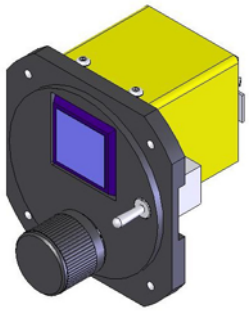
SAM™ PILOT'S OPERATING HANDBOOK



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ICARUS INSTRUMENTS, INC.
6930 CARROLL AVE., SUITE 300
TAKOMA PARK MD 20912
www.icarusinstruments.com

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instruments incorporated

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

In no event shall Icarus or Centurion be liable for any incidental, special, indirect, or consequential damages, whether resulting from the use, misuse, or inability to use this product, or from defects in the product. Some states do not allow the exclusion of incidental or consequential damages, so the above limitations may not apply to you.

Note to Customers

It is the purchaser's responsibility to ensure that the aircraft in which the SAM system is installed is equipped with all necessary avionics systems to allow proper operation of SAM, as specified in the *SAM Installation Guide*. Without the associated systems and their connections, SAM will not support all the features described in the *SAM Pilot's Operating Handbook*. Also note that there are two versions of SAM: the SAM I product provides full functionality, while SAM II provides full functionality minus roll steering capability.

Introduction

The Steering Assist Module (SAM™) couples an existing autopilot to a panel-mounted GPS to provide roll steering -- precisely guiding your aircraft through GPS approaches and en route waypoints. SAM's innovative roll steering mechanism uses the autopilot's heading mode, anticipating all turns and continually accounting for current winds and aircraft ground speed.

In addition to roll steering, SAM displays GPS and other valuable aircraft system information. SAM also generates pilot-configurable verbal and visual alerts that annunciate such information as waypoint passage, altitude targets, and system warnings. SAM's data entry system is designed to make common tasks, such as setting a new barometric pressure or target altitude, easy to perform.

With these combined features, SAM reduces your workload, increases your situational awareness, and enhances safety.

SAM Pilot's Controls

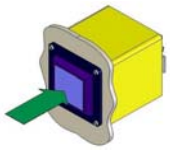
The SAM control panel has three controls that govern SAM operation:

- A Display Button used to turn roll steering on and off that also contains a backlit, sunlight-readable LCD display
- A Rotary Control Knob to enter data and select display parameters
- An Audio Control Toggle Switch to control audio annunciations

Display Button

The Display Button serves a dual purpose:

- As a pushbutton switch to engage and disengage Roll Steering
- As the SAM display
- The button should be mounted near your primary flight instruments, giving you immediate visual access to SAM's data display.



LCD Display

SAM's LCD display is integrated into the Display Button. The display contains two pilot-selectable data display lines (Upper and Lower) for displaying GPS and other aircraft system information. By default, the display presents the next waypoint on the Upper line and the distance to the next waypoint on the Lower line. What is displayed in the Upper and Lower positions can be easily changed in flight as can the power-on default selections.

A third line indicates SAM's GPS roll steering state, the current GMT, the audio status (when muted) and whether the upper two lines are currently annunciating an Alert. A bar appears at the left edge of the display indicating display wait time status (when relevant).

The display provides information in green in GPS Roll Steering (GPSS) mode and cyan in Heading (HDG) mode. A dimmer mechanism displays black letters on a light background or white letters on a dark background, depending upon ambient light conditions in the aircraft and a pilot-settable brightness level.

Rotary Control Knob

The Rotary Control Knob is the primary input mechanism available to the pilot to use and control SAM.

At the start of a flight, you use the Rotary Control Knob to update the barometric pressure and destination altitude, assuming that there isn't another altitude alerter or altitude pre-selector in the aircraft.

You also use the Rotary Control Knob to select GPS and other aircraft system parameters to be presented in the Upper and Lower lines on the display. Additionally, you can use the Rotary Control Knob to change other settings, such as the volume of the audio alerts and display brightness.

Using the Rotary Control Knob

Various Rotary Control Knob actions allow you to make choices in SAM's menu system. Sometimes the same knob action has different effects, depending upon the context.

Rotary Control Knob Transition Actions

- Push and turn to rotate through the options in the Main menu (this action is valid at any time, even when editing)

- Turn to navigate through the options in a submenu
- Turn to change a numeric value like altitude or barometric setting

- Push to enter a barometric setting
- Push to acknowledge an alert message
- Push to force an immediate data entry to save time

Rotary Control Knob Edit Actions

- Push to change the current column for data entry, i.e., to the hundreds digit in an altitude
- Push to store a parameter value for current and future flights

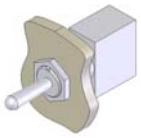
- Turn to view the options for a parameter
- Turn to change a numeric value, i.e., entering a new target altitude or barometric setting. There is always carryover to the next column, i.e., one CW click from 2,900 feet results in 3,000 feet

- Wait several seconds to store a parameter value for the current flight and move to the next display. While ticking, this wait

time is depicted as a shrinking bar on the left edge of the display. Any time you enter a new target or barometric setting, the GPS two line display will automatically appear after this short interval.

Audio Toggle Switch

The Audio Toggle Switch controls SAM's aural annunciation system.



The switch has two positions, Up and Down:

- **The Up position mutes the audio system. When the system is silenced in this manner, "Muted" appears in the lower right hand corner of the display, and a soft tone sounds every 5 minutes as a reminder.**
- **The down position is spring-loaded.**
  - Switching to the Down position once repeats the most recent audio alert message.
  - Switching to Down subsequent times voices current information about the next waypoint. This information is updated once per second.

⚠ **Caution:** Your pressure altimeter is the only approved source of altitude information for all phases of flight. The altitude alerts provided by SAM are advisory in nature and you must maintain assigned altitudes based solely upon your pressure altimeter.

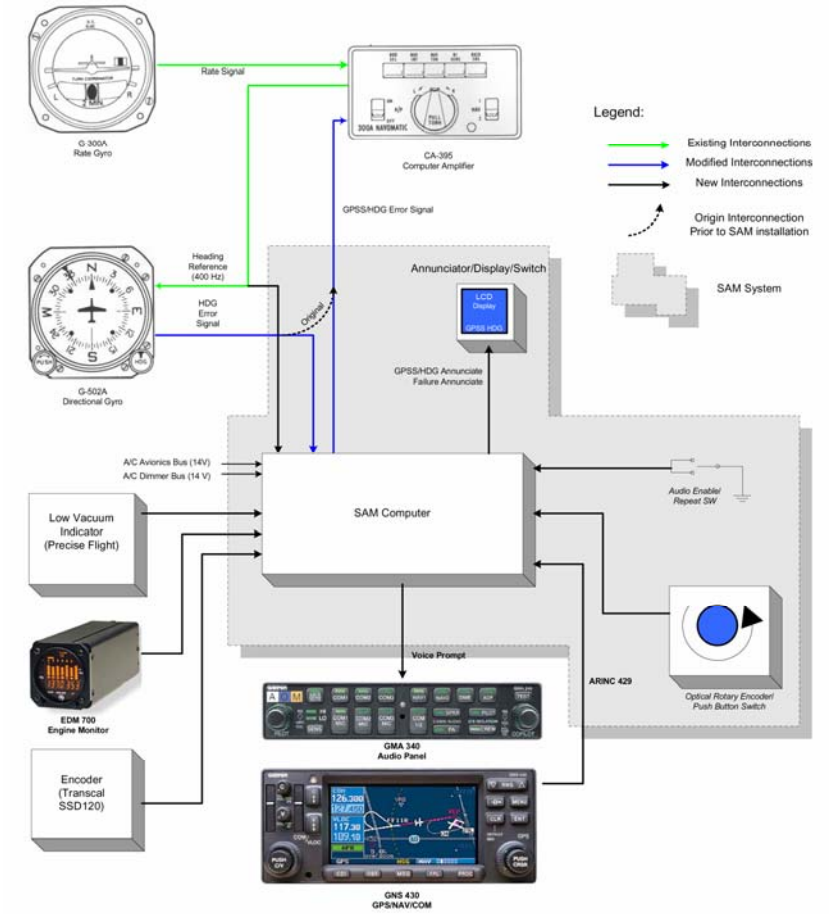
Should your pressure altimeter fail, the display of pressure altitude by SAM may be used as an emergency backup. It is essential to enter the current barometric pressure. If your altitude

source to SAM is from an encoder with 100 foot resolution, you will see your altitude change in 100 foot increments. Since the encoder is not calibrated as precisely as your pressure altimeter, there could be errors of 200 feet or more between SAM's display and your actual altitude. The best performance will occur with a 10 foot resolution encoder at lower altitudes. During normal use, observe your altitude on SAM so you can determine how close your encoder and pressure altimeter agree at any given altitude.

SAM's gear alert is functional only if a proper Destination Elevation and proper barometric pressure are entered. If you decide to go to an airport other than the one whose elevation you set prior to departure, then be sure to go to AUX mode and re-set DEST to the new airport's elevation.

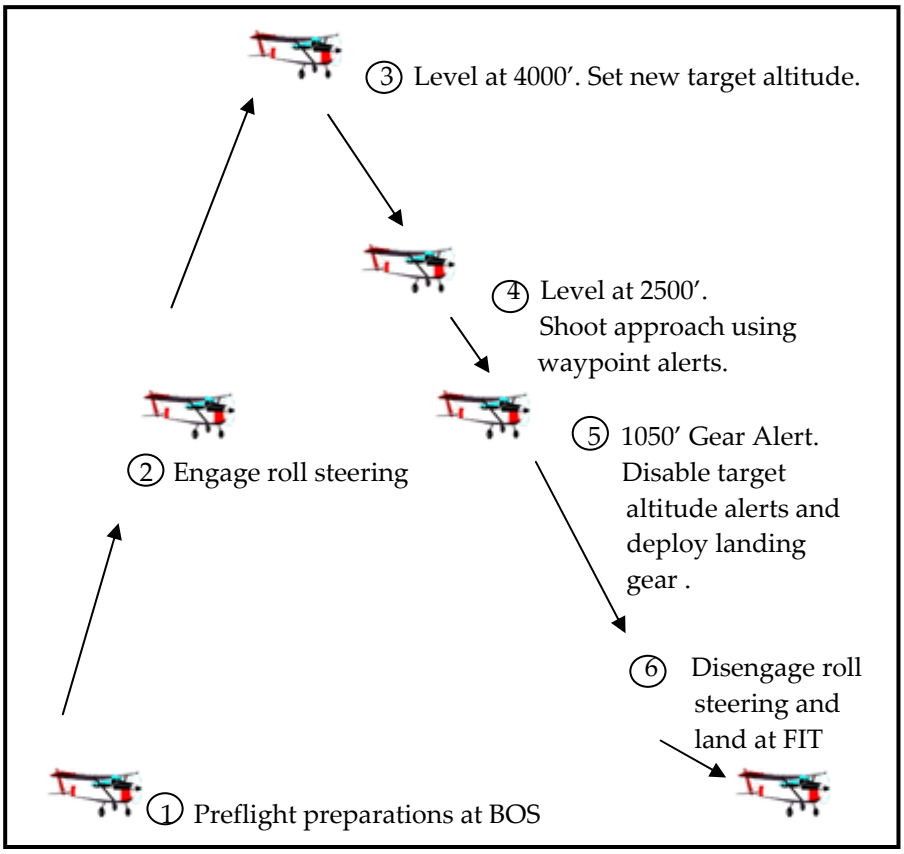
System Diagram

The following diagram depicts the SAM system components.



Getting Started

This section describes SAM-related tasks you would perform during a typical flight. It is based on a scenario for a flight from Logan airport (BOS) to Fitchburg, Massachusetts (FIT), as depicted in the following figure:



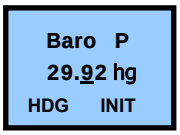
Caution: SAM is considered a secondary system that relies on a certified primary system for information. The pilot should refer to the primary system for verification of SAM-provided data.

① *Preflight Preparations*

On the ground at Boston, when you power up your aircraft avionics, the SAM system conducts a self-test and then waits for input at the Barometric Pressure screen. At this point, you should initialize the SAM system by entering a barometric pressure, a destination altitude, and a target altitude. These settings are used by SAM to generate altitude-related alerts. The destination altitude is also used to calculate the Gear Alert altitude as you descend to land and to determine the valid range of values for a Decision Altitude (DA).

To perform SAM initialization:

1. At the Barometric pressure (Baro P) screen, use to change numeric values, and to move between tenths and hundredths columns. When the proper barometric pressure is selected, use to accept the value and move to the DEST screen.



2. To enter an initial destination altitude value, use to change numeric values, and to move between columns. After you enter the destination altitude, use to accept the value and move to the Target screen.

3. To enter an initial target altitude value, use to change numeric values, and to move between columns.

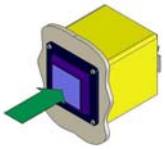
4. Wait several seconds and the screen transitions to the default GPS display.

Caution: If the pilot does not initialize the Barometer pressure and Destination Altitude, alerts will not occur. However, roll steering will still be available.

② *Engage Roll Steering*

After departing Boston and entering a flight plan into your GPS system, you can engage roll steering using the following procedure:

1. Place the autopilot in HDG mode.
2. Turn on the GPS system, enter a valid flight plan, and activate it.
3. Press the Display Button to engage GPSS mode. SAM will annunciate "G P S S Engaged" and "GPSS" will appear in the lower left hand corner of the display in place of "HDG" and changes the display color from cyan to green.



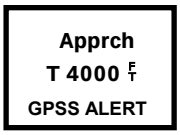
Your heading bug will now be inoperative and the roll steering output from SAM will drive your autopilot, enabling precise tracking of your desired course.

Caution: If your GPS system is turned on and programmed with a valid flight plan, engaging Roll Steering mode will cause your aircraft to initiate up to a standard rate turn in the direction of the next waypoint.

Caution: To ensure that SAM knows the flight mode, leave Garmin GPS systems in self-test mode for no more than 30 seconds. Self-test mode causes the GARMIN to output a groundspeed that SAM interprets as meaning the aircraft is in-flight.

③ *Set a New Target Altitude*

When you near the target altitude you set during SAM initialization, SAM issues an "Approaching" alert. For instance, if you set a target altitude of 4000 feet, SAM voices "Approaching 4000 feet" and displays "Apprch T 4000 ft" when you are within 300 feet of the target altitude. If you fail to get within 150 feet of the target within 30 seconds of the "Approaching" alert, you will hear "Check Target Altitude 4000 ft" as a reminder to continue your climb or descent.



You can adjust the "Offset", the difference between the target altitude and the altitude when the "Approaching" alert is issued. This is so that for fast-climbing aircraft you will have plenty of time to level off before actually reaching the target altitude. The Offset can be set from 100 to 1,000 feet from your Target.

After leveling off at 4000 feet, use the following procedure to set a new target altitude (for instance, 2500 feet for the initial approach altitude for FIT):

1. Use and turn the Rotary Control Knob one increment to move to the Target Altitude screen. Since this operation is performed often, it is the easiest to do.
2. Enter a new target altitude value by using to change numeric values, and to move between columns. If you are only changing the 1,000's digit, each CW click increases the target by 1,000 feet and each CCW click decreases the target by 1,000 feet. A single push of the knob moves to the hundreds digit if required.
3. Wait several seconds to accept the new value. The screen will transition to the default two line GPS display.

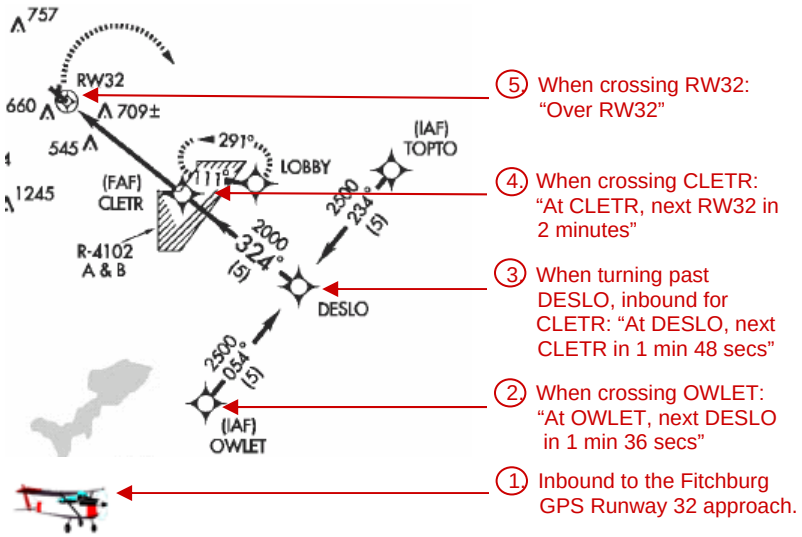
Once level at the target altitude, any deviations of 150 feet or more will be annunciated with a "Check Altitude". If you intended to go to another altitude, this becomes a reminder to set a new target altitude. This reminder will continue until you set a new target or recapture the present target altitude.

Caution: The FAA ATC system alerts the controller to an altitude error when you are 300 feet off of your assigned altitude. Remember that your pressure altimeter is the only legal source of altitude information for all phases of flight.

④ *Flying an Approach using Waypoint Alerts*

SAM automatically annunciates alert information as you approach and pass waypoints.

For instance, after you select the GPS RW32 approach for FIT, the following waypoint alerts are issued.



SAM also displays alert messages as each waypoint is approached and passed.

⑤ *Silence Altitude Alerts and Deploy Landing Gear*

Hint: When you begin descending for final approach, you can turn the Control Knob to the right several turns to disable Target Altitude alerts (this operation sets the target altitude to a high value so that the alert threshold is unlikely to be crossed). This is the only way to cancel altitude alerts altogether.

SAM issues a Gear Alert at 1050 feet. This altitude is based on the Destination Altitude of 350 feet, plus a pilot-configurable gear value of 600 feet, plus 100 feet. At this point, you can deploy landing gear and begin your final approach.

There are actually two gear alerts. You will hear “Gear Down” if your gear down lights have been wired to SAM and the gear is down when you get to the “gear” altitude. This alert is simply for you to verify that all three wheels are down.

If your gear down lights are not wired to SAM, the alert is “Check Gear”. This alert MUST be acknowledged by simply pressing the knob when you have verified that the gear is down. This alert will repeat until acknowledged. A good plan is to not acknowledge this alert until you know the gear is down.

Some aircraft have a switch on the throttle that sounds a gear horn if the gear is up when the throttle is retarded to a certain point. SAM can be wired to this switch such that a “Gear, Gear” alert will sound along with the horn. Follow the procedure in your aircraft’s POH if the Gear horn is heard.

⑥ *Disengage Roll Steering*

Before landing, you disengage from Roll Steering mode and assume manual control of your aircraft. To disengage, simply press the Display Button. SAM will transition to Heading mode, as indicated in the lower-left corner of the SAM display and the display color transitions from green to cyan.

At this point, as long as the autopilot is still engaged and in Heading Mode, the aircraft will turn towards the heading bug. If you want to keep the wings level as you disengage roll steering, be sure the heading bug is at the top of the DG or HSI.

Of course, if you disengage the autopilot completely, SAM's Roll Steering mode has no effect.

⚠ **Caution:** After you disengage roll steering, the aircraft will move in the direction of the heading bug as long as the autopilot remains engaged in Heading mode. Ensure that the heading bug is properly set before disengaging roll steering.

Roll Steering Operating Procedures

This section reviews various SAM roll steering procedures.

General Principles of Roll Steering

The Steering Assist Module integrates an aircraft's GPS system with the autopilot's heading error signal. When in Roll Steering mode, the roll steering converter receives ground speed and bank angle information from the GPS system and translates them into a specified turn rate. This information is then converted to a heading error signal that can be recognized by the autopilot. In this way, lateral steering by the autopilot can be governed by commands generated by the GPS system, eliminating the need for pilot adjustment of the course arrow or heading bug.

The display button allows you to switch between Heading mode (HDG) and Roll Steering (GPS) mode. When in Heading mode, the course arrow and heading bug operate normally, as if no coupling with the GPS system existed.

SAM provides course guidance based on your GPS flight plan, including the ability to anticipate sharp turns, holding patterns, and arcs. Some GPS systems do not support all of these capabilities; see your GPS pilot's guide for more information.

Pre-flight Procedures

Before embarking on a flight, follow these steps:

1. Power up the aircraft master and avionics systems.
   Note: Upon system power-up, SAM performs a self-test. The Ver x.x/Byyyy screen is displayed after successful completion.
2. Verify that the SAM system is in HDG mode.
3. Initialize the SAM system by entering or confirming a barometric pressure, a destination altitude, and a target altitude.

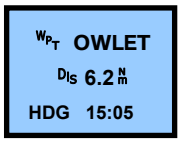
To engage Roll Steering:

1. Ensure that your GPS system is turned on and programmed with a valid flight plan.
2. Engage your autopilot, and ensure that it is in Heading mode.
3. Push the Display Button. SAM voices "GPSS Engaged". While roll steering is engaged, "GPSS" is displayed at the lower left hand corner of a green display.

4. Verify that the aircraft is tracking to the next waypoint on your flight plan.

⚠ Caution: If your GPS system is turned on and programmed with a valid flight plan, engaging Roll Steering mode will cause your aircraft to initiate up to a standard rate turn in the direction of the next waypoint.

To disengage SAM from Roll Steering mode, push the Display Button. SAM voices "GPSS Disengaged" When roll steering is disengaged, "HDG" is displayed at the lower left hand corner of a cyan display. Begin aircraft navigation using the heading bug. Or you can always engage your autopilot's NAV or Approach mode if that is appropriate when exiting GPSS mode.



⚠ Caution: After you disengage roll steering, the aircraft will move in the direction of the heading bug as long as the autopilot remains engaged in the Heading mode. Ensure that the heading bug is properly set before disengaging roll steering.

Holding Patterns and Procedure Turns

If your GPS system supports holding patterns or procedure turns, SAM conveys appropriate guidance information for those maneuvers to the autopilot. If your GPS system does not provide such support, and you want to fly a holding pattern or procedure turn, you must disengage SAM from Roll Steering mode and use the autopilot's Heading mode to maneuver the aircraft through the appropriate procedure. For instance, Garmin 430 and 530 GPS receivers will bring you into a hold, but require manual flying once established in a hold.

When you are reestablished on the approach, you can reengage SAM to conduct the rest of the approach using Roll Steering support.

Overlay Approaches

Some GPS systems can provide course information for non-GPS approach procedures (ILS, LOC, NDB, or VOR). This information is for monitoring purposes only, and does not absolve the pilot of the responsibility to use the appropriate navigational equipment for the approach procedure.

GPS Roll Steering Failure Procedures

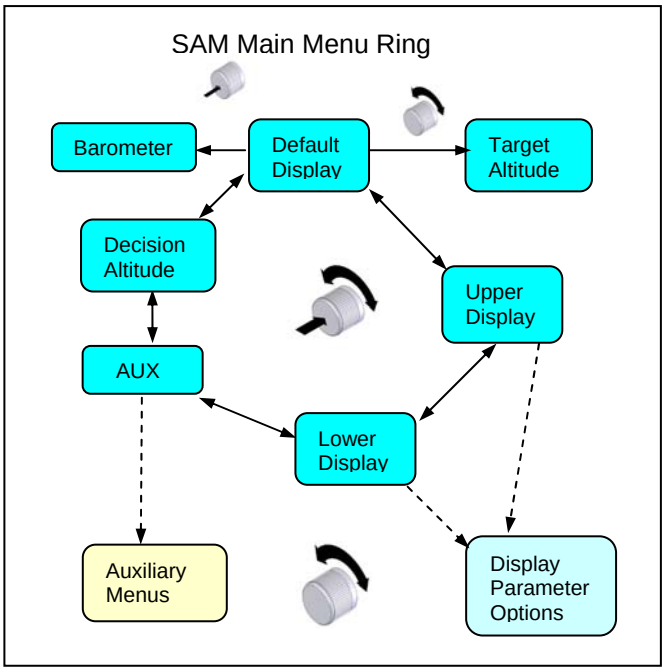
If SAM detects an error condition, or if it disengages because the roll signal is invalid, SAM will cause the aircraft to roll wings level and will not follow a GPS course. Roll Steering only guides the lateral axis of the autopilot, so the pitch of the aircraft is not affected.

If the problem is due to a large cross track error, low ground speed, or a loss of GPS signal, SAM displays a RDY mode. In such cases, once you correct the error, SAM reengages GPS roll steering.

If the problem is caused by a SAM system failure, SAM displays the FAIL mode. In such cases, do not continue to use the SAM system. If the system is still engaged, disengage SAM from Roll Steering mode. Verify that the autopilot Heading mode is still operational. If the Heading mode is malfunctioning, follow the procedures recommended by your autopilot manufacturer. Do not attempt to use the SAM system again until the problem has been diagnosed and corrected. See your installer for information about repairs.

SAM Main Menu System

The following figure depicts the SAM Main menu ring.



Main menu ring tasks are as follows:

- Changing the barometer setting and target altitude
- Accessing the menu rings that let you select information displayed in the Upper and Lower lines of the SAM display
- Accessing the menus that let you change the settings for display and alert message behavior, such as the loudness of aural annunciations
- Setting and arming, or disarming a Decision Altitude

Turn the knob to select a target or press the knob to change the barometer. You can access any other element in the Main menu ring by pushing in the knob while turning it either clockwise or counter-clockwise .

Setting a New Barometric Pressure

During your flight, you must set and maintain a barometric pressure, as this value is required for SAM to calculate valid altitude levels.

The following procedure sets a new barometric pressure in the SAM system (this and succeeding instructions assume that you are starting from the default display screen):

1. Use  to move to the Barometric Pressure screen.	
2. To enter a new barometric pressure value, use  to change numeric values, and  to move between tenths and hundredths columns. Once you have set the baro at power up, each time you push the knob to enter baro mode, you will automatically be at the hundredths position and should turn the knob as you would set your altimeter.	
3. Wait several seconds  and the screen transitions to the default two line GPS display.	

Setting a New Target Altitude

Use the following procedure to set a new target altitude:

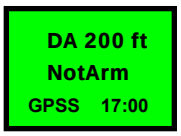
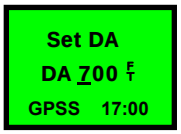
1. Use  and turn the Rotary Control Knob one increment to move to the Target Altitude screen.	
2. Enter a new target altitude value by using  to change numeric values, and  to move between columns. Each click will change the target by 1,000 feet unless you move to the hundreds or tens digit.	
3. Wait several seconds  to accept the new	

value. The screen transitions to the default two line GPS display.	

Setting and Arming a Decision Altitude (DA)

SAM's Main menu provides an option that lets you set and arm a DA or "Decision Altitude" (some pilots refer to this as the DH or "Decision Height"). The Decision Altitude must be at least 200 feet above the Destination Altitude. Target alerts are suspended while the Decision Altitude is armed, and resumed after the Decision Altitude alert.

To set and arm a decision altitude alert, follow these steps when intercepting the glide slope:

1. Use  at the Main menu ring and turn one increment counterclockwise to display the Decision Altitude option, then turn  one increment to display the Set DA screen	
2. Use  to change numeric values, and  to select and move between columns (if you have a high resolution altitude encoder, you can set the DA in 10 foot increments).	
3. Wait several seconds  to accept the value, with the Decision Altitude alert armed. An aural "D A Armed" annunciation is generated, and the default two line GPS display is resumed.	

To disarm an armed Decision Altitude, simply set in a new target altitude. Then wait several seconds, while SAM voices "D A Disarmed" and transitions to the default display.

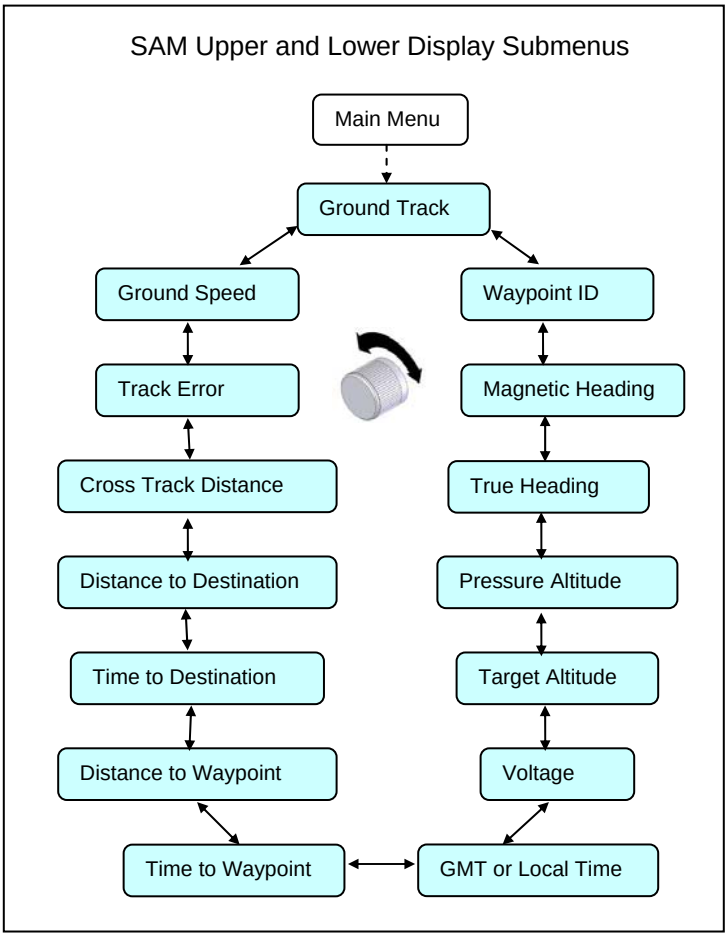
If you set a target altitude that is the missed approach climb altitude prior to arming a DA, that altitude will automatically become the new

target altitude when the DA alert happens. If you decide to cancel the approach and do the missed approach, your missed approach climb altitude will have been set already.

Upper/Lower Display Submenus

You use the Upper and Lower Display submenus to select and modify the parameters that are viewed in the Upper and Lower lines of the SAM display. The options in both menus are identical, allowing you to place any given parameter in either line. If you choose the same parameter for both, it will only be displayed in the Upper line.

The following figure depicts the items available in the Upper and Lower Display submenu rings.



Upper/Lower Display Knob Actions

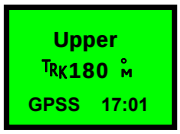
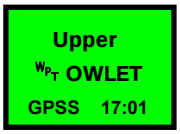
Use the following knob actions to change the SAM Upper/Lower display:

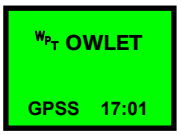
- From the Main menu, use  to navigate to either the Upper or Lower screen. Then use  to go through the options.
- When you stop on the desired parameter, it will appear in the appropriate display location after a short delay  . The parameter can be displayed for the duration of the current flight, or until you replace it with another parameter.
- Pushing the control knob prior to the timeout  stores the parameter as the Upper or Lower default display for current and future flights as well. This display will appear after you enter BARO, DEST and Target on your next flight.

Note: When you enter the Upper or Lower selection page, each CW or CCW click of the knob will begin changing the displayed parameter beginning with the parameter adjacent to the currently selected parameter in the "loop". For example, if the Upper display is set to Time to Destination, a CCW click will display Distance to waypoint and a CW click will display Distance to Destination.

Setting the Upper Display to Waypoint ID

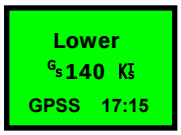
As an example, you can use the following procedure to change the Upper display so that it displays the current waypoint ID.

1. Use  to navigate to the Upper screen. The previously selected parameter is displayed.	
2. Use  to navigate and select the Waypoint ID screen.	

3. Wait several seconds ⧗ to return to the default display, which now displays the current waypoint ID in the Upper line.	

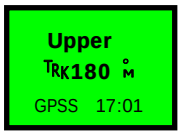
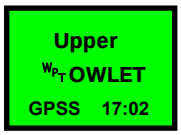
Setting the Lower Display to Ground Speed

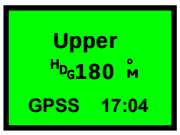
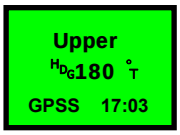
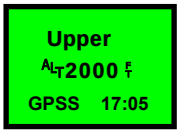
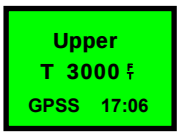
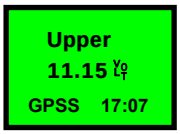
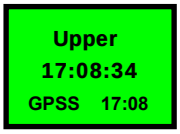
You can use the following procedure to set the Lower display to Ground Speed.

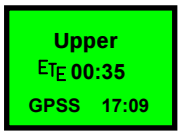
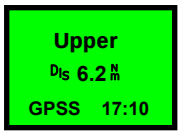
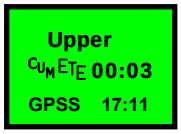
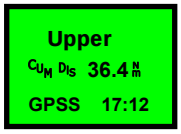
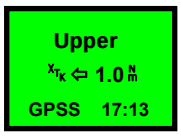
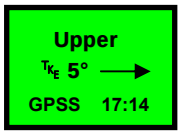
1. Use to navigate to the Lower screen. The previously selected parameter is displayed.	
2. Use to navigate and select the Ground Speed screen.	
3. Wait several seconds to return to the default display, which now displays the ground speed (in knots) in the Lower line.	

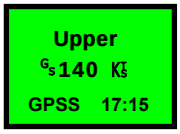
Upper/Lower Display Submenu Options

The following table describes each Upper/Lower Display submenu option, in clockwise ring order.

Upper/Lower Display Submenu Options	
Ground Track Indicates the GPS ground track (in degrees). *	
Waypoint ID Indicates the current Waypoint ID. Without a GPS flight plan, ". . ." is displayed. *	

Upper/Lower Display Submenu Options	
Magnetic Heading Indicates the current magnetic heading in degrees. This parameter is available only if your GPS has a connection to your HSI via an airdata computer.	
True Heading Indicates the current true heading in degrees.*	
Pressure Altitude Indicates the current pressure altitude, as reported to ATC, corrected for the current barometer setting. This display can be used as an emergency altimeter, limited by the accuracy and resolution of your encoder.	
Target Altitude Indicates the currently set Target Altitude.	
Voltage Indicates the current avionics bus voltage. This value is refreshed every two seconds.	
GMT or Local Time Indicates the current GMT or local time in hours, minutes, and seconds. See Time Zone in the Settings section for information about selecting a time zone.*	

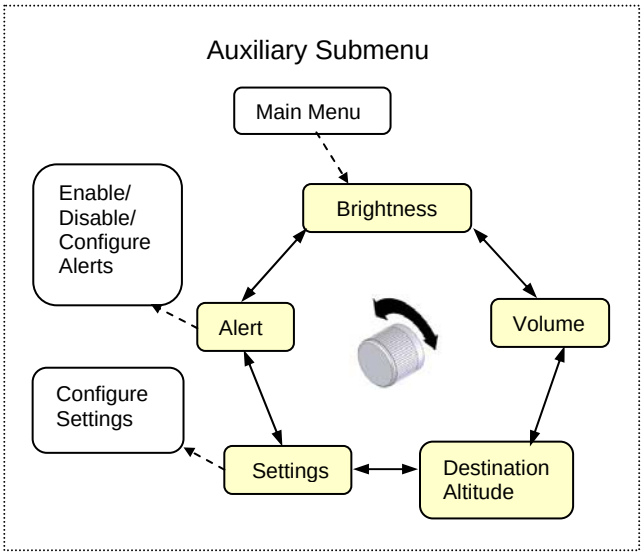
Upper/Lower Display Submenu Options	
Time to Waypoint Indicates the time to the next waypoint in hours, minutes, and seconds (hours are omitted when zero).*	
Distance to Waypoint Indicates the distance to the next waypoint in nautical miles.*	
Time to Destination Indicates the time to destination in hours and minutes. The destination is the final waypoint in your flight plan.*	
Distance to Destination Indicates the distance to destination in nautical miles.*	
Cross Track Distance Indicates the cross track distance. This is the distance to the left or right of your desired course line. *	
Track Error Indicates the track error in degrees. The arrow indicates the direction to turn so that your actual track is the same as your desired track. If Track Error is zero, you are flying the desired track, but you could be flying parallel to the desired course. The arrow has tick marks at 2° intervals and indicates a maximum of 10° of track error. It is not displayed for track errors over 99°. *	

Ground Speed Indicates the current ground speed in knots.*	

* This parameter is displayed if your GPS system provides support for it.

Auxiliary Submenu

The following diagram shows the Auxiliary (AUX) submenu. To minimize pilot workload, the selection of the Alert and Settings options of the auxiliary submenu are presented only during preflight and postflight conditions.

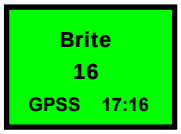
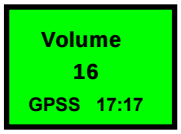
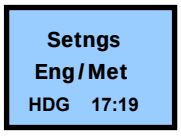


To access the Auxiliary (AUX) submenu ring, use the following procedure:

1. Push and turn at the Main menu ring until you reach the AUX screen.
2. Use to cycle through the options.
3. At the desired option, wait several seconds or push the Rotary Control Knob to view the screen for that option.

Auxiliary Submenu Options

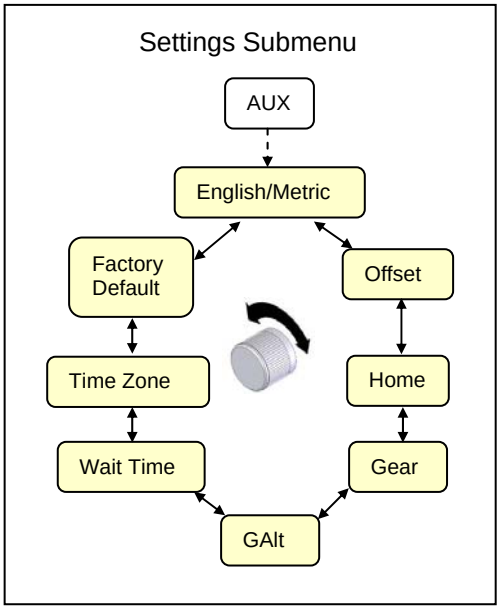
The following table describes each Auxiliary submenu option. Parameter values shown are the factory defaults:

Auxiliary Submenu Options	
Brightness Indicates the screen brightness, in increments between 1 and 32. Brightness has minimal effect when SAM is connected to your aircraft's dimmer circuit.	
Volume Indicates the volume level (from 1-32) for SAM's auditory annunciations. The value is voiced to help select the appropriate level.	
Destination Altitude Indicates the currently set Destination Altitude. If the Destination Altitude is changed, the gear alert is armed and the Decision Altitude alert is disarmed. The minimum DA altitude is now recalculated, since it must be at or above DEST plus 200'.	
Settings Allows you to move to the Settings submenu (the first option is English/Metric). Turn to move through the other options. This screen is only available for selection during preflight and postflight conditions.	
Alert Allows you to move to the Alert submenu (the first option is Repeat). Turn to move	

Auxiliary Submenu Options	
through the other options. This screen is only available for selection during preflight and postflight conditions.	

Settings Submenu

The following diagram shows the Settings submenu. These screens are only available for selection during preflight and postflight conditions.



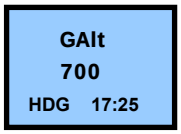
Use these procedures to access the Settings submenu ring:

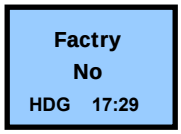
1. Push and turn at the Main menu ring until you reach the AUX screen.
2. Use to cycle through the AUX options until you reach the Setngs option.
3. Wait several seconds or push the Rotary Control Knob to cause the Setngs:Eng/Met screen to appear.
4. Use to cycle through the options in the Settings submenu. Once you choose an option, wait several seconds or push the Rotary Control Knob to view the screen for that option.

Settings Submenu Options

The following table describes each Settings submenu option. Parameter values shown are the factory defaults:

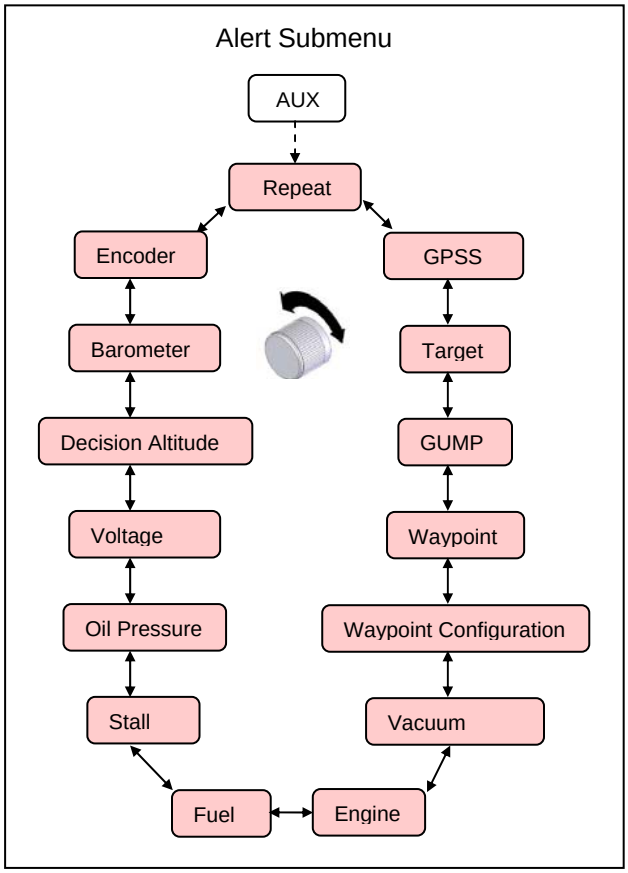
Settings Submenu Options	
English/Metric Indicates whether English or Metric values are displayed for barometric pressure. To change the current setting, wait several seconds at AUX:Eng/Met, then turn the knob. After a few seconds, the "Baro P" screen appears so that the value in the new units can be confirmed.	
Offset The number of feet above or below target altitude that the pressure altitude must be to trigger a target alert. This parameter can vary between 100' and 1000'. A value of 200' works fine for most piston aircraft, while faster-climbing aircraft should use higher values.	
Home Indicates the default altitude for an aircraft's home airport. Turn the knob to enter the altitude in increments of 10 or 100 feet, depending on encoder resolution. To save time on power-up, this altitude becomes the default Destination Altitude.	

Settings Submenu Options	
Gear Indicates the type of Gear alert issued by SAM. Choices are Off, Gear, and GUMP. Turn the knob to move between the possible choices.	
Gear Altitude Indicates the number of feet above the Destination Altitude at which the gear alert is issued. GAlt can range between 500' and 1000'. For the Gear alert to be armed, the pressure altitude must exceed the Destination Altitude + 100 feet + GAlt at some point during your flight. A low flight around the pattern may not arm the Gear alert, so always follow your checklist for verifying that your gear is down.	
Wait Time For displays with a timeout, indicates the number of seconds SAM waits before advancing to the next screen. While ticking, the wait time is shown as a shrinking bar on the left edge of the display. The range for this parameter is two to eight seconds.	
Time Zone Indicates the time zone used in the Upper/Lower display (for GMT, use 0). Turn to change the value. The time displayed on the lower right is always GMT.	

Settings Submenu Options	
Factory Defaults Allows the setting of all pilot-selectable parameters back to factory default settings. Turn to PshKnb, then push to set factory defaults. When you perform this procedure, SAM reinitializes and then displays the Barometer entry screen.	

Alert Submenu

The following diagram depicts the Alert submenu. These screens are only available for selection during preflight and postflight conditions. Certain screens are displayed only when connected to the appropriate aircraft sub-systems (Gear, Vacuum, Engine, Fuel, Stall, and Oil Pressure).



To access the Alert submenu ring, follow these procedures:

1. Push and turn at the Main menu ring until you reach the AUX screen.
2. Use to cycle through the AUX options until you reach the Alert option.
3. Wait several seconds or push the Rotary Control Knob to display the Alert:Repeat screen.
4. Use to cycle through the other Alert options. Once you choose an option, wait several seconds or push the Rotary Control Knob to view the screen for that option.

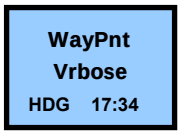
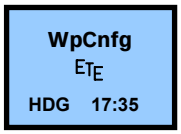
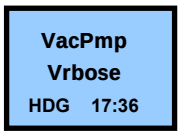
Many of the Alert screens allow you to customize alert annunciation, with the following choices:

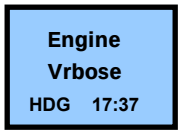
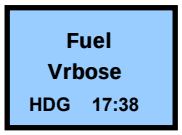
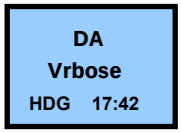
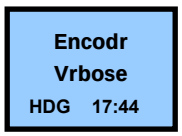
- Off - Ignore the conditions for this alert or alert category
- DsPlay - Display the alert, without aural annunciations
- Tone - Display the alert, and sound a tone
- Vrbose - Display the alert, and use a Verbose vocalization (default)
- Terse1 - Display the alert, and use a terse vocalization
- Terse2 - Display the alert, and use a terse vocalization (repeated once) (default for the Stall alert)

Alert Submenu Options

The following table describes each Alert submenu option. Parameter values shown are the factory defaults:

Alert Submenu Options	
Repeat Indicates the number of seconds in which to repeat a recurring Alert. The value can range between 15 and 60 seconds. Turn to change the value.	

Alert Submenu Options	
Roll Steering Indicates the alert mode for Roll Steering alerts and GPSS engaged/disengaged aural annunciations. Off is not an option. Turn to change the value.	
Target Indicates the alert mode for Target alerts (Approaching and Check Target). Turn to change the value.	
GUMP Indicates the alert mode for GUMP and Gear alerts. Turn to change the value.	
Waypoint Alert Indicates the alert mode for Waypoint alerts. An additional option (Phnetc) can be selected to spell waypoints phonetically. Turn to change the value.	
Waypoint Configuration Indicates the information presented in a Next Waypoint verbal annunciation (used for waypoint alerts and voicing repeats). Options are Distance (DIS), Time (ETE), and Desired Track (DTK). Turn to select the appropriate combination.	
Vacuum Pump Indicates the alert mode for Vacuum Pump alerts. Turn to change the value. If two pumps are installed, the alerts will specify right/left or front/rear.	

Alert Submenu Options	
Engine Indicates the alert mode for Engine alerts. Turn to change the value.	
Fuel Indicates the alert mode for Fuel alerts. Turn to change the value.	
Stall Indicates the alert mode for Stall alerts. Turn to change the value.	
Oil Pressure Indicates the alert mode for Oil Pressure alerts. Turn to change the value.	
Voltage Indicates the alert mode for High and Low Voltage alerts. Turn to change the value.	
Decision Altitude Indicates the alert mode for Decision Altitude alerts. Turn to change the value.	
Barometer Indicates the alert mode for Barometer alerts when transitioning 18,000 feet. Turn to change the value.	
Encoder Indicates the alert mode for Altitude Encoder operational/non-operational alerts. Turn to change the value.	

SAM Alert Messages

SAM's alert mechanism processes real-time data received from the GPS unit and other aircraft systems.

- Alert messages are generated when relevant data nears defined threshold values.
- You can enable and disable specific alerts through the SAM menu system.
- When alerts occur, they are propagated to the display, preempting the current contents.
- Alerts may display in white, amber or red depending on their degree of immediacy. Red alerts are further enhanced with pixel inversion of the display approximately every ½ second.

SAM provides alert message options in the following categories:

- Roll Steering alerts
- Altitude-oriented alerts, generated when you approach or deviate from a specified altitude (includes Decision Altitude when set and armed)
- Waypoint passage and up-to-the-moment information regarding the next waypoint, such as bearing, distance, and time
- Gear checks and system warnings

In most cases, after an alert message is issued, the default display information reappears after several seconds. However, a Roll Steering Disconnected alert requires pilot acknowledgement before the default display is resumed. An acknowledgement is performed by simply pressing the knob.

Aircraft system alerts that might otherwise become annoying as they repeat, present a display that allows you to turn them off for the remainder of the flight. You can do this by turning the Rotary Control Knob  , then selecting and confirming the Off option  after the More screen is displayed. The More option will cause SAM to

continue to monitor the source of the alert and generate additional alerts if the condition reappears.

Caution: SAM is considered a secondary system that relies on a certified primary system for information. The pilot should refer to the primary system for verification of SAM-provided data.

Roll Steering Alert

The Roll steering alert is generated when SAM is disconnected due to system failure.

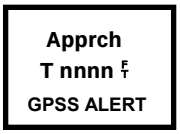
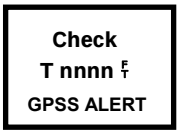
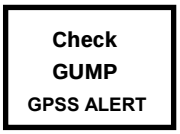
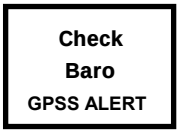
Roll Steering Alerts		
Audio Alert	**Description**	**Display**
"GPSS Disconnected"	SAM's GPS Roll Steering capability is disconnected.	

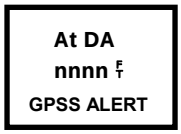
Altitude-Oriented Alerts

For proper operation of altitude-oriented alert messages, you must set and maintain the following values:

- Barometric pressure.
- Destination altitude.
- Desired in-flight target altitude.
- Decision altitude (used when flying a glide slope or LNAV/VNAV GPS approach).

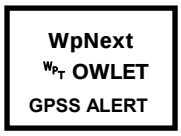
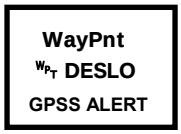
At some point in every flight there comes a time when target altitude alerts are neither required nor desired. A complete clockwise turn of the Rotary Control Knob will set the target altitude well above your present altitude, canceling any further target altitude alerts as you progress to a landing.

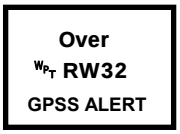
Altitude-Oriented Alerts		
Audio Alert	**Description**	**Display**
"Approaching xxxx feet"	Aircraft is within offset distance of the Target altitude.	
"Check target altitude xxxx feet"	Aircraft has descended 200′ below or ascended 200′ above the Target altitude. This alert repeats every 10 seconds unless the pilot corrects the aircraft altitude or resets the target altitude. This alert will also occur if you do not reach your target within 30 seconds of the "Approaching" alert.	
"Check gear"	Current altitude has reached, or is less than, the Destination Altitude plus 100′ plus the currently set Gear Altitude. If an up-gear condition causing this alert is not resolved, and if the alert is not acknowledged by the pilot, it will recur at 20 second intervals.	
"Check GUMP"	Current altitude has reached the Destination Altitude + 100′ + the currently set Gear Altitude. This alert occurs if the Gear parameter in the Settngs:Gear sub-menu is set to GUMP.	
"Check Barometer Setting"	Aircraft is approaching the 18,000′ transition altitude.	

Altitude-Oriented Alerts		
Audio Alert	**Description**	**Display**
"At Decision Altitude"	The current altitude is at or above the Decision Altitude plus 100'. This alert occurs if the pilot has set and armed a Decision Altitude. After the alert occurs, the Decision Altitude must be re-set and re-armed for the next use. When armed, this alert occurs only once.	

Waypoint Alerts

The GPS must be turned on and configured with a valid flight plan to enable waypoint passage information.

Waypoint Alerts		
Audio Alert	**Description**	**Display**
"Waypoint OWLET in one minute"	Aircraft is one minute away from reaching the next Waypoint. To avoid voicing clutter, this alert is only applicable for waypoints that were initially at least 2 minutes away.	
"At Waypoint OWLET. Next Waypoint DESLO in xx minutes" Optional additional information includes "in xxxx nautical miles" and 'heading xxx degrees"	Aircraft has passed Waypoint OWLET and is now moving toward the next Waypoint at DESLO.	

Waypoint Alerts		
Audio Alert	**Description**	**Display**
"Over Waypoint RW32"	Aircraft has reached the final waypoint in the currently selected flight plan.	

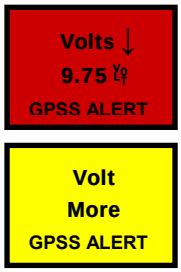
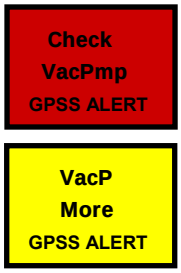
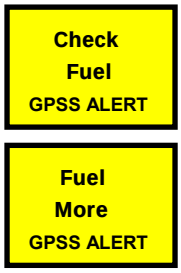
Aircraft System Alerts

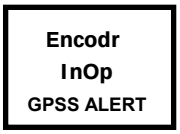
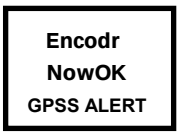
With the exception of the bus voltage alert, all of the other system alerts require that specific devices in the aircraft must be connected to SAM's computer module.

Some examples of system alert dependencies are as follows:

- The engine and fuel alerts are triggered by instruments such as a JPI EDM 700/800.
- The vacuum, alert(s) require that your aircraft be equipped with a low vacuum switch such as those supplied by Precise Flight.
- The oil pressure alert requires wiring to a Hobbs meter or oil pressure switch.
- The stall alert requires that that your aircraft's electric stall warning be wired to SAM.
- The"Gear Down" alert requires that your gear down lights are wired to SAM. The "Check Gear" alert will occur without this wiring.
- The "Gear, Gear" alert will occur only if the throttle switch is wired to SAM. This alert will be heard along with your gear horn.

It should also be noted that some of SAM's aircraft system alerts are repeatedly generated at regular intervals unless turned off by the pilot. In such cases, you can turn off future alerts at the More screen following the alert by turning the Rotary Control Knob to select Off.

Aircraft System Alerts		
Audio Alert	**Description**	**Display**
"Bus voltage high" "Bus voltage low"	The voltage level is lower than or exceeds recommended levels. Suggested voltage levels are 24 to 34 volts for a 24-volt system and 12 to 15.5 volts for a 12-volt system. If the condition causing this alert is not resolved, and if the alert is not turned off by the pilot, it will recur at three minute intervals.	
"Check Vacuum Pump"	The vacuum pump is not functioning properly. The specific pump is identified for installations with two vacuum systems. If the condition causing this alert is not resolved, and if the alert is not turned off by the pilot, it will recur at three minute intervals.	
"Check fuel"	The fuel level is low. If the condition causing this alert is not resolved, and if the alert is not turned off by the pilot, it will recur at three minute intervals.	

Aircraft System Alerts		
Audio Alert	**Description**	**Display**
"Altitude encoder inoperative"	The altitude encoder is not functioning.	
"Altitude encoder operating"	The altitude encoder has become operational.	
"Check oil pressure"	The oil pressure is low. If the condition causing this alert is not resolved, and if the alert is not turned off by the pilot, it will recur at three minute intervals.	 
"Check engine"	The engine is not functioning properly. If the condition causing this alert is not resolved, and if the alert is not turned off by the pilot, it will recur at three minute intervals.	 
"Stall, stall"	The stall warning indicator is detecting a stall condition. If the condition causing this alert is not resolved, and if the alert is not turned off by the pilot, it will recur at frequent intervals.	 

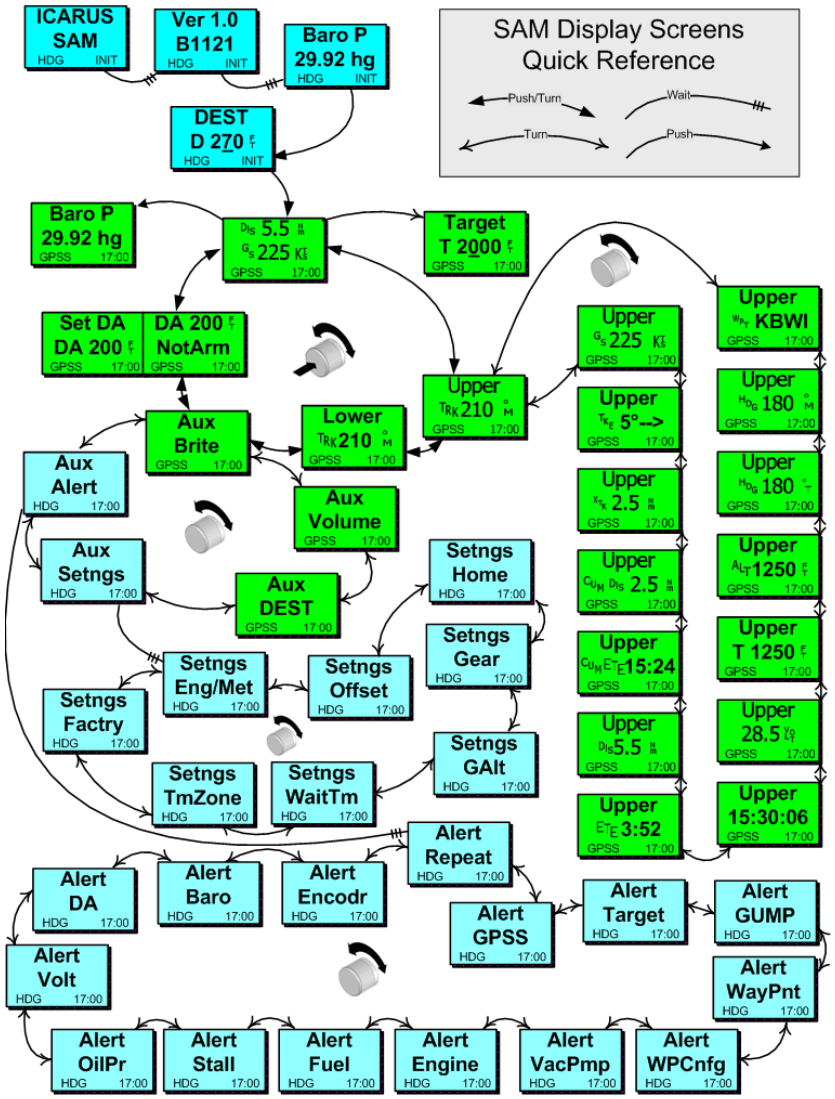
Aircraft System Alerts		
Audio Alert	**Description**	**Display**
"Check Gear Down"	The aircraft landing gear warning system is indicating a warning to check the gear position. If installed, this alert occurs only if the gear lights are in an up configuration. This alert is not pilot-configurable.	

SAM Specifications

The following table shows specifications for the SAM components.

SAM Specifications			
Product Options	SAM I SAM II	Full functionality Full functionality minus roll steering support	
Power	14/28 VDC	250 MA Typical 500 MA Maximum	
Weight	SAM I Computer SAM II Computer	0.9 lb 0.9 lb	PN 0025-5001 PN 0025-5002
	SAM Display Unit	0.2 lb	PN 0025-5003
	SAM Rotary Switch	N/A	PN 0025-5004
	SAM Audio Switch	N/A	PN 0025-5005
Dimensions	SAM Computer	7.86"Lx4.43"Wx1.22"H	
	SAM Display	1.94"Lx1.43"Wx1.51"H	
Operating Temperature Range		From -20° c to 55° c	
GPS Requirements for Roll Steering		The GPS system must have an ARINC 429 output	
Altitude Input		ICARUS or Apollo Serial Format, 10 or 100 Ft resolution	
5-28VDC Digital Inputs	Oil Pressure Switch Low Vacuum Light Engine Warn Switch Landing Gear Warn System	Gear Light(s) Fuel Warn Switch Stall Switch	
Mounting Options	Integrated 2¼" round mount Integrated ½" ATI mount 1" Square mount	PN 0025-2008 PN 0025-2007 PN 0025-2006	

Appendix A: SAM Display Modes



Appendix B: SAM Roll Steering States

The lower left-hand corner of the SAM display may indicate any of the following GPS roll steering states, which reflect the current system disposition.

GPS Roll Steering State	Description
HDG	The aircraft heading bug is connected to the autopilot.
RDY1*†	GPSS state selected; system initializing roll steering
RDY2*†	GPSS state selected; system not receiving bank information from the GPS.
RDY3*†	GPSS state selected; ground speed is below 25 knots.
RDY4*†	GPSS state selected; aircraft has deviated too far from desired track(for instance, at 120 knots this threshold is 1.5 nm, and at 213 knots this threshold is 2.5 nm). A 2 ½ minute grace period timer allows the aircraft to close any track distance error after engaging GPSS.
GPSS†	GPSS state selected; GPS roll steering is operational
FAIL	Roll steering not available due to system failure
	SAM II, without GPS Roll Steering support

* Normally, the roll steering RDY states are so brief that the display transitions directly from HDG to GPSS mode.

† The display background color is green to indicate GPSS has been selected and/or engaged.

Appendix C: SAM Alert Phrases

The following table lists SAM alert phrases for each alert category (defaults are bolded).

Alert Type	Verbose	Terse1 (Terse2 repeats)
GPS Roll Steering	**G P S S Engaged** **G P S S Disengaged** **G P S S Disconnected**	SAM Engaged SAM Disengaged SAM Disconnected
Voltage	**Check Bus Voltage Low** **Check Bus Voltage High**	Voltage Low Voltage High
Vacuum	**Check Vacuum Pump (Left)** **Check Vacuum Pump (One)**	Vacuum (Left) Vacuum (One)
Engine	**Check Engine**	Engine
Stall	Stall Warning	**Stall Stall** (Terse2)
Oil Pressure	**Check Oil Pressure**	Oil
Fuel	**Check Fuel**	Fuel
Gear/GUMP	**Check Gear** (acknowledgement required)	Gear/GUMP
Gear (with wiring to lights, and gear down)	**Gear Down** (no acknowledgement required)	Gear Down (no acknowledgement required)
Landing Gear Warning System	**Check Gear Down**	Check Gear Down
DA	**At Decision Altitude** **Decision Altitude Armed** **Decision Altitude Disarmed**	At DA DA Armed DA Disarmed
Barometer	**Check Barometer Setting**	Barometer (display enters BARO edit screen)
Target	**Approaching *xxxx* feet** **Check target altitude *xxxx* feet**	Approaching Target Deviating from Target
Encoder	**Altitude Encoder Off** **Altitude Encoder Operating**	Altitude Encoder Off Altitude Encoder On
Waypoint, One Minute (Not voiced if waypoints are very close	**Waypoint *xyz* One Minute**	Waypoint One Minute

Alert Type	Verbose	Terse1 (Terse2 repeats)
together)		
Waypoint, Next	**At Waypoint *xyz1*, Next Waypoint *xyz2*, <config waypoint data>** (default voices waypoint time)	At Waypoint, Next Waypoint <waypoint data as configured>