



SAI-340

Installation Manual



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2	1/22/2016	ECN 4146 - Changes for V15 software. Added default baro configuration options (STD, LAST, AUTO). Added airspeed units configuration setting (KTS or MPH). Changed exit method of setup mode. Fixed gyro rate discrepancy. Clarified wording on degraded mode of operation.	L. Harrison

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Section 1 - General Description

1.1 Introduction

This manual describes the installation of the SANDIA aerospace SAI 340 Attitude Indicator. It is intended for use by FAA certified repair stations to install the SAI 340 indicator and includes both mechanical and electrical installation information.

System configuration, continued airworthiness and sample POH are included. The installer must ensure that all functions are operating properly according to their intended purpose in their particular installation.

1.2 SAI 340 Product Description

The SAI 340 Attitude Indicator is a panel mounted attitude, airspeed, altitude and slip. The instrument is self-contained and directly incorporates all of the sensors required to measure and display the listed flight parameters.

All information is displayed on a color 3.5" diagonal LCD display in traditional aerospace symbology. The unit also contains a rechargeable battery capable of providing continued operation in the event of aircraft electrical failure.

1.2.1 System Functions

The SAI 340 performs the following functions:

- Display of Indicated Airspeed (Knots or MPH)
- Display of Barometric Altitude (Feet)
- Display of Roll & Pitch (Fixed Pointer Format, Degrees)
- Display of Slip Indication (Degrees)

- Pilot Entered Baro Correction (mb or inHg, Configurable Default)
- Automatic and Manual Backlight Control (%)
- Display of Battery Charge Status (% Remaining)
- Display of V-Speed Limitations (Colored Bands)

Various parameters can be configured by the installer (not pilot accessible):

- Configuration of Roll & Tilt Offsets
- Calibration of Airspeed and Altitude
- Configuration of V-Speeds
- Configuration of Baro Units
- Configuration of Battery Type

Non TSO'd functions have been verified to not interfere with TSO'd functions.

1.2.2 System Interfaces

Airspeed and altitude are derived from internal pressure sensors that are connected to the aircraft's pitot and static lines. Airspeed is determined by the pressure difference between the pitot and static ports, while altitude is determined by the pressure on the static port. Altitude is barometrically corrected by the pilot entered baro value prior to being displayed.

Attitude is aided by airspeed to provide better pitch performance during takeoffs and in-flight accelerations and decelerations. TSO performance levels are maintained with or without this additional aiding.

Aircraft power is the only electrical interface present. No communication or data interfaces are provided to other avionic systems in the aircraft.

1.2.3 Unit Outer Dimensions

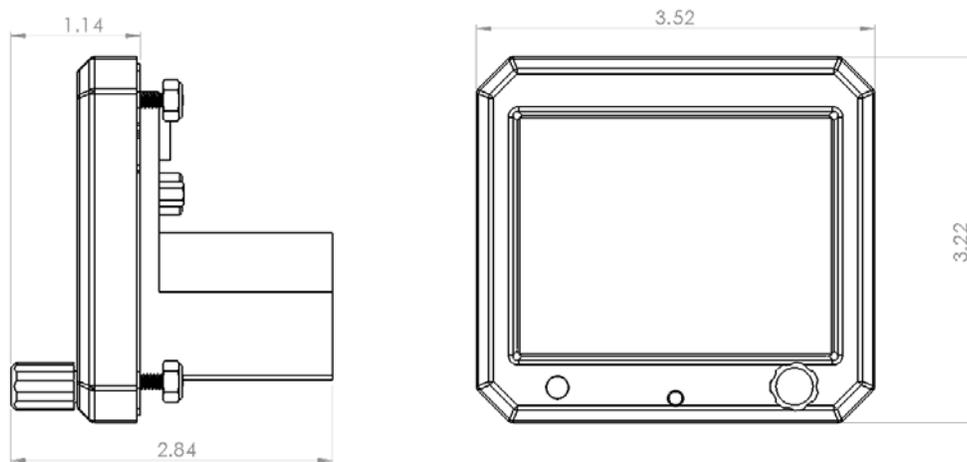


Figure 1 – Unit Outer Dimensions

1.3 Specifications

1.3.1 Physical Characteristics

Mounting	Standard 3" Round Hole
Overall Dimensions.....	3.52 x 3.22 x 2.25 in
Bezel Dimensions.....	3.52 x 3.22 x 0.51 in
Weight.....	0.8 lbs (Including Battery & Bracket)
Pneumatic Fittings.....	1/16 NPTF (1/8" Barbed Adapters Supplied)
Viewing Angle	60° Left/Right, 45° Up/Down
Operating Temp	-20°C to +55°C
Power Input	10-32 VDC
Current	2 Amp Max

1.3.2 Performance Characteristics

Time to Initialize	< 3 Minutes (1 Minute Typical)
Airspeed Range	20 to 400 Knots
Altitude Range	-1500 to 35,000 Feet
Baro Correction Range (inHg)	28.00 to 31.00 inHg
Baro Correction Range (mb)	948 to 1050 mb
Roll/Pitch Accuracy	1° Static Conditions
Roll/Pitch Range	Unlimited
Slip Range	±7° Displayable
Slip Accuracy	1° Static Conditions
AHRS Degraded Modes.....	Loss Of Air Data
Max Roll Rate	400° / Second
Max Sustained G.....	.6g
Roll/Pitch/Slip Resolution.....	Sub-pixel (340 x 240)
Battery Type 0 (P/N 306186).....	Li-Poly, 7.4V, 1300mAh, Heated
Battery Life (-20°C, 100% Brightness)	0.5 Hours Minimum
Battery Life (+23°C, 100% Brightness)	2.0 Hours Minimum
Battery Life (+55°C, 100% Brightness)	3.0 Hours Minimum
Battery Charge Time	4 Hour Typical (From Fully Discharged)
Battery Heat Time	15 Minutes Max @ -20°C Cold Soaked

1.3.3 Certification

Airspeed	TSO-C2d (Type B)
Airspeed Limits.....	Vso, Vs1, Vfe, Vno, Vne, Vyse, Vmc
Turn and Slip.....	TSO-C3e
Bank and Pitch	TSO-C4c
Altimeter	TSO-C10b (Type II)
Display	TSO-C113a
AHRS	TSO-C201 (A5HXT7)
Battery.....	RTCA DO-347 ("Small" Lipo – 4.81Wh)
Software Design Assurance	RTCA DO-178C (DAL C)
Hardware Design Assurance	N/A
Environmental	RTCA DO-160G (See Qual Table)
MTBF.....	>10,000 hours

1.4 Environmental Qualification Form for the SAI 340

NOMENCLATURE SAI 340 Attitude Indicator
MODEL/PART NO SAI 340 / 306171-XX
TSO NUMBER TSO-C2d (Type B), TSO-C3e, TSO-C4c, TSO-C10b (Type II),
 TSO-C113a, TSO-C201
SPECIFICATION(S) INSTALLATION MANUAL, P/N 306181
 ENVIRONMENTAL QUAL PLAN, P/N 901099-EQTP
MANUFACTURER SANDIA AEROSPACE
ADDRESS 3700 OSUNA RD NE, SUITE 711, ALBUQUERQUE, NM 87109
DO-160 REVISION REV G (DECEMBER 8, 2010)
DATE OF TESTS 2014-2015

CONDITION	SECTION	DESCRIPTION OF TEST CONDUCTED
Temperature	4.5	Category A1/C1
Ground Survival Low	4.5.1	-55°C
Short Term Low	4.5.1	-40°C
Operating Low	4.5.2	-20°C
Ground Survival High	4.5.3	+85°C
Short Term High	4.5.3	+70°C
Operating High	4.5.4	+55°C
In-Flight Loss of Cooling	4.5.5	Not Applicable
Altitude	4.6	
Altitude	4.6.1	35,000 Feet
Decompression	4.6.2	8,000 to 35,000 Feet
Overpressure	4.6.3	-15,000 Feet
Temperature Variation	5.0	Category C, 2°C / Min
Humidity	6.0	Category A
Shock and Crash Safety	7.0	Category B, AC Type 5, Random
Vibration	8.0	Category S, Zone 2, Curve M
Explosive Atmosphere	9.0	Category X, No Test Performed
Waterproofness	10.0	Category X, No Test Performed
Fluids Susceptibility	11.0	Category X, No Test Performed
Sand and Dust	12.0	Category X, No Test Performed
Fungus	13.0	Category X, No Test Performed
Salt Spray	14.0	Category X, No Test Performed
Magnetic Effect	15.0	Category Z
Power Input	16.0	Category BXX
Voltage Spike	17.0	Category A
Audio Freq Cond Susceptibility	18.0	Category B
Induced Signal Susceptibility	19.0	Category X, No Test Performed ^{Note 1}
Radio Freq Susceptibility	20.0	Category WF
Emission of Radio Freq	21.0	Category M
Lighting Induced Transient Susc.	22.0	Category B3K3
Electrostatic Discharge	25.0	Category A

Notes:

- 1) Equipment does not incorporate electrical interfaces to other equipment. Test does not apply.

Section 2 - Installation Considerations

2.1 General

The SAI 340 provides stand-alone, basic airspeed, altitude, attitude and slip functions. The SAI 340 does not support integration with other avionics systems, nor does it provide complex switching interfaces with other equipment or systems. Installation is limited to power, ground, pitot and static connections.

2.2 Handling Considerations

The SAI 340 incorporates sensitive sensor elements that may be damaged or degraded by improper handling. Observe the following prior to and during installation:

- Do not apply excessive pressure or vacuum to either the pitot or static pressure ports
- Do not insert objects into the pressure ports (other than approved fittings)
- Do not drop, jar or otherwise mechanically shock the unit
- Do not scratch or otherwise mar the display or surrounding bezel
- Clean the display only with products approved for LCD screens
- Do not drop, puncture or otherwise tamper with the battery pack

2.3 Certification Considerations

2.3.1 Installation Approval

The conditions and tests for TSO approval of this article are minimum performance standards. Those installing this article, on or in a specific type or class of aircraft, must determine that the aircraft installation conditions are within the TSO standards. TSO articles must have separate approval for installation in an aircraft. The article may be installed only according to 14 CFR part 43 or the applicable airworthiness requirements.

This article meets the minimum performance and quality control standards required by a technical standard order (TSO). Installation of this article requires separate approval.

2.3.2 EFIS Standby Applications

If installation is being performed on an aircraft with a retro-fit EFIS/PFD installation, the FAA approved installation guidance for that product must be considered when installing the SAI 340 as a backup to those installations. Compatibility with the primary EFIS/PFD must be evaluated and considerations may include:

- Electrical architecture (single / dual bus, multi-engine, etc)
- Independent power source requirements
- Electrical load analysis
- Mounting location relative to primary instrumentation
- Compatibility of airspeed, altitude, baro setting units relative to the primary instrumentation
- Compatibility of roll pointer (fixed pointer vs fixed scale)

- Compatibility of environmental qualification levels
- Compatibility of software design assurance levels (DAL)
- Compatibility of airspeed limitations (Mmo, variable Vmo/Vne or placarded limits)
- Compatibility of HIRF and lightning levels
- Compatibility of Functional Limitations (See section below)

2.3.3 Substitution of Rate-Of-Turn Indicator

The SAI 340 may be eligible to replace the Rate-Of-Turn Indicator in certain applications. Refer to FAA AC 91-75 for additional details.

2.3.4 Battery Operation

The battery sub-system in the SAI 340 is designed to fulfill the needs of an independent power source per 14 CFR 23.1353(h). Considerations are as follows:

- Automatic transition to battery will occur if the externally supplied power drops below approximately 7 VDC.
- A load-test is performed on each power-on cycle - a faulted battery indication will be shown if this test fails.
- Battery operational time is highly dependent on the ambient operating temperature and backlight intensity settings. See the specifications section in this document for minimum guaranteed operating time under different conditions.
- Reference the SAI 340 Pilots Guide (document number 306192) for additional details on battery operation.

2.3.5 Functional Dependencies

Air-data is utilized to help refine the attitude solution during specific operational maneuvers. If air-data is lost, a Degraded Mode of operation is automatically entered. During this mode, errors in pitch may be observed during long accelerations or decelerations, however attitude information is always available - it is never removed or made un-available.

Errors will not exceed TSO limit specifications. Degraded Mode maintains basic attitude performance and is sufficient to maintain positive aircraft control for VFR and IFR operations. When operating in the Degraded Mode, an amber CROSS CHECK message may be displayed on the screen.

The SAI 340 is not sensitive to external magnetic fields. Altitude indication requires correct static pressure. Airspeed indication requires both correct pitot and correct static pressure. Slip indication has no functional dependencies.

2.3.6 Operational Limitations

The following operational limitations apply:

- Geographic limitation: None
- Magnetic field sensitivity: None
- Lightning direct effects sensitivity: None
- Lightning indirect effects sensitivity: Approved for catastrophic functions
- HIRF Susceptibility: Approved for catastrophic functions
- Viewing Angle Limitations: 60° Left / Right, 45° Up / Down

- Displayable Vspeeds: Vne, Vno, Vfe, Vs1, Vso (Vmc, Vyse ME Only)
- Maximum displayable airspeed: 400 Knots / 460 Mph
- Minimum displayable airspeed: 20 Knots / 20 Mph
- Maximum displayable altitude: 35,000 Feet
- Minimum displayable altitude: -1,500 Feet
- Maximum configurable baro correction: 1050 mb / 31.00 inHg
- Minimum configurable baro correction: 948 mb / 28.00 inHg
- Minimum operational duration on battery: 30 Minutes
- Maximum roll rate: 400 degrees / second
- Maximum operating G force: 6 G

- Battery operation may be inhibited for up to 15 minutes during cold-starts. TSO performance is met within 10 minutes during cold-starts.
- No operational capability on internal battery is possible if the battery is faulted, as shown by a Red-X over the battery icon.
- Battery charging is disabled below approximately 0°C and above 40°C ambient, or when power input is below approximately 11 volts DC.
- After extended operation on battery and re-application of external power, the cell technology may take up to 1 hour to re-stabilize before an accurate capacity measurement can be

determined. During this time period, the percent charge shown may be inaccurate and should not be relied upon to determine charge status.

- In-Flight alignment must be performed with wings-level non-accelerated flight conditions.
- NOTE: Approximately nine percent of the population has some sort of color vision deficiency (what is commonly called “color blindness”). It should also be noted that the FAA does not test for all potential color deficiencies. (Source TSO-C113a / AS8034)

2.3.7 TSO Deviations

TSO deviations are related to environmental test conditions and software certification basis. In both cases, the latest versions of RTCA DO-160 (Revision G) and RTCA DO-178 (Revision C) were utilized in lieu of older guidance.

In certain circumstances, this is a deviation from older TSO and associated MOPS guidance as follows:

TSO’s that reference older versions of DO-160:

- TSO-C2d § c(2)(viii) and corresponding MOPS AS8019 § 5
- TSO-C3e § 6 (g) and corresponding MOPS AS8004 § 5

TSO’s that directly include a list of environmental specifications:

- TSO-C4c § 514.14 and corresponding MOPS AS396B § 3.3, § 3.4, § 3.5, § 4.4, § 7
- TSO-C10B § a(2)(ii) and corresponding MOPS AS392C § 3.3, §7

TSO’s that reference older versions of DO-178:

- TSO-C2d § a(3), §a(3)(i), § c(1)(xi), §c(2)(vii)
- TSO-C3e § 3(e), § 6(h)
- TSO-C113a § 3(e), § 6(g)
- TSO-C201 §3(e), § 6(g) and corresponding MOPS DO-334 § 2.1.7.2

The above deviations have been FAA approved.

2.3.8 Mounting Hole

The SAI 340 is designed to mount in a standard 3" round mounting hole. The supplied front mounting bracket (P/N 306179) and rear mounting bracket (P/N 306185) must be utilized to mount the instrument. The panel cutout should be as follows:

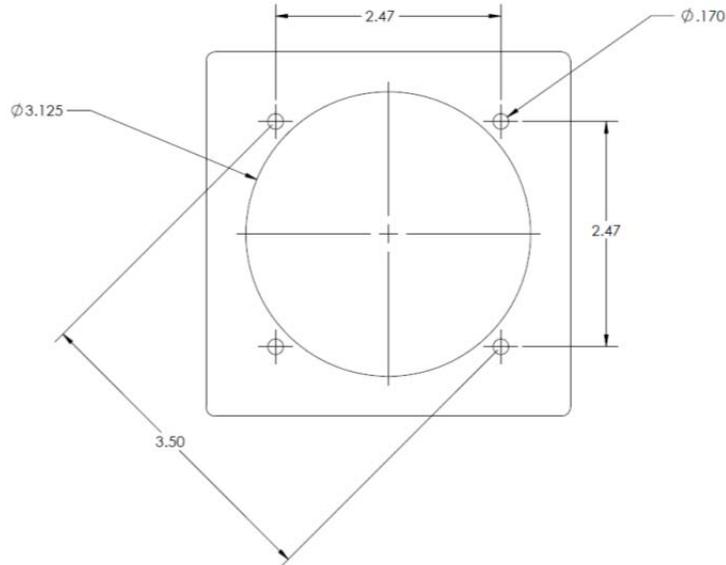


Figure 2 - Instrument Cutout

Front and rear mounting brackets adapt the unit connection points to the 3" round instrument hole cutout. The front bracket is constructed of stainless steel, and should be inspected prior to installation to insure general flatness. The rear bracket is utilized to fasten the unit to the panel. The supplied screws and nuts must be used to retain the brackets.

2.3.9 Mounting Bracket & Bonding

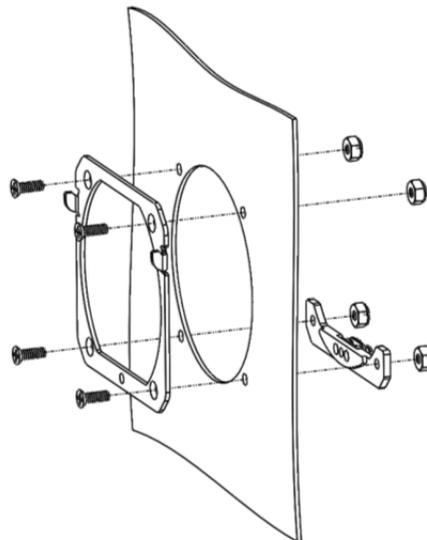


Figure 3 – Front & Rear Mounting Bracket

Electrical bonding must be carefully considered when installing the mounting bracket to the instrument panel, as this is the primary grounding mechanism for High-Intensity Radiated Fields (HIRF) and lightning protection.

The mounting bracket must remain un-painted and be bonded to the aircraft frame (or equivalent for composite aircraft) with a resistance of 2.5 milliohms or less. This can be achieved by cleaning and/or removing paint from the rear side of the instrument panel where the retaining nuts make contact with the panel structure.

2.3.10 Electrical Connections

The SAI 340 is supplied with one 9 pin Sub-D female mating connector and back-shell. The Sub-D connector uses screw lock assemblies to secure the connector to the unit.



Figure 4 - Sub-D Back-Shell

All electrical connections are made on the single rear mounted 9 pin Sub-D. Connections indicated as Reserved - Do Not Connect (DNC) should not be connected in the installation. Power is applied to pins 5 and 9.

PIN #	FUNCTION	TYPE	NOTES
1	Serial 1 RX	Input	Reserved – DNC
2	Serial 1 TX	Output	Reserved – DNC
3	Serial 0 RX	Input	Reserved – DNC
4	Serial 0 TX	Output	Reserved – DNC
5	Power +	Power	Main Power Input
6	Select	Input	Reserved – DNC
7	V Battery	Output	Reserved – DNC
8	Serial Ground	Signal	Reserved – DNC
9	Power -	Power	Main Power Ground

Table 1- Electrical Pin-Out

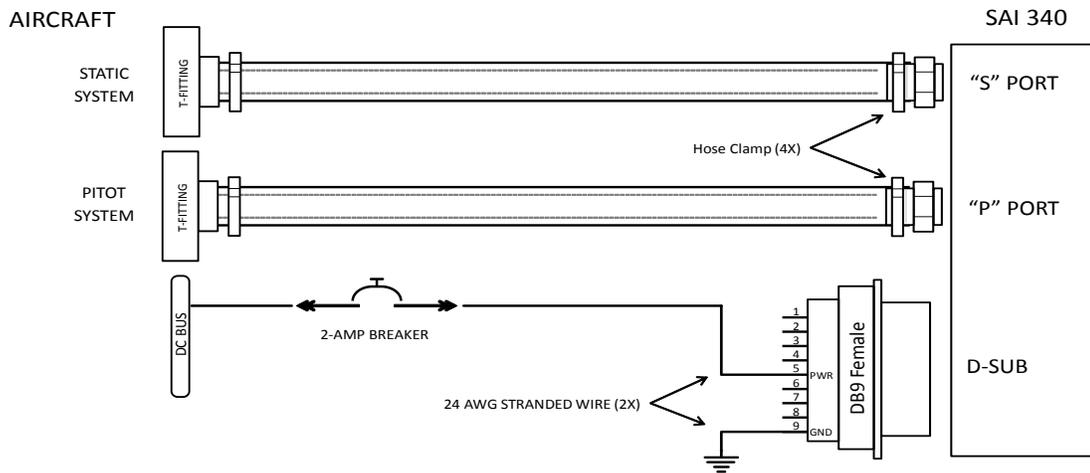


Figure 5 - Wiring Diagram

2.3.11 Pneumatic Source

For operations in IFR conditions, a TSO-C16a (or equivalent) heated pitot and static port must be utilized as the source of pitot and static air pressure.

The Sandia Aerospace SAI-340 utilizes air-data to help refine the attitude solution during specific operational maneuvers. The SAI-340 is certified to support a Degraded Mode to address operation where air-data aiding has been lost. If the external air-data source becomes unavailable (plugged pitot static port, or similar fault), the unit will enter the Degraded Mode automatically.

Operation in this Degraded Mode does not imply that attitude availability from the SAI-340 has been lost. During this Degraded Mode, attitude information is always available to the pilot - it is never removed or made un-available

When operating in this Degraded Mode, the SAI-340 will show a slight pitch-up during long accelerations and a slight pitch-down during long decelerations, both on the order of $\pm 3.0^\circ$. This condition will self-correct once the maneuver is completed. Roll accuracy is not affected. This behavior has been verified in both simulated and flight test conditions.

The limited performance degradation in this mode meets the applicable performance requirements of DO-334 § 2.2.4.2 (Degraded Mode Accuracy), 2.2.4.2.1 (Degraded Mode Pitch Accuracy), & 2.2.4.2.2 (Degraded Mode Roll Accuracy), for “basic attitude performance”, meaning it is sufficient to maintain positive aircraft control and perform the operations.

Therefore, for backup applications where air data is also utilized in the PFD solution, should air data become un-available in a common mode failure scenario, “basic attitude performance” is maintained by the SAI-340. This is compliant with 14 CFR 23.1311 § (b) and applicable sections of AC 23-1311.1C.

Degraded Mode operation is a characteristic allowed by the FAA AHRS design guidance. Degraded Mode, as defined by RTCA DO-334 § 2.2.4, is as follows:

The intended function of a degraded mode (if provided) is to provide basic attitude performance, despite one or more AHRS failures. A degraded mode is intended to allow a pilot to maintain positive aircraft control while maneuvering under IMC, including IFR en route operations, climbs, descents, holds, fly an instrument approach to minimums, and return the aircraft back to level following an upset.(...)

2.3.12 Pneumatic Fittings

The pitot and static connections are provided by two 1/16 NPTF fittings on the rear of the unit. Also supplied are two 0.17" ID barbed fittings for optional usage.

Alternate adaptors may be required to interface to existing pitot and static lines, of which standard AN fittings should always be used. If application of thread sealant is required, "sensor safe" chemicals must be utilized.

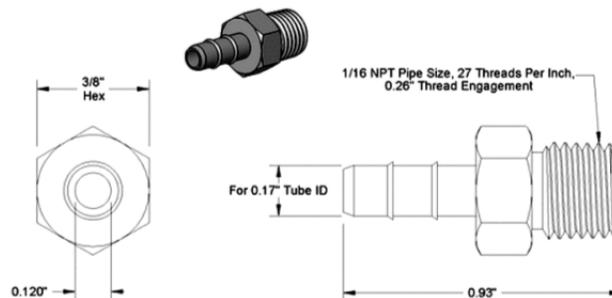


Figure 6 – Supplied Pneumatic Fitting

When selecting alternate fittings, do not allow the threads to penetrate more than 0.3 inches into the unit, otherwise sensor damage will occur. Do not remove the foam filter located in the body of the unit.

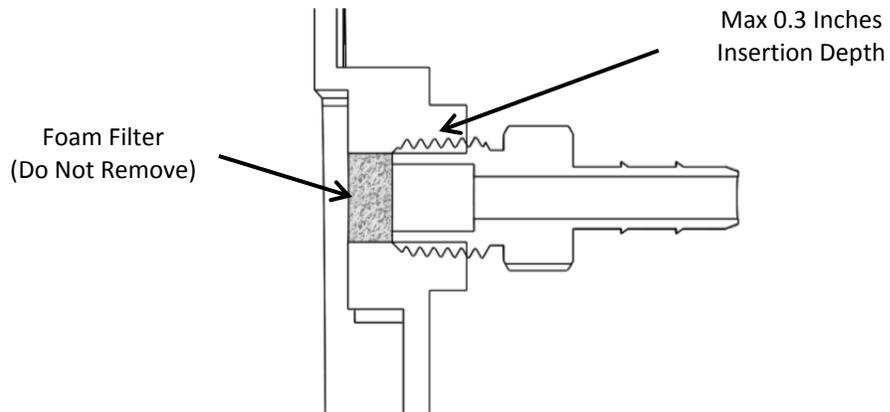


Figure 7 – Thread Depth Limit

2.3.13 Cooling Considerations

The SAI 340 does not require any special cooling considerations.

Section 3 – Installation Procedures

3.1 General

Installation consists of securely fastening the mounting bracket to the instrument panel, constructing & connecting the power cable assembly, constructing & connecting the pneumatic lines, and mounting the unit to the bracket. Power-On is then performed, followed by unit configuration and finally unit checkout procedures.

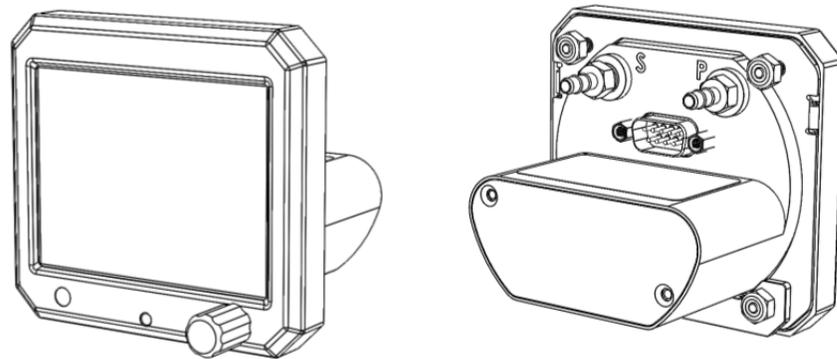


Figure 8 – Unit Front and Rear Views

3.2 Equipment Required

3.2.1 Supplied

SAI 340 (Unit)	P/N 306171
SAI 340 Battery Type 0	P/N 306186
Kit, Install Electrical SAI-340.....	P/N 306188
Conn, “D” 9 Pos, Rcpt, Sldr Cup	P/N 305214
Clamp, D Conn Size 1 45/180 Deg	P/N 305207
Kit, Install Mechanical SAI-340	P/N 206187
Bracket, Mounting Front.....	P/N 306179
Bracket, Mounting Rear	P/N 306185
Screw, Phillips, Flat Undercut SS (X4).....	6-32 x 3/8
Nut, Nylon Insert, Std Zinc (X4).....	6-32
Hex Wrench, 3/32” L-WR Short.....	P/N 306333

3.2.2 Operational Software

SAI 340 Operation Software	P/N 901099-00-EOC-V[X]
(X=Latest FAA Approved Version)	

3.2.3 Required But Not Supplied

- Power & Ground Wire (24 AWG, Stranded)
- Pitot & Static Tubing (As required)
- Pitot & Static T-Fittings (As Required)

3.3 Mounting Bracket Installation

1. Inspect the mounting bracket to ensure general flatness and integrity.
2. Remove any paint from REAR of instrument panel around the nut-to-panel interface points – the mounting bracket must be fully grounded to the instrument panel.
3. Install the bracket and tighten the four screws & nuts. Ensure that the bracket is level relative to the aircraft while the nuts are being tightened.
4. Minor roll error can be corrected by slightly rotating the bracket prior to tightening and during the configuration of the unit.

3.4 Wiring Installation

1. Construct the power and ground lines utilizing aviation grade 24 AWG, non-shielded, stranded wire.
2. The power line must be protected by a 2 AMP circuit breaker.
3. Keep power and ground lines less than 1 meter in length.

3.5 Pneumatic Line Installation

1. Tap into the Pitot and Static lines of the aircraft with appropriate t-fittings (not supplied).
2. Construct the pneumatic lines ensuring that sufficient service loop is accounted for to allow the unit to be easily removed from the front of the panel and access to the battery can be achieved without disconnecting the pneumatic lines.
3. Connect the Pitot line to the rear of the unit on the fitting labeled “P”.
4. Connect the Static line to the rear of the unit on the fitting labeled “S”.

3.6 Unit Mounting

1. The unit connects to the mounting bracket utilizing two upper tabs and a lower fastener.
2. The unit is installed by engaging the two upper tabs first, then securing the bottom screw.
3. Hold the unit at a slight angle off of the instrument panel (as shown below) and align the upper tabs with the slots on the rear of the unit.

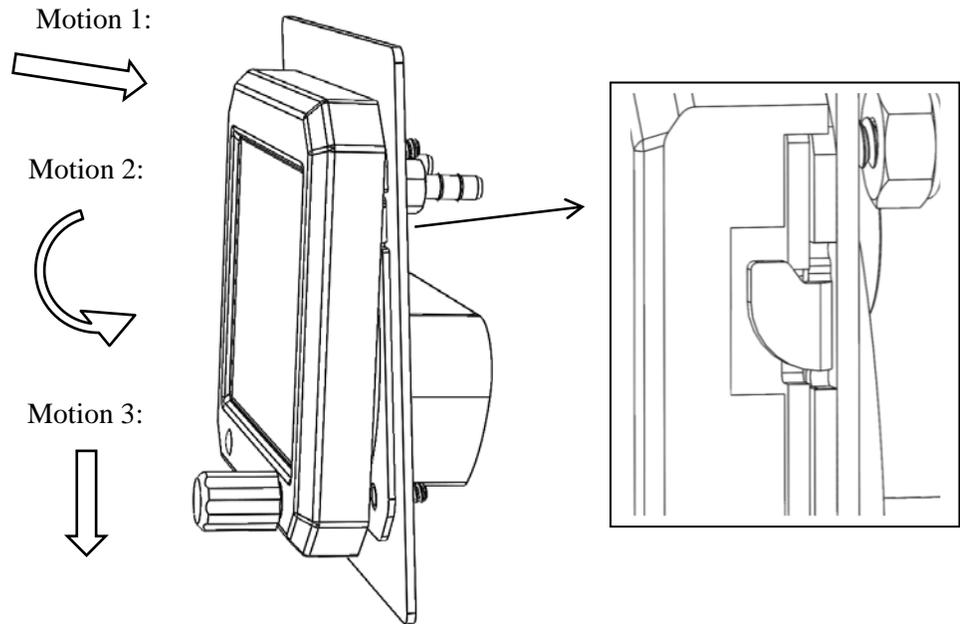


Figure 9 - Unit Mounting With Tab/Slot Cutaway

4. Push the unit toward the instrument panel until it stops against the bracket.
5. While maintaining inward pressure, rotate the bottom such that the unit is now parallel to the panel.
6. Once parallel to the panel, apply downward pressure to ensure the upper tabs remain fully engaged.
7. While holding in-ward and down-ward pressure on the unit, tighten the lower screw with the 3/32 hex drive. Torque to 5 inch-lbs. Do not over-tighten.
8. Verify that the unit is firmly attached and completely parallel to the instrument panel. (The bezel of the unit will stand-off slightly from the instrument panel, which is normal.)

3.7 System Configuration

The following section provides instructions for initial setup configuration of the SAI 340. For complete operation guide, including normal and abnormal operation, see the Pilots Guide (document number 306192).

3.7.1 Initial Power On

Upon normal power-on, the unit will display the company logo, battery status and software version as follows:



Figure 10 - Power On Screen

If the unit does not power-on, check the following:

- Ensure power and ground connections are correct.
- Verify the breaker is in the on position and applying power to the unit.
- Verify the supply voltage is greater than 10V DC.
- Verify the integrity of all electrical connections.
- Test independent operation by removing the unit and powering from a dedicated cable and bench power source.

After displaying the splash screen for approximately 15 seconds, the unit will enter the main operating mode.

3.7.2 Entry & Exit From Setup Mode

Setup mode is enabled when the unit is powered-on while the rotary knob is being held in the pressed state. After verifying basic power-on, cycle power to the unit and enter the setup mode. Upon successful entry into the setup mode, the startup screen will be bypassed and a series of setup menus will become available. The rotary knob can then be released once the setup mode is indicated.



Figure 11 – Setup Mode Menu

Exiting the setup mode is accomplished by navigating to the last setup page and selecting YES, and then pressing the rotary knob.

While in the setup mode, the unit is fully operational and will continue through the sensor stabilization functions. Once stabilized, all displayed parameters will be shown, and any adjustments (such as roll/pitch trim, IAS speed markings, etc), will all be updated real-time with user adjustment. This can be useful for trimming certain parameters such as airspeed and altitude trim.

Each pages value is internally stored when the corresponding page is exited, not upon exit of the last page.

3.7.3 Default Baro Setting

The default baro can be selected between Standard (STD), Automatically estimated (AUTO), or last pilot set value (LAST).

STD will default to 29.92 InHg (or 1013 Mb). AUTO will utilize the airport elevation on the last power-down to estimate a current baro setting. LAST will retain the last pilot entered value.

The setting selected is pilot preference, and the configuration should be communicated to the operator.

3.7.4 Setup Pages

A total of 16 setup pages are available as follows:

Setup Page	Purpose	Min Value	Max Value	Increment
Panel Tilt	Used to adjust for various panel tilts.	-45°	+45°	1°
Roll Trim	Used to adjust for minor variations in roll.	-5°	+5°	0.1°
IAS Trim	Used to adjust for minor variations in airspeed.	-50 kts	+50 kts	1kt
ALT Trim	Used to adjust for minor variations in altitude.	-999 ft	+999 ft	1ft
IAS Units	Used to set units for IAS (KTS or MPH)	n/a	n/a	n/a
Vs0	Used to set Vs0 band on IAS indicator.	0 kts	400 kts	1 kt
Vs1	Used to set Vs1 band on IAS indicator.	0 kts	400 kts	1 kt
Vfe	Used to set Vfe band on IAS indicator.	0 kts	400 kts	1 kt
Vno	Used to set Vno band on IAS indicator.	0 kts	400 kts	1 kt
Vne	Used to set Vne band on IAS indicator.	0 kts	400 kts	1 kt
Vyse	Used to set Vyse mark on IAS indicator. 0 Disables.	0 kts	400 kts	1 kt
Vmc	Used to set Vme mark on IAS indicator. 0 Disables.	0 kts	400 kts	1 kt
Baro Units	Used to set baro units (InHg or Mb)	n/a	n/a	n/a
Baro Default	Used to set default baro settings (STD, AUTO, LAST)	n/a	n/a	n/a
Battery Type	Used to set battery type. Only type 0 is currently supported.	0	0	1
Vibe Mon	Used to monitor for excessive airframe vibration during engine operation.	n/a	n/a	n/a

Table 2 - Setup Parameters

3.8 Post Installation Vibration Test

The following procedure is to be used to determine if aircraft vibration levels exceed the operational characteristics of the internal sensors. Enter the setup mode and go to the vibration monitor page (last page). The following will be shown:



Figure 12 - Vibration Monitor

The horizontal line shows the ability for the system to operate correctly during vibration. Post installation, slowly run the engine through the RPM range and monitor the horizontal line. If it shrinks to the point where it turns red, please contact the factory.

Section 4 - Instructions for Continued Airworthiness

4.1 ICA General

The following Instructions for Continued Airworthiness (ICA) are to be utilized by approved mechanics. The instructions contained here-in are required to ensure proper unit functionality and performance on an on-going basis.

4.2 Airworthiness Limitations

The Airworthiness Limitations section is FAA approved and specifies maintenance required under §§ 43.16 and 91.403 of the Federal Aviation Regulations unless an alternative program has been FAA approved.

4.2.1 Battery Limitations

The battery must be replaced when any of the following occurs:

- The battery fails the power-on self-test as indicated by a Red-X over the on-screen battery icon.
- The battery fails to charge during normal operation.
- The battery fails the full-duration load test (described below).
- The battery pack is over 5 years old, as measured by the battery pack installation date.

4.2.2 Altimeter Limitations

The altimeter function must be tested and inspected in accordance with 14 CFR 91.411.

4.3 Battery Maintenance

The SAI 340 contains a field-replaceable Li-Poly battery pack. This battery requires periodic replacement to ensure sufficient capacity is available to meet performance specifications.

4.3.1 Full-Duration Load Test

This test performs a full-discharge cycle to ensure that proper capacity is available. A degraded or aged battery will be detected by this procedure.

This procedure must be performed every 24 months.

- 1) This test is to be done at ambient temperature ranging from +50°F (+10°C) to +90°F (+26°C). The unit must be fully thermally stabilized in this range.
- 2) Ensure battery is fully charged by verifying that a charge of 100% is shown. If not, charge as follows:
 - a. Place the aircraft on ground-power and turn the unit on.
 - b. Allow the battery to fully charge to 100% and verify that the battery charging symbol is no longer presented. (Battery charging may continue for a short duration even though 100% is shown).
- 3) Set the display to full-intensity by pressing the rotary knob and rotating clockwise as needed. Press the knob again to dismiss the brightness menu.
- 4) Remove power to the unit by pulling the corresponding circuit breaker and cancel the power-down sequence by pressing the knob.
- 5) Note the current time and allow unit to operate for 2 hours. At the end of the 2 hour period, if the unit has shut-down, or on-screen parameters are Red-X'ed, the battery must be replaced.

4.3.2 Battery Replacement Procedure

The following procedure is to be used to replace the battery pack. The battery pack consists of 4 individual cells with protection and heater circuitry all enclosed in a PVC wrapping. Two sets of leads are present: 1) Heater Leads, and 2) Battery Power Leads.

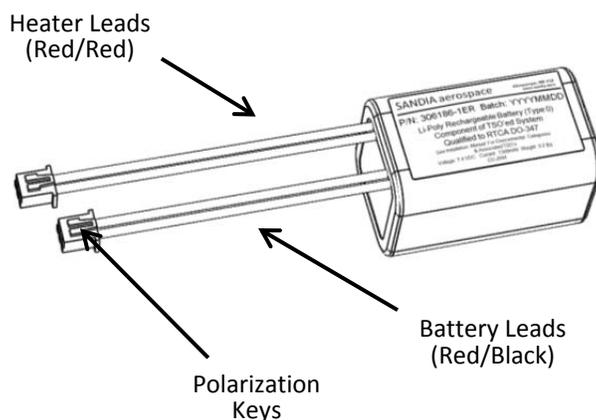


Figure 13 - Li-Poly Battery Pack

! IMPORTANT !

Do not inadvertently connect the battery to the heater connector.

Identical connectors are utilized for each.

Follow the indicated color coding

DAMAGE TO THE UNIT MAY OCCUR

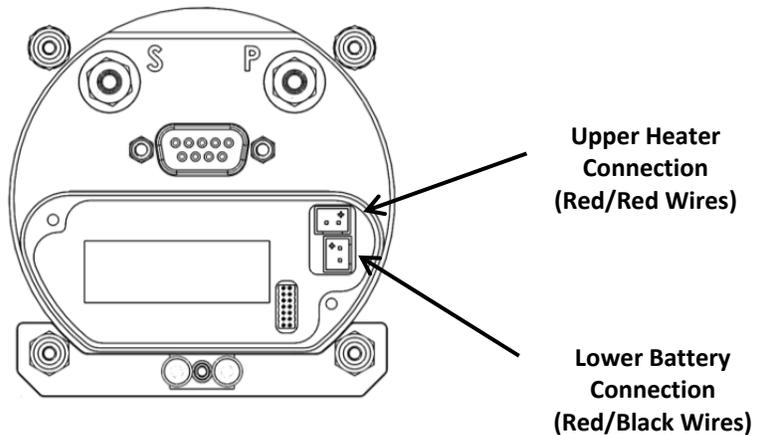


Figure 14 - Li-Poly Battery Connections

1. Only the approved batteries are to be used. See specification section of this document for the applicable Sandia part number(s).
2. Ensure power is not supplied to the unit by either pulling the applicable circuit breaker, or turning off the master switch. (Ensure the unit is not running on battery)
3. Remove the unit from the aircraft instrument panel - it is not required to disconnect the power cable or pitot/static lines unless in-adequate service loop was provided.
4. Carefully remove and retain the two Phillip's head screws that retain the battery cover.
5. Extract the battery pack.
6. Grasp the leads in pairs and gently pull the connectors loose from the unit. Do not pull excessively on just one individual wire. The connector is a high-friction fit connector, but does not utilize a specific un-latching mechanism.
7. Discard the old battery pack per local regulations as related to Li-Poly battery procedures.
8. Position the new battery pack such that with the tip of one finger, the connectors can be firmly pressed into place.
9. Observe the polarity lock on each connector – Note that the same connector is utilized for each function and must not be connected incorrectly.
10. Connect the longer red/red heater connector first into the upper mating connector – ensure the connector fully seats with a click.
11. Connect the shorter red/black power connector secondly into the lower mating connector – ensure the connector fully seats with a click.
12. Loop the excess wire into the cavity co-located with the battery connector. Do not run the excess wire adjacent to, over, or under the battery pack itself.
13. Insert the battery pack into the battery cavity with the label facing the battery cover.

14. Replace the battery cover, tighten the screws firmly into position. Take care to ensure that the battery wires are fully contained within the battery compartment, and do not get pinched under the battery cover plate.
15. Re-install the unit following the procedures defined in this manual.
16. Note the date of battery replacement in the aircrafts log book. The age of the battery is determined by the placed-in-service date, not manufacture date.
17. New battery packs will not have full charge. The battery pack should be fully charged prior to re-entry into service.

4.4 **Airspeed and Altimeter Test & Calibration**

Both the airspeed and attitude sensors have the ability to be tested and calibrated in the field. Greater accuracy will be obtained by allowing the unit to fully stabilize in the on-state for a period of approximately 5 - 10 minutes prior to determining any required adjustments.

4.4.1 **Altimeter System Test and Inspection**

This procedure should only be performed utilizing a calibrated air-data test set. The physical connection (pitot and static) of the air-data test set is identical to that of traditional mechanical instruments. No vibration is required to be applied to the unit during testing or calibration.

The SAI 340 must be calibrated every 24 months per CFR 91.411.

4.4.2 **Airspeed Trim Procedure**

The IAS TRIM parameter in the setup menus allows a trim factor to be applied to the measured airspeed and can be used to eliminate any low-speed static-offsets present in the unit (i.e. if the airspeed indicator shows airspeed even though no pitot pressure is applied), or correct for an inaccurate IAS value. The value entered for IAS TRIM will be added to the measured airspeed prior to being displayed. See the System Configuration section for additional details.

4.4.3 **Altitude Trim Procedure**

The ALT TRIM parameter in the setup menus allows a trim factor to be applied to the measured altitude and can be used to correct for an inaccurate altitude value. Ensure the baro value is set to 29.92 inHg (or 1013 mb) prior to making any trim adjustments. The value entered for ALT TRIM will be added to the measured altitude prior to being displayed. See the System Configuration section for additional details.

4.5 Troubleshooting

The following information can be utilized to recognize and correct probable malfunctions.

Symptom	Possible Solutions
Attitude remains Red-X'ed	Ensure proper supply power is available. Return unit for service.
Airspeed remains Red-X'ed	Ensure proper supply power is available. Ensure airspeed limit has not been exceeded. Return unit for service.
Altitude remains Red-X'ed	Ensure proper supply power is available. Ensure altitude limit has not been exceeded. Return unit for service.
Battery icon is Red-X'ed	Ensure battery is correctly installed. Perform battery load test. Replace battery. Return unit for service.
Battery icon is Red-X'ed	For deeply discharged batteries, pre-charge as follows: Apply power for 10 minutes, momentarily remove power, then re-apply power. Verify charging cycle starts correctly.
On Ground, Cross-Check remains annunciated	Ensure proper supply power is available. During power-on, ensure minimal aircraft motion is present. Return unit for service.
Aligning message remains annunciated	Ensure proper supply power is available. During power-on, ensure minimal aircraft motion is present. Return unit for service.
Altitude shows error	Perform altitude trim procedure. Return unit for service.
Airspeed shows error	Perform airspeed trim procedure. Return unit for service.
Attitude shows error	Set panel tilt correctly. Set roll trim correctly. Return unit for service.
Memory Error is shown	Return unit for service.

Table 3 – Troubleshooting

Section 5 - Pilots Operating Handbook

This section contains an FAA approved sample Supplemental POH (Pilots Operating Handbook) for the SAI-340. The supplement may be inserted into the POH or supplied to the airplane owner upon delivery of the system.

FAA APPROVED SUPPLEMENTAL PILOT'S OPERATING HANDBOOK

Sandia Aerospace SAI 340

Aircraft Serial Number: _____

Aircraft Registration Number: _____

Aircraft Make/Model/TC Number: _____

FAA Approved in the normal category based on CFR23. This document must be carried in the airplane at all times.

Section 1: General

This supplement to the POH provides information necessary to safely and efficiently operate the SAI 340. The SAI 340 provides a stand-alone source of barometric attitude, indicated airspeed, altitude and slip. An integral backup battery provides continued operation of power is lost. Operation under VFR and IFR conditions are approved.

Section 2: Operational Limitations

- Airspeed Limitations Markings are provided on the IAS tape. The top of the colored bands are defined as follows:

All Aircraft

Over-speed	Upper red band
Vne	Top of yellow band
Vno	Top of green band
Vfe	Top of white band
Vs1	Bottom of green band
Vso	Bottom of white band
Under-speed	Lower red band

Multi-Engine Aircraft

Vmc	Red radial mark
Vyse	Blue radial mark

- Maximum displayable airspeed is 400 Knots / 460 Mph
- Minimum displayable airspeed is 20 Knots / 20 Mph
- Maximum displayable altitude is 35,000 Feet
- Minimum displayable altitude is -1,500 Feet
- Maximum configurable baro correction is 1050 mb / 31.00 inHg
- Minimum configurable baro correction is 948 mb / 28.00 inHg
- Minimum operational duration on battery is 30 Minutes
- Maximum roll rate is 400 Degrees / Second
- Maximum operating G force is 6 G
- No operational capability on internal battery is possible if the battery status indicator is faulted, as shown by a red-X over the battery icon.

Section 3: Emergency Procedures

- While in flight and power is lost, no pilot action required to switch to internal battery.
- While in flight and primary instrumentation is lost, no pilot action is required to activate backlight flight parameters.
- Ensure barometric pressure is set correctly.
- When operating on battery, reduction of the display intensity to lowest safe level will extend operational duration.
- In-Flight power-on alignment must be performed in non-accelerated conditions and wings level.

Section 4: Normal Procedures

- See Sandia Aerospace SAI 340 Pilots Guide (document number 306192) for full normal operating procedures.
- Ensure barometric pressure is set correctly and maintained.
- Prior to departure or entry into IFR conditions, verify that the battery is not faulted (no red-X over the battery icon), and that a charge level of at least 80% is shown.
- TSO performance of airspeed, attitude, slip and attitude is met within 10 minutes during cold-starts.
- Prior to departure or entry into IFR conditions, verify that the battery has completed power-on heating (no BAT HEATING indication shown over the battery icon). Battery operation may be inhibited for up to 15 minutes during cold-starts.
- No autopilot, pre-select, path deviation or flight director interfaces are provided by the SAI 340.

Section 5: Performance

- No change to aircraft performance.