Compliance, continued				
Function	TSO/ETSO/SAE/ RTCA/EUROCAE	Category	Applicable LRU SW Part Numbers	Applicable Custom Logic Device Part Numbers
Airborne Radio Marker Receiving Equipment	TSO-C35d RTCA DO-143	Category A	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Airborne ILS Localizer Receiving Equipment Operating Within The Radio Frequency Range of 108-112 Megahertz	TSO-C36e RTCA DO-195	Class A	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
VHF Radio Communications Transmitting Equipment Operating Within The Radio Frequency Range 117.975 to 137.000 Megahertz	TSO-C37d** RTCA DO-186A	Class 3 Class 5 200nm 25 kHz 8.33 kHz	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
VHF Radio Communications Receiving Equipment Operating Within The Radio Frequency Range 117.975 to 137.000 Megahertz	TSO-C38d** RTCA DO-186A	Class C Class E 200nm 25 kHz 8.33 kHz	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
VOR Receiving Equipment Operating Within The Radio Frequency Range Of 108-117.95 Megahertz (MHz)	TSO-C40c RTCA DO-196		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Airborne Automatic Direction Finding Equipment (ADF)	TSO-C41d RTCA DO-179	Class A	006-B0319-42 and later 006-B0319-()	006-C0035-() 006-C0036-()
Temperature Instruments	TSO-C43c SAE AS8005A	Class IIIb	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Fuel Flowmeters	TSO-C44b SAE AS407C	Type I and II	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Manifold Pressure Instruments	TSO-C45a SAE AS8042	Type II Range : See Note Below	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()

TSO Compliance, continued				
Function	TSO/ETSO/SAE/ RTCA/EUROCAE	Category	Applicable LRU SW Part Numbers	Applicable Custom Logic Device Part Numbers
Pressure Instruments - Fuel, Oil, and Hydraulic	TSO-C47 SAE AS408C	Type II Range : See Note Below	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Electric Tachometer: Magnetic Drag (Indicator and Generator)	TSO-C49b SAE AS404C	Range : See Note Below	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Flight Director Equipment	TSO-C52b SAE AS8008		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Fuel and Oil Quantity Instruments (Reciprocating Engine Aircraft)	TSO-C55 SAE AS405C	Range : See Note Below	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Airborne Weather and Ground Mapping Pulsed Radars	TSO-C63c RTCA DO-173	Class 7	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Distance Measuring Equipment Operating Within the RF Range of 960- 1215 MHz (DME)	TSO-C66c RTCA DO-189		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Airborne ATC Transponder Equipment	TSO-C74c		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Airborne Low-Range Radio Altimeter	TSO-C87††		All 006-B0319-() except 006-B0319-00 through 006-B0319-59	006-C0035-() 006-C0036-()
Airborne Passive Thunderstorm Equipment	TSO-C110a RTCA DO-191		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()

TSO Compliance, continued				
Function	TSO/ETSO/SAE/ RTCA/EUROCAE	Category	Applicable LRU SW Part Numbers	Applicable Custom Logic Device Part Numbers
Air Traffic Control Radar Beacon System/Mode Select (ATCRBS/Mode S) Airborne Equipment	TSO-C112 RTCA DO-181C		All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Traffic Alert and Collision Avoidance System (TCAS) Airborne Equipment, TCAS I	TSO-C118 RTCA DO-197A		All 006-B0319-() except 006-B0319-00 through 006-B0319-59	006-C0035-() 006-C0036-()
Airborne Supplemental Navigation Equipment Using the Global Positioning System (GPS)	TSO-C129a** RTCA DO-208	Class A1	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Stand-alone Airborne Navigation Equipment Using the Global Position System Augmented by the Wide Area Augmentation System	TSO-C146a*** RTCA DO-229C	Class 3	All 006-B0319-() except 006-B0319-00 through 006-B0319-49	006-C0035-() 006-C0036-()
Traffic Advisory System (TAS) Airborne Equipment	TSO-C147 RTCA DO-197A	Class A	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
Terrain Awareness and Warning System	TSO-C151b*	Class B	All 006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()
VHF Radio Communications – Transceiver Equipment	TSO-C169*** RTCA DO-186A	Class 3 Class 5 Class C Class E	All 006-B0319-() except 006-B0319-00 through 006-B0319-49	006-C0035-() 006-C0036-()

Note : The range for these engine gauges is configurable and will vary with aircraft type.

*TSO-C151b applies only when the system is configured to enable TAWS. A TERRAIN configuration only partially complies with TSO-C151b, excluding audio, excessive rate of descent alerting, negative climb rate alerting, altitude loss after takeoff alerting, the 500 foot voice callout, and the TAWS self test capability. Hence, TSO-C151b does not apply to units without the TAWS configuration.

**Applies only when installed with a GIA 63 (non-WAAS unit).

***Applies only when installed with a GIA 63W (WAAS unit).

† The GDU 1500 meets the requirements of TSO-C113 and SAE AS8034, and additional requirements from SAE ARP4256A.

†† Applies only when installed with a Bendix/King KRA-405B.

1.5.2 TSO Deviations

TSO	Deviation
TSO-C2d	<p>1. Garmin was granted a deviation from TSO-C2d to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.</p> <p>2. Garmin was granted a deviation from TSO-C2d to use SAE AS 8019A instead of SAE AS 8019 as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>3. Garmin was granted a deviation from TSO-C2d to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>4. Garmin was granted a deviation from TSO-C2d to eliminate the requirement 3.2.3 in SAE AS 8019A that requires “the instrument face to be marked with ‘Airspeed’ or ‘IAS’ and also with the applicable units of measure.” The GDU10XX is a multi-function display and not dedicated to Airspeed information. Therefore, the display will indicate Airspeed or TAS but the face of the instrument will not be marked.</p> <p>5. Garmin was granted a deviation from TSO-C2d to modify the requirement 3.2.5 in SAE AS 8019A that requires “The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular.” Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction. The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.</p>
TSO-C3d	<p>1. Garmin was granted a deviation from TSO-C3d to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>2. Garmin was granted a deviation from TSO-C3d to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.</p> <p>3. Garmin was granted a deviation from TSO-C3d to modify the requirement 3.7 in SAE AS 8004 that requires “The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular.” Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction. The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.</p>
TSO-C4c	<p>1. Garmin was granted a deviation from TSO-C4c to use SAE AS 8001 instead of SAE AS 396B for Minimum Performance Standards and Environmental Standards.</p> <p>2. Garmin was granted a deviation from SAE Aerospace Standard AS 8001 to use RTCA DO-160E instead of RTCA DO-138 as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>3. Neither TSO-C4c nor SAE Aerospace Standard AS 8001 specifies use of a standard for software development; Garmin intends to use RTCA DO-178B as the standard for Software Considerations in Airborne Systems and Equipment Certification.</p>
TSO-C6d	<p>1. Garmin was granted a deviation from TSO-C6d to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>2. Garmin was granted a deviation from TSO-C6d to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.</p> <p>3. Garmin was granted a deviation from TSO-C6d to use SAE AS 8013A instead of SAE AS 8013 as the Minimum Performance Standard.</p> <p>4. Garmin was granted a deviation from TSO-C6d to modify the requirement 3.10.2 in SAE AS 8013A that requires “The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular.” Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction. The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.</p>

TSO Deviations, continued	
TSO	Deviation
TSO-C8d	<p>1. Garmin was granted a deviation from TSO-C8d to use RTCA DO-160E instead of RTCA DO-160C as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>2. Garmin was granted a deviation from TSO-C8d to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.</p> <p>3. Garmin was granted a deviation from TSO-C8d to use SAE AS 8016A instead of SAE AS 8016 as the Minimum Performance Standard</p> <p>4. Garmin was granted a deviation from TSO-C8d to modify the requirement 3.2.4 in SAE AS 8016A that requires “The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular.” Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction. The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.</p>
TSO-C9c	<p>1. Garmin was granted a deviation from AS-402B paragraph 4.4.1 to limit autopilot engagement to attitudes considered safe for the certified aircraft. This may vary for each aircraft certification, but would typically be less than 45 degrees of roll and between 25 degrees nose up and 20 degrees nose down. The system is not designed to perform safe recoveries from attitudes outside this range. This limitation is consistent with many currently certified AFCS systems.</p> <p>2. Garmin was granted a deviation from TSO-C9c to use SAE AS-402B instead of AS-402A. The justification for this deviation is to use the latest accepted environmental standards.</p> <p>3. Garmin was granted a deviation from TSO-C9c to use DO-160E instead of specified environmental tests. The justification for this deviation is to use the latest accepted environmental standards.</p> <p>4. Garmin was granted a deviation from TSO-C9c subpart A (c), which requires marking the weight of the unit on the unit. Garmin will provide this information in the installation manual in lieu of marking on the serial tag. Garmin does not currently list the weight on other avionics units.</p> <p>5. Garmin was granted a deviation from AS402B paragraph 4.3.2 to not provide servo effort indications when the automatic pilot is not engaged. The GFC 700 design does not allow servo effort when the autopilot is not engaged and, therefore, this indication is unnecessary. Furthermore, when the autopilot is engaged, the FD command bars will provide indication of unsatisfied errors in the system, denoting servo effort in the indicated direction. The GFC 700 system also indicates significant mistrims with an amber visual warning message, which includes the direction of the mistrim. Garmin believes that these indications satisfy the intent of this paragraph when the autopilot is engaged.</p>
TSO-C10b	<p>1. Garmin was granted a deviation from TSO-C10b to use SAE AS 8009A instead of SAE AS 392c as the Minimum Performance Standard.</p> <p>2. Garmin was granted a deviation from TSO-C10b to use RTCA DO-160E instead of RTCA DO160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>3. Garmin was granted a deviation from TSO-C10b to modify the requirement 3.7 in SAE AS 8009A that requires “Pointers and dial markings shall be visible from any point within the frustrum of a cone; the side of which makes an angle of 30 degrees with the perpendicular to the dial and the small diameter of which is the aperture the instrument case.” Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction. The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.</p> <p>4. Garmin was granted a deviation from SAE AS 8009A Section 3.11 to not display ALTITUDE or ALT next to the tape indicating altitude. The GDU 10XX, as do many other Electronic Flight Instrumentation Systems (EFIS), presents a scrolling altitude tape with digital readout in a standardized format and location that does not need the specific label of ALTITUDE or ALT. The altitude tape is presented directly to the right of the attitude indication on the primary flight display.</p>

TSO Deviations, continued	
TSO	Deviation
TSO-C34e	<p>1. Garmin was granted a deviation from TSO-34e to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>2. Garmin was granted a deviation from TSO-C34e to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.</p>
TSO-C35d	<p>1. Garmin was granted a deviation from TSO-C35d to use RTCA DO-160E instead of RTCA DO-138 as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>2. Garmin was granted a deviation from TSO-C35d to use FAR §21.607(d) instead of FAR §37.7 as the general rules governing holders of the TSO authorizations.</p> <p>3. Garmin was granted a deviation from TSO C-35d which calls out RTCA DO-143 Section 2.15 to allow the visual indication of the Standard Test Signal to not flash synchronized with the keying, but to flash at the following fixed rates while keyed: Outer 1.33 Hz, Middle 3 Hz, Inner 4 Hz. An inner marker beacon has a dot repetition rate of 6 dots per second that is equivalent to an 83ms dot duration. Incandescent bulbs have historically been used for this function and cannot turn on and off at this rate. The proposed flash rates of 1.33 Hz, 3 Hz and 4 Hz provide optimum visual recognition and aural association which is superior to literal compliance with the TSO requirement for synchronization.</p>
TSO-C36e	<p>1. Garmin was granted a deviation from TSO36e to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>2. Garmin was granted a deviation from TSO-C36e to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.</p>
TSO-C37d	<p>1. Garmin was granted a deviation from TSO-C37d to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.</p> <p>2. Garmin was granted a deviation from TSO-C37d to use RTCA DO-160E instead of RTCA DO-160C as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>3. Garmin was granted a deviation from TSO-C37d paragraph (a)(1) to allow using RTCA document DO-186a instead of RTCA document DO-186 to specify minimum performance standards.</p> <p>4. Garmin was granted a deviation from TSO-C37d paragraph (a)(5) to allow 8.33 kHz spacing in addition to the 25 kHz spacing.</p> <p>5. Garmin was granted a deviation from TSO-C37d paragraph (b)(1) to allow the marking to call out 8.33 kHz spacing in addition to the 25 kHz spacing.</p>

TSO Deviations, continued	
TSO	Deviation
TSO-C38d	1. Garmin was granted a deviation from TSO-C38d to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.
	2. Garmin was granted a deviation from TSO-C38d to use RTCA DO-160E instead of RTCA DO-160C as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
	3. Garmin was granted to deviate from TSO-C38d paragraph (a)(1) to allow using RTCA document DO-186a instead of RTCA document DO-186 to specify minimum performance standards.
	4. Garmin was granted a deviation from TSO-C38d paragraph (a)(5) to allow 8.33 kHz spacing in addition to the 25 kHz spacing.
TSO-C40c	1. Garmin was granted a deviation from TSO-C40c to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.
	2. Garmin was granted a deviation from TSO-C40c to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
TSO-C41d	1. Garmin was granted a deviation from TSO-C41d to use RTCA DO-178B instead of RTCA DO-178 to demonstrate compliance for the verification and validation of the computer software.
	2. Garmin requests a deviation from TSO-C41d to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
TSO-C43c	1. Garmin was granted a deviation from TSO-C43c to use RTCA DO-160E instead of RTCA DO-160C as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
	2. Garmin was granted a deviation from TSO-C43c to use SAE AS 8005A instead of SAE AS 8005 as the Minimum Performance Standard
TSO-C44b	1. Garmin was granted a deviation from TSO-C44b section a.3 to use DO-160E for the Environmental Standard.
	2. Garmin was granted a deviation from TSO-C44b section b.1 to not display the software part number on the outside of the unit. Notice 8110.49 paragraph 5-4.d states, "For airborne equipment having separate part numbers for hardware and software, the software part number need not be displayed on the outside of the unit, as long as it can be verified through some kind of electronic query."
	3. Garmin was granted a deviation from TSO-C44b to use SAE AS 407C instead of SAE AS 407B to demonstrate compliance for Fuel Flowmeters.
	4. Garmin was granted a deviation from TSO-C44b to modify the requirement 4.2.5 in SAE AS 407C that requires "The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular." Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction. The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.
	5. Garmin was granted a deviation from TSO-C44b to modify the requirement 4.1.1 in SAE AS 407C that requires "Type I Instruments: Rotating pointer with fixed graduated dial or counter type indication. Clockwise pointer motion shall indicate increasing rate of flow." Garmin instead will define the gauge as a horizontal or vertical bar with fixed graduations, with a pointer motion to the right or up indicating an increase rate of flow. Engine indications presented on an EFIS are typically smaller than done with standalone electromechanical instruments. Due to these physical space constraints and issues of display clutter, Garmin believes an equivalent or improved indication can be provided by using a horizontal or vertical bar with right or up indicating increased flow. Garmin believes the up or right movement of the indication is consistent with the intent of the TSO.

TSO Deviations, continued	
TSO	Deviation
TSO-C45a	<p>1. Garmin was granted a deviation from TSO-45a to use RTCA DO-160E instead of RTCA DO-160C as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.</p> <p>2. Garmin was granted a deviation from TSO-45a SAE 8042 3.10.5 to use MAN as abbreviation instead of MANIFOLD PRESSURE or MANIF PRESS. Engine indications presented on an EFIS are typically smaller than done with standalone electromechanical instruments. Due to these physical space constraints and issues of display clutter, Garmin believes an equivalent or improved indication can be provided by using the terminology “MAN” in a conspicuous and obvious location on the manifold pressure indication on the EFIS display.</p> <p>3. Garmin was granted a deviation from TSO-C45a to modify the requirement 3.10.9 in SAE AS 8042 that requires “The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular.” Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction . The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.</p>
TSO-C47	<p>1. Garmin was granted a deviation from TSO-C47 to use SAE AS 408C instead of SAE AS 408A for Minimum Performance Standards and Environmental Standards.</p> <p>2. Garmin was granted a deviation from TSO-C47 to modify the requirement 4.1.5 in SAE AS 408C that requires “The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular.” Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction. The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.</p> <p>3. Garmin was granted a deviation from TSO-C47 to use RTCA DO-160E instead of AS 408C as the standard for Environmental Standards.</p>
TSO-C49b	<p>1. Garmin was granted a deviation from TSO-C49b to use SAE AS 404C instead of SAE AS 404B for Minimum Performance Standards and Environmental Standards.</p> <p>2. Garmin was granted a deviation from TSO-C49b to modify the requirement 4.1.2 in SAE AS 404C that requires “The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular.” Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction. The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.</p> <p>3. Garmin was granted a deviation from TSO-C49b, SAE AS 404C requirement 4.1.3.2, second sentence which states, “The increment between graduations shall not exceed 2-1/2% of full scale, above 600 RPM.” Since the Garmin tachometer gauge incorporates a full time digital readout, multiple graduations on the dial are not needed in order for the correct reading to be obtained. The resolution of the digital readout will be 10 RPM which is less than 2-1/2% of full scale. The tachometer as a whole will be a multicolor arc with graduations at the beginning and end, a pointer with clockwise motion for increasing RPM, and a digital readout.</p> <p>4. Garmin was granted a deviation from TSO-C49b to use DO-160E instead of SAE AS 407B as the Environmental Standard. Garmin also believes the listing of “AS 407B” is a typographical error where “AS 404B” should have been indicated as the Environmental Standard.</p>

TSO Deviations, continued	
TSO	Deviation
TSO-C52b	1. Garmin was granted a deviation from AS-8008 paragraph 3.6 to limit flight director operation to attitudes considered safe for the certified aircraft. This may vary for each aircraft certification, but would typically be less than 45 degrees of roll and between 25 degrees nose up and 20 degrees nose down. The system is not designed to perform safe recoveries from attitudes outside this range. This limitation is consistent with many currently certified AFCS systems.
	2. Garmin was granted a deviation from TSO-52b to use RTCA DO-160E instead of RTCA DO-160C as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
TSO-C55	1. Garmin was granted a deviation from TSO-C55 to use SAE AS 405C instead of SAE AS 405B to demonstrate compliance for Fuel and Oil Quantity Instruments.
	2. Garmin was granted a deviation from TSO-C55 to modify the requirement 4.2.5 in SAE AS 405C that requires "The indicating means to be visible from all points on a surface defined as making an angle of 30 degrees with the perpendicular." Garmin instead will define the viewing envelope (per TSO-C113 and SAE AS8034 Section 4.2) as 45 degrees in both horizontal directions, 45 degrees in the up vertical direction, and 10 degrees in the down vertical direction . The 45 degree down vertical viewing requirement is not practical or needed for panel mount displays. This requested envelope is consistent with TFT LCD display technology.
	3. Garmin was granted a deviation from TSO-C55 to modify the requirement 4.2.4 in SAE AS 405C to allow "FUEL QTY" to be used to abbreviate "Fuel Quantity". Engine indications presented on an EFIS are typically smaller than done with standalone electromechanical instruments. Due to these physical space constraints and issues of display clutter, Garmin believes an equivalent or improved indication can be provided by using the terminology "FUEL QTY" in a conspicuous and obvious location on the manifold pressure indication on the EFIS display.
	4. Garmin was granted a deviation to use RTCA/DO-160E for the Environmental Standard. Other members of the GDU 1XXX family, specifically the GDU 10XX units, were previously tested to RTCA/DO-160D.
TSO-C63c	1. Garmin was granted a deviation from TSO-63c to use RTCA DO-160E instead of RTCA DO-160A as the standard Environmental Conditions and Test Procedures for Airborne Equipment.
	2. Garmin was granted a deviation from TSO-63c to use RTCA DO-178B instead of RTCA DO-178 to demonstrate compliance for the verification and validation of the computer software.
TSO-C66c	1. Garmin was granted a deviation from TSO-C66c to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.
	2. Garmin was granted a deviation from TSO-C66c to use RTCA DO-160E instead of RTCA DO-160C as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
TSO-C74c	1. Garmin was granted a deviation from TSO-C74c section (c) Marking to allow the environmental categories to be left off of the S/N Tag.
	2. Garmin was granted a deviation to use RTCA/DO-160E for the Environmental Standard. Other members of the GDU 1XXX family, specifically the GDU 10XX units, were previously tested to RTCA/DO-160D.
TSO-C87	1. Garmin was granted a deviation from TSO-C87 to use RTCA/DO-160E instead of the FAA Document for "Environmental Test Procedures for Airborne Electronic Equipment," dated August 31, 1962.
TSO-C110a	1. Garmin was granted a deviation from TSO-C110a to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.
	2. Garmin was granted a deviation from TSO-C110a to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
TSO-C112	1. Garmin was granted a deviation from TSO-C112 to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.
	2. Garmin was granted a deviation from TSO-C112 to use Section 2 of RTCA DO-181C to meet the minimum performance standard instead of the revisions DO-181 revisions and changes listed. DO-181C contains all the revisions listed by the TSO.
	3. Garmin was granted a deviation from TSO-C112 to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.

TSO Deviations, continued	
TSO	Deviation
TSO-C113	1. Garmin was granted a deviation from TSO-C113 to use RTCA DO-178B instead of RTCA DO-178A to demonstrate compliance for the verification and validation of the computer software.
	2. Garmin was granted a deviation from TSO-C113 to use RTCA DO-160E instead of RTCA DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
TSO-C118	1. Garmin was granted a deviation from TSO-C118 to use RTCA/DO-178B sections 2 through 11 instead of RTCA/DO-178A to demonstrate compliance for the verification and validation of the computer software.
	2. Garmin was granted a deviation from TSO-C118 to use RTCA/DO-160E instead of RTCA/DO-160B as the standard for Environmental Conditions and Test Procedures for Airborne Equipment.
	3. Garmin was granted a deviation from TSO-C118 to use RTCA/DO-197A instead of RTCA/DO-197 as the Minimum Operational Performance Standards.
TSO-C129a	1. Garmin was granted a deviation from TSO-C129a to use DO-160E instead of DO-160C for the environmental standard.
	2. Garmin was granted a deviation from TSO-C129a to eliminate the annunciation for pending CDI scale change 3.0 NM from the FAF.
	3. Garmin was granted a deviation from TSO-C129a involving the use of GPS calibrated altitude in approach mode.
	4. Garmin was granted a deviation from TSO-C129a to extend automatic CDI sensitivity changes to non-approach mode navigation.
	5. Garmin was granted a deviation from TSO-C129a to eliminate the requirement in (a)(3)(xi)1.b.ii to "alert the pilot of the need to manually insert the barometric pressure".
	6. Garmin was granted a deviation from TSO-C129a to modify the requirement (a)(3)(xii)(3) to allow the approach mode to be deselected by performing a direct-to action on the unit. This action will require pressing the "DIR" button followed by the "ENT" button. All other requirements of section (a)(3)(xii)(3) will be met.
	7. Garmin was granted a deviation from TSO-C129a to eliminate the requirement in (a)(3)(xv)4.b to provide a "means to manually identify a satellite that is expected to be unavailable at the destination (for scheduled maintenance as identified in FAA Notice to Airmen) shall be provided" for the RAIM prediction process.
	8. Garmin was granted a deviation from TSO-C129a to change the requirement in paragraph (a)(7)(ii) to match the WAAS TSO-C145a and DO-229 requirements for Power input testing. Paragraph (a)(7)(ii) shall be re-worded as follows: The equipment shall output a valid position within 10 seconds after any power fluctuations identified in paragraphs 2.4.13.1 of DO-208. During the normal operating conditions tests (DO-208 2.4.13.1), the equipment shall continue to provide valid navigation information throughout the test. During the abnormal operation conditions tests (DO-208 2.4.13.2), it is acceptable to indicate a loss of navigation function and the equipment shall output a valid position within 5 minutes after any power fluctuations. For the voltage spike conducted tests, (DO-208 2.4.14), the equipment shall continue to provide valid navigation information throughout the test.

TSO Deviations, continued	
TSO	Deviation
TSO-C146a	<p>1. Garmin was granted a deviation from RTCA/DO-229C 2.2.1.1.4.3 which states, "They [all displays] shall be fully readable up to a vertical viewing angle of 20 degrees from normal to the face of the display screen." Garmin requests a deviation to use a 10 degree vertical viewing angle below the lower display edge. DO-229C makes no distinction between upper and lower display edges for the requirement of a 20 degree vertical viewing angle. The GDU 1500 will not be installed in a manner that requires a viewing angle greater than 10 degrees below the lower edge.</p> <p>2. Garmin was granted a deviation from RTCA/DO-229C 2.2.1.4.9.c which states, "BRG to or from a VOR: The bearing is based on the true-to-magnetic conversion at the waypoint location, using the same magnetic conversion as used to define the path." Garmin requests a deviation to base this conversion upon the present aircraft location instead, which is how other waypoint's magnetic variation is computed.</p> <p>3. Garmin was granted a deviation from RTCA/DO-229C 2.2.4.2.3 which states, "If the aircraft is past the FPAP - (length offset), and the pilot has not already activated the missed approach, the receiver shall automatically transition to missed approach guidance." Garmin requests a deviation to not implement this requirement since it is being eliminated in DO-229D. Additionally, the GDU 1500 will use a common navigation library with other products which do not support a complete set of leg types, and thus automatically sequencing to the missed approach procedure could provide misleading guidance to the hold fix without pilot intervention to perform the required heading/altitude legs.</p> <p>4. Garmin was granted a deviation from RTCA/DO-229C 2.2.4.6.4 and 2.2.5.6.4 pertaining to the low altitude alerting function. Garmin requests a deviation to rely on the GDU 1500's TERRAIN or TAWS capabilities to avoid CFIT when TERRAIN or TAWS are enabled and not in one of the following states: FAIL, N/A, TEST, or INHIBIT. Garmin will use the low altitude alert described in DO-229C 2.2.4.6.4 and 2.2.5.6.4 when neither TERRAIN nor TAWS is enabled, or when one is enabled but the current state is FAIL, N/A, TEST, or INHIBIT.</p> <p>5. Garmin was granted a deviation to use RTCA/DO-160E for the Environmental Standard. Other members of the GDU 1XXX family, specifically the GDU 10XX units, were previously tested to RTCA/DO-160D.</p> <p>6. Garmin was granted a deviation from TSO-C146a 5.c(2) which states, " If the appliance accomplishes any additional functions beyond that described in paragraphs 3 and 3a of this TSO or covered by another TSO authorization, then a copy of the data and information specified in paragraphs 5a(13) and (14) must also go to each person receiving for use one or more articles manufactured under this TSO." TSO-C146a 5.a(13) primarily states "A list of all drawings and processes, including revision level, necessary to define the article's design." TSO-C146a 5.a(14) primarily states "If the article includes software: Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary." Garmin requests a deviation to not furnish each person receiving a GDU 1500 copies of the above data for the following reasons:</p> <ul style="list-style-type: none"> • This data is primarily concerned with defining design information necessary to manufacture and certify, not operate or install, the equipment. • The information in this data is considered proprietary and is not generated with the intent for use by customers who intend to operate or install the equipment. • Garmin adequately documents the other TSO authorizations and non-TSO functions provided by the GDU 1500 in the Installation Manual that is provided to installers for use in determining its certification basis and suitability for a particular installation. • Newer TSOs, such as TSO-C169, do not have a similar requirement to furnish this data to customers. <p>7. RTCA/DO-229C 2.2.1.1.6 states: "If a function is implemented as a discrete action, the equipment shall use the labels or messages in the Table". The table (TABLE 2-5 LABELS AND MESSAGES), states that the function "Indication that there is a message" shall be labeled as "MSG" or "M".</p> <p>Garmin was granted a deviation to use the terms "ADVISORY" and "ALERTS" in addition to "MSG" depending upon the installation. The GDU 1XXX family provides full aircraft alerting in its installations. Per OEM request, some installations use the nomenclature of ADVISORY and ALERTS to encompass message advisories.</p>

TSO Deviations, continued	
TSO	Deviation
TSO-C147	1. Garmin was granted a deviation to use RTCA/DO-160E for the Environmental Standard. Other members of the GDU 1XXX family, specifically the GDU 10XX units, were previously tested to RTCA/DO-160D.
TSO-C151b	<p>1. Garmin was granted a deviation from TSO-C151b 5.c(2) which states, " If the appliance accomplishes any additional functions beyond that described in paragraphs 3 and 3a of this TSO, than [sic] a copy of the data and information specified in paragraphs 5a(11) through (13) must also go to each person receiving for use one or more articles manufactured under this TSO."</p> <p>TSO-C151b 5.a(11) states "An environmental qualification form as described in RTCA/DO-160D or the most current revision for each component of the TAWS equipment."</p> <p>TSO-C151b 5.a(12) primarily states "A list of all drawings and processes, including revision level, necessary to define the article's design."</p> <p>TSO-C151b 5.a(13) primarily states "If the article includes software: Plan for Software Aspects of Certification (PSAC); Software Configuration Index; and Software Accomplishment Summary."</p> <p>Garmin was granted a deviation to not furnish each person receiving a GDU 1XXX copies of the data in 5.a(12) and 5.a(13) for the following reasons:</p> <ul style="list-style-type: none"> • This data is primarily concerned with defining design information necessary to manufacture and certify, not operate or install, the equipment. • The information in this data is considered proprietary and is not generated with the intent for use by customers who intend to operate or install the equipment. • Garmin adequately documents the other TSO authorizations and non-TSO functions provided by the GDU 1XXX in the Installation Manual that is provided to installers for use in determining its certification basis and suitability for a particular installation. <p>Newer TSOs, such as TSO-C169, do not have a similar requirement to furnish this data to customers.</p> <p>2. Garmin was granted a deviation to use RTCA/DO-160E for the Environmental Standard. Other members of the GDU 1XXX family, specifically the GDU 10XX units, were previously tested to RTCA/DO-160D.</p>
TSO-C169	<p>1. Garmin was granted a deviation to TSO-C169, paragraph 4.e requirement to mark (DEV) after the TSO number on the equipment. Garmin will mark as follows, as TSO-C169 is not the primary TSO and the Install Manual contains all of the TSO-C169 information including deviations. TSO-C113 See Install Manual for additional TSO's</p> <p>2. Garmin was granted a deviation to use RTCA/DO-160E for the Environmental Standard. Other members of the GDU 1XXX family, specifically the GDU 10XX units, were previously tested to RTCA/DO-160D.</p>

1.5.3 Non-TSO Functions

These functions were tested to RTCA/DO-160E environmental qualifications and were demonstrated only when the GDU 1500 is installed as a component of a G1000 system.

Function	Design Assurance	Applicable LRU SW Part Numbers	Applicable Custom Logic Device Part Numbers
<p>Traffic Information Service (TIS) The GDU contains a subset of the TIS function. The Minimum Operational Performance Specifications (MOPS) for TIS are contained in RTCA/DO-239. The GDU 1500 has been demonstrated to meet these MOPS only when installed as a component in a G1000 system, using a GTX 33/GTX 33D transponder.</p>	<p>RTCA/DO-178B Level D RTCA/DO-254 Level B</p>	<p>All 006-B0319-() except 006-B0319-00 through 006-B0319-41</p>	<p>006-C0035-() 006-C0036-()</p>
<p>Configurable Minor and Major Alert Configurable alerts can provide alert information both audibly and visually. These alerts are airframe specific, and are defined during the airframe specific software upload process. The Configurable Alert function provides the logic to support the generation of alerts up to "Hazardous" level of critically, however the criticality of each alert configured with this function is considered separately and is consistent with the data used by the function to generate the alert or the capability of the display function to communicate it to the pilot/crew. Each alert provided by this function is at a criticality level that is appropriate for that alert.</p>	<p>RTCA/DO-178B Level B RTCA/DO-254 Level B</p>	<p>All 006-B0319-() except 006-B0319-00 through 006-B0319-41</p>	<p>006-C0035-() 006-C0036-()</p>
<p>En Route and Terminal Baro-altitude Vertical Navigation (BARO VNAV) Guidance based on specified altitudes at waypoints in the active flight plan or the direct-to waypoint is provided. The Minimum Operational Performance Specifications (MOPS) for BARO VNAV are based on RTCA/DO-236B and RTCA/DO-283A. It includes vertical path guidance to a descending path, which is provided to the flight crew as a linear deviation from the desired path. The desired path is defined by a line joining two waypoints with specified altitudes or as a vertical angle from a specified waypoint/altitude. The desired vertical path is pilot selectable. The vertical waypoints are integrated into the active flight plan display and thus accessible by a single press of the FPL key. A vertical direct-to function similar to the lateral direct-to feature is provided. Both manual and autopilot-coupled guidance are supported. Compensation of altitudes at extreme cold temperatures is not provided. No performance management related capability, such as speed control, is provided.</p>	<p>RTCA/DO-178B Level C RTCA/DO-254 Level B</p>	<p>All 006-B0319-() except 006-B0319-00 through 006-B0319-49</p>	<p>006-C0035-() 006-C0036-()</p>

1.6 Reference Documents

The following publications are sources of additional information for installing the GDU 1500. Before installing the GDU 1500, the technician should read all referenced materials along with the manual.

Part Number	Document
190-00303-00	G1000 System Installation Manual
190-00303-04	G1000 Line Maintenance and Configuration Manual

1.7 Limited Warranty

This Garmin product is warranted to be free from defects in materials or workmanship for two years from the date of purchase. Within this period, Garmin will at its sole option, repair or replace any components that fail in normal use. Such repairs or replacement will be made at no charge to the customer for parts or labor, provided that the customer shall be responsible for any transportation cost. This warranty does not cover failures due to abuse, misuse, accident or unauthorized alteration or repairs.

THE WARRANTIES AND REMEDIES CONTAINED HEREIN ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES EXPRESS OR IMPLIED OR STATUTORY, INCLUDING ANY LIABILITY ARISING UNDER ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, STATUTORY OR OTHERWISE. THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, WHICH MAY VARY FROM STATE TO STATE.

IN NO EVENT SHALL GARMIN BE LIABLE FOR ANY INCIDENTAL, SPECIAL, INDIRECT OR CONSEQUENTIAL DAMAGES, WHETHER RESULTING FROM THE USE, MISUSE, OR INABILITY TO USE THIS PRODUCT OR FROM DEFECTS IN THE PRODUCT. Some states do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you.

Garmin retains the exclusive right to repair or replace the unit or software or offer a full refund of the purchase price at its sole discretion. SUCH REMEDY SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY BREACH OF WARRANTY.

To obtain warranty service, contact your local Garmin Authorized Service Center. For assistance in locating a Service Center near you, call Garmin Customer Service at one of the numbers shown below.

Products sold through online auctions are not eligible for rebates or other special offers from Garmin. Online auction confirmations are not accepted for warranty verification. To obtain warranty service, an original or copy of the sales receipt from the original retailer is required. Garmin will not replace missing components from any package purchased through an online auction.

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2 INSTALLATION OVERVIEW

2.1 Introduction

This section provides hardware equipment information for installing the GDU 1500 and related hardware. Installation of the GDU 1500 should follow the aircraft TC or STC requirements. Cabling is fabricated by the installing agency to fit each particular aircraft. The guidance of FAA advisory circulars AC 43.13-1B and AC 43.13-2A, where applicable, may be found useful for making retro-fit installations that comply with FAA regulations. Refer to the G1000 System Installation manual, Garmin part number 190-00303-00, for further details on the mechanical aspects of the G1000 system.

2.1.1 Unit Configurations

The GDU 1500 is only available as a single unit under the following part numbers:

NOTE

All units are black, unless otherwise noted.

Item	Applicable LRU SW Part Numbers	Applicable Custom Logic Device Part Numbers	Garmin P/N
GDU 1500 Unit Only, (011-01108-00)	006-B0319-() except 006-B0319-00 through 006-B0319-41	006-C0035-() 006-C0036-()	010-00387-00

2.1.2 Required Accessories

Each of the following accessories is provided separately from the GDU 1500 unit and is required to install the unit.

Item	Garmin P/N
GDU 10XX Connector Kit w/SPIDER	011-00820-00
GDU 10XX Connector Kit w/Shield Block	011-00820-01
GDU 1500 Mounting Hardware	011-01175-XX (See Section 2.5)

2.2 Installation Considerations

Fabrication of a wiring harness is required. Sound mechanical and electrical methods and practices are required for installation of the GDU 1500.

2.3 Cabling and Wiring

Use AWG #24 or larger wire for all connections unless otherwise specified by the aircraft manufacturer or Garmin. The standard pin contacts supplied in the connector kit are compatible with up to AWG #22 wire. In cases where some installations have more than one unit sharing a common circuit breaker, sizing and wire gauge is based on aircraft circuit breaker layout, length of wiring, current draw of units, and internal unit protection characteristics. Do not attempt to combine more than one unit on the same circuit breaker unless it is specified on aircraft manufacturer approved drawings.

In some cases, a larger gauge wire such as AWG #18 or #16 may be needed for power connections. The provided connector kit supplies extended barrel contacts for AWG #16 and #18 wire, if required. Special thin-wall heat shrink tubing is also provided to insulate the extended barrels inside the backshell. If using #16 or #18 barrel contacts, ensure that no two contacts are mounted directly adjacent to each other. This minimizes the risk of contacts touching and shorting to adjacent pins and to ground.

Ensure that routing of the wiring does not come in contact with sources of heat, RF or EMI interference. Check that there is ample space for the cabling and mating connectors. Avoid sharp bends in cabling and routing near aircraft control cables.

2.4 Cooling Requirements

Refer to the G1000 System Installation manual, Garmin part number 190-00303-00, for information on G1000 system cooling requirements.

2.5 Mounting Requirements

The GDU 1500 mounting hardware is designed to accommodate various sheet metal panel thickness (see the following table).

GDU Mounting Hardware P/N	Sheet Metal Panel Thickness
011-01175-00	0.080" \pm 0.005
011-01175-01	0.125" \pm 0.005
011-01175-02	0.090" \pm 0.005
011-01175-03	0.100" \pm 0.005

The locking socket (See Figure 2-1) can be attached by using a rivet or screw. If using rivets, the rivet should be a 1/8" flat head 100° countersunk solid rivet. If using screws, the screw should be #4-40 flat head 100° countersunk screws with standard hex nuts on the back. If screws are used, thread locking compound (Loctite or equivalent) or a self locking nut with a nylon locking feature should be used. The specified screws and rivets are designed to provide a flush front surface. See Figure B-1 for the GDU Panel Cutout.

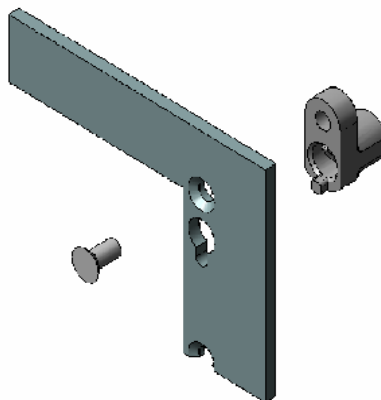


Figure 2-1. GDU 1500 Locking Socket

3 INSTALLATION PROCEDURE

3.1 Unpacking Unit

Carefully unpack the equipment and make a visual inspection of the unit for evidence of damage incurred during shipment. If the unit is damaged, notify the carrier and file a claim. To justify a claim, save the original shipping container and all packing materials. Do not return the unit to Garmin until the carrier has authorized the claim. Retain the original shipping containers for storage. If the original containers are not available, a separate cardboard container should be prepared that is large enough to accommodate sufficient packing material to prevent movement.

3.2 Wiring Harness Installation

Allow adequate space for installation of cables and connectors. The installer shall supply and fabricate all of the cables. All wiring must be in accordance with FAA AC 43.13-1B. All electrical connections are made through a single 62-pin high-density D subminiature connector. Section 4 defines the electrical characteristics of all input and output signals. Required connectors and associated hardware are supplied with the connector kit.

See Appendix B for examples of interconnect wiring diagrams. Construct the actual harness in accordance with aircraft manufacturer authorized interconnect standards.

Table 3-1. Pin Contact Part Numbers

Manufacturer	62 pin D-Subminiature connector (P10001)		
	16 AWG (Power Only)	18-20 AWG	22-28 AWG
Garmin P/N	336-00044-01	336-00044-00	336-00021-00
Military P/N	N/A	N/A	M39029/58-360
AMP	N/A	N/A	204370-2
Positronic	N/A	N/A	MC8522D
ITT Cannon	N/A	N/A	030-2042-000

Table 3-2. Recommended Crimp Tools

Manufacturer	Hand Crimping Tool	18-20 AWG		22-28 AWG	
		Positioner	Insertion/ Extraction Tool (note 2)	Positioner	Insertion/ Extraction Tool
Military P/N	M22520/2-01	N/A	M81969/1-04	M22520/2-09	M81969/1-04
Positronic	9507	9502-11	M81969/1-04	9502-3	M81969/1-04
ITT Cannon	995-0001-584	N/A	N/A	995-0001-739	N/A
AMP	601966-1	N/A	91067-1	601966-6	91067-1
Daniels	AFM8	K774	M81969/1-04	K42	M81969/1-04
Astro	615717	N/A	M81969/1-04	615725	M81969/1-04

NOTES

1. Non-Garmin part numbers shown are not maintained by Garmin and consequently are subject to change without notice.
2. Extracting the #16 and #18 contact requires that the expanded wire barrel be cut off from the contact. It may also be necessary to push the pin out from the face of the connector when using an extractor due to the absence of the wire. A new contact must be used when reassembling the connector.
3. For applications using 16 AWG wire, contact Garmin for information regarding connector crimp positioner tooling.

3.3 Backshell Assemblies

The GDU 10XX connector kit includes one Garmin backshell assembly. The backshell assembly houses the configuration module/temperature sensor, if applicable. Garmin's backshell also gives the installer the ability to easily terminate shield grounds at the backshell housing using one of two methods available (SPIDER or Shield Block). To assemble the backshell, configuration module, and grounding system, refer to instructions provided in the G1000 System Installation Manual (190-00303-00), as well as the SPIDER Installation Instructions (190-00313-03) and Shield Block Installation Instructions (190-00313-09).

NOTE

Information about the SPIDER grounding system is provided in support of existing installations. All new installations shall use the SHIELD BLOCK grounding system.

3.4 Unit Installation

The GDU 1500 is installed by holding the unit flush with the instrument panel. The locking studs should be oriented with the alignment marks in the vertical position for installation. A 3/32" hex drive tool is then used to turn each of the four locking sockets 1/4 turn clockwise. When locked, the alignment marks are in the horizontal position.

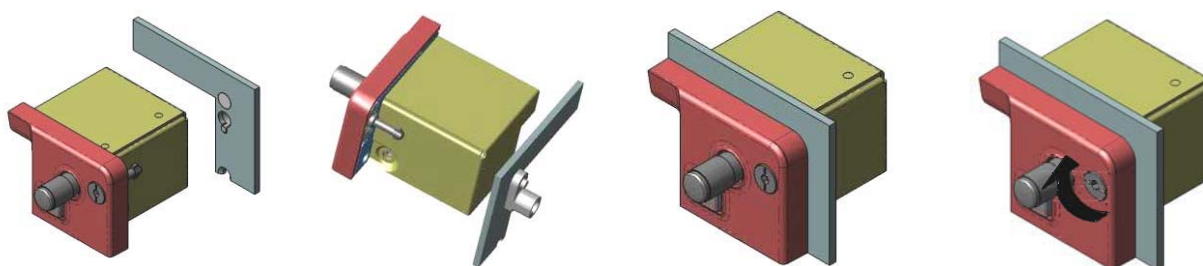


Figure 3-1. GDU 1500 1/4 Turn Fastener

3.5 Post Installation Configuration & Checkout

NOTE

The GDU 1500 does not provide valid outputs until the aircraft post installation configuration procedures are completed.

The GDU 1500 must be installed with a Garmin G1000 system and have FAA approved configuration data. Configuration data is loaded to the GDU 1500 from an aircraft-specific G1000 SW Loader Card. GDU 1500 settings are predetermined for a specific aircraft and are typically contained within the file names:

- 'AIRFRAME'
- 'SYSTEM'
- 'MANIFEST'
- 'PFD1'
- 'MFD1'
- 'PFD2' (Dual PFD installation only)

For basic configuration information, refer to the G1000 Line Maintenance and Configuration Manual, Garmin Part Number 190-00303-04. For actual aircraft installation/checkout, use only aircraft manufacturer approved checkout procedures.

3.6 Continued Airworthiness

Maintenance of the GDU 1500 is “on condition” only. For regulatory periodic functional checks, refer to approved aircraft maintenance manuals or manual supplements for actual aircraft maintenance requirements. Refer to the G1000 Line Maintenance and Configuration Manual (Garmin part number 190-00303-04) for a list of possible periodic maintenance instructions.

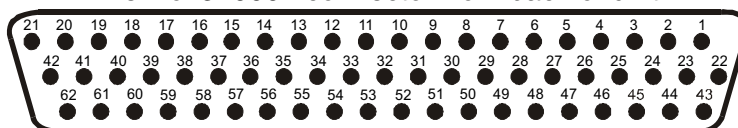
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4 SYSTEM INTERCONNECTS

4.1 Pin Function List

4.1.1 P10001 Connector

View of J10001 connector from back of unit



Pin	Pin Name	I/O
1	CONFIG MODULE GROUND	Out
2	ETHERNET OUT 1 A	Out
3	ETHERNET OUT 1 B	Out
4	ETHERNET IN 1 A	In
5	ETHERNET IN 1 B	In
6	ETHERNET OUT 2 A	Out
7	ETHERNET OUT 2 B	Out
8	ETHERNET IN 2 A	In
9	ETHERNET IN 2 B	In
10	ETHERNET OUT 3 A	Out
11	ETHERNET OUT 3 B	Out
12	ETHERNET IN 3 A	In
13	ETHERNET IN 3 B	In
14	FAN MONITOR VALID*	In
15	REVERSIONARY MODE SELECT 2	In
16	ARINC 429 IN 2 A	In
17	ARINC 429 IN 2 B	In
18	ARINC 429 IN 1 A	In
19	ARINC 429 IN 1 B	In
20	RESERVED	--
21	RESERVED	--
22	CONFIG MODULE DATA	I/O
23	CONFIG MODULE POWER OUT	Out
24	RESERVED	--
25	RESERVED	--
26	SIGNAL GROUND	--
27	POWER GROUND	--
28	RESERVED	--
29	POWER GROUND	--
30	SIGNAL GROUND	--
31	POWER GROUND	--
32	SIGNAL GROUND	--
33	POWER GROUND	--
34	SIGNAL GROUND	--

Connector P10001, continued		
Pin	Pin Name	I/O
35	AIRCRAFT POWER 1	In
36	SIGNAL GROUND	--
37	AIRCRAFT POWER 1	In
38	SIGNAL GROUND	--
39	AIRCRAFT POWER 2	In
40	SIGNAL GROUND	--
41	AIRCRAFT POWER 2	In
42	SIGNAL GROUND	--
43	CONFIG MODULE CLOCK	Out
44	RS-232 OUT 1	Out
45	RS-232 IN 1	In
46	RS-232 OUT 2	Out
47	RS-232 IN 2	In
48	UNIT 5 REMOTE POWER OFF	Out
49	UNIT 4 REMOTE POWER OFF	Out
50	UNIT 3 REMOTE POWER OFF	Out
51	UNIT 2 REMOTE POWER OFF	Out
52	UNIT 1 REMOTE POWER OFF	Out
53	RESERVED	--
54	DEMO MODE SELECT*	In
55	CDU SYSTEM ID PROGRAM* 1	In
56	CDU SYSTEM ID PROGRAM* 2	In
57	CDU SYSTEM ID PROGRAM* 3	In
58	REVERSIONARY MODE SELECT 1	In
59	LIGHTING BUS HI	In
60	LIGHTING BUS LO	In
61	RESERVED	--
62	RESERVED	--

* Indicates Active Low

4.2 Power

4.2.1 Power Functions

This section covers the power input requirements.

4.2.1.1 Aircraft Power

Pin Name	Connector	Pin	I/O
AIRCRAFT POWER 1	P10001	35	In
AIRCRAFT POWER 1	P10001	37	In
AIRCRAFT POWER 2	P10001	39	In
AIRCRAFT POWER 2	P10001	41	In
POWER GROUND	P10001	27	--
POWER GROUND	P10001	29	--
POWER GROUND	P10001	31	--
POWER GROUND	P10001	33	--

Pins 35 and 37 are internally connected to form AIRCRAFT POWER 1. Pins 39 and 41 are internally connected to form AIRCRAFT POWER 2. AIRCRAFT POWER 1 and AIRCRAFT POWER 2 are “diode ORed” to provide aircraft power redundancy.

4.2.1.2 Remote Power

Pin Name	Connector	Pin	I/O
UNIT 5 REMOTE POWER OFF	P10001	48	Out
UNIT 4 REMOTE POWER OFF	P10001	49	Out
UNIT 3 REMOTE POWER OFF	P10001	50	Out
UNIT 2 REMOTE POWER OFF	P10001	51	Out
UNIT 1 REMOTE POWER OFF	P10001	52	Out

Used to control power of a remote sub-system. 28 Volts DC turns the remote unit off. Ground/Open turns the remote unit on.

4.3 Configuration

4.3.1 CDU System ID Program

CDU SYSTEM ID PROGRAM 1 (P10001, Pin 55)	CDU SYSTEM ID PROGRAM 2 (P10001, Pin 56)	CDU SYSTEM ID PROGRAM 3 (P10001, Pin 57)	DISPLAY
Open	Open	Ground	MFD
Open	Open	Open	PFD1
Ground	Open	Open	PFD2

These inputs determine if the GDU 1500 is an MFD or PFD.

4.3.2 Configuration Module

Pin Name	Connector	Pin	I/O
CONFIG MODULE GROUND	P10001	1	Out
CONFIG MODULE DATA	P10001	22	I/O
CONFIG MODULE POWER OUT	P10001	23	Out
CONFIG MODULE CLOCK	P10001	43	Out

4.3.3 Reversionary Mode

Pin Name	Connector	Pin	I/O
REVERSIONARY MODE SELECT 1	P10001	58	In
REVERSIONARY MODE SELECT 2	P10001	15	In

These inputs determine whether to place the system in reversionary mode.

4.3.4 Demo Mode

Pin Name	Connector	Pin	I/O
DEMO MODE SELECT*	P10001	54	In

This is an active low input that places the unit in demo mode. This input is not to be used in aircraft installations.

4.4 Serial Data

4.4.1 RS-232

Pin Name	Connector	Pin	I/O
RS-232 OUT 1	P10001	44	Out
RS-232 IN 1	P10001	45	In
RS-232 OUT 2	P10001	46	Out
RS-232 IN 2	P10001	47	In

The RS-232 outputs conform to EIA Standard RS-232C with an output voltage swing of at least $\pm 5V$ when driving a standard RS-232 load.

4.4.2 ARINC 429

Pin Name	Connector	Pin	I/O
ARINC 429 IN 2 A	P10001	16	In
ARINC 429 IN 2 B	P10001	17	In
ARINC 429 IN 1 A	P10001	18	In
ARINC 429 IN 1 B	P10001	19	In

The ARINC 429 inputs conform to ARINC 429 electrical specifications when loaded with up to 2 standard ARINC 429 transmitters.

4.4.3 Ethernet

Pin Name	Connector	Pin	I/O
ETHERNET OUT 1 A	P10001	2	Out
ETHERNET OUT 1 B	P10001	3	Out
ETHERNET IN 1 A	P10001	4	In
ETHERNET IN 1 B	P10001	5	In
ETHERNET OUT 2 A	P10001	6	Out
ETHERNET OUT 2 B	P10001	7	Out
ETHERNET IN 2 A	P10001	8	In
ETHERNET IN 2 B	P10001	9	In
ETHERNET OUT 3 A	P10001	10	Out
ETHERNET OUT 3 B	P10001	11	Out
ETHERNET IN 3 A	P10001	12	In
ETHERNET IN 3 B	P10001	13	In

This Ethernet based HSDB (High Speed Data Bus) meets the hardware aspects of IEEE standard 802.3 for 10 base T Ethernet communications.

4.5 Lighting

Pin Name	Connector	Pin	I/O
LIGHTING BUS HI	P10001	59	In
LIGHTING BUS LO	P10001	60	In

The GDU 1500 display and keys can be configured to track 28 Vdc, 14 Vdc, 5 Vdc, or 5 Vac lighting busses using these inputs. Alternatively, the GDU 1500 can be configured to automatically adjust for ambient lighting conditions based on the photocell. See the G1000 Line Maintenance and Configuration manual, Garmin part number 190-00303-04, for more information.

4.6 Fan Monitor

Pin Name	Connector	Pin	I/O
FAN MONITOR VALID*	P10001	14	In

An active low input that monitors the status of the cooling fan.

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APPENDIX A OUTLINE & INSTALLATION DRAWINGS

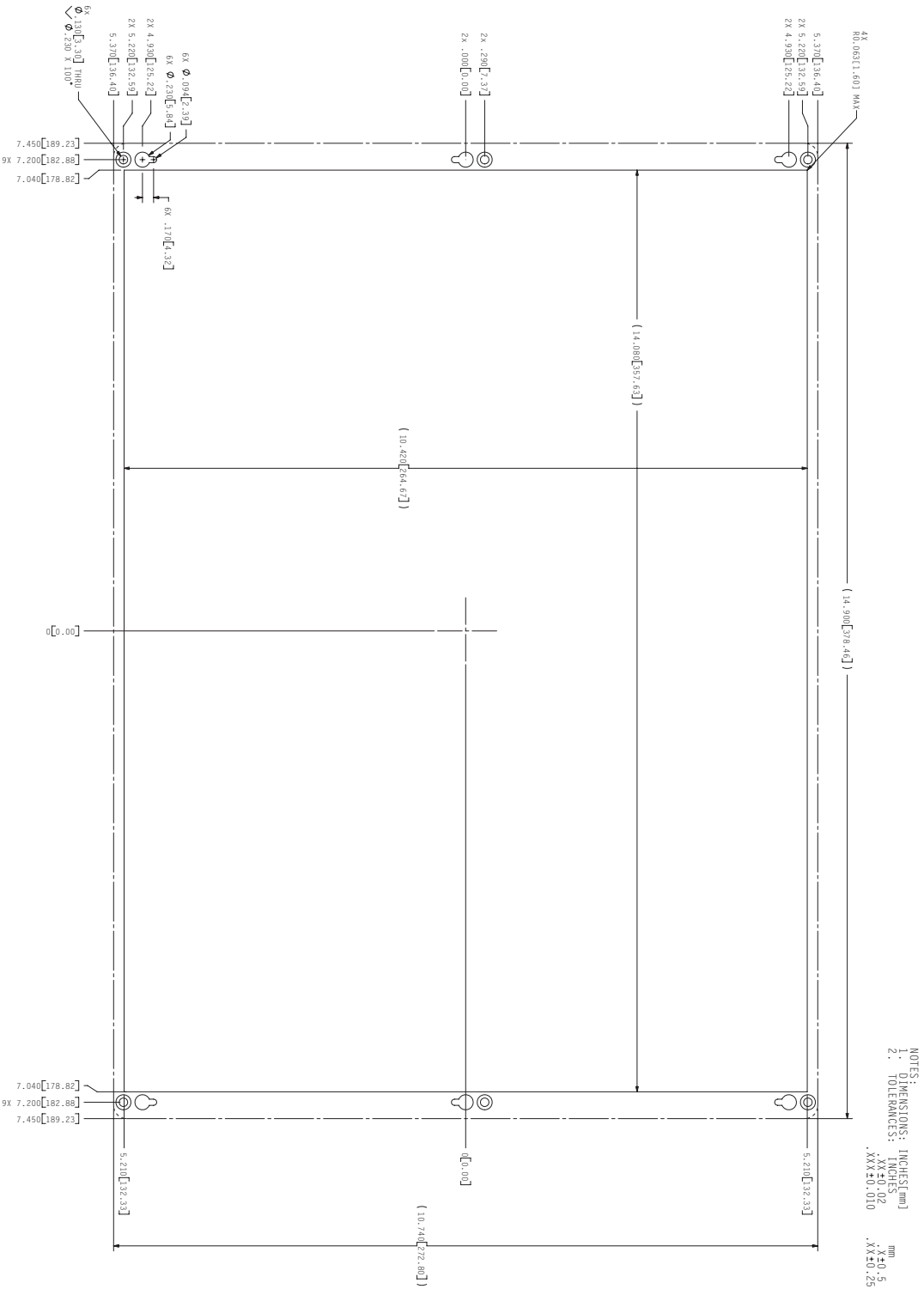


Figure A-1. GDU 1500 Cutout Drawing (Not To Scale)

APPENDIX A OUTLINE & INSTALLATION DRAWINGS

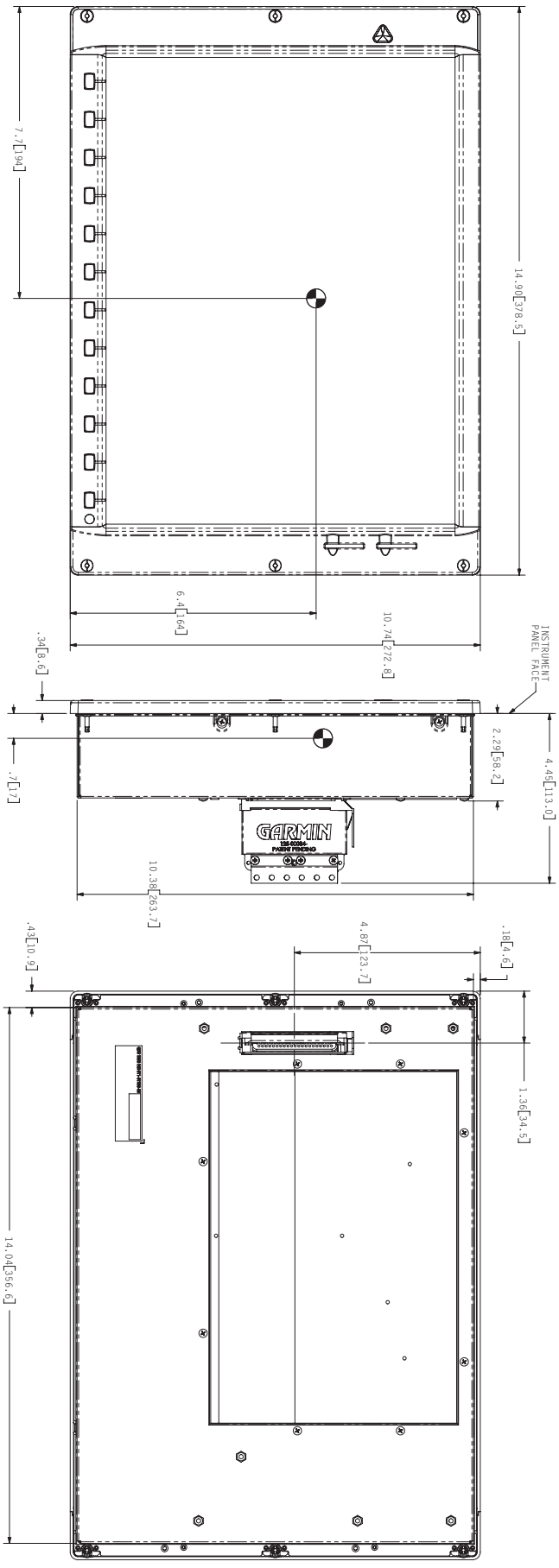


Figure A-2. GDU 1500 Outline Drawing

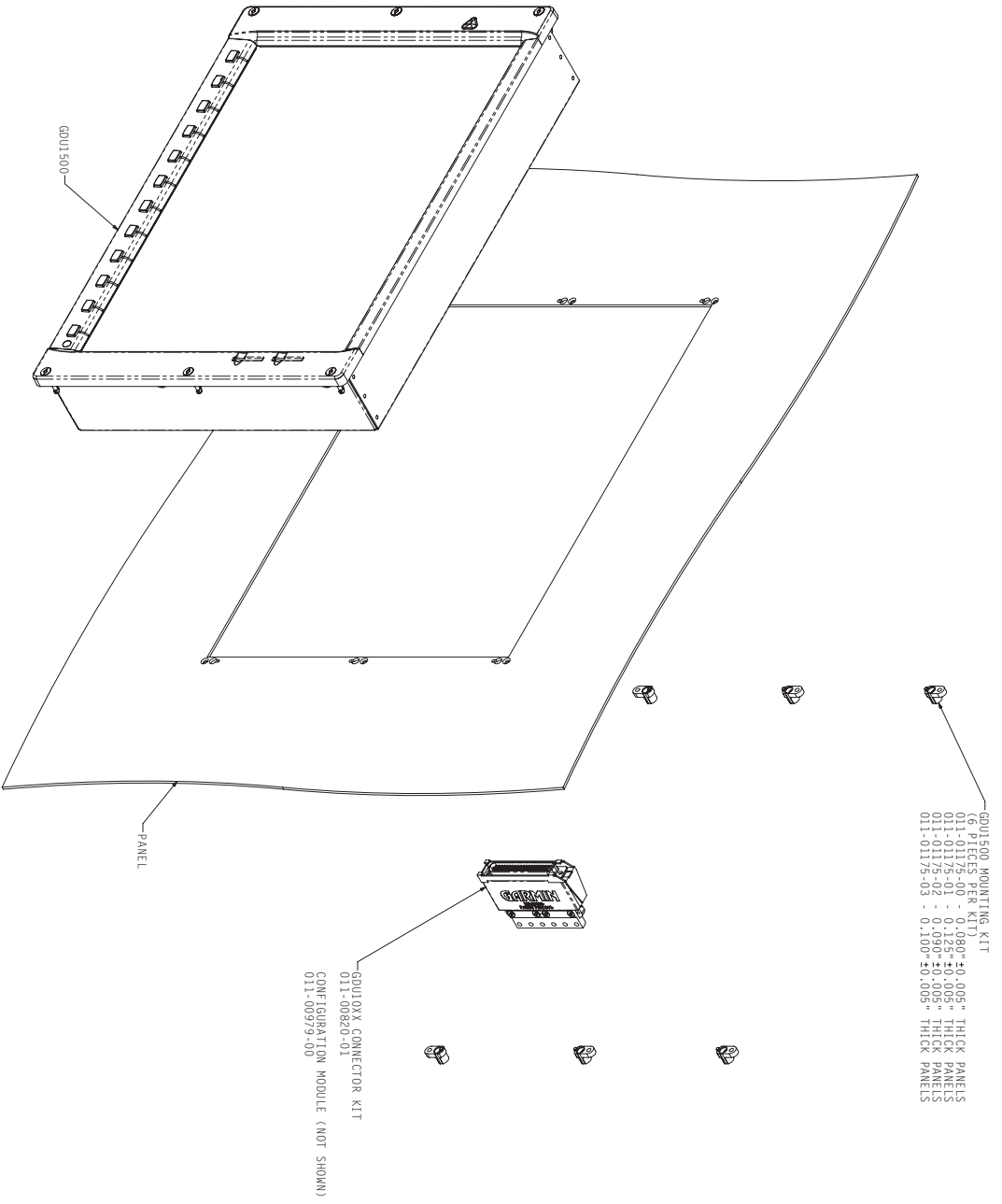
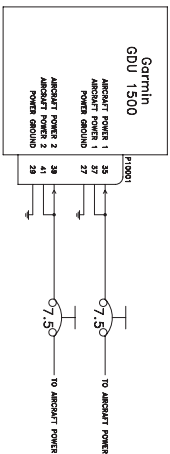
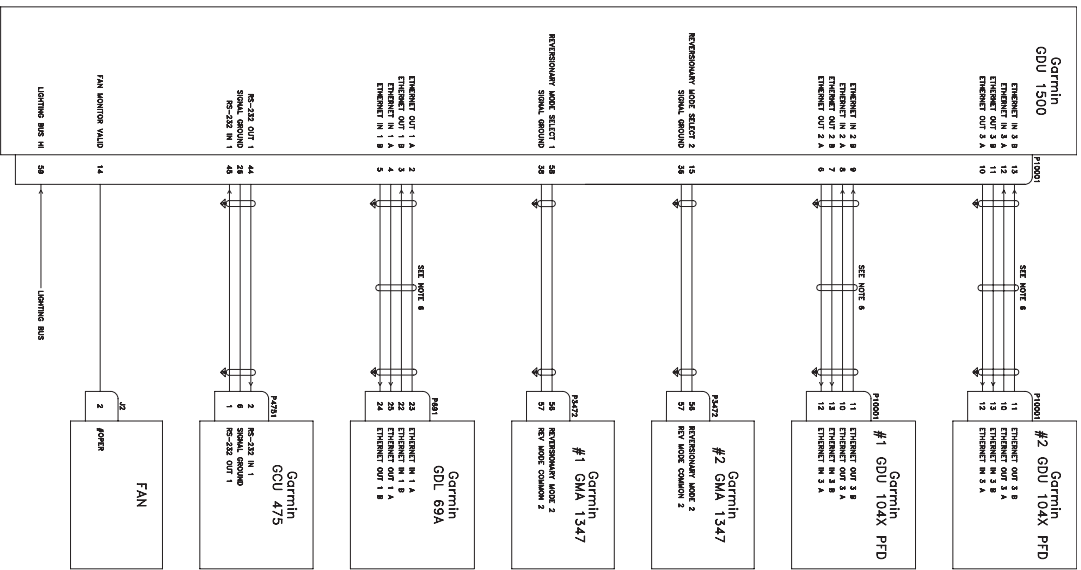


Figure A-3. GDU 1500 Installation Drawing



NOTES:

1. UNLESS OTHERWISE NOTED, ALL STRANDED WIRE MUST CONFORM TO MIL-W-22759/16 OR EQUIVALENT
2. UNLESS OTHERWISE NOTED, ALL SHIELDED WIRE MUST CONFORM TO MIL-C-27500 OR EQUIVALENT
3. UNLESS OTHERWISE NOTED, ALL WIRES ARE 24 GAUGE MINIMUM.
4. SYMBOL DESIGNATIONS
 - TWISTED SHIELDED SINGLE CONDUCTOR
 - TWISTED SHIELDED 4 CONDUCTOR SHIELD TERMINATED TO GROUND
 - TWISTED SHIELDED SINGLE CONDUCTOR SHIELD FLOATS
 - WHFT TWISTED SHIELDED PAIR
 - WHFT TWISTED SHIELDED PAIR TERMINATED TO GROUND
 - WHFT TWISTED SHIELDED PAIR FLOATS
 - WHFT TWISTED SHIELDED 3 CONDUCTOR
 - WHFT TWISTED SHIELDED 3 CONDUCTOR TERMINATED TO GROUND
 - WHFT TWISTED SHIELDED 3 CONDUCTOR FLOATS
 - WHFT TWISTED SHIELDED 3 CONDUCTOR COAXIAL CABLE
 - N/C = NO CONNECTION
5. UNLESS OTHERWISE NOTED, ALL SHIELD GROUNDS MUST BE MADE TO THE RESPECTIVE UNIT BACKSHEATHS
6. USE AIRCRAFT GRADE CATEGORY 5 ETHERNET CABLE. THESE INCLUDE ELECTRONIC CABLE SPECIALIST P/N 392404.

MANUFACTURER	P/N
PIC WIRE AND CABLE	E10422 (23 GAUGE)
PIC WIRE AND CABLE	E10424 (24 GAUGE)
ELECTRONIC CABLE SPECIALIST	392404 (24 GAUGE)

Figure B-1. GDU 1500 Example Interconnect