SANDIA aerospace

# SAC 7-35

# Airdata Computer Installation Manual

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# Section 1 General Description

## 1.1 INTRODUCTION

This manual describes the installation of the SANDIA aerospace SAC 7-35 Airdata Computer. It is intended for use by FAA certified repair stations to install the SAC 7-35 Airdata Computer and includes both the mechanical and electrical installation information for the SAC 7-35. Calibration, system configuration and checkout procedures are included. The installer should ensure that all functions are operating according to their intended purpose in their particular installation. This manual covers software version 13.

### 1.1.1 Product Description

The SAC 7-35 is a solid state -1000 to 35,000 foot airdata computer and altitude encoder. With the addition of a fuel flow transducer(s), the SAC 7-35 will also provide fuel flow data to systems capable of displaying that information. The SAC 7-35 provides five data outputs that allow it to interface with a wide range of transponders, MFD's, Navigation Systems and a variety of other avionics products.

- One ARINC 429 High Speed output, airdata and/or ADS-B.
- Two RS-232 airdata output ports (including fuel flow or ADS-B).
- Two RS-232 serial encoder outputs

  Note: All four of the RS-232 outputs can be individually configured to match the system(s) being interfaced.
- One Gillham Grey code output for legacy transponders.
- One SANDIA Altitude In-flight Monitoring (AIM) feature. With the addition of an optional panel mounted switch and annunciator the AIM mode will monitor and advise the pilot if the aircraft deviates from a selected altitude.

All calibration and configuration is accomplished via a lap top computer through the 6 pin Din connector on the front of the SAC 7-35.

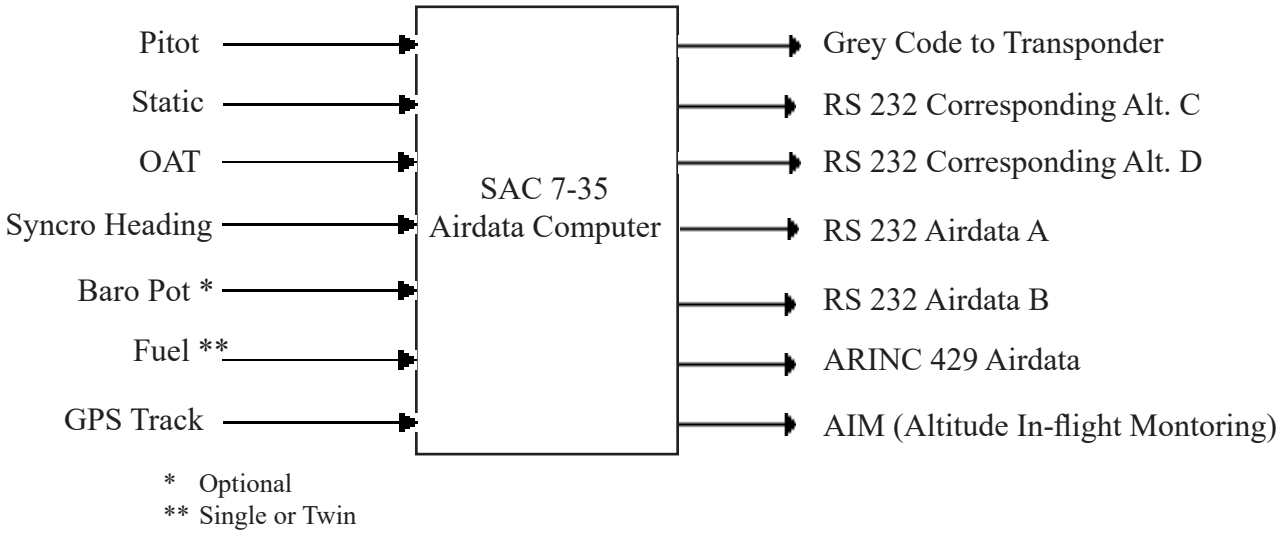


Figure 1-1
System Configuration

## 1.2 TECHNICAL CHARACTERISTICS

### 1.2.1 Physical Characteristics

Width: 4.87” (5.11” with mounting tray)
Height: 1.89” (2.35” with mounting tray)
Depth: 5.62” (5.62” with mounting tray)
Weight: 1.18 lbs. (1.39lbs. with mounting tray)

### 1.2.2 Operational Characteristics

| | |
|---|---|
| Operating Temp. | -20° C to + 55° C |
| Input Voltage: | 11 - 32 Vdc |
| Current | 1.0 amp maximum with heater on |
| Altitude Range | -1000’ to 35,000’ |
| Pressure Altitude Tolerance: | 0’ +/- 25’<br>2000’ +/- 25”<br>3000‘ +/- 30’<br>4000’ +/- 25’<br>5000’ +/- 25’<br>8000 +/- 30’<br>11000’ +/- 35’<br>14000’ +/- 40’<br>17000’ +/- 45’<br>20000’ +/- 50’<br>30000’ +/- 100’<br>40000’ +/- 125’ |
| Resolution: | Grey Code 100’<br>RS232 10’<br>ARINC 429 1’ |
| Density Altitude Accuracy | Pressure Alt Correction Tolerance<br>1000’ - 18000’ (P Alt) 250 ft. max. |
| Maximum Vertical Speed: | 9,999 fpm Serial<br>20,000 fpm ARINC 429 |
| Accuracy | ±1000 ft/min at ±20000 ft/min<br>±0300 ft/min at ±6000 ft/min<br>±0200 ft/min at ±4000 ft/min<br>±0100 ft/min at ±2000 ft/min<br>±0050 ft/min at ±1000 ft/min<br>±0045 ft/min below ±1000 ft/min |

| | |
|---|---|
| Indicated Airspeed: | 0-450 KTS<br>0.088-.999 MACH |

Accuracy

| Kts | Accuracy |
|---|---|
| 50 | 5.0 |
| 80 | 3.5 |
| 100 | 2.0 |
| 120 | 2.0 |
| 150 | 2.0 |
| 200 | 2.0 |
| 250 | 2.4 |
| 300 | 2.8 |
| 350 | 3.2 |
| 400 | 3.6 |
| 450 | 4.0 |

MACH Number Accuracy

| MACH | Tolerance |
|---|---|
| 0.3 to 0.4 | 0.012 |
| .0.5 | 0.010 |
| 0.6 | 0.0075 |
| 0.7-0.9 | 0.0050 |
| .95 | 0.0075 |

True Airspeed Accuracy

| ALT | IAS | TAS | TAS Accuracy |
|---|---|---|---|
| 10000 | 50 | 53 | 6.6 |
| 10000 | 100 | 105 | 3.0 |
| 10000 | 200 | 211 | 3.3 |
| 10000 | 300 | 314 | 4.6 |
| 10000 | 400 | 416 | 5.9 |
| 10000 | 450 | 467 | 6.5 |
| 30000 | 50 | 80 | 10.1 |
| 30000 | 100 | 160 | 4.6 |
| 30000 | 200 | 315 | 5.2 |
| 30000 | 300 | 460 | 6.9 |

## 1.2.2 Operational Characteristics con't

| | |
|---|---|
| Wind Speed: | 0-200 KTS |
| Accuracy | 6.5 Kts |
| Wind Direction Accuracy | 10 degrees |
| Air Temp: | |
| Range: | -60°C to +60°C |
| Accuracy | +1.5°C |
| Fuel Flow: | |
| Flow Rate: | 1-14400 GPH |
| K-Factor Range | 500-130,000 |
| Outside Air Temperature | -60°C - +60°C |
| Accuracy | 1.5°C |

**The SAC 7-35 fuel flow conversion is limited to 2000 input pulses per second**
**For example, do not install where the K factor and maximum fuel flow exceed:**

**500K — 14,400 gph** **19700K — 365 gph**
**84600K — 85 gph** **130000K — 55 gph**

## 1.2.3 Operating Limitations

**1.2.3.1** All functions of the SAC 7-35 meet the appropriate design assurance qualifications for a secondary system for airplanes in Class I, Class II and Class III in accordance with AC 23.1309-1D, Figure 2. The TSO authorization with the RTCA/DO178B software levels by functions are listed in Section 1.2.6

**1.2.3.2** The SAC 7-35 is for navigation information only and not for primary flight information.

**1.2.3.3** Fuel flow limited to 2000 input pulses per second.

## 1.2.4 Outputs

### 1.2.4.1 RS-232

#### 1.2.4.1.1 RS-232 (A & B) Airdata

The airdata outputs supported by the SAC 7-35 are Garmin Z-message, Garmin-G and King D. Each of these output formats work with 'Aviation' format input.

The SAC 7-35 will also interface to a Garmin ADS-B serial output on port -B at 9600 baud. When connected to ADS-B input no serial data is output on port-B.

| | |
|---|---|
| Baud Rate | Installation Configurable to 1200, 9600, 19200 or 38400 |
| Data Bits | 8 |
| Stop Bit | 1 |
| Parity | None |
| Output Rate: | 1 +/- .2 seconds |
| Altitude Resolution | 10" |
| Airspeed Resolution | 1 Kt |

#### 1.2.4.1.2 RS 232 (C & D) Corresponding Altitude

The SAC 7-35 supports Garmin and Garmin AT RS232 Corresponding Altitude formats.

| | |
|---|---|
| Baud Rate | Installation Configurable to 1200, 9600, 19200 or 38400 |
| Data Bits | 8 |
| Stop Bit | 1 |
| Parity | None |
| Output Rate: | 1 +/- .2 seconds |

### 1.2.4.2 ARINC 429, High Speed

If Selected, the following 100 kbit/sec (High Speed) ARINC 429 Airdata Labels are transmitted by the SAC 7-35:

| Label | Parameter | Units | Repeat Rate | Range | Resolution |
|---|---|---|---|---|---|
| 162 | Density Altitude | Feet | 62.5ms | 131072 | 1 |
| 203 | Pressure Altitude | Feet | 62.5ms | 131072 | 1 |
| 204 | Baro Altitude | Feet | 62.5ms | 131072 | 1 |
| 205 | MACH Number | Mach | 62.5ms | 4.0 | 6.25E-5 |
| 206 | IAS | Knots | 62.5ms | 1024 | 0.0625 |
| 210 | True Airspeed | Knots | 62.5ms | 2048 | 0.0625 |
| 211 | Total Air Temp | degC | 500ms | 512 | 0.25 |
| 212 | Altitude Rate | ft/min | 62.5ms | 32768 | 16 |
| 213 | Static Air Temp | degC | 500ms | 512 | 0.25 |
| 235 | Baro Setting | InHg | 62.5ms | 39.999 | 0.001 |
| 244 | Total Fuel Flow | Lb/hr | 62.5ms | 32768 | 0.5 |
| 315 | Wind Speed | Knots | 500ms | 256 | 1 |
| 316 | Wind Direction | Deg True | 500ms | 360 | 0.05 |
| 320 | Magnetic Heading | Deg Mag | 62.5ms | 360 | 0.0055 |
| 347 | L/R Fuel Flow | Lb/hr | 62.5ms (Alternates L/R) | 32768 | 0.5 |

If selected, the following 100 kbit/sec (High Speed) ARINC 429/743 ADS-B Labels are transmitted by the SAC 7-35 (-01 version only):

| Label | Parameter | Units | Repeat Rate | Range | Resolution | Data bits |
|---|---|---|---|---|---|---|
| 103 | Ground Track | Degrees | as received | 180 | 0.0055 | 15 |
| 110 | Latitude | degrees | as received | 180 | 1.7E-4 | 20 |
| 111 | Longitude | degrees | as received | 180 | 1.7E-4 | 20 |
| 112 | Ground Speed | knots | as received | 4096 | 0.125 | 15 |
| 120 | Fine Latitude | degrees | as received | 1.7E-4 | 8.4E-8 | 11 |
| 121 | Fine Longitude | degrees | as received | 1.7E-4 | 8.4E-8 | 11 |
| 130 | Horiz Prot Level | nm | 1 sec | 16 | 1.22E-4 | 17 |
| 133 | Vert Prot Level | feet | 1 sec | 32768 | 0.125 | 18 |
| 136 | Vert. Fig of Merit | feet | 1 sec | 32768 | 0.125 | 18 |
| 165 | Vert Velocity | fpm | as received | 32768 | 1 | 15 |
| 166 | North/South Velocity | knots | as received | 4096 | 0.125 | 15 |
| 174 | East/West Velocity | knots | as received | 4096 | 0.125 | 15 |
| 247 | Horiz Fog of Merit | nm | 1 sec | 16 | 6.10E-5 | 18 |
| 273 | GPS Status | discr | 1 sec | discr | discr | discr |
| 335 | Track Angle Rate | deg/s | as received | 32 | 0.015625 | 11 |
| 370 | GPS Height | feet | as received | 131072 | 0.125 | 20 |

#### 1.2.4.3 Gillham Grey Code Outputs

a. 10 Bits available: D4, A4, A2, A1, B4, B2, B1, C4, C2, C1
b. Bit On Impedance: Less than 5 ohms
c. Bit Off Leakage: Less than 10uA
d. Maximum Current per bit: 20 mA
e. Minimum working current: 10 uA
f. Maximum voltage per bit: 50V
g. Minimum working voltage: 5V
h. Bit update rate: Less than 250 mS
i. Minimum strobe switching bandwidth: Greater than 10kHz

#### 1.2.4.4 AIM Outputs

Maximum Lamp Current: 80 mA
Maximum off Voltage: 50V

### 1.2.5 Inputs

| | |
|---|---|
| Static Pressure | -1000 to 35,000 feet |
| Pitot Pressure | 0 to 450 Kts |
| Outside Air Temp (OAT) | $-60^{O}$ to $+60^{O}$ C |
| Heading | ARINC 407 Syncro (line voltage 11.8 Vrms)<br>Leg H 10 KΩ<br>Leg X 17 KΩ<br>Leg Y 17 KΩ |
| Fuel Flow | 0 to 14400 GPH (2000 pulses/sec max) |
| K-factor | 500-130000 |
| Baro | 0 to +5Vdc Baro Pot |
| AIM Pushbutton | Active Low with Internal Pull Up |
| Strobe | From On board Transponder |

### 1.2.6 Certification

TSO C88a (Encoder)
TSO C106 (Airdata Computer)
Hardware DO 160E
Software DO 178B Level C
Complex Hardware DO-254 Level C

"The conditions and test required for TSO approval of this article are minimum performance standards. It is the responsibility of those desiring to install the article either on or within a specific type or class of aircraft to demonstrate that the aircraft installation conditions are within the TSO standards. The article may be installed only if installation of the article is approved by the Administrator."

## Environmental Qualification Form for the SAC 7-35 Airdata Computer

**NOMENCLATURE**: SAC 7-35, Airdata Computer
**TYPE/MODEL/PART NO**: SAC 7-35 / 305548-00
**TSO NUMBER**: C88a, C106
**MANUFACTURER'S SPECIFICATION AN/OR OTHER APPLICABLE SPECIFICATION**:
SAC 7-35 INSTALLATION MANUAL P/N 305586-00
QUALIFICATION TEST PLAN, 901000-QTP
MANUFACTURER: SANDIA AEROSPACE
ADDRESS: ALBUQUERQUE, NM 87109

**REVISION & CHANGE NUMBER OF DO-160:** REV E

| Conditions | Section | Description |
|---|---|---|
| Temperature And Altitude | 4.00 | Category C4 |
| Low Temperature | 4.5.1 | -20C Operation Cold Temp |
| High Temmperature | 4.5.2 & 4.5.3 | +55C Operating High Temp<br>-40C Short Time Op Low Temp<br>+55C Short Time Op High Temp<br>-55C Ground Survival Lo<br>+85C Ground Survival High |
| | 4.5.4 | Test Not Applicable |
| In-Flight Loss of Cooling<br>Altitude Decompression<br>Overpressure | 4.6.1<br>4.6.2<br>4.6.3 | 35,000 Feet<br>Test Not Applicable<br>Test Not Applicable |
| Temperature Variation | 5.0 | Tested to Category C 2C/Min |
| Humidity | 6.0 | Tested to Category A |
| Operational Shock and Crash Safety | 7.0 | Tested to Catecory A, Aircraft Type 5. Random Orientation |
| Vibration | 8.0 | Tested to Categories S & U2, Aircraft Zone 2 using vibration cures M, F & I |
| Explosion | 9.0 | Equipment identified as Category X, no test performed |
| Waterproofness | 10.0 | Equipment identified as Category X, no test performed |
| Fluids Suseptibility | 11.0 | Equipment identified as Category X, no test performed |
| Sand and Dust | 12.0 | Equipment identified as Category X, no test performed |
| Fungus | 13.0 | Equipment identified as Category X, no test performed |
| Salt Spray | 14.0 | Equipment identified as Category X, no test performed |
| Magnetic Effect | 15.0 | Equipment is Category Z <0.3M Deflection |
| Power Input | 16.0 | Tested to Category B |
| Voltage Spike | 17.0 | Tested to Category A |
| Audio Frequency Suseptibility | 18.0 | Tested to Category B |
| Induced Signal Suseptibility | 20.0 | Tested to Category TT |
| Radio Frequency Emmision | 21.0 | Tested to Category M |
| Lightning Induced Transient Suseptibility | 22.0 | Equipment identified as Category X, no test performed |
| Lightning Direct Effects | 23.0 | Equipment identified as Category X, no test performed |
| Icing | 24.0 | Equipment identified as Category X, no test performed |
| | | |

Figure 1-2
SAC 7-35 Environmental Qualification Form

## Environmental Qualification Form for the STP 78 OAT Probe

**NOMENCLATURE**: Outside Air temperature Probe
**TYPE/MODEL/PART NO**: STP 78 OAT Probe /305561-01
**TSO NUMBER**: C88a, C106
**MANUFACTURER'S SPECIFICATION AN/OR OTHER APPLICABLE SPECIFICATION**:
SAC 7-35 INSTALLATION MANUAL P/N 305586-00
QUALIFICATION TEST PLAN, 901000-QTP
MANUFACTURER: SANDIA AEROSPACE
ADDRESS: ALBUQUERQUE, NM 87109

**REVISION & CHANGE NUMBER OF DO-160:** REV E

| CONDITIONS | SECTION | DESCRIPTION OF TESTS CONDUCTED |
|---|---|---|
| Temperature and Altitude | 4.0 | Category C2 |
| Low Temperature | 4.5.1 | -55C Operating Low Temp |
| High Temperature | 4.5.2 & 4.5.3 | +70C Operating High Temp<br>-55C Short Time Op Low Temp<br>+70C Short Time Op High Temp<br>+55C Ground Survival Low<br>+85C Ground Survival High |
| In-Flight Loss of Cooling | 4.5.4 | Test not Applicable |
| Altitude | 4.6.1 | 35,000 feet |
| Decompression | 4.6.2 | Test not Applicable |
| Overpressure | 4.6.3 | Test not Applicable |
| Temperature Variation | 5.0 | Tested to Category A 10C/Min<br>Tested separately from SAC 7-35 |
| Humidity | 6.0 | Tested to Category C<br>Tested separately from SAC 7-35 |
| Operational Shock and Crash Safety | 7.0 | Test to Category A, Aircraft Type 5. Random Orientation |
| Vibration | 8.0 | Tested to Categories S & U2, Aircraft Zone 1 using vibration curves M, F & F1 |
| Explosion | 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 | 13.0 | Equipment identified as Category X, no test performed |
| Salt Spray | 14.0 | Equipment identified as Category X, no test performed |
| Magnetic Effect | 15.0 | Equipment is category Z |
| Power Input | 16.0 | Equipment identified as Category X, no test performed |
| Voltage Spike | 17.0 | Equipment identified as Category X, no test performed |
| Audio Frequency Susceptibility | 18.0 | Tested to Category B |
| Induced Signal Susceptibility | 19.0 | Tested to Category BC |
| Radio Frequency Susceptibility | 20.0 | Tested to Category TT |
| Radio Frequency Emission | 21.0 | Tested to Category M |
| | 22.0 | Equipment identified as Category X, no test performed |
| | 23.0 | Equipment identified as Category X, no test performed |

Figure 1-3
OAT Probe Environmental Qualification Form

# Section 2 Installation Considerations

## 2.1 INTRODUCTION

The SAC 7-35 Airdata Computer enhances installations that include GPS, Moving Map Displays and other avionics that can utilize airdata information. Additionally, the SAC 7-35 is TSO'd as an Altitude Encoder for use with transponder systems. The SAC 7-35 provides standard Gillham Grey Code output on its 15 pin connector (P-101) for use with legacy transponders. Two independent RS232 corresponding altitude outputs are provided on the 25 pin connector (J-100). The RS 232 outputs can be used on new generation transponders that accept RS-232 altitude format or other systems that require corresponding altitude. The P-101 Grey Code connector follows the standard interconnect format used by most encoder manufacturers. By following this convention, upgrading to the SAC 7-35 is made easier. If an existing encoder is being replaced, it is important to check the wiring information before plugging the existing connector into the SAC 7-35.

Two RS232 Airdata and one high-speed ARINC 429 airdata outputs are available from the SAC 7-35.

Fuel flow data is supported by the SAC 7-35 if pulse type fuel flow transducer(s) are mounted in the aircraft's fuel lines. The SAC 7-35 only accepts pulse type fuel information such as that provided by Flow Scan transducers. If the aircraft is equipped with a Flow Scan transducer(s) the SAC 7-35 can parallel off the signal line. The SAC 7-35 must be configured with the transducer(s) K-factor number.

If the aircraft has an altimeter with a 5 VDC baro pot, the SAC 7-35 can use this to provide corrected altitude output on the ARINC 429 bus. The Garmin-Z output format does not support Baro Correction information. But, when the baro input is avaiable the data will be included in the King-D and Garmin-G serial RS-232 airdata outputs.

The SAC 7-35 also incorporates SANDIA aerospace's exclusive Altitude In-flight Monitoring (AIM) feature that advises pilots if they deviate from their selected altitude by more than one hundred feet. The AIM feature can be installed by adding a switch and annunciators to the aircraft panel.

The SAC7-35 accepts (five wire HSI) heading input in ARINC 407 format. Heading, GPS ground speed and track inputs are required in order for the SAC 7-35 to calculate winds aloft.

The SAC 7-35 does not require warm up unless the outside temperature is below 20 degrees C. When warm up time is required, the internal heater is generally capable of warming the SAC 7-35 from -55 degrees C to operating temperature in less than one minute.

Systems configuration and calibration is accomplished using an installer supplied computer. The SAC 7-35 is connected to the computer's 9 pin RS 232 port from the 6 pin DIN connector located on the front panel of the SAC 7-35.

## 2.2 MOUNTING CONSIDERATIONS

The SAC 7-35 can be mounted in any orientation, either inside or outside the pressure vessel. Mounting location should be chosen to minimize the static pressure line length from the SAC 7-35 to the altimeter. Be sure to allow an ample service loop on the cable to allow for calibration of the SAC 7-35. You'll notice that the SAC 7-35 mounting tray has the same hole pattern as the SAE 5-35 encoder. This will simplify installations where the SAE 5-35 is being upgraded with the SAC 7-35.

**CAUTION: DO NOT mount the SAC 7-35 in the direct airstream or near either the hot or cold air ducts.**

The STP 78 Outside Air Temperature (OAT) probe is supplied with the SAC 7-35. It should be mounted in a location away for the engine exhaust or other area that prevent it from accurately measuring outside air temperature. The OAT probe should never be mounted on a dark painted surface. This will cause errors in the OAT measurement.

**CAUTION: DO NOT mount the Outside Air Temperature (OAT) probe near the aircraft exhaust or prop wash, dark surfaces, transmitting antennas or cabin heaters.**

## 2.3 COOLING

The SAC 7-35 does not require external cooling.

# Section 3 Installation Procedures

## 3.1 GENERAL

The SAC 7-35 is supplied with a mounting tray and crimp type mating connectors. It is important that the proper crimping tools and techniques be observed in attaching wires to the mating connectors. Failure to do so could result in a failure in the connection and cause intermittent or non operation of the SAC 7-35.

## 3.2 EQUIPMENT REQUIRED

### 3.2.1 Supplied

| | | |
|---|---|---|
| SAC 7-35 System | | 705548-XX |
| Includes: | SAC 7-35 Airdata Computer | 305548-XX |
| | SAC 7-35 Installation Manual | 305586-00 |
| | SAC 7-35 Installation Kit, Electrical | 305588-00 |
| | 15 Pin Connector Hood | 305208 |
| | 2 each 25 Pin Connector Hoods | 305437 |
| | 25 Pin Female Connector w/Crimp Pins | 305583 |
| | 25 Pin Connector w/Crimp Sockets | 305720 |
| | 15 Pin Male Connector w/Crimp Pins | 305721 |
| | SAC 7-35 Installation Kit, Mechanical | 305589-00 |
| | Mounting Tray | 305557 |
| | Knurled Hold-down Nut | 305558 |
| | STP 78 OAT Probe | 305561-91 |
| | OAT Probe Installation Kit | 305595-00 |
| | Mounting Nut | 305560-03 |
| | Mounting Lock Washer | 305050-10 |
| | Fiber Shoulder Washer | 305587-03 |
| | Flat Fiber Mounting Washer | 305581-04 |

### 3.2.2 Required But Not Supplied

Number 6-32 Mounting Screws, 3 or 4 depending on your selected mounting option.
Static Port Fitting
Pitot Port fitting
9 pin RS 232 to 6 pin DIN adapter cable

## 3.3 MOUNTING TRAY INSTALLATION

The mounting tray is mounted to the airframe using either three or four number 6-32 screws. The mounting hole pattern for the SAC 7-35 mounting tray contains five holes. For new installations, it is recommended that the four corner holes be used to mount the SAC 7-35 tray. The fifth hole has been added to facilitate upgrades from some manufactures encoders. Refer to the SAC 7-35 tray dimensions in Figure 3-1 to determine if the hole pattern of the removed system match the hole pattern of the SAC 7-35 mounting tray.

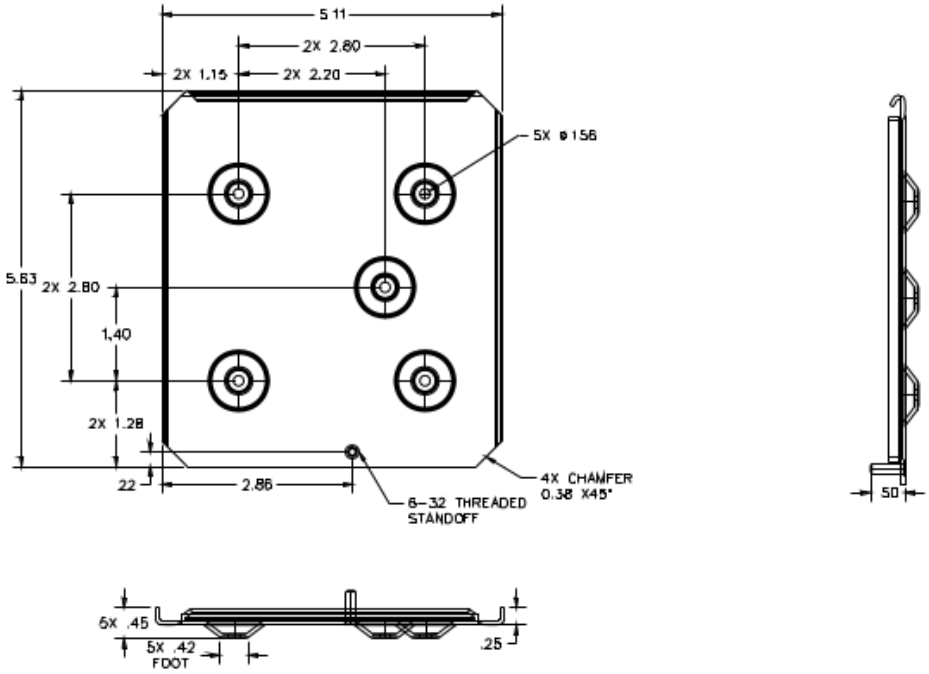


Figure 3-1
Mounting Tray Dimensions

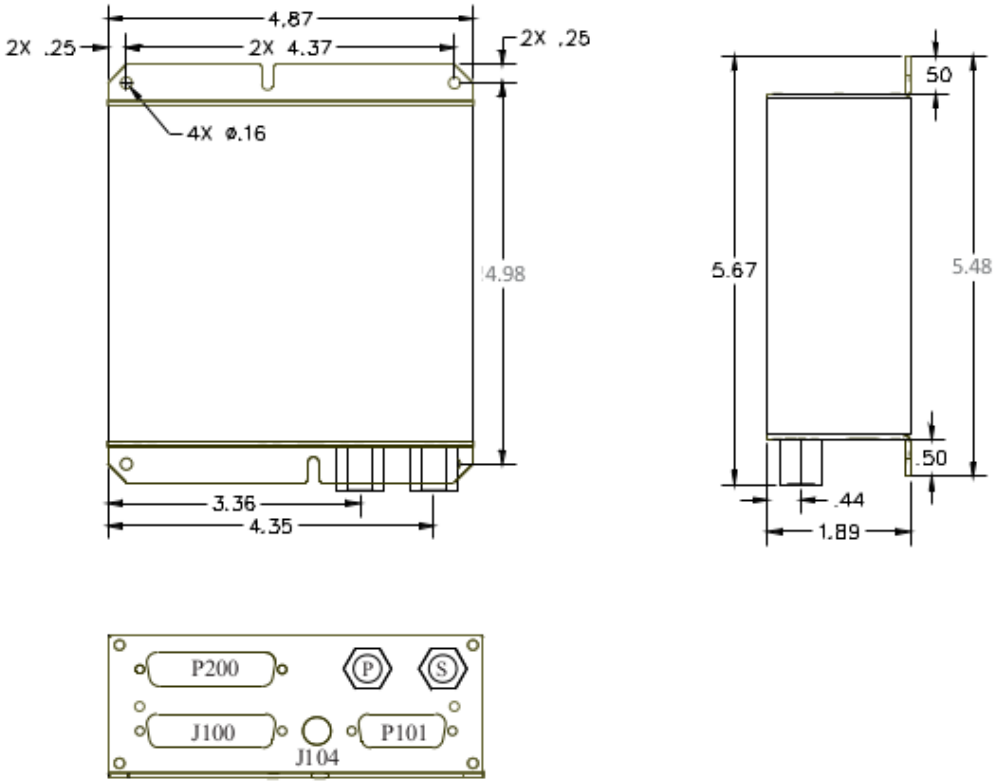


Figure 3-2
Unit Outline Dimensions

## 3.4 STATIC AND PITOT PORT CONNECTION

Standard 1/8 - 27 NPT brass fittings are provided on the front plate of the SAC 7-35 for attaching to the aircraft static and pitot systems. An adapter may be used to convert these to match the aircraft static and pitot plumbing. When attaching the mating fittings, make sure that they are secure and free from leaks that can induce errors in the static and pitot systems. To reduce the likelihood of the brass fitting rotating while installing the static line, a "D" shaped hole is used to mount the brass fittings into the front panel. Upon completion of the installation of the SAC 7-35, a Case Leak test is to be performed per FAR Part 43 Appendix E.

**NOTE: Since significant force can be applied to the SAC 7-35 during static and pitot fitting installation, dual wrench techniques are always recommended to avoid damage to the airdata computer.**

## 3.5 OUTSIDE AIR TEMPERATURE (OAT) PROBE INSTALLATION

The SAE 7-35 is supplied with the STP 78 OAT probe P/N 305561-91. Avoid mounting the OAT probe in or near prop airstream, engine or heater exhaust, transmitting antennas or on dark painted surface. Failure to do so will result in improper OAT readings. The OAT probe requires a 7/16" hole be drilled in the skin of the aircraft. The installer should consider fabricating an appropriate doubler plate in accordance with accepted installation practices as outlined in AC 43.13-1B. Skin thickness including doubler should be a minimum of 0.050" and a maximum of 0.188". See figure 3-4 for mounting details. The OAT probe comes with a three wire pigtail approximately 3 feet in length. The installer can cut this cable to length or extend it by adding additional wire. Make sure that any connections are away from areas that can accumulate water or chemicals.

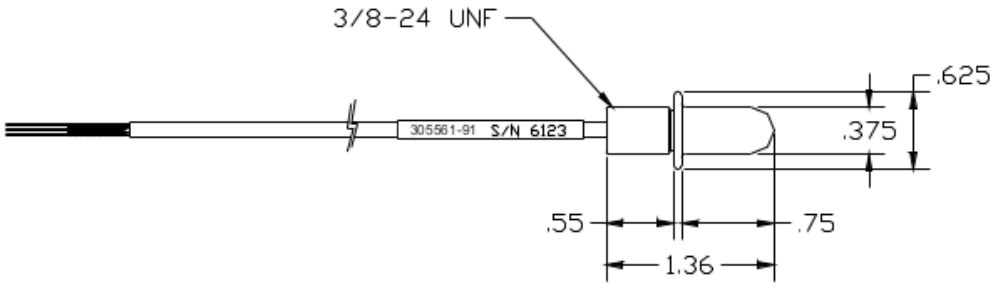


Figure 3-3
STP 78 OAT Probe Dimensions

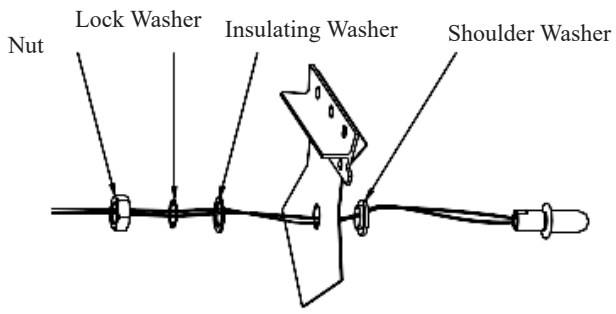


Figure 3-4
STP 78 OAT Probe Mounting

## 3.6 ELECTRICAL INSTALLATION

The SAC 7-35 is designed to operate from 11-32 Vdc without any special wiring considerations. Power can be supplied from the aircraft buss through a 2 Amp circuit breaker. Since the SAC 7-35 is TSO'd as an encoder, power can also be supplied from the onboard transponder. If power is supplied from the transponder, the SAC 7-35 and it's airdata functions will not operate if the transponder is turned off or removed from the aircraft.

**Installation to be in accordance with FAA AC 43.13-1B**

**NOTE: If the power source for the SAC 7-35 is from the on board transponder, the SAC 7-35 and it's airdata outputs will not be available if the transponder is turned off or removed from the aircraft.**

SAE document AS8003 *Minimum Performance Standard for Automatic Pressure Altitude Code Reporting Equipment* states that "a means shall be incorporated in the equipment to indicate the loss of electrical power or the effect thereof, unless the electrical power to operate the code generating equipment is supplied by an ATC Transponder which also supplies an indication of this power loss." The two power pins 14 and 8 on P101 are internally connected in the SAC 7-35. Only one of these connections is necessary to supply power to the unit. The unused connection can be used to drive a panel-mounted indicator if desired.

The SAC 7-35 uses crimp type Sub-D connectors with screw lock assemblies. The proper crimp tool for use with machined Sub-D connector pin and sockets is required to ensure that the wire and connector have good electrical and mechanical bond.

## 3.7 FUEL FLOW INTERCONNECT

The SAC 7-35 accepts Fuel Flow from a pulse type fuel flow transducer, such as the Flow Scan 201 series, that outputs flow rates from 0-14400 GPH (2000 pulses/sec max). The SAC 7-35 can use existing Fuel Flow transducers that are already installed in the aircraft, if they are of the proper type. The signal and ground wire(s) can be paralleled into the SAC 7-35 (in this case, power should not be connected from the SAC 7-35). Fuel Flow signals are inputted on J100.

Fuel Flow transducers should never have power connected to two sources. This will cause damage to one of the devices.

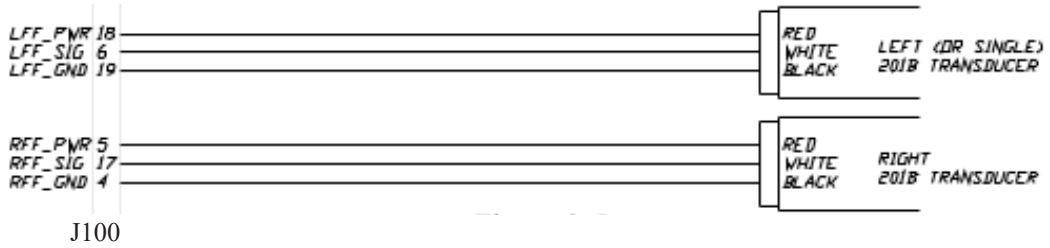


Figure 3-5
Fuel Flow Interconnect

## 3.8 SYNCHRO INPUTS

The heading synchro heading inputs follow ARINC 407 standard. There are five imput signals; SYNC-VX, SYNC-VY, SYNC VZ, SYNC VH and SYNC VC. They are available from a slaved compass system with a boot strap output.

**Note: SYNC VC is grounded.**

## 3.9 BARO INTERFACE

If the aircraft is so equipped, the SAC 7-35 will accept a Baro correction input from the onboard altimeter. The Baro signals are BARO Pwr and Baro Sig. The baro setting input is a 5Vdc potentiometer which is included in several common altimeters. The BARO PWR signal is an accurate 5Vdc output that energizes the potentiometer in the altimeter. The BARO SIG is the voltage on the wiper of the pot. Representative baro setting versus voltages are:

| InHG | Volts |
|---|---|
| 28.10 | 0.484 |
| 28.50 | 1.029 |
| 29.00 | 1.701 |
| 29.50 | 2.364 |
| 29.92 | 2.916 |
| 30.06 | 3.098 |
| 30.50 | 3.664 |
| 30.90 | 4.174 |
| 30.99 | 4.288 |

## 3.10 TRANSPONDER INTERCONNECT

All transponder functions including the Gilham Grey Code output are on the 15 pin connector P101. The two RS232 digital outputs for new generation transponders and other avionics that require corresponding altitude are on P100 pin 9 & 10 and 21 & 22. The two RS-232 corresponding outputs that can be independently configured. The Grey code output is enabled by grounding the Strobe line on J101 pin 6. There are three methods to accomplish this grounding.

1. Permanently ground this line.
2. The transponder provides a switched ground enable signal.
3. The transponder provides a strobe-ground enable signal.

The SAC 7-35 is compatible with all three systems. Refer to the appropriate transponder installation manual for detail. Interconnect information for the most popular transponders can be found in Figure 3-7. For other makes of transponders, refer to the manufactures installation manual.

**Note: The RS232 serial data outputs are not affected by the Strobe/Enable input signal.**

## 3.11 AIM INTERCONNECT

The SAC 7-35 incorporates SANDIA's AIM (Altitude Inflight Monitoring) feature that will alert the pilot any time he deviates from his selected altitude by 100' or more. The AIM functions are on P100, pins 1, 2 and 14. A momentary pushbutton and two annunciators are required for this function.

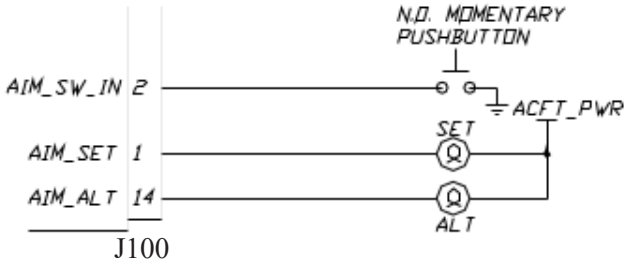


Figure 3-6
AIM Interconnect

Notes:

1. Maximum lamp current 80mA
2. AIM switch is a momentary contact
3. If the AIM function uses annunciator lamps provided by the installer, they should be appropriately labeled. The lamp connected to pin 14 should be labeled 'ALT' and the lamp connected to pin 1 should be labeled 'SET'.
4. Sandia recommends a Green lamp for the SET Annunciator and Amber for the ALT Annunciator

| SAE5-35 J4 | Function | Bendix TPR2060 | Bendix TR641A/B | Cessna RT359T, RT459A, RT859A | Garmin GTX32X Series | Garmin GTX330, GTX33 (J3301) | Honeywell KT70/71 (Connector JKT701) | Honeywell KT76A/78A | Honeywell KXP | Narco AT50/A, AT150 | Narco AT5, AT6/A | UPSAT SL70 | Wilcox 1014A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | D4 | No Connection | N | 10 | 18 | 11 | 8 | No Connection | V | No Connection | No Connection | 35 | C |
| 2 | A1 | 4 | A | 14 | 3 | 2 | M | M | G | 7 | 2 | 13 | k |
| 3 | A2 | 6 | B | 13 | 5 | 4 | K | K | H | 6 | 4 | 31 | c |
| 4 | A4 | 8 | C | 15 | 6 | 5 | J | J | J | 8 | 8 | 12 | W |
| 5 | B1 | 9 | D | 19 | 9 | 7 | E | E | K | 12 | 9 | 33 | T |
| 6 | Strobe/Enable | Aircraft Ground | Aircraft Ground | 11 | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | 5 | 12 | Aircraft Ground | Aircraft Ground |
| 7 | Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground |
| 8 | Aircraft Power | Note 1 | Note 1 | 9 or per Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | 18 or per Note 1 | 13 or per Note 1 | Note 1 | Note 1 |
| 9 | B2 | 10 | E | 17 | 11 | 9 | C | C | L | 10 | 10 | 14 | L |
| 10 | B4 | 11 | F | 16 | 12 | 10 | B | B | M | 9 | 11 | 32 | D |
| 11 | C1 | 3 | H | 21 | 10 | 8 | D | D | P | 14 | 1 | 16 | P |
| 12 | C4 | 7 | K | 20 | 7 | 6 | H | H | S | 13 | 5 | 15 | Z |
| 13 | C2 | 5 | J | 18 | 4 | 3 | L | L | R | 11 | 3 | 34 | f |
| 14 | Aircraft Power | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 | Note 1 |
| 15 | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground | Aircraft Ground |

Figure 3-7
Gilham Gray Code Interconnect w/ Most Popular Transponders

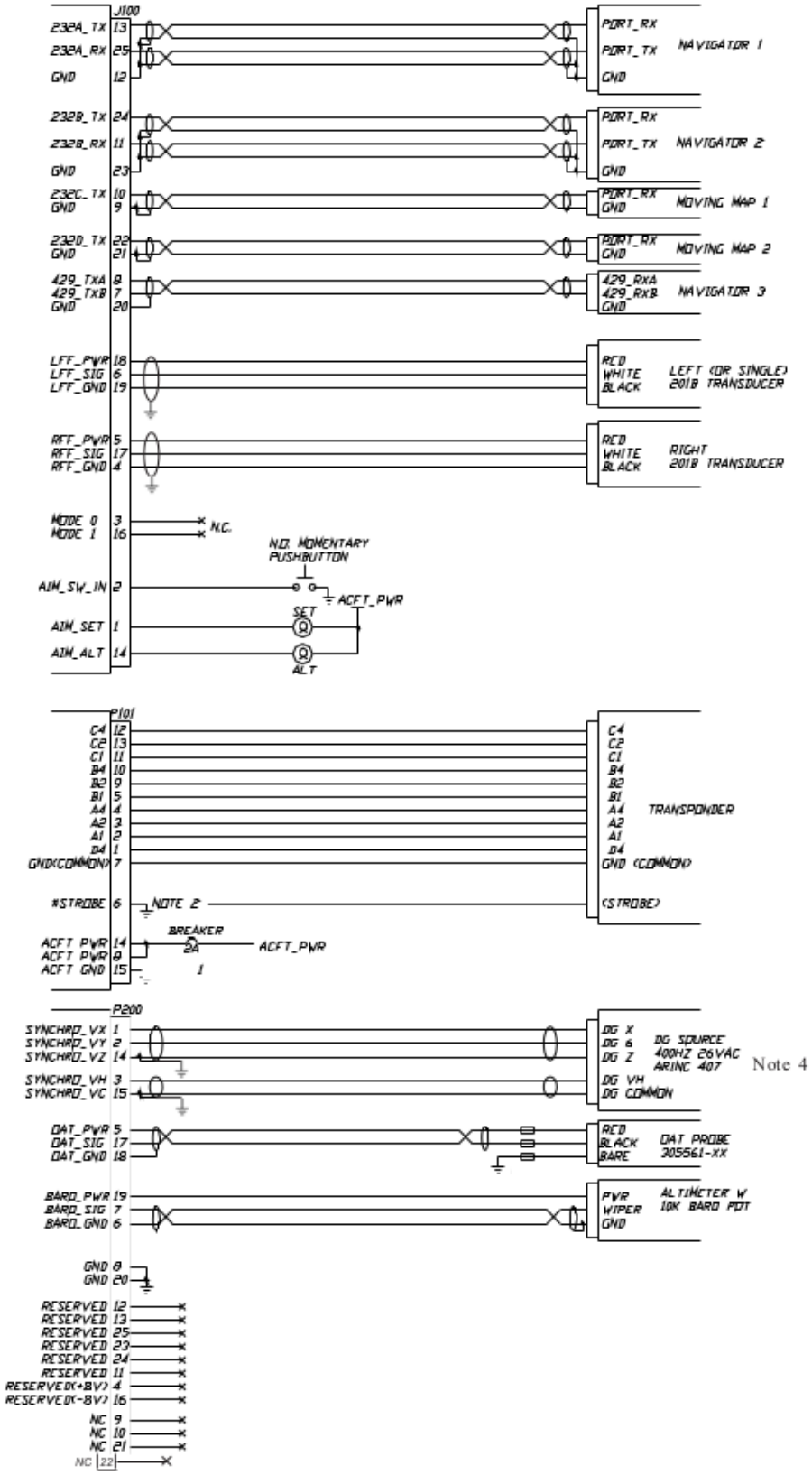


Figure 3-8
SAC 7-35 Interconnect Wiring Diagram

Installation Notes:

Note 1: All wires are 24 AWG or larger unless otherwise noted.
Note 2: Ground Strobe output to P101-6 if not required for transponder.
Note 3: Fuel Flow transducers should never have power connected to two sources. This will cause damage to one of the devices.
Note 4: Mode 0 and Mode 1, J100 Pins 3 and 16 Must be left unconnected in the aircraft

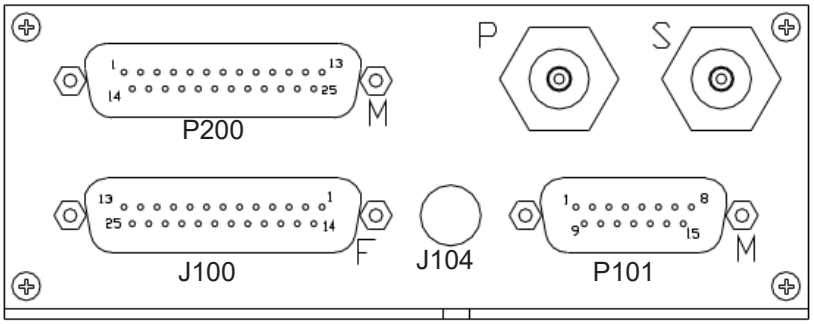


Figure 3-9
Front Panel Connector Location

| J100 | | | P200 | | P101 | |
|---|---|---|---|---|---|---|
| 13 | RS232A TX | RS 232A Airdata | 1 | Syncro VX | 12 | C4 |
| 25 | RS232A RX | | 2 | Syncro VY | 13 | C2 |
| 12 | Gnd | | 14 | Syncro VZ | 11 | C1 |
| 24 | RS232B TX | RS232B Airdata | 3 | Syncro VH | 10 | B4 |
| 11 | RS232B RX | | 15 | Syncro VC | 9 | B2 |
| 23 | Gnd | | | | 5 | B1 |
| 10 | RS232C TX | RS232C Corresponding Alt | 5 | OAT Pwr (+5V) | 4 | A4 |
| 9 | Gnd | | 17 | OAT Signal | 3 | A2 |
| 22 | RS232D TX | RS232D Corresponding Alt | 18 | OAT Return | 2 | A1 |
| 21 | Gnd | | 19 | BARO Pwr | 1 | D4 |
| 8 | ARINC 429 TXA | | Note 2 7 | BARO Signal | 7 | Gnd |
| 7 | ARINC 429 TXB | | 6 | BARO Return | 6 | Strobe |
| 20 | Gnd | | 12 | Reserved | Note 1 14 | A/C Pwr |
| 18 | Left Fuel Flow Pwr | | 13 | Reserved | 8 | A/C Pwr |
| 6 | Left Fuel Flow Signal | | 25 | Reserved | 15 | A/C Gnd |
| 19 | Left Fuel Flow return | | 23 | Reserved | | |
| 5 | Right Fuel Flow Pwr | | 24 | Reserved | | |
| 17 | Right Fuel Flow Signal | | 11 | Reserved | | |
| 4 | Right Fuel Flow Return | | 9 | N/C | | |
| 3 | Configuration Mode | | 10 | N/C | | |
| 16 | N/C - Reserved | | 21 | N/C | | |
| 15 | Oper (Unit Valid) | | 22 | N/C | | |
| 2 | AIM SW In | | Note 1 8 | Gnd | | |
| 1 | AIM SET | | 20 | Gnd | | |
| 14 | AIM ALT | | 4 | Reserved (+8V) | | |
| | | | 10 | Reserved (-8V) | | |

Note 1 Internally Connected
Note 2 Ground Pin 7 if Baro Pot not connected

Figure 3-8
SAC 7-35 Pinout

# Section 4 Configuration and Calibration

## SYSTEM CONFIGURATION

### 4.1 Setup for Configuration

The SAC 7-35 has a configuration mode allowing it to be configured for varying aircraft equipment. A DIN to 9-pin serial port adapter can be plugged into the configuration connector, J104 (a 6 pin Din to 9 Pin serial adapter cable, SANDIA upart number 305580, is supplied with each unit).The SAC 7-35 automatically senses if a computer is plugged into this connector and will enter configuration mode on power up. The unit will set the RS232B port for system configuration mode. Disconnect J100 from the SAC 7-35 durning this procedure to prevent any possible interference on the RS232 lines. This port will have the following parameters:

Baud: 9600 Bits: 8 Stop bits: 1 Parity: None

A terminal application (Hyperterminal, minicom etc) can then be used to configure the SAC 7-35

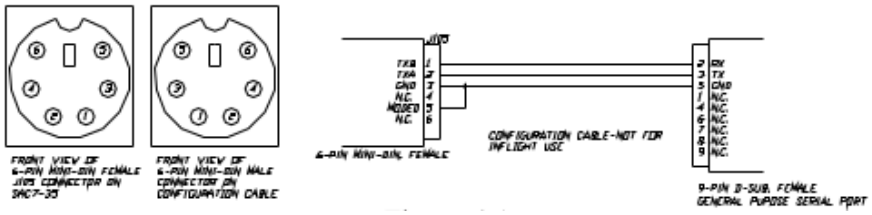


Figure 4-1
6 Pin Din to Serial Interconnect

**SAC 7-35 J100 MUST be disconnected during configuration and calibration procedures to eliminate possible interference on the RS 232 lines.**

### 4.2 Changing Configuration Parameters

When first connecting the SAC 7-35, the installer will be presented with the following menu:

```
SANDIA AEROSPACE SAC 7-35 305548-XX Copyright 2004-2009
SW PN: 901001-0C-00 SW VER: XX.X

 CONFIGURATION:
Serial > K:9600 G:38400 S:1200 E:19200 Mode>> IAS_Cutoff=40 Arinc=A DASH -00
Trim >> Alt:-1270:1270 IAS:0:10 Baro:-1.27:1.27 OAT:.0:.0 Hdg:000:0

Fuel >> K=130000:500 0s delay 6.02lb/g

CONFIGURATION MENU:

 1. PortA Format      2. PortA Baud      3. PortB Format      4. PortB Baud
 5. PortC Format      6. PortC Baud      7. PortD Format      8. PortD Baud
 9. Airspeed Trim     a. Altitude Trim   b. Baro Trim         c. Airspeed Cut off
 d. Fuel Start Delay  e. Fuel Engine Cnt f. Fuel Density     g. Reserved
 h. Syncro CW/CCW      i. Syncro Index   j. Reserved          k. Fuel Kfactor
 l. List Inputs       m. Mode Select     n. Reserved          o. Oat Trim
 x. Exit
```

Select an Option to Configure:

The configuration menu presents all the adjustable parameters. To change a parameter enter a single character followed by return. For example:

Select an Option to Configure: 1<enter>

Select the number 1 and press Enter. This would change the Port1 Format parameter. The prompt will then change to:

1. Garmin Z
2. King D
3. Garmin G
4. ADS-B
5. Disabled

Select a Navigation System:

Then enter a selection (or value) followed by enter. For Example:

Select a Navigation System:1<enter>

The status lines will show the new configuration. (Garmin-Z is represented by a Z):

Serial > Z:1200 G:38400 S:1200 E:19200 Mode>> IAS_Cutoff=40 Arinc=A DASH -00
Trim >> Alt:-1270:1270 IAS:0:10 Baro:-1.27:1.27 OAT:.0:.0 Hdg:000:0
Fuel >> K=130000:500 0s delay 6.02lb/g

After all the configuration parameters are programmed, select x<enter> to store the parameters. Press Enter again to record changes or Escape to go back. The status lines should be recorded for future reference. Then the DIN to Serial cable adapter removed. Upon a power cycle, the new parameters will be set into the SAC 7-35.

**Note: Record and save the Status lines for future use. They can be use to reprogram the unit should service or replacement be required.**

SAC 7-35 S/N _____ A/C N# _____

Serial > ___ : _____ ___: _____ ___ : _____ ___ : _____ Mode>>IAS_Cutoff= _____ Arinc= ____ DASH _____
_____

Trim >> Alt: _____ : _____ IAS: _____ : _____ Baro: _____ : _____ OAT: _____ : _____ Hdg: _____:_____

Fuel>> K = _____:_____ _____S delay _____lb/g

## 4.3 Status Line Descriptions

There are three status lines that indicate the various parameter settings. The first line contains information about the RS232 port communication settings.:

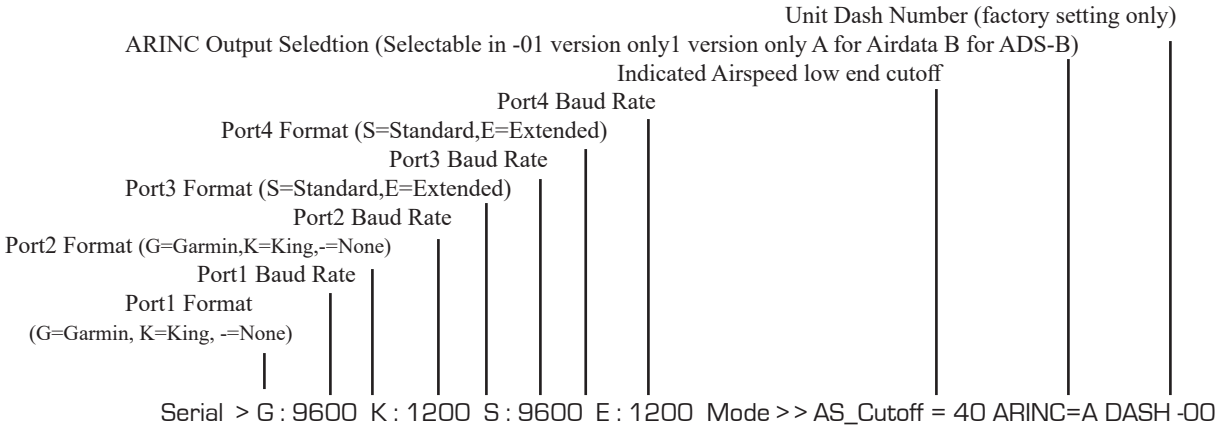


Figure 4-2
RS-232 Status Lines Setting

---

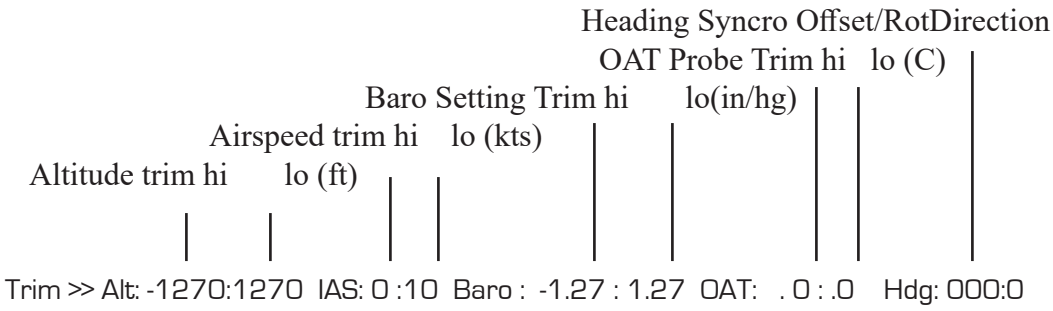


Figure 4-3
SAC 7-35 Configuration Mode - Unit Trim Status

---

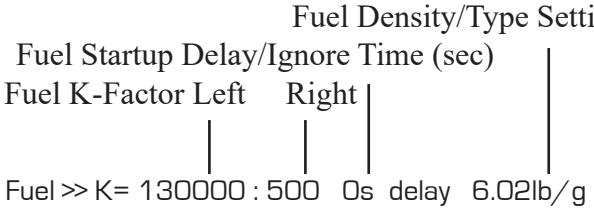


Figure 4-4
SAC 7-35 Configuration Mode - Unit Fuel Status

## Parameter Descriptions

### 4.3.1 Serial Port Settings

| Parameter | Description | Allowed Settings |
|---|---|---|
| 1. Port 1 Format | Set Port 1 (RS232A) Data Format | 1. Garmin-Z<br>2. King-D<br>3. Garmin-G<br>5. Disable |
| 2. Port 1 Baud | Set Port 1 (RS232A) Baud Rate | 1. 1200 bps<br>2. 9600 bps<br>3. 19200 bps<br>4. 38400 bps |
| 3. Port 2 Format | Set Port 2 (RS232B) Data Format | 1. Garmin-Z<br>2. King-D<br>3. Garmin-G<br>4 ADS-B<br>5. Disable |
| 4. Port 2 Baud | Set Port 2 (RS232B) Baud Rate | 1. 1200 bps<br>2. 9600 bps<br>3. 19200 bps<br>4. 38400 bps |
| 5. Port 3 Format | Set Port 3 (RS232C) Data Format | 1. Standard<br>2. Extended<br>3. No Output |
| 6. Port 3 Baud | Set Port 3 (RS232C) Baud Rate | 1. 1200 bps<br>2. 9600 bps<br>3. 19200 bps<br>4. 38400 bps |
| 7. Port 4 Format | Set Port 4 (RS232D) Data Format | 1. Standard<br>2. Extended<br>3. No Output |
| 8. Port 4 Baud | Set Port 4 (RS232D) Baud Rate | 1. 1200 bps<br>2. 9600 bps<br>3. 19200 bps<br>4. 38400 bps |

### 4.3.2 Airspeed Trim

| Parameter | Description | Allowed Settings |
|---|---|---|
| 9. Airspeed Trim | Adjust for high speeds 460 Kts. Moves speeds +/-12.7 knots in 0.1 kt increments. Use a negative sign for negative trim. | +/- 12.7 knots |
| | Adjust for low speeds (40 Kts). Moves low speeds +/-12.7 knots in 0.1 kt increments. Use a negative sign for negative trim. | +/- 12.7 knots |

### 4.3.3 Syncro Input Settings

| Parameter | Description | Allowed Settings |
|---|---|---|
| h. Syncro Rotation | Direction of rotation | 0. Positive Rotation<br>1. Negative Rotation |
| i. Synchro Index | Adjustment of syncro input index | 0-359 degrees in 1 degree steps |

### 4.3.4 Altitude Trim

The altitude trim adjusts all of the SAC 7-35 altitude output including: the Gillham Grey code, serial encoder, Pressure Altitude, Density Altitude and Baro Corrected Altitude output values.

There are two trim values, high trim and low trim. The low trim value is applied for sea level altitudes. The high trim value is applied at the units certified service ceiling 35,000ft. For other altitudes the two trim values are interpolated.

| Parameter | Description | Allowed Settings |
|---|---|---|
| a.Altitude Trim | Adjust for high altitude (35,000 feet). Moves high altitudes +/-635 feet in 5' increments. Use a negative sign for negative trim. | +/- 635 (feet) |
| | Adjust for low altitude ( -1000 feet.) Moves low altitudes +/-635 feet in 5' increments. Use a negative sign for negative trim. | +/- 635 (feet) |

### 4.3.5 Baro Setting Trim

| Parameter | Description | Allowed Settings |
|---|---|---|
| b. Baro Trim | Adjust for high and low Baro settings (32.0 and 28.0 inHg) Enter high and then low trim offsets | +/- 127 0.01 inHg |

### 4.3.6 Airspeed Cutoff

| Parameter | Description | Allowed Settings |
|---|---|---|
| c. Airspeed Cutoff | Select the airspeed cutoff value. Below the cutoff value the airspeed is output as zero to minimize wind gust airspeed reports on the ground. Enter the desired value in knots: | |
| | On software Rev 14 Even values of 0-30 are supported. | 0-30 |
| | On Software Rev 13 and below even values 40 and 0-28 are supported. | 0-40 |

## Parameter Descriptions Con't

### 4.3.7 Fuel Flow Configuration and K-factor

| Parameter | Description | Allowed Settings |
|---|---|---|
| d. Fuel Start-up delay | Delay Fuel Flow Calculation | (0-12 for 0-60 second delay) |
| e.Fuel Input | Engine count | 0 ,1,2 |
| f. | Fuel Density | 0 = 100LL<br>1 = Jet B<br>2 = Jet 1A<br>3 = JetA<br>or enter # |
| k. | Fuel Tranducer K-Factors (L&R) | 500-130000 |

### 4.3.8 List Inputs

| Parameter | Description | Allowed Settings |
|---|---|---|
| l. List Inputs | This confiruration menu selection lists the current Altitude. Airpseed, Outside Air Temperature and Baro Setting. The list is in the form:<br><br>Trimmed inputs>>Alt=1234 IAS=321 Baro=29.92 OAT=15.12<br><br>The alt is in feet, IAS knots, Baro InHg and OAT in Deg C | N/A |

### 4.3.9 ARINC Mode

**Note: The ARINC output select is available only in-01 units. In -01 units the ARINC 429 output can be disabled. The output can also be configured for Airdata only, ADS-B only or both**

| Parameter | Description | Allowed Settings |
|---|---|---|
| m. Mode Select | Select the ARINC output mode<br>0. ARINC 429 Output Disable<br>1. ARINC 429 Output Airdata Only<br>2. ARINC 429 Output ADS-B only<br>3. ARINC 429 Output ADS-B and Airdata | 0-3 |

### 4.3.10 OAT Probe Trim

The OAT probe trim should always be set to 0 for SAC 7-35 installations with the Sandia Aerospace OAT Probe (305561-01).

| Parameter | Description | Allowed Settings |
|---|---|---|
| o. OAT Probe | Outside Air Temperature Trim<br>Enter high (+60c) and then low (-60c) trim offsets | +/-127 0.05$^{O}$ C |

## 4.4 Continued Airworthiness

The encoder portion of the SAC 7-35 requires calibration every 24 months per FAR 91.411. All other maintenance is on condition only.