STRATUS
by APPAREO

Stratus ES/ESG Installation Instructions

Revision 3.0

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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.

Table of Contents

List of Figures

List of Tables

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 Number	Change Description	Revision Date	Inserted By
1.0	Initial Release	5/29/15	AAL
1.1	CM 10281	1/06/16	AAL
1.2	CM 10323	1/13/16	AAL
1.3	CM 10633	2/09/16	AAL
1.4	CM 11303	5/10/16	AAL
1.5	CM 11511	6/08/16	AAL
2.0	CM 13664	3/28/17	AAL
2.1	CM 13664	6/22/17	AAL
2.2	CM 14496	2/20/18	AAL
3.0	Added helicopter installation instructions	10/03/19	AAL

Related Documentation

Document Number	Title
Appareo 600845-000024	Stratus ES/ESG Maintenance Manual
Appareo 600890-000049	Stratus ES/ESG Pilot's Guide
Appareo 601837-000024	Stratus ES/ESG Installation and Wiring Drawings
Appareo 601837-000050	Stratus ES/ESG Helicopter Installation and Wiring Drawings
FAA AC 20-165B	Airworthiness Approval of Automatic Dependent Surveillance - 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 367 Van Ness Way, Suite 602 Torrance, California 90501 Phone: (310) 782-1076 www.antcom.com
AV-801 (GPS antenna)	RAMI	Rami 14500 168th Avenue P.O. Box 858 Grand Haven, MI 49417 Phone: (616) 842-9450 www.rami.com
AV-74 (transponder antenna)	RAMI	Rami 14500 168th Avenue P.O. Box 858 Grand Haven, MI 49417 Phone: (616) 842-9450 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 Office	Branch of the FAA that works with the applications for certifications.
ADS-B	Automatic Dependent Surveillance - Broadcast	Technology implemented by the FAA to provide surveillance and improved situational awareness to both pilots and air traffic controllers.
ATC	Air Traffic Control	Service that directs aircraft on the ground and through controlled airspace.
ATCRBS	Air Traffic Control Radar Beacon 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 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 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. Part of the marketing name for Stratus ES.
ESG	Extended Squitter and GPS	Part of the marketing name for Stratus ESG.
FAA	Federal Aviation Administration	Agency of the United States Department of Transportation with authority to regulate and oversee all aspects of civil aviation in the United States.
FCC	Federal Communications Commission	Branch of the government responsible for controlling the regulations around electronic equipment.
FMS	Flight Management System	System that automates the aircraft’s flight plan.
GPS	Global Positioning 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 (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 Augmentation System	System of satellites that augments existing satellite systems and provides increased position accuracy.
STC	Supplemental Type Certificate	Type Certificate issued when an applicant has received FAA approval to modify an aircraft from its original design.
TIS-B	Traffic Information Service-Broadcast	Aviation information service broadcast provided to aircraft using both 1090 MHz ES and UAT.
TSO	Technical Standard 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 Frequency	Range of frequency between 30 MHz to 300 MHz.
WAAS	Wide Area Augmentation 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 www.appareo.com/resources.

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 System/Mode Select (ATCRBS / Mode S) Airborne Equipment
FAA TSO-C145d (Stratus ESG only)	Technical Standard Order: Airborne Navigation Sensors Using The Global Positioning System
FAA TSO-C166b	Technical Standard Order: Extended Squitter Automatic Dependent Surveillance - Broadcast (ADS-B) and Traffic Information Service - Broadcast (TIS-B) Equipment Operating on the Radio Frequency of 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 (Stratus ESG only)	Section 3, Subpart D	Environmental qualification testing was performed to DO-160G, not DO-160E.

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 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 (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 (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 (Transponder with rack and connectors)	Airplane install: 3.3 lbs. (1.5 kg) Helicopter install: 4.2 lbs. (1.9 kg)

Table 6: Equipment weight

1.8.3. Electrical specifications

Characteristic	Specification
Altitude	Up to 25,000 ft
External 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 Serial altitude encoder: up to 126,700 ft
Mode S Capability	Parallel altitude encoder: up to 62,700 ft 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 0.5 A at 14 VDC
Power Input	8 W Typical 59.5 W Max

Table 8: Power requirements

1.9. Required tools

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

Tool	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.

1.10.1. Airplane Installation

Supplied parts

Item	Appareo Part Number	Commercial Part Number	Quantity
Backplate	153510-000015	-	1
Stratus ES Transponder or Stratus ESG Transponder	153510-000069 or 153510-000017	-	1
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	353060-000007	- (ALT: MS51957-13)	6
Strain Relief Backshell	356070-000006	M85049/48-1-4F	1

Table 10: Required hardware (airplane installation) (supplied parts)

Additional parts

Item	Appareo Part Number	Commercial Part Number	Quantity
#6-32 x 100° Flat Head SS Screw	-	MS24693C, AN507R or other approved fastener	6
Metal Hex Stop Nut *	-	MS21042-06	6
Monadnack Clip Nut 6-32*	-	294667	6

Table 11: Required hardware (airplane installation) (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.

1.10.2. Helicopter Installation

Supplied parts

Item	Appareo Part Number	Commercial Part Number	Quantity
Backplate	353070-000369	-	1
Stratus ES Transponder or Stratus ESG Transponder	153510-000069 or 153510-000017	-	1
Stratus ES/ESG Rack	353070-000368	-	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	353060-000007	- (ALT: MS51957-13)	8
Strain Relief Backshell	356070-000006	M85049/48-1-4F	1

Table 12: Required hardware (helicopter installation) (supplied parts)

Additional parts

Item	Appareo Part Number	Commercial Part Number	Quantity
#6-32 x 100° Flat Head SS Screw	-	MS24693C, AN507R or other approved fastener	6
Metal Hex Stop Nut *	-	MS21042-06	6
Monadnack Clip Nut 6-32*	-	294667	6

Table 13: Required hardware (helicopter installation) (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 ± 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 14: 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 15: 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

This article meets the minimum performance and quality control standards required by a technical standard order (TSO). If you are installing this article on or in a specific type or class of aircraft, you must obtain separate approval for installation.

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

Aircraft
Stratus ES/ESG 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

NOTE: 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.

1. Refer to Stratus ES/ESG Installation and Wiring Drawings (601837-000024 for airplanes or 601837-000050 for helicopters) to assemble the mounting rack with the supplied hardware specified in Section 1.10.

2. Mount the rack to the aircraft using the six holes on the side of the rack with the additional hardware specified in Section 1.10.

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

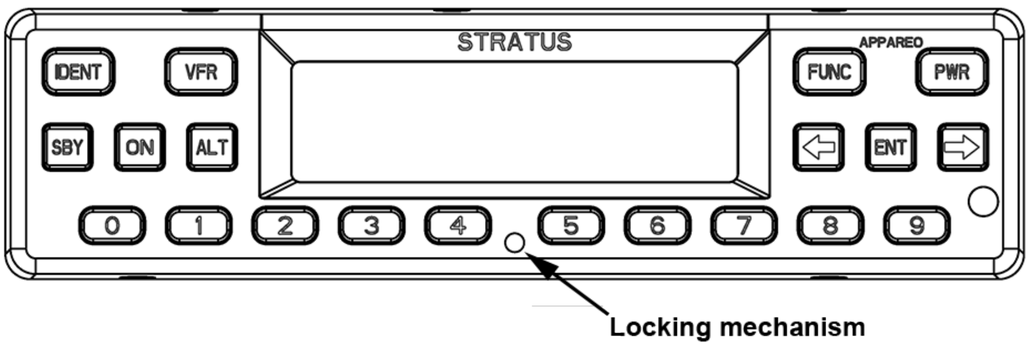


Figure 1: Locking mechanism location

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 airplanes or 601837-000050 for helicopters) 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				Stratus ESG		
Pin #	Pin Name	I/O		Pin #	Pin Name	I/O
1	Aircraft Ground	-		1	Aircraft Ground	-
2	Aircraft Power	-		2	Aircraft Power	-
3	RS232-RX External GPS input	In		3	RS232-RX Maintenance	In
4	-	-		4	-	-
5	RS232-RX Altitude	In		5	RS232-RX Altitude	In
6	RS232-TX GPS 1PPS	Out		6	RS232-TX GPS 1PPS	Out
7	External Standby	In		7	External Standby	In
8	Software Update Enable	In		8	Software Update Enable	In
9	Altitude A1	In		9	Altitude A1	In
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 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 16: Pin assignments

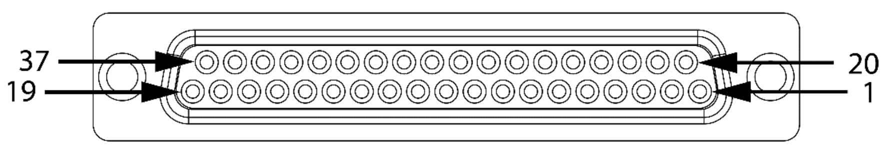


Figure 2: Pin-out

Refer to the wiring diagrams in Stratus ES/ESG Installation and Wiring Drawings (601837-000024 for airplanes or 601837-000050 for helicopters) 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 17: 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 External GPS input	In
18	External GPS Common Ground	-

Table 18: GPS position source pin assignments

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 19: Parallel altitude encoder pin assignments

For serial altitude encoders:

Pin #	Pin Name	I/O
5	RS232-RX Altitude	In

Table 20: 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 21: 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 22: 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 23: 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 24: 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 25: 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 for airplanes or 601837-000050 for helicopters).

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
	Cancel an input
ENT	Edit a configuration
	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 26: 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	Type	Protocol	Used when
Parallel	Parallel	--	--
Serial—trim/gar	Serial	Trimble/Garmin	Altitude encoder resolution is **25 ft or worse** (e.g. 100 ft).
Serial—trim/gar-25 ft	Serial	Trimble/Garmin	Altitude encoder resolution is **25 ft or better** (e.g. 10 ft)
Serial—shad/rms	Serial	Shadin/RMS	Altitude encoder resolution is **25 ft or worse** (e.g. 100 ft).
Serial—shad/rms-25 ft	Serial	Shadin/RMS	Altitude encoder resolution is **25 ft or better** (e.g. 10 ft)

Table 27: Altitude source configurations

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

Table 28: GPS week number rollovers

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 Position	BIT Failure	Display Message	Corrective Action
1 (left)	Transmitter Failure	TRANSMITTER FAILURE CHECK CONNECTION	Verify that the connection between Stratus ES/ESG and the transponder antenna is secure. See Section 7 for more information.
2	Transmitter PLL	TRANSMITTER FAILURE	Contact Appareo
3	GPS Failure (Stratus ES only)	GPS INPUT FAILURE	Verify that the connection between Stratus ES and the GPS position source is secure.
4	Transmitter	TRANSMITTER FAILURE	Contact Appareo
5	Display	none	Contact Appareo
6	GPS Failure (Stratus ESG only)	GPS RECEIVERFAILURE	Contact Appareo
7	Altitude Source	ALTITUDE INPUT FAILURE	Use the altitude diagnostic screen to troubleshoot the altitude encoder connection
8	Internal 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 IDENT	EXTERNAL IDENT 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 Checksum	MEMORY READ FAILURE	Re-configure Stratus ES/ESG, if necessary. Verify that the GPS Week Number Rollover is set to the correct value.
15	Squitter Rate	SQUITTER FAILURE	Contact Appareo
16	Mode S Address	ICAO ADDRESS CHANGE	Contact Appareo
17	GPS Failure (Stratus ESG only)	GPS RECEIVER FAILURE	Contact Appareo
18	1030 MHz RX VCO Lock	1030 MHZ RECEIVER FAILURE	Contact Appareo
19	DSC RAM	RAM FAILURE	Contact Appareo
20	FPGA RAM	none	Contact Appareo
21	GPS Failure (Stratus ESG only)	GPS RECEIVER FAILURE	Contact Appareo
22 (right)	GPS Failure (Stratus ESG only)	GPS RECEIVER FAILURE	Contact Appareo

Table 29: 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.

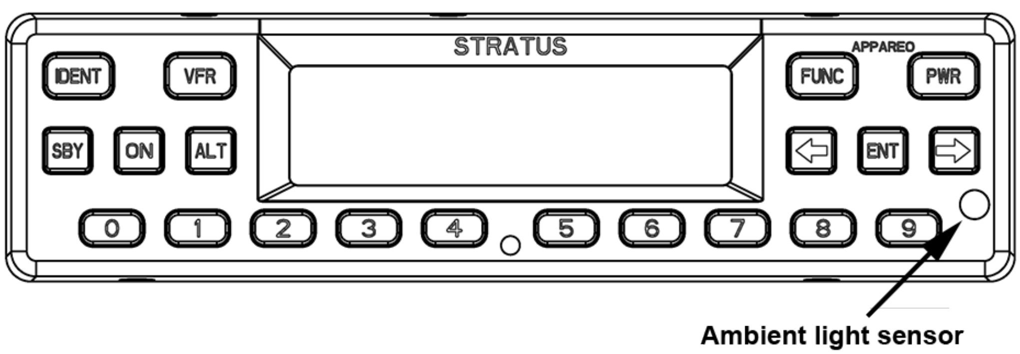


Figure 3: Ambient light sensor location

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.

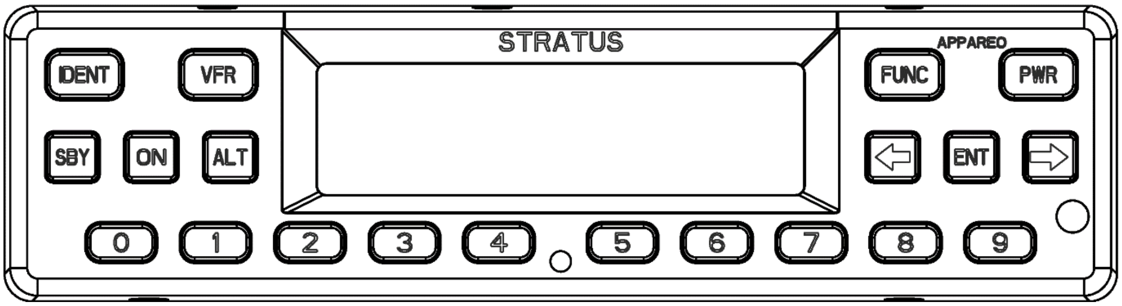


Figure 4: Stratus ES/ESG front panel

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-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 30: 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.

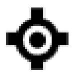
Indicator	Meaning
	ADS-B transmission contains GPS position information with a radius of containment under 1 nautical mile.
	A response was transmitted from a mode A/C/S interrogation. The indicator will time out if another reply does not occur within one second.
	A built-in-test (BIT) has failed. See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

Table 31: 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.

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.

   FLIGHT ID: N 9 9 9 Z Z Z Z

	ABC	DEF	GHI	JKL	MNO	PQR	STU	VWX	YZ
0	1	2	3	4	5	6	7	8	9

   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.

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

Transponder is not receiving the squat switch position	1. Check the connections and the pin-out of the transponder to verify that the squat switch port is correctly connected. 2. Verify that the squat switch works independent of the transponder.
The power key does not power on Stratus ES/ESG	1. Verify that the power key is not stuck. 2. Verify that the circuit breaker has not tripped. **If it has tripped**: Reset the circuit breaker switch and try the power key again. **NOTE**: 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	1. Enter into configuration mode on Stratus ES/ESG and verify that the altitude source is set as the currently used altitude source. If the altitude source is a serial connection, verify that the correct encoding option was selected. 2. Verify that the correct connections are made to the transponder. 3. Use an altitude simulator to verify the cabling. 4. Verify that there is not a problem with the altitude source.
The screen displays a “transmitter failure” error message	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. 1. Verify that the transponder is completely seated in the rack. Ensure back plate has been properly installed to rack. 2. Verify that the transponder antenna is connected to the port labeled XPNDR ANT and that the GPS antenna is connected to the port labeled GPS (Stratus ESG only). 3. Check all connectors to ensure they are properly mated. Check these connectors for opens or shorts. 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 (BIT) failure The display screen will display a warning message and a degraded state indicator ⚠ if any of Stratus ES/ESG's BITs fail.	The Stratus ES/ESG screen might display a warning message with the instructions below. Below is guidance regarding how to assess the failure: • **PRESS FUNC TO CLEAR**: 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. • **PLEASE RESTART UNIT**: A critical error has been detected. Restarting the unit may fix the error. If the message returns after restarting, contact Appareo for further assistance. • **PLEASE SHUTDOWN UNIT**: A critical error has been detected. Power off the unit and do not turn it back on. Contact Appareo for further assistance. • **OVERHEATED**: The transponder has overheated. Transponder function will resume when the 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 suppression input is constantly in a suppressed state. Contact Appareo for further assistance. • **ATTEMPTING TO RECOVER**: A squitter rate error has been detected. The transponder may recover itself, but if it does not, restart the unit. If the message returns after restarting, contact Appareo for further assistance.

Table 32: Troubleshooting

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 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 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 Crash Safety	7.0	
Operational Shocks	7.2	Equipment tested to Category B.
Crash Safety	7.3	Equipment tested to Category B. Aircraft type: 5F
Vibration	8.0	
	8.5.1	Equipment tested to Category S.
	8.8.1	Equipment tested to Category U.

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 Conditions	16.6.1	Equipment tested to Category BXX.
Voltage	16.6.1.1	Equipment tested to Category BXX.
Abnormal Operating Conditions	16.6.2	Equipment tested to Category BXX.
Voltage Spike	17.0	Equipment tested to Category A.
Audio Frequency Conducted Susceptibility	18.0	Equipment tested to Category B.
Induced Signal Susceptibility	19.0	Equipment tested to Category ZCX.
Radio Frequency 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 Energy	21.0	Equipment tested to Category B.
Lightning Induced transient 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.

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 33: DO-160G tests performed