

# Stratus ES/ESG Installation Instructions

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## STRATUS ES AND STRATUS ESG

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### Warranty

To view the Stratus ES/ESG warranty, log into the Appareo Dealer Portal or visit www.appareo.com/resources.



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# Warnings

- The pilot must read the Stratus ES/ESG Pilot's Guide (600890-000049) before their first flight.
- Squawk codes 7500 (hijacking), 7600 (radio failure), and 7700 (emergency) are
  reserved for emergencies. There may be other reserved codes, depending on the region
  you are flying in. It is the pilot in command's responsibility to comply with their
  jurisdiction's operating rules and regulations.



# **Record of Revision**

| Revision<br>Number | Change Description                                                       | Revision Date | Inserted By |
|--------------------|--------------------------------------------------------------------------|---------------|-------------|
| 1.0                | Initial Release                                                          | 2/09/16       | AAL         |
| 1.1                | CM 11159                                                                 | 4/26/16       | AAL         |
| 1.2                | CM 11262                                                                 | 5/05/16       | AAL         |
| 1.3                | CM 11306                                                                 | 5/10/16       | AAL         |
| 1.4                | CM 11688                                                                 | 6/22/16       | AAL         |
| 1.5                | CM 13045                                                                 | 9/22/16       | AAL         |
| 2.0                | CM 13743                                                                 | 6/21/17       | AAL         |
| 2.1                | CM 14765                                                                 | 2/20/18       | AAL         |
| 2.2                | Added Note in 1.7, updated GPS sources in 1.11.1.1, added Note in 4.19.1 | 9/12/18       | VJMJ        |
| 2.3                | Updated GPS sources in 1.11.1.1                                          | 8/20/19       | VJMJ        |



# **Related Documentation**

| Document Number       | Title                                                                                 |
|-----------------------|---------------------------------------------------------------------------------------|
| Appareo 600845-000025 | Stratus ES/ESG Instructions for Continued Airworthiness                               |
| Appareo 600890-000049 | Stratus ES/ESG Pilot's Guide                                                          |
| Appareo 601837-000024 | Stratus ES/ESG Installation and Wiring Drawings                                       |
| FAA AC 20-165B        | Airworthiness Approval of Automatic Dependent Surveillance -<br>Broadcast OUT Systems |
| FAA AC 43.13-1B       | Acceptable Methods, Techniques, and Practices - Aircraft Inspection and Repair        |
| FAA AC 43.13-2B       | Acceptable Methods, Techniques, and Practices - Aircraft Alterations                  |
| RTCA DO-160G          | Environmental Conditions and Test Procedures for Airborne Equipment                   |

### **Vendor Information**

| Part                        | Vendor | Contact Information                                                                                                        |
|-----------------------------|--------|----------------------------------------------------------------------------------------------------------------------------|
| 42G15A-XT-1 (GPS antenna)   | ANTCOM | Antcom Corporation<br>367 Van Ness Way, Suite 602<br>Torrance, California 90501<br>Phone: (310) 782-1076<br>www.antcom.com |
| AV-801 (GPS antenna)        | RAMI   | Rami<br>14500 168th Avenue<br>P.O. Box 858<br>Grand Haven, MI 49417<br>Phone: (616) 842-9450<br>www.rami.com               |
| AV-74 (transponder antenna) | RAMI   | Rami<br>14500 168th Avenue<br>P.O. Box 858<br>Grand Haven, MI 49417<br>Phone: (616) 842-9450<br>www.rami.com               |

# Abbreviations, Terms, and Definitions

| Abbreviation | Term                                                  | Definition                                                                                                                                                                           |
|--------------|-------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AC           | Advisory Circular                                     | Document provided by the FAA that provides airworthiness recommendations.                                                                                                            |
| ACO          | Aircraft Certification<br>Office                      | Branch of the FAA that works with the applications for certifications.                                                                                                               |
| ADS-B        | Automatic<br>Dependent<br>Surveillance -<br>Broadcast | Technology implemented by the FAA to provide surveillance<br>and improved situational awareness to both pilots and air<br>traffic controllers.                                       |
| ATC          | Air Traffic Control                                   | Service that directs aircraft on the ground and through controlled airspace.                                                                                                         |
| ATCRBS       | Air Traffic Control<br>Radar Beacon<br>System         | The surveillance system used by Air Traffic Control to augment radar operations.                                                                                                     |
| BIT          | Built In Test                                         | A series of tests performed on start up to monitor the function of the equipment.                                                                                                    |
| CFR          | Code of Federal<br>Regulations                        | Codification of the general and permanent rules and regulations published in the Federal Register by the executive departments and agencies of the United States Federal government. |
| EMI          | Electromagnetic<br>interference                       | Type of test conducted to ensure system performance when in an electromagnetic environment.                                                                                          |
| ES           | Extended Squitter                                     | A periodic message that provides position, velocity, and time.<br>Part of the marketing name for Stratus ES.                                                                         |
| ESG          | Extended Squitter<br>and GPS                          | Part of the marketing name for Stratus ESG.                                                                                                                                          |
| FAA          | Federal Aviation<br>Administration                    | Agency of the United States Department of Transportation<br>with authority to regulate and oversee all aspects of civil<br>aviation in the United States.                            |
| FCC          | Federal<br>Communications<br>Commission               | Branch of the government responsible for controlling the regulations around electronic equipment.                                                                                    |
| FMS          | Flight Management<br>System                           | System that automates the aircraft's flight plan.                                                                                                                                    |
| GPS          | Global Positioning<br>System                          | Satellite-based navigation system that provides location and time information.                                                                                                       |
| HF           | High Frequency                                        | Range of frequency between 3 MHz to 30 MHz.                                                                                                                                          |
| Hz           | Hertz                                                 | Unit of frequency based upon cycles per second.                                                                                                                                      |
| IDENT        | IDENT<br>(Identification)                             | Transponder feature that allows for aircraft to be uniquely identified by Air Traffic Control by pulsing the aircraft's reply on ATC's monitors for 18 seconds.                      |



| MHz   | Megahertz                                 | 1,000,000 hertz.                                                                                                                                                                     |
|-------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SBAS  | Satellite-Based<br>Augmentation<br>System | System of satellites that augments existing satellite systems and provides increased position accuracy.                                                                              |
| STC   | Supplemental Type<br>Certificate          | Type Certificate issued when an applicant has received FAA approval to modify an aircraft from its original design.                                                                  |
| TIS-B | Traffic Information<br>Service-Broadcast  | Aviation information service broadcast provided to aircraft using both 1090 MHz ES and UAT.                                                                                          |
| TSO   | Technical Standard<br>Order               | Minimum performance standard for specified materials, parts, and appliances used on civil aircraft (FAA definition).                                                                 |
| VFR   | Visual Flight Rules                       | A set of regulations for flying in which the pilot flies without using instruments in generally clear meteorological conditions.                                                     |
| VHF   | Very High<br>Frequency                    | Range of frequency between 30 MHz to 300 MHz.                                                                                                                                        |
| WAAS  | Wide Area<br>Augmentation<br>System       | System of ground-based antennas whose precisely known locations are used to correct satellite signals and provide greater positional and integrity of service to aircraft in flight. |

# 1. About Stratus ES/ESG

### 1.1. Overview

Stratus ES and Stratus ESG by Appareo are panel-mounted level 2els Class 1 Extended Squitter transponders. They are Class B1S transponders which are ADS-B Out compliant. Stratus ES and Stratus ESG respond to legacy Mode A/C interrogations and Mode S interrogations from both ground radar and airborne collision avoidance systems. To support the ADS-B Out function, Stratus ESG also contains a Class Beta 1 GPS/WAAS receiver. Stratus ES receives GPS information from approved GPS position sources.

Stratus ES/ESG may be referred to as "transponder" unless product differences require them to be identified separately.

The most recent version of this document and other Stratus ES/ESG documentation can be found on the Appareo Dealer Portal or at <u>www.appareo.com/resources</u>.

### **1.2. TSO and FCC compliance**

#### TSO

Stratus ES/ESG is compliant with the following Technical Standard Orders:

| Reference/Issue                                                                                                                                                                        | Title                                                                                                                 |  |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|--|--|
| FAA TSO-C112e                                                                                                                                                                          | Technical Standard Order: Air Traffic Control Radar Beacon<br>System/Mode Select (ATCRBS / Mode S) Airborne Equipment |  |  |
| FAA TSO-C145d                                                                                                                                                                          | Technical Standard Order: Airborne Navigation Sensors Using The                                                       |  |  |
| (Stratus ESG only)                                                                                                                                                                     | Global Positioning System                                                                                             |  |  |
| FAA TSO-C166b       Technical Standard Order: Extended Squitter Automatic Dependence         Broadcast (TIS-B) Equipment Operating on the Radio Frequence         1090 Megahertz (MHz) |                                                                                                                       |  |  |

Table 1: TSO compliance

FCC

Stratus ES/ESG has an FCC ID of 2AETC-1505005.

### 1.3. TSO deviations

| TSO                             | Section              | Deviation                                                                     |  |
|---------------------------------|----------------------|-------------------------------------------------------------------------------|--|
| TSO-C145d<br>(Stratus ESG only) | Section 3, Subpart D | Environmental qualification testing was<br>performed to DO-160G, not DO-160E. |  |
| Table 2: TSO deviations         |                      |                                                                               |  |

Table 2: TSO deviations

### 1.4. Non-TSO functions

Below are Stratus ES/ESG's non-TSO functions:

• VFR key (and configuration).

This non-TSO function does not interfere with Stratus ES/ESG's compliance with the requirements of the TSOs listed in Section 1.2.

### 1.5. Environmental qualifications

Stratus ES/ESG is tested to DO-160G. The Stratus ES/ESG Environmental Qualification form is found in Appendix A of this document.

### 1.6. Criticality level

Software level determination is based on the Functional Hazard Assessment (FHA) and Preliminary System Safety Assessment (PSSA). These assessments determined that the most severe failure conditions (see Table 3) are classified as Major. As such, the Software Assurance Level has been determined to be Major.

Major failure conditions would reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that it would be a significant reduction in safety margins or functional capabilities or a significant increase in crew workload. Software whose anomalous behavior would cause or contribute to a failure of the system function resulting in a Major failure condition for the aircraft is identified as Level C.

| Function                                | Description                                                             | Classification |
|-----------------------------------------|-------------------------------------------------------------------------|----------------|
| ATCRBS / Mode S<br>Transponder          | Malfunction of the ATCRBS / Mode S transponder function without warning | Major          |
| ADS-B Out                               | Broadcast of incorrect ADS-B messages without warning                   | Major          |
| GPS/SBAS Receiver<br>(Stratus ESG only) | Loss or malfunction of the GPS/SBAS receiver function                   | Major          |
| Pressure Altitude Output                | Failure of the pressure altitude output function                        | Major          |
| RF Feed-Through                         | Malfunction of the RF feed-through function without warning             | Major          |

Table 3: Criticality level

### 1.7. Embedded Hardware and Software

The embedded hardware and software information listed below is current as of the time of publication of this document.

| Description              | Part number   | Revision<br>(or later FAA approved) |
|--------------------------|---------------|-------------------------------------|
| Embedded Hardware (FPGA) | 501010-000109 | R05                                 |
| Software (DSC)           | 501010-000113 | R07                                 |

#### Table 4: Embedded hardware and software

NOTE: Software and Embedded Hardware are subject to change without notification.

### **1.8.** Equipment specifications

#### **1.8.1. Equipment dimensions**

| Characteristic                                                                                   | Dimension              |  |
|--------------------------------------------------------------------------------------------------|------------------------|--|
| Bezel Width                                                                                      | 6.38 inches (162 mm)   |  |
| Bezel Height                                                                                     | 1.69 inches (43 mm)    |  |
| Rack Width                                                                                       | 6.32 inches (160.4 mm) |  |
| Rack Height                                                                                      | 1.65 inches (42 mm)    |  |
| Depth from back of bezel to end of strain relief on rack (not compensating for wire bend radius) | 10.75 inches (273 mm)  |  |

Table 5: Equipment dimensions

#### 1.8.2. Equipment weight

| Component                              | Weight             |  |
|----------------------------------------|--------------------|--|
| Stratus ES/ESG Unit Weight             | 2.8 lbs. (1.3 kg)  |  |
| Stratus ES/ESG Total Installed Weight  | 2.2  lbs (1.5  kg) |  |
| (Transponder with rack and connectors) | 5.5 IDS. (1.5 Kg)  |  |

Table 6: Equipment weight

# 1.8.3. Electrical specifications

| Characteristic                | Specification                              |
|-------------------------------|--------------------------------------------|
| Altitude                      | Up to 25,000 ft                            |
| Extornal Suppression Input    | Low ≤ 0.5 V                                |
|                               | High ≥ 5 V (suppressed)                    |
| Mode A Capability             | 4096 Identification Codes                  |
| Mode C. Altitude Capability   | Parallel altitude encoder: up to 62,700 ft |
| Mode C Allitude Capability    | Serial altitude encoder: up to 126,700 ft  |
| Mode S Capability             | Parallel altitude encoder: up to 62,700 ft |
| Mode S Capability             | Serial altitude encoder: up to 126,700 ft  |
| Operational Temperature Range | -20°C to +55°C                             |
| Receiver Frequency            | 1030 MHz                                   |
| Receiver Sensitivity          | -74 dBm nominal for 90% replies            |
| Transmitter Frequency         | 1090 MHz ± 1 MHz                           |
| Transmitter Power             | 310 Watts nominal                          |

**Table 7: Electrical specifications** 

### 1.8.4. Power requirements

| Characteristic       | Specification                       |
|----------------------|-------------------------------------|
| Input Voltage Range  | 11 to 36 VDC                        |
| Nominal Current Draw | 0.28 A at 28 VDC<br>0.5 A at 14 VDC |
| Power Input          | 8 W Typical<br>59.5 W Max           |

**Table 8: Power requirements** 

### 1.9. Required tools

The following tools are needed for installation of Stratus ES/ESG.

| ΤοοΙ                           | Part Number  | Used For                                         |
|--------------------------------|--------------|--------------------------------------------------|
| 3/32" hex driver               | -            | Securing locking mechanism through the faceplate |
| External retaining ring pliers | -            | RF pass through adapter                          |
| Crimp tool                     | M22520/2-01  | DSUB pins                                        |
| Positioner                     | M22520/2-08  | DSUB pins                                        |
| Insertion/Extraction tool      | M81969/39-01 | DSUB pins                                        |

Table 9: Required tools

### 1.10. Required hardware

The following parts are required for the installation of Stratus ES/ESG.

#### Supplied parts:

| Item                                           | Appareo Part<br>Number | Commercial Part<br>Number | Quantity |
|------------------------------------------------|------------------------|---------------------------|----------|
| Backplate                                      | 153510-000015          | -                         | 1        |
| Stratus ES Transponder                         | 153510-000069          |                           |          |
| or                                             | or                     | -                         | 1        |
| Stratus ESG Transponder                        | 153510-000017          |                           |          |
| Stratus ES/ESG Rack                            | 153540-000027          | -                         | 1        |
| 37 Pin DSUB Connector                          | 251015-000074          | M24308/2-4F               | 1        |
| RF TNC Pass Through Adapter (Stratus ESG only) | 251015-000077          | -                         | 1        |
| RF BNC Pass Through Adapter                    | 251015-000078          | -                         | 1        |
| Screw                                          | 356060-000007          | -<br>(ALT: MS51957-13)    | 6        |
| Strain Relief Backshell                        | 356070-000006          | M85049/48-1-4F            | 1        |

 Table 10: Required hardware (supplied parts)

#### Additional parts:

| Item                               | Appareo Part<br>Number | Commercial Part<br>Number                         | Quantity |
|------------------------------------|------------------------|---------------------------------------------------|----------|
| #6-32 x 100° Flat Head SS<br>Screw | -                      | MS24693C, AN507R<br>or other approved<br>fastener | 6        |
| Metal Hex Stop Nut *               | -                      | MS21042-06                                        | 6        |
| MONADNACK CLIP NUT 6-32*           | -                      | 294667                                            | 6        |

 Table 11: Required hardware (additional parts)

\*These parts are identified as usable components, but are not identified as the only components that can be used. Installer must determine if the part is appropriate for specific installation or if an alternate part is required.

### 1.11. Compatible equipment

Stratus ES/ESG requires input from the following:

- Transponder antenna
- GPS position source (Stratus ES) or GPS antenna (Stratus ESG)
- Altitude encoder

This section describes the requirements for this equipment. Inputs from systems described below may be pre-existing. If these systems do not exist or have specifications outside those described, selection of new equipment will be required. These installation instructions do not



cover the installation of the antennas or other input sources, and they should be installed per manufacturer's instructions.

#### 1.11.1. GPS

#### 1.11.1.1. GPS position source (Stratus ES)

Stratus ES is compatible with the following GPS position sources:

- Garmin GPS 175
- Garmin GPS 400W, GNC 420W/420 AW, and GNS 430W/430AW with software version 5.00 or later
- Garmin GPS GNS 480 (CNX80)
- Garmin GPS 500W and GNS 530W/530AW/530TAWS with software version 5.02 or later
- Garmin 6XX and 7XX with software version 3.00 or later.
- Avidyne IFD440 and IFD540 with software version 10. 3.0 or later

Connect Stratus ES to an open RS232 serial port (out) on the GPS position source and use the GPS position source to configure the port to use the ADSB+ protocol.

#### 1.11.1.2. GPS antenna (Stratus ESG)

Stratus ESG requires an active antenna with the specifications of either TSO-C190 or TSO-C144.

If meeting the specifications of TSO-C190, the GPS antenna must meet the following:

- Powered at 5 Volts
- Gain of 30 dB  $\pm$  5 dB
- Qualified DO-160E Lightning, Zone 2A
- Qualified DO-160E Icing, Category C

Alternatively, the following TSO-C144 antenna is compatible:

| Manufacturer | Part Number |
|--------------|-------------|
| AntCom       | 42G15A-XT-1 |
| RAMI         | AV-801      |

#### Table 12: Compatible GPS antenna

The antenna should be installed using the antenna manufacturer's instructions. The antenna must also be installed at least 2 feet away from any other comm transmitter or transmitter antenna in a location that does not break line of sight with satellites. Typical installation locations are on the top of the aircraft or on the empennage with consideration for line of sight with satellites.

Keep the antenna away from any protruding metal such as engines, propellers, other antenna masts, landing gear (and/or doors), and access doors; breaks in the antenna's ground plane; or



anything that can affect the reception pattern. If mounted on a composite aircraft, a conductive ground plane should be added to the aircraft. Additional information regarding location and mounting of antenna can be found in FAA AC 43.13-2B, Chapter 3.

All wiring should have a cable loss of minimum 2 dB and maximum 7 dB. The standard installation has 3 BNC/TNC connections. Any additional BNC/TNC connections should estimate a 0.2 dB loss per connection and be taken into consideration for maximum dB loss.

**NOTE**: Using RG400 the minimum cable length is 10 feet and the maximum length is 37 feet. If the installation requires you to go outside of these length specifications, the selection of coax should be 50 ohm.

These instructions do not cover the installation in a pressure vessel. If the manufacturer of the antenna has installation approval on the aircraft, follow the manufacturer's approved instructions. Otherwise, seek other approval. Other provisions could be made by contacting your Regional Aircraft Certification Office (ACO).

#### 1.11.2. Transponder antenna

Stratus ES/ESG requires a passive antenna with the specifications of TSO-C74() or TSO-C66(). The following antenna is an example of an antenna that meets these specifications. The installation is not limited to this antenna.

| Manufacturer                             | Part Number |
|------------------------------------------|-------------|
| Rami                                     | AV-74       |
| Table 42. Compatible transponder enterna |             |

Table 13: Compatible transponder antenna

The antenna should be installed using the antenna manufacturer's instructions using cabling with a maximum of 2 dB loss. The antenna should be mounted vertically on the bottom of the aircraft and a minimum of:

- 6 feet away from DME antenna
- 3 feet away from ADF antenna or any other communication antenna
- 3 feet away from TCAS antenna
- 3 feet away from the transponder itself to prevent self-interference

Keep the antenna away from any protruding metal such as engines, propellers, other antenna masts, landing gear (and/or doors), and access doors; breaks in the antenna's ground plane; or anything that can affect the radiation pattern. If mounted on a composite aircraft, a conductive ground plane should be added to the aircraft in order for the radiation pattern of the antenna to be maximized. Additional information regarding location and mounting of antenna can be found in FAA AC 43.13-2B, Chapter 3.

**NOTE**: A determination should be made whether the current cabling is acceptable for the installation. Using RG400, the maximum cable length is 14 feet with a maximum of 2 dB loss. If the installation requires more length, select other 50 ohm coax that will not exceed the maximum of 2 dB loss.

### 1.11.3. Altitude encoder

Stratus ES/ESG requires input from an independent altitude encoder. Stratus ES/ESG will connect to an encoder that has a Gillham (gray code) connection or a serial altitude encoder output on a RS232 port. The altitude encoder must meet the performance requirements of TSO-C88 (a or b). Serial altitude encoders must have Trimble/Garmin or Shadin/RMS protocol.

The altitude encoder should be installed using the altitude encoder manufacturer's instructions.

**NOTE**: The altitude encoder might have a longer power up time than Stratus ES/ESG. While the altitude encoder powers up, the altitude field will be replaced by dashes. If the altitude encoder has not powered up within five minutes, an error message will appear. Once the altitude encoder is completely powered on and transmitting data, the error message will disappear.

# 2. Installing Stratus ES/ESG

### 2.1. Unpacking/inspection requirements

When unpacking Stratus ES/ESG, visually inspect for any damage to the unit or missing components. If damage or missing parts are present, contact Appareo.

### 2.2. Limitations for installation

The following limitations should be taken into consideration when installing Stratus ES/ESG.

#### Aircraft

Stratus ES/ESG is intended for use on a Part 23 aircraft and may not be acceptable for installation on all aircraft makes and models.

#### Cooling air

Stratus ES/ESG does not require an air cooling system, nor does it have a duct to port air for a system. Do not install Stratus ES/ESG near a heat source. An alternate method of cooling is required if the unit must be installed near a heat source.

#### GPS

Stratus ESG cannot be used as a GPS position source for navigation for LNAV approaches outside of SBAS coverage.

### 2.3. Backplate and rack installation

If the aircraft does not have a location already designated or a transponder has not been removed for this installation, refer to FAA AC 43.13-2B, Chapter 2.

Refer to Stratus ES/ESG Installation and Wiring Drawings (601837-000024) to assemble the mounting rack with the hardware specified in Table 10. Mount the rack to the aircraft using the six holes on the side of the rack with the hardware specified in Table 11.

Refer to Section 1.8 for dimensions and weight information.



**NOTE**: For an optimal fit, mounting brackets may be required, but are not supplied. If additional brackets are needed, they should be fabricated for each individual installation.

**NOTE**: Ensure that the unit is supported in the back. This may require additional support.

### 2.4. Unit installation



Figure 1: Locking mechanism location

- 1. Adjust the locking mechanism on the transponder using a 3/32 hex wrench so that the front lobe is in a vertical position. Insert the unit by hand until it comes to a stop. This occurs when the front lobe contacts the clearance slot of the install rack.
- 2. Tighten the locking mechanism clockwise with the 3/32 hex wrench until it is tight and the connectors have mated. Do not overtighten. If the mechanism will not tighten, verify that the transponder is properly seated in the rack. The unit is fully seated when the unit does not move back when tightening the locking mechanism.

**NOTE:** Ensure that the transponder is seated as far back as possible against the backplate so that there is a secure connection between the transponder and the connectors.

To remove the Stratus ES/ESG assembly:

Turn the 3/32 hex wrench counter-clockwise on the locking mechanism through the front of the transponder to loosen the lock until the transponder connectors disconnect. Keep loosening the unit until it stops sliding out of the install rack. Do not loosen any further. Pull out the transponder by hand.

### 2.5. Cleaning

Use a dry cloth to clean the transponder. If necessary, you can use a lightly damp cloth with a solution of mild detergent. Do not use cleaners containing ammonia, acetone, or other strong acids or bases to clean the transponder display or faceplate.

### 2.6. Circuit protective device marking

If Stratus ES/ESG is replacing an existing transponder, ensure that the circuit protective device is sufficiently marked.

If Status ES/ESG is a new installation, ensure that the labeling is in accordance with AC 43.13-2B, Chapter 2, Section 207, Sub-Section f., Paragraph (4).

# 3. Cabling and wiring

This section describes cabling and wiring specifications, pin-out information, and antenna and GPS position source connection procedures.

### 3.1. Cabling and wiring specifications

Wiring is not supplied by Appareo. Use 22 gauge wire and install wiring in accordance with FAA AC 43.13-1B and AC 43.13-2B. Wire length and routing will vary by installation. See Stratus ES/ESG Installation and Wiring Drawings (601837-000024) for exact specifications.

Re-use of existing wiring is permitted, but it must be in compliance with these installation instructions and with the Stratus ES/ESG wiring diagrams.

**NOTE:** Previously installed equipment may have additional components inline that could impede the function of Stratus ES/ESG. Removal of those components is required.

**CAUTION:** Remove aircraft power before wiring to avoid damaging the device.

### 3.2. Pins

The following are the pin assignments and pin-out for Stratus ES/ESG.

**NOTE:** Not all pins will be used for all configurations. See the sub-sections below to determine which pins will be used for your installation.

| Stratus ES |                                |     |
|------------|--------------------------------|-----|
| Pin #      | Pin Name                       | I/O |
| 1          | Aircraft Ground                | -   |
| 2          | Aircraft Power                 | -   |
| 3          | RS232-RX<br>External GPS input | In  |
| 4          | -                              | -   |
| 5          | RS232-RX Altitude              | In  |
| 6          | RS232-TX GPS 1PPS              | Out |
| 7          | External Standby               | In  |
| 8          | Software Update Enable         | In  |
| 9          | Altitude A1                    | In  |

| Stratus ESG |                        |     |  |  |
|-------------|------------------------|-----|--|--|
| Pin #       | Pin Name               | I/O |  |  |
| 1           | Aircraft Ground        | -   |  |  |
| 2           | Aircraft Power         | -   |  |  |
| 3           | RS232-RX Maintenance   | In  |  |  |
| 4           | -                      | -   |  |  |
| 5           | RS232-RX Altitude      | In  |  |  |
| 6           | RS232-TX GPS 1PPS      | Out |  |  |
| 7           | External Standby       | In  |  |  |
| 8           | Software Update Enable | In  |  |  |
| 9           | Altitude A1            | In  |  |  |

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| 10 | Altitude A4                   | In  | 10 | Altitude A4           | In  |
|----|-------------------------------|-----|----|-----------------------|-----|
| 11 | Altitude B2                   | In  | 11 | Altitude B2           | In  |
| 12 | Altitude C1                   | In  | 12 | Altitude C1           | In  |
| 13 | Altitude C4                   | In  | 13 | Altitude C4           | In  |
| 14 | External Suppress In          | In  | 14 | External Suppress In  | In  |
| 15 | 28V Lighting Bus HI           | In  | 15 | 28V Lighting Bus HI   | In  |
| 16 | -                             | -   | 16 | -                     | -   |
| 17 | AUX +5V Power                 | Out | 17 | AUX +5V Power         | Out |
| 18 | External GPS Common<br>Ground | -   | 18 | AUX Ground            | -   |
| 19 | AUX +5V Power                 | Out | 19 | AUX +5V Power         | Out |
| 20 | Aircraft Ground               | -   | 20 | Aircraft Ground       | -   |
| 21 | Aircraft Power                | -   | 21 | Aircraft Power        | -   |
| 22 | RS232-TX Maintenance          | Out | 22 | RS232-TX Maintenance  | Out |
| 23 | RS232-TX AUX                  | Out | 23 | RS232-TX AUX          | Out |
| 24 | RS232-TX Altitude             | Out | 24 | RS232-TX Altitude     | Out |
| 25 | External IDENT                | In  | 25 | External IDENT        | In  |
| 26 | External Squat Switch         | In  | 26 | External Squat Switch | In  |
| 27 | Altitude D4                   | In  | 27 | Altitude D4           | In  |
| 28 | Altitude A2                   | In  | 28 | Altitude A2           | In  |
| 29 | Altitude B1                   | In  | 29 | Altitude B1           | In  |
| 30 | Altitude B4                   | In  | 30 | Altitude B4           | In  |
| 31 | Altitude C2                   | In  | 31 | Altitude C2           | In  |
| 32 | External Suppress I/O         | I/O | 32 | External Suppress I/O | I/O |
| 33 | 14V Lighting Bus HI           | In  | 33 | 14V Lighting Bus HI   | In  |
| 34 | -                             | -   | 34 | -                     | -   |
| 35 | -                             | -   | 35 | -                     | -   |
| 36 | Aux +5V Power                 | Out | 36 | Aux +5V Power         | Out |
| 37 | Altitude Common (GND)         | -   | 37 | Altitude Common (GND) | -   |

Table 14: Pin assignments



Figure 2: Pin-out

Refer to the wiring diagrams in Stratus ES/ESG Installation and Wiring Drawings (601837-000024) to complete wiring. The sections below describe the function of each pin in more detail.

#### 3.2.1. Power

Stratus ES/ESG requires a 5 amp circuit breaker. A minimum of 2 ground pins should be tied.

| Pin # | Pin Name        | I/O |
|-------|-----------------|-----|
| 1     | Aircraft Ground | -   |
| 2     | Aircraft Power  | -   |



| 20                              | Aircraft Ground | - |
|---------------------------------|-----------------|---|
| 21                              | Aircraft Power  | - |
| Table 15: Power pin assignments |                 |   |

#### 3.2.2. GPS Position Source (Stratus ES only)

Stratus ES requires connection to an external GPS source. The RS232 output from the GPS source requires configuration.

| Pin # | Pin Name                       | I/O |
|-------|--------------------------------|-----|
| 3     | RS232-RX<br>External GPS input | In  |
| 18    | External GPS Common<br>Ground  | -   |

#### 3.2.3. Altitude

Stratus ES/ESG can be connected to either a parallel or serial altitude encoder. The pins utilized will depend on the type of altitude encoder.

#### For parallel altitude encoders:

| Pin # | Pin Name              | I/O |
|-------|-----------------------|-----|
| 9     | Altitude A1           | In  |
| 10    | Altitude A4           | In  |
| 11    | Altitude B2           | In  |
| 12    | Altitude C1           | In  |
| 13    | Altitude C4           | In  |
| 27    | Altitude D4           | In  |
| 28    | Altitude A2           | In  |
| 29    | Altitude B1           | In  |
| 30    | Altitude B4           | In  |
| 31    | Altitude C2           | In  |
| 37    | Altitude Common (GND) | -   |

Table 16: Parallel altitude encoder pin assignments

For serial altitude encoders:

|                                                 | Pin # | Pin Name          | I/O |  |
|-------------------------------------------------|-------|-------------------|-----|--|
|                                                 | 5     | RS232-RX Altitude | In  |  |
| Table 17: Carial altitude anadar pin accimments |       |                   |     |  |

Table 17: Serial altitude encoder pin assignments

**NOTE:** Pin 24 (RS232 TX Altitude) can be used as a serial altitude source for other equipment.



#### 3.2.4. Suppression

The External Suppression pins are used to suppress signals from a shared antenna, DME, or other source of interference.

| Pin #                                 | Pin Name              | I/O |
|---------------------------------------|-----------------------|-----|
| 14                                    | External Suppress In  | In  |
| 32                                    | External Suppress I/O | I/O |
| Table 18: Suppression pin assignments |                       |     |

**NOTE**: Only one suppression may be connected.

#### 3.2.5. Lighting

Stratus ES/ESG can be connected to the aircraft lighting bus to control the brightness with a panel control. To connect to the lighting bus, connect **one** of the following pins, depending if the aircraft runs at 28V or 14V.

| Pin # | Pin Name            | I/O |
|-------|---------------------|-----|
| 15    | 28V Lighting Bus HI | In  |
| 33    | 14V Lighting Bus HI | In  |

Table 19: Aircraft lighting bus pin assignments

To control brightness with the ambient light sensor, do not connect these pins and select the ambient light sensor during backlight source configuration. Use the ambient light sensor if the aircraft lighting bus does not provide full bus voltage when the lighting bus is turned off.

#### 3.2.6. External IDENT

External IDENT can be wired to an external switch to transmit an IDENT response.

| Pin #                                   | Pin Name       | I/O |
|-----------------------------------------|----------------|-----|
| 25                                      | External IDENT | In  |
| Table 20: External IDENT nin assignment |                |     |

Table 20: External IDENT pin assignment

#### 3.2.7. External standby

External Standby is used in case of a dual transponder setup. Use this to suppress Stratus ES/ESG when not in use. To put Stratus ES/ESG into standby mode, ground pin 7.

| Pin #                                     | Pin Name         | I/O |  |
|-------------------------------------------|------------------|-----|--|
| 7                                         | External Standby | In  |  |
| Table 21, External standby nin assignment |                  |     |  |

 Table 21: External standby pin assignment

#### 3.2.8. Squat switch

The Squat Switch input is connected when the aircraft has a squat switch. The configuration you select in Section 4.9 will determine if the squat switch is closed when on the ground or closed when airborne.

| Pin #                                  | Pin Name              | I/O |
|----------------------------------------|-----------------------|-----|
| 26                                     | External Squat Switch | In  |
| Table 00. Ownet awitch win agains mant |                       |     |

Table 22: Squat switch pin assignment

### 3.3. Connecting antennas and position source

Stratus ES requires input from a GPS position source, and Stratus ESG requires a GPS antenna. Both systems require a transponder antenna and altitude encoder. Use the wiring information specified in Section 1.11 to connect them to the back of the transponder, following the Stratus ES/ESG Installation and Wiring Drawings (601837-000024).

# 4. Configuring Stratus ES/ESG

If it is the first time the transponder has been configured, press the **PWR** key. It will automatically enter into configuration mode.

To enter into configuration mode during subsequent configurations, while Stratus ES/ESG is off, hold the **FUNC** key. Then, press and release the **PWR** key.

**NOTE**: Stratus ES/ESG must be powered off to enter into configuration mode.

While in configuration mode, use the following keys:

| Key         | Function                                       |
|-------------|------------------------------------------------|
| FUNC        | Cycle through the configuration screens        |
| FUNC        | Cancel an input                                |
|             | Edit a configuration                           |
| ENI         | Confirm an input                               |
| Arrow keys  | Cycle through the configuration screens        |
|             | Cycle through selections within configurations |
| Number keys | Input numbers, letters, or spaces              |
| PWR         | Exit configuration mode                        |

Table 23: Keys used during configuration



Sometimes, a textual or non-numerical input will be required. If this is the case, press the number that is associated with the letter group you want to input, according to the graphic on the screen. To cycle through the letters associated with each number, press the number key repeatedly until the letter you want to input appears. You can input a space after cycling through all of the letters for a particular number key. Once the correct character is selected, use the right arrow key to advance to the next field to enter the next character in the sequence.

### 4.1. ICAO address

Enter the aircraft's 6 digit hex code. You can look up your code on the FAA's N-Number Inquiry webpage.

### 4.2. VFR squawk

Enter the VFR squawk code. The default factory setting is 1200.

**NOTE**: If you enter an emergency squawk code (7500—hijacking, 7600—radio failure, or 7700—emergency), a warning will appear. Press **ENT** to clear the warning and enter a new squawk code.

### 4.3. Aircraft registration

Enter the aircraft's tail number (registration number).

### 4.4. Aircraft airspeed category

Select the range of numbers that includes the aircraft's maximum airspeed.

### 4.5. Aircraft category

Select the category that best describes the aircraft:

- Light (<15,550 lbs)
- Small (15,500-75,000 lbs)
- Rotorcraft

### 4.6. Aircraft length

Select the range of numbers that includes the aircraft's length.

### 4.7. Aircraft width

Select the range of numbers that includes the aircraft's width (wingspan).

### 4.8. Altitude format

Select the pilot's preferred unit to display altitude in:

- Flight Level
- Feet
- Meters

### 4.9. Squat switch

Select the squat switch options:

- None: the aircraft does not have a squat switch
- Low when on ground: the squat switch is closed when on the ground
- Low when airborne: the squat switch is closed when airborne

### 4.10. Altitude source

Select the altitude source based on the type of altitude encoder in the aircraft:

| Configuration         | Туре     | Protocol       | Used when                                                           |
|-----------------------|----------|----------------|---------------------------------------------------------------------|
| Parallel              | Parallel |                |                                                                     |
| Serial—trim/gar       | Serial   | Trimble/Garmin | Altitude encoder resolution is <b>25 ft or worse</b> (e.g. 100 ft). |
| Serial—trim/gar-25 ft | Serial   | Trimble/Garmin | Altitude encoder resolution is <b>25 ft or better</b> (e.g. 10 ft)  |
| Serial—shad/rms       | Serial   | Shadin/RMS     | Altitude encoder resolution is <b>25 ft or worse</b> (e.g. 100 ft). |
| Serial—shad/rms-25 ft | Serial   | Shadin/RMS     | Altitude encoder resolution is <b>25 ft or better</b> (e.g. 10 ft)  |

### 4.11. Backlight source

Select the pilot's preferred backlight source.

- Ambient light sensor
- Lighting bus

### 4.12. Backlight slope

Adjust the backlight control slope to a number between 0 and 100. A low number will brighten the display when there is a large ambient light change, and a high number will brighten the display when there is a small ambient light change.

### 4.13. Backlight offset

Adjust the backlight control offset to a number between 0 and 100. A low number will cause the backlight to display dimmer, and a high number will cause the backlight to display brighter.

### 4.14. Backlight response time

Adjust the backlight control response time to a number between 0 and 100. A low number will cause the backlight to adjust to ambient light changes more quickly, and a high number will cause the backlight to adjust to ambient light changes more slowly.

### 4.15. GPS antenna lateral offset

Select the measurement that most closely represents the distance from the lateral center of the aircraft to the GPS antenna to the nearest two meters.

**NOTE:** If using Stratus ES, confirm that these offsets are not already applied to the GPS position source settings.

- 2M L
- 4M L
- 6M L
- 0M
- 2M R
- 4M R
- 6M R

### 4.16. GPS antenna longitudinal offset

Select the measurement that most closely represents the distance from the front of the aircraft to the GPS antenna to the nearest two meters.

**NOTE:** If using Stratus ES, confirm that these offsets are not already applied to the GPS position source settings.

- 2M
- 4M
- 6M
- 8M
- ...
- 54M
- 56M
- 58M
- ≥ 60M

### 4.17. ADS-B In capability

Select the ADS-B In capability of the aircraft, installed or portable.

- UAT
- 1090 ES
- UAT and 1090 ES
- None

**NOTE**: There are currently no known ADS-B In solutions that provide only 1090 ES.

# 4.18. SBAS service provider (Stratus ESG only)

Select the SBAS service provider:

- WAAS (North America)
- EGNOS (Europe)
- MSAS (Japan)
- GAGAN (India)
- SDCM (Russia)
- Automatic (automatically chooses service provider based on location)

Choose Automatic if the pilot might change regions during the operation of Stratus ESG.

### 4.19. Diagnostic screens

The following screens are used for diagnostic purposes only and usually do not require any input from the installer.

#### 4.19.1. GPS week number rollovers (Stratus ESG only)

The GPS week number rollovers screen tracks the number of GPS rollovers, which occur every 1024 weeks (19.7 years). The screen should display the following values, depending on the year:

| Dates                             | Rollover number |
|-----------------------------------|-----------------|
| August 22, 1999 – April 6, 2019   | 1               |
| April 7, 2019 – November 20, 2038 | 2               |

If the value shown on the screen is incorrect, edit the configuration and select the correct rollover number.

**NOTE:** Upon the date for rollover, the GPS number will automatically roll over without user interface.

### 4.19.2. Altitude input diagnostic

The altitude input diagnostic screen shows the current gray code altitude input from the parallel altitude encoder and also displays the current altitude. You can use this screen to verify that a parallel altitude encoder is properly connected. If a serial altitude encoder is connected, or there is no altitude encoder connected, the altitude input will display all 0's.

### 4.19.3. External inputs diagnostic

The external digital inputs diagnostic screen shows if the IDENT and standby modes are active or inactive. It also shows if the squat switch is indicating that the aircraft is ground, airborne, or unknown. You can use this screen to verify that the squat switch settings are properly configured.



### 4.19.4. Analog inputs diagnostic

The analog inputs diagnostic screen shows the current reading of the lighting bus and ambient light sensor to the nearest percentage, and the current reading of the internal temperature sensor to the nearest degree Celsius.

#### 4.19.5. GPS receiver diagnostic

The GPS receiver diagnostic screen shows the current reading of the GPS latitude, GPS longitude, and Navigation Integrity Category (NIC).

#### 4.19.6. GPS CN0 diagnostic (Stratus ESG only)

The GPS CN0 diagnostic screen shows the current value of GPS CN0 for all 12 channels.

#### 4.19.7. Software versions diagnostic

The software versions diagnostic screen shows the DSC part number, version number, and flash checksum.

#### 4.19.8. Complex hardware versions diagnostic

The complex hardware versions diagnostic screen shows the FPGA part number, version number, and flash checksum.

#### 4.19.9. BIT diagnostic

The BIT diagnostic screen displays any Built In Test failure codes. If the screen displays all zeros, no BIT failure has been detected. Otherwise, a "1" will display.

Each number corresponds with a specific failure, depending on its position in the string of numbers on the screen—failure position 1 being the leftmost space, and failure position 20 being the rightmost space. Reference the table below to determine which BIT has failed. Once all BIT failures have been resolved, press **ENT** to clear all codes.

**NOTE:** The following BIT failure positions are applicable to software (DSC) version R07. For version R06, the first 2 BITs are not present. For earlier versions, the first 3 BITs are not present.

| Failure<br>Position | BIT Failure         | Display Message                         | Corrective Action                                                                                                                        |
|---------------------|---------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| 1                   | Transmitter Failure | TRANSMITTER FAILURE<br>CHECK CONNECTION | Verify that the connection<br>between Stratus ES/ESG and the<br>transponder antenna is secure.<br>See Section 7 for more<br>information. |
| 2                   | Transmitter PLL     | TRANSMITTER FAILURE                     | Contact Appareo                                                                                                                          |



| 3  | GPS Failure<br>(Stratus ES only)  | GPS INPUT FAILURE            | Verify that the connection<br>between Stratus ES and the GPS<br>position source is secure.                                |
|----|-----------------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| 4  | Transmitter                       | TRANSMITTER FAILURE          | Contact Appareo                                                                                                           |
| 5  | Display                           | none                         | Contact Appareo                                                                                                           |
| 6  | GPS Failure<br>(Stratus ESG only) | GPS RECEIVERFAILURE          | Contact Appareo                                                                                                           |
| 7  | Altitude Source                   | ALTITUDE INPUT<br>FAILURE    | Use the altitude diagnostic screen<br>to troubleshoot the altitude<br>encoder connection                                  |
| 8  | Internal<br>Temperature           | OVERHEATED                   | Let the transponder cool down.                                                                                            |
| 9  | Single Event Upset                | none                         | Contact Appareo                                                                                                           |
| 10 | Stuck Key                         | KEY STUCK                    | Try to unstick the stuck key                                                                                              |
| 11 | Stuck External<br>IDENT           | EXTERNAL IDENT<br>STUCK      | Use the external inputs diagnostic screen to check correctness of external IDENT polarity                                 |
| 12 | Suppression                       | SUPPRESSED                   | Check correctness of suppression input polarity                                                                           |
| 13 | FPGA Checksum                     | none                         | Contact Appareo                                                                                                           |
| 14 | EEPROM<br>Checksum                | MEMORY READ FAILURE          | Re-configure Stratus ES/ESG, if<br>necessary. Verify that the GPS<br>Week Number Rollover is set to<br>the correct value. |
| 15 | Squitter Rate                     | SQUITTER FAILURE             | Contact Appareo                                                                                                           |
| 16 | Mode S Address                    | ICAO ADDRESS CHANGE          | Contact Appareo                                                                                                           |
| 17 | GPS Failure<br>(Stratus ESG only) | GPS RECEIVER FAILURE         | Contact Appareo                                                                                                           |
| 18 | 1030 MHz RX VCO<br>Lock           | 1030 MHZ RECEIVER<br>FAILURE | Contact Appareo                                                                                                           |
| 19 | DSC RAM                           | RAM FAILURE                  | Contact Appareo                                                                                                           |
| 20 | FPGA RAM                          | none                         | Contact Appareo                                                                                                           |
| 21 | GPS Failure<br>(Stratus ESG only) | GPS RECEIVER FAILURE         | Contact Appareo                                                                                                           |
| 22 | GPS Failure<br>(Stratus ESG only) | GPS RECEIVER FAILURE         | Contact Appareo                                                                                                           |

Table 24: BIT diagnostic codes

# 5. Functional tests

When installed in accordance with these installation instructions, Stratus ES/ESG complies with 14 CFR Part 91.227.

Final installation checks for Stratus ES/ESG are the responsibility of the installer. The installer must ensure that Stratus ES/ESG is installed on an aircraft that coincides with the approval given within the testing performed for the TSOs held by this device: TSO-C112e, TSO-C145d (Stratus ESG only), and TSO-C166b. Refer to Appendix A.



After installation is complete, verify operation as identified in 14 CFR Part 43, Appendix F. The IFR6000 with OPT3 (manufactured by Cobham AvComm – formerly Aeroflex Test Solutions) or equivalent test set can be used to determine compliance.

Additional testing requirements can be found in Chapter 4 of Advisory Circular (AC) 20-165B. Additional functional tests may be required.

When installed correctly, Stratus ES/ESG complies with 14 CFR Part 91.215 & 91.225. While in airspace specified in 14 CFR Part 91.215, Stratus ES/ESG must be maintained to 14 CFR Part 91.413. Additional maintenance information can be found in the Instructions for Continued Airworthiness (600845-000025).

In addition to maintaining compliance to the regulations above, perform the following operational tests after configuration.

**NOTE**: Tests should be executed in an area where the aircraft has an unimpeded view of the sky so that a proper GPS fix can be established.

#### 5.1. Power bus

Turn on power to the aircraft. Verify that the unit powers on.

### 5.2. Discrete inputs

**NOTE**: Depending on the installation, the functional tests for the following discrete inputs are optional.

- 1. Turn off Stratus ES/ESG and enter into configuration mode (while holding the **FUNC** key, press and release the **PWR** key).
- 2. Press **FUNC** or the arrow keys to advance to the external input diagnostics screen. The screen displays the real-time state of the external standby, external IDENT, and squat switch inputs.
- 3. Activate and deactivate each discrete input and verify that the proper state is reflected on the display.
  - External standby: Ground each transponder's external standby pin and verify that the state is "inactive."
  - External IDENT: Activate the external switch and verify that the state is "active."
  - Squat switch: Activate the squat switch and verify that the correct state is shown.

### 5.3. Analog inputs

- 1. Enter into configuration mode on Stratus ES/ESG.
- 2. Press **FUNC** or the arrow keys to advance to the analog input diagnostics screen. The screen displays the real-time values read from the lighting bus and ambient light sensor.
- 3. Block the ambient lighting sensor input. Verify that the signal percentage drops.



Ambient light sensor

Figure 3: Ambient light sensor location

- 4. Shine a light on the ambient light sensor. Verify that the signal percentage increases.
- 5. If you are using the 14V or 28V lighting bus: Adjust the lighting bus input to minimum. Verify that the displayed value is 0%.
- 6. If you are using the 14V or 28V lighting bus: Adjust the lighting bus input to maximum. Verify that the displayed value is 100%.

#### 5.4. Altitude

- 1. Enter into configuration mode on Stratus ES/ESG.
- 2. Press **FUNC** or the arrow keys to advance to the altitude diagnostic screen.
- 3. Verify that the altitude displayed is correct to your geographic location.

#### 5.5. EMI check

**NOTE:** The EMI testing shall not be performed until after the system functional ground test is complete and passes.



#### 5.5.1. Communications

#### (i) Cockpit intercom

Using the cockpit intercom, verify interference-free communications between the crew while monitoring the effects of Stratus ES/ESG.

#### (ii) Cabin paging

Verify that cabin paging is functioning clearly while monitoring the effects of Stratus ES/ESG.

#### 5.5.2. VHF communications

Set VHF communications radios to multiple frequencies and monitor the effects of Stratus ES/ESG while transmitting and receiving. At a minimum, the frequencies listed below should be tested, in addition to locally available frequencies. Each transmission should occur for 35 seconds for each frequency.

Verify that the NIC value on the GPS receiver diagnostic screen is 7 or greater.

Test each frequency in 1 MHz increments between 118 -136.000 MHz.

Test the following frequencies for VHF radios with 25kHz spacing:

| 121.150 | 121.175 | 121.200 | 121.225 |
|---------|---------|---------|---------|
| 121.250 | 131.200 | 131.225 | 131.250 |
| 131.275 | 131.300 | 131.325 | 131.350 |

Test the following frequencies for VHF radios with 8.33kHz spacing:

| 121.185 | 121.190 | 130.285 | 131.290 |
|---------|---------|---------|---------|
|         |         |         |         |

#### 5.5.3. HF communications

If the aircraft is equipped with HF communications radios, set to multiple frequencies and monitor effects of Stratus ES/ESG while transmitting and receiving. Record the frequencies tested:

#### 5.5.4. SATCOM communications (Stratus ESG only)

If aircraft is equipped with a SATCOM system, operate the SATCOM equipment while monitoring the GPS CN0 diagnostic screen. Verify that the CN0 values on the GPS receiver diagnostic screen do not drop by 2 dB or more.



#### 5.5.5. Navigation

#### (i) VOR / ILS

Verify the operation of each VHF nav receiver in both VOR and ILS modes (including glide slope) while monitoring the effects of Stratus ES/ESG. Record the frequencies tested.

108.000 MHZ 108.100 MHZ

#### (ii) DME

Verify the operation of each DME while monitoring the effects of Stratus ES/ESG. The same frequencies used for VOR and ILS testing may be used for this test.

#### (iii) Marker Beacon

Verify the operation of each Marker Beacon Receiver while monitoring the effects of Stratus ES/ESG. The same frequencies used for the ILS test above may be used.

#### (iv)ADF

Verify the operation of each ADF receiver while monitoring the effects of Stratus ES/ESG. Frequencies from each band should be tested when possible. Public broadcast stations are acceptable for conducting test.

#### 5.5.6. Flight management systems

#### (i) FMS

Enter a flight plan into each FMS and verify the display of the track and navigation information while monitoring the effects of Stratus ES/ESG.

#### (ii) GPS

Monitor GPS signals for each GPS receiver and verify stability of the signals while monitoring the effects of Stratus ES/ESG.

Record GPS position coordinates for the aircraft.

#### (iii) Auto pilot

Verify the function of auto pilot while monitoring the effects of Stratus ES/ESG.

#### 5.5.7. Safety equipment

#### (i) EGPWS / TAWS

Verify the function of the EGPWS and Terrain Display (if equipped) while monitoring the effects of Stratus ES/ESG.



#### (ii) TCAS

Verify the function of the TCAS while monitoring the effects of Stratus ES/ESG. Self-test and monitoring targets of opportunity should both be evaluated.

#### (iii) Weather radar

Verify the function of each weather radar system while monitoring the effects of Stratus ES/ESG. All displays capable of showing weather radar should be evaluated.

#### (iv) Radio altimeter

Verify each radio altimeter system functions correctly while monitoring the effects of Stratus ES/ESG. Each unit should self-test correctly and be free of continuous variation while parked on the ramp.

#### (v) Engine indications & fuel flow (engines operating)

Aircraft must be taken off ground power (if necessary). Start aircraft engines. Check to be certain that all engine indicators read appropriately.

Check to be certain that all fuel flow indicators read appropriately.

### 5.6. Compass swing test

After successful completion of the EMI tests above, evaluate the necessity of a swing test.

### 5.7. Weight and balance

Installation of Stratus ES/ESG may have impacted the weight and balance of the aircraft. Refer to Chapter 7 of FAA-H-8083-1B: Weight and Balance Handbook.

### 5.8. Flight test

**NOTE:** The flight test shall not be performed until after the system functional ground test and EMI test is complete and passes.

It is recommended that a flight test be conducted after installation to verify proper operation and installation of Stratus ES/ESG. A compliance report can be obtained by emailing **9-AWA-AFS-300-ADSB-AvionicsCheck@faa.gov** with the aircraft information. This method is controlled by the FAA and may be subject to change.

For additional information visit the FAA website: www.faa.gov/nextgen/equipadsb.



# 6. Using Stratus ES/ESG

See the Stratus ES/ESG Pilot's Guide (600890-000049) for a full description of Stratus ES/ESG's function.



Figure 4: Stratus ES/ESG front panel

### 6.1. Mode selection keys

The table below describes each transponder mode. These modes will automatically transition for various phases of flight. Unless otherwise instructed, no action is needed.

When powered on, Stratus ES/ESG will be restored to the same mode that it was in when it was powered off (ALT, ON, or SBY).

| Mode     | Key               | Description                                                                                                       |
|----------|-------------------|-------------------------------------------------------------------------------------------------------------------|
| Off      | PWR               | Stratus ES/ESG is powered off.                                                                                    |
| Standby  | SBY               | Stratus ES/ESG is powered on and does not send responses to any ATC interrogations.                               |
| Altitude | ALT               | Stratus ES/ESG is powered on and responds to all Mode A/C/S interrogations. Altitude is reported.                 |
| Ground   | Auto-<br>detected | Stratus ES/ESG is powered on and is on the ground.* Altitude is not reported.                                     |
| On       | ON                | Stratus ES/ESG is powered on and responds to all Mode A/C/S interrogations, but altitude reporting is suppressed. |

#### Table 25: Mode selection keys

\*If Ground mode is detected while you're in the air, press **ALT** or **ON** to override Ground mode and enter into Altitude or On mode. This disables automatic Ground mode.

To re-enable automatic Ground mode, press **SBY**. You will enter into Standby mode and clear the ground mode override. Then, press **ALT** or **ON** to return to Altitude or On mode (with automatic Ground mode enabled).

### 6.2. Event indicators

When certain events occur, an indicator will appear on your Stratus ES/ESG display. The table below describes each indicator's meaning.

| Indicator | Meaning                                                                                                                                                             |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0         | ADS-B transmission contains GPS position information with a radius of containment under 1 nautical mile.                                                            |
| R         | A response was transmitted from a mode A/C/S interrogation. The indicator will time out if another reply does not occur within one second.                          |
| A         | A built-in-test (BIT) has failed. See Section 4.19.9 of this document and the Stratus ES/ESG Pilot's Guide (600890-000049) for more information about BIT failures. |

Table 26: Event indicators

### 6.3. FUNC key

Press the **FUNC** key or the arrow keys, to switch from the Default screen to the Pressure Altitude screen, GPS screen, Flight ID screen, and Brightness screen. These screens are described below:

**Pressure Altitude screen**: Displays the current pressure altitude. If no valid altitude is detected or Stratus ES/ESG is in On mode, the altitude field will be replaced by dashes.



Figure 5: Pressure Altitude screen

**GPS screen**: Displays the aircraft's GPS position in degrees latitude and longitude. If no GPS signal is being received, the latitude and longitude fields will be replaced by dashes.



Figure 6: GPS screen

Flight ID screen: Displays the currently entered Flight ID.



Figure 7: Flight ID screen



**Brightness screen**: Allows for adjustment of screen brightness while in flight. Press **ENT**, then the left or right arrow keys to adjust brightness. Press **ENT** again to confirm the new setting.

SBY

Figure 8: Brightness screen

### 6.4. Other keys

#### 6.4.1. Arrow keys

Use the arrow keys to advance forward and backward when entering numbers or letters and to cycle through options in Configuration mode. They can also be used for cycling through the display screens.

#### 6.4.2. Numerical keys

Use the numerical keys to enter information such as the flight ID or squawk code. See Section 6.5 for directions for how to enter the squawk code for your aircraft's flight, and see Section 6.6 for instructions for how to enter a flight ID.

Sometimes, a textual or non-numerical input will be required. If this is the case, press the number that is associated with the letter group you want to input, according to the graphic on the screen. To cycle through the letters associated with each number, press the number key repeatedly until the letter you want to input appears. You can input a space after cycling through all of the letters for a particular number key. Once the correct character is selected, use the arrow keys to advance to the next field to enter the next character in the sequence.

#### 6.4.3. Identification (IDENT) key

If you are instructed by Air Traffic Control (ATC) to IDENT, press the **IDENT** key on your Stratus ES/ESG. Pressing **IDENT** will make your aircraft's reply pulse on ATC's monitors for 18 seconds. "IDENT" will be shown on the display while IDENT is activated.

#### 6.4.4. VFR key

Press the **VFR** key to broadcast the VFR squawk code. The factory-set VFR code is 1200, but the default number may be reconfigured.

### 6.4.5. Power (PWR) key

The **PWR** key is used to power Stratus ES/ESG on and off. When Stratus ES/ESG is powered on, it retains the last used squawk code and operation mode.

### 6.5. Entering a squawk code

While on any screen that the squawk code is shown, press the appropriate number keys (0 through 7) to enter the squawk code. The new digits will be shown on the display screen. Five seconds after the fourth digit is entered, Stratus ES/ESG will automatically save the entered squawk code.

**NOTE**: If you incorrectly enter a number before the code is automatically saved, press the left arrow key and then press the correct number key.

**WARNING**: Squawk codes 7500 (hijacking), 7600 (radio failure), and 7700 (emergency) are reserved for emergencies. There may also be other reserved codes, depending on the region the pilot is flying in. It is the pilot in command's responsibility to comply with their jurisdiction's operating rules and regulations.

### 6.6. Entering the flight identification number

To enter your flight identification number:

- 1. Press **FUNC** or the arrow keys until "Flight ID" appears. The registration number will be displayed in the Flight ID screen.
- 2. Press ENT.
- 3. Use the number keys to overwrite the registration number. Use the left and right arrow keys to change the cursor position. See Section 6.4.2 for instructions for how to enter non-numerical input.

**NOTE**: If the new flight ID is less than 8 digits and there are characters from the registration number remaining after the new flight ID has been entered, insert spaces in those fields to overwrite the characters.



Figure 9: Flight ID entry screen

4. Press **ENT** to confirm the new flight ID.

# 7. Troubleshooting

Use the table below to troubleshoot possible problems with Stratus ES/ESG.

For a full list of BIT failures, see Section 4.19.9.

| Problem                                                  | Troubleshooting Steps                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GPS information is not being received                    | <ul><li>Stratus ES:</li><li>1. Enter into configuration mode on Stratus ES.</li><li>2. Go to the BIT diagnostic screen.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                          | If the GPS Failure BIT failed (a "1" appears):                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                                          | There is a problem with the connection to the GPS position source. Verify that the connection between Stratus ES and the GPS position source is secure.                                                                                                                                                                                                                                                                                                                                                                  |
|                                                          | If the GPS Failure BIT did not fail (a "0" appears):                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                                          | The GPS position source is not achieving GPS<br>lock, but the connection is good and the position<br>source is configured correctly. Refer to the<br>documentation for your GPS position source for<br>troubleshooting.                                                                                                                                                                                                                                                                                                  |
|                                                          | <b>NOTE:</b> A BIT failure will not appear until 5 minutes after Stratus ES is powered on.                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                          | <ol> <li>Stratus ESG:</li> <li>Verify that the aircraft has a clear view of the sky.</li> <li>Verify that the antenna connections and cables are not loose.</li> <li>Verify that the coax cable is connected to the correct port.</li> </ol>                                                                                                                                                                                                                                                                             |
|                                                          | NOTE: Initial GPS fix could take up to 20 minutes.                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| GPS antenna signal quality is reduced (Stratus ESG only) | <ol> <li>Turn off all avionics.</li> <li>Enter into configuration mode on Stratus ESG.</li> <li>Go to the CN0 diagnostic screen and wait for the<br/>CN0 values to populate.</li> <li>Turn on one avionic at a time. If the CN0 values<br/>drop by 2 dB or more, there might be an<br/>interference problem. The avionic causing the<br/>interference might need to be relocated in the<br/>cockpit, antennas might need to be moved farther<br/>apart, or filters might need to be added to the<br/>avionic.</li> </ol> |



| Transponder is not receiving the squat switch position    | <ol> <li>Check the connections and the pin-out of the<br/>transponder to verify that the squat switch port is<br/>correctly connected.</li> <li>Verify that the squat switch works independent of<br/>the transponder.</li> </ol>                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The power key does not power on Stratus ES/ESG            | <ol> <li>Verify that the power key is not stuck.</li> <li>Verify that the circuit breaker has not tripped.</li> <li>If it has tripped: Reset the circuit breaker switch<br/>and try the power key again.</li> </ol>                                                                                                                                                                                                                                                                          |
|                                                           | <b>NOTE</b> : If the circuit breaker opens it may be reset only once.                                                                                                                                                                                                                                                                                                                                                                                                                        |
|                                                           | If it did not trip: Verify that the electrical connection to the transponder is secure. Verify that the voltage at the input to the unit is between 11 VDC and 36 VDC.                                                                                                                                                                                                                                                                                                                       |
| The altitude displayed is incorrect                       | <ol> <li>Enter into configuration mode on Stratus ES/ESG<br/>and verify that the altitude source is set as the<br/>currently used altitude source. If the altitude source<br/>is a serial connection, verify that the correct<br/>encoding option was selected.</li> <li>Verify that the correct connections are made to the<br/>transponder.</li> <li>Use an altitude simulator to verify the cabling.</li> <li>Verify that there is not a problem with the altitude<br/>source.</li> </ol> |
| The screen displays a "transmitter failure" error message | <ul> <li>This message appears when one of the following issues occurs: improper impedance between antenna and transponder, improper connection on connectors, improper seating of transponder into tray.</li> <li>1. Verify that the transponder is completely seated in</li> </ul>                                                                                                                                                                                                          |
|                                                           | the rack. Ensure back plate has been properly installed to rack.                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                           | 2. Verify that the transponder antenna is connected to<br>the port labeled XPNDR ANT and that the GPS<br>antenna is connected to the port labeled GPS<br>(Stratus ESG only).                                                                                                                                                                                                                                                                                                                 |
|                                                           | <ol> <li>Check all connectors to ensure they are properly<br/>mated. Check these connectors for opens or<br/>shorts.</li> </ol>                                                                                                                                                                                                                                                                                                                                                              |
|                                                           | 4. Verify that the maximum loss from the transponder connector to the antenna connector is 2 db.                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                           | 5. Inspect the transponder antenna to ensure functionality and adherence to requirements identified in the transponder antenna section.                                                                                                                                                                                                                                                                                                                                                      |
|                                                           | 6. Inspect wiring to ensure cabling integrity.                                                                                                                                                                                                                                                                                                                                                                                                                                               |



| The screen displays a Built in Test<br>(BIT) failure                                                                            | The Stratus ES/ESG screen might display a warning message with the instructions below. Below is guidance regarding how to assess the failure:                                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| The display screen will display a warning message and a degraded state indicator <b>A</b> if any of Stratus ES/ESG's BITs fail. | • <b>PRESS FUNC TO CLEAR</b> : A non-critical error has been detected. The transponder will run in a degraded state until the error is resolved. Contact Appareo for further assistance.                                                 |
|                                                                                                                                 | • <b>PLEASE RESTART UNIT</b> : A critical error has been detected. Restarting the unit may fix the error. If the message returns after restarting, contact Appareo for further assistance.                                               |
|                                                                                                                                 | • <b>PLEASE SHUTDOWN UNIT</b> : A critical error has been detected. Power off the unit and do not turn it back on. Contact Appareo for further assistance.                                                                               |
|                                                                                                                                 | • <b>OVERHEATED</b> : The transponder has overheated.<br>Transponder function will resume when the<br>transponder cools down.                                                                                                            |
|                                                                                                                                 | • WAITING TO BE UNSTUCK: A key has been depressed for more than 20 seconds. If a key is stuck, try to unstick the key.                                                                                                                   |
|                                                                                                                                 | WAITING FOR RELEASE: The external<br>suppression input is constantly in a suppressed<br>state. Contact Appareo for further assistance.                                                                                                   |
|                                                                                                                                 | • ATTEMPTING TO RECOVER: A squitter rate error<br>has been detected. The transponder may recover<br>itself, but if it does not, restart the unit. If the<br>message returns after restarting, contact Appareo<br>for further assistance. |



# Appendix A

**Nomenclature**: Stratus ES / Stratus ESG Transponder

Part number: 153510-000069 / 153510-000017

TSO number: TSO-C112e, TSO-C145d (Stratus ESG only), TSO-C166b

Manufacturer's specification and/or other applicable specification: 608080-000021

Manufacturer: Appareo Systems

Address: 1830 NDSU Research Circle North, Fargo, ND 58102, USA

| Conditions                             | DO-160G<br>Section | Description of tests conducted                         |
|----------------------------------------|--------------------|--------------------------------------------------------|
| Temperature and Altitude               | 4.0                |                                                        |
| Low Temperature                        | 4.5.2              | Equipment tested to Category B1.                       |
| High Temperature                       | 4.5.3              | Equipment tested to Category B1.                       |
| Operating High Temp<br>Test            | 4.5.4              | Equipment tested to Category B1.                       |
| In-Flight Loss of Cooling              | 4.5.5              | Equipment identified as Category X, no test performed. |
| Altitude                               | 4.6.1              | Equipment tested to Category B1.                       |
| Decompression                          | 4.6.2              | Equipment identified as Category X, no test performed. |
| Overpressure                           | 4.6.3              | Equipment identified as Category X, no test performed. |
| Temperature Variation                  | 5.0                | Equipment tested to Category C.                        |
| Humidity                               | 6.0                | Equipment tested to Category A.                        |
| Operational Shocks and<br>Crash Safety | 7.0                |                                                        |
| Operational Shocks                     | 7.2                | Equipment tested to Category B.                        |
| Crash Safety                           | 7.3                | Equipment tested to Category B.<br>Aircraft type: 5F   |



|                                               | 8.0      |                                                              |
|-----------------------------------------------|----------|--------------------------------------------------------------|
| Vibration                                     | 8.5.1    | Equipment tested to Category S.<br>Group 3 during, 1 after   |
| Explosion Proofness                           | 9.0      | Equipment identified as Category X, no test performed.       |
| Waterproofness                                | 10.0     | Equipment identified as Category X, no test performed.       |
| Fluids Susceptibility                         | 11.0     | Equipment identified as Category X, no test performed.       |
| Sand and Dust                                 | 12.0     | Equipment identified as Category X, no test performed.       |
| Fungus Resistance Test                        | 13.0     | Equipment identified as Category X, no test performed.       |
| Salt Fog Test                                 | 14.0     | Equipment identified as Category X, no test performed.       |
| Magnetic Effect                               | 15.0     | Equipment tested to Category A.                              |
| Power Input                                   | 16.0     |                                                              |
| Normal Operating<br>Conditions                | 16.6.1   | Equipment tested to Category BXX.<br>Group 3 during, 2 after |
| Voltage                                       | 16.6.1.1 | Equipment tested to Category BXX.                            |
| Abnormal Operating<br>Conditions              | 16.6.2   | Equipment tested to Category BXX.<br>Group 3 during, 2 after |
| Voltage Spike                                 | 17.0     | Equipment tested to Category A.                              |
| Audio Frequency Conducted<br>Susceptibility   | 18.0     | Equipment tested to Category B.                              |
| Induced Signal Susceptibility                 | 19.0     | Equipment tested to Category ZCX.                            |
| Radio Frequency<br>Susceptibility             | 20.0     |                                                              |
| Conducted Susceptibility                      | 20.4     | Equipment tested to Category TT.                             |
| Radiated Susceptibility                       | 20.5     | Equipment tested to Category TT.                             |
| Emission of Radio Frequency<br>Energy         | 21.0     | Equipment tested to Category B.                              |
| Lightning Induced transient<br>Susceptibility | 22.0     | Equipment tested to Category A1XXXX.                         |
| Lightning Direct Effects                      | 23.0     | Equipment identified as Category X, no test performed.       |



| Icing                   | 24.0 | Equipment identified as Category X, no test performed.                                                                                            |
|-------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Electrostatic Discharge | 25.0 | Equipment tested to Category A.<br>No group test during, 2 after                                                                                  |
| Fire, Flammability      | 26.0 | Flammability testing was performed utilizing the method as indicated in 14 CFR Part 25, Section 25.853(a) and Appendix F, Part 1, Par (a)(1)(ii). |

Table 27: DO-160G tests performed