![AeroVonics logo]

AV-20 / AV-20-S

Multi-Function Display

Part Number U-1001-0 / U-1002-0

Pilot's Guide

(D-0014-0, AV-20, PILOTS GUIDE, REV B)

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Document Revisions

Revision	Date	Description of Change	Author	PDF Sig
A	9/20/2017	Initial Release	JDB	
B	10/03/2018	Updated for initial NORSEE certification, latest UI for Software Release 1.0. Updates from FAA Review.	JDB	

Table of Contents

1. System Description

The AeroVonics AV-20 and AV-20-S Multi-Function Display provides a wide array of supplemental flight information.

Features Include:

- AoA Display (Voice Alerting & Peaks)
- G-Meter Display (Voice Alerting & Peaks)
- Attitude (Roll / Pitch)
- Slip / Skid
- Clock (GMT / Local)
- Outside Air Temperature (C / F)
- Bus Voltage Display
- Dual User Timers (Count Up / Down)
- Engine Run Timer
- Flight Timer
- Density Altitude Display
- True Airspeed Display (Kts / Mph)
- Internal Battery Operation

The unit incorporates a full color sunlight readable display, bezel-mounted light sensor for automatic display brightness, and an internal battery for operation in the event of power loss. The AV-20-S connects to the pitot and static systems of the aircraft, while the AV-20 model does not.

Figure 1 - AV-20 and AV-20-S

2. Unit Functionality

2.1. Angle of Attack

Angle of Attack is derived from pitot and static pressure measurements combined with internal inertial reference measurements. No dedicated external probes or other aircraft modifications are required for AoA functionality.

AoA is computed based on the difference between aircraft pitch angle, and the aircrafts path angle through the air, and current G loading.

An upper "near-stall" calibration point is set by the pilot and represents the desired alerting / maximum scale point. A lower calibration point represents the nominal "cruise" AoA and is used to set the lower boundary of the AoA scale. The amount of pre-warning for an AoA alert prior to the certified aircraft stall point is based on pilot preference.

Both visual and aural alerting is provided when the AoA is approaching or exceeds the upper calibration point. AoA and associated alerting is only available on the AV-20-S model. AoA information is not for primary aircraft control and is provided for supplemental situational awareness only.

2.2. G Meter

G Load is determined via the internal inertial sensors and will measure up to 8G in either direction. Independent positive and negative G limits are configurable, with both visual and aural alerting being provided. Peak negative and positive G Loads are also measured for display.

The range of the color-coded G scale is automatically scaled based on the pilot configured limits such that the maximum indication (positive or negative) represents the maximum value configured. G-Meter and associated alerting is available only on the AV-20-S model. G Load information is not for primary aircraft control and is provided for supplemental situational awareness only.

2.3. Attitude & Slip/Skid

Attitude (Roll & Pitch) and slip/skid is determined from the internal inertial sensors. AoA and slip/skid can be overlaid on the attitude indicator page. A pitch-zero feature allows the current pitch angle to be trimmed to zero, allowing synchronization with other on-board instrumentation.

Attitude accuracy is better than 1° under stable conditions and better than 2.5° under dynamic flight conditions. Airspeed is utilized to help stabilize pitch during takeoff, landing and extended accelerations. Attitude is only available on the AV-20-S model. Attitude information is not for primary aircraft control and is provided for supplemental situational awareness only.

2.4. Clock/Run Time

Clock functions include display of time in local and GMT time zones and can be set by the pilot. A local offset value determines the difference between the GMT and local time zone. The clock is internally backed up via an internal battery which automatically recharges during flight. The clock function is available in both the AV-20 and the AV-20-S models.

2.5. Outside Air Temperature

OAT is measured by an external temperature probe and is displayable in either Celsius or Fahrenheit. OAT is available in both the AV-20 and the AV-20-S models.

OAT data is also utilized in the computation of TAS and Density Altitude and must be connected for those data parameters to be displayed, however, as these parameters also require pressure measurements, they are only available on the AV-20-S model. A compatible OAT probe must be installed for OAT related features to be enabled.

2.6. Bus Voltage

Bus voltage is measured directly from the powered supply lines and displayed on the clock combo page. Bus voltage is available in both the AV-20 and the AV-20-S models.

2.7. Dual User Timers

Dual independent timers are available for general purpose usage. Each timer can be configured as a count-up or count-down timer, with both a visual and aural alert when the count-down goes to zero. Resolution of the timers is 1 second. User timers are available in both the AV-20 and the AV-20-S models.

2.8. Engine Run Timer

The engine run timer initiates counting based on bus voltage increasing above the no-load battery voltage (alternator running), and special switching logic accommodates both 12V and 24V aircraft. The timer can be reset by the pilot.

The engine run timer is not maintained between power-cycles, and does not represent a HOBBS type function. The engine run timer is available in both the AV-20 and the AV-20-S models.

2.9. Flight Timer

The flight timer initiates counting based on airspeed above 40 kts and can be reset by the pilot. The timer will stop counting when the speed is below the threshold.

The flight timer is not maintained between power-cycles. The flight timer is only available on the AV-20-S model, as airspeed switching is not available on the AV-20.

2.10. User Setup

The pilot accessible setup menu can be used to easily configure an array of instrument parameters. All parameters are configurable by the pilot, with certain functions being inhibited during flight.

Options include display color choice, page enable/disable, audio alerts enable/disable, audio volume, OAT trim, temperature units, time units, airspeed units, alert popup behavior, AoA thresholds and G alert limits.

2.11. Battery Operation

The unit incorporates a small Li-Po battery that can operate the unit for approximately 30 minutes under normal ambient temperatures. If external power is lost and airspeed is above 40 kts, the unit will automatically transition to internal power with no pilot action required. When airspeed drops below 40 kts, a normal shutdown will occur. This feature is only available on the AV-20-S model.

This battery is also utilized to maintain the clock time. Therefore, if battery operation continues to the point of battery depletion, the clock may need to be reset on the next power-up.

Note that the AV-20 also incorporates the identical battery but is not utilized for operation when external power is lost, only for clock keep-alive functionality.

The battery is automatically recharged during normal operation.

2.12. Model Functionality

The AV-20 is available in two configurations:

- The AV-20 model, which <u>does not</u> include internal inertial sensors or pitot-static sensors. Functions are limited to those indicated below.

- The AV-20-S model, which includes the AV-20 base model functions, plus the features gained from the full sensor set. Full functionality is available in this configuration.

Feature / Model	AV-20	AV-20-S
Clock	✓	✓
OAT	✓	✓
Bus Voltage	✓	✓
Dual User Timers	✓	✓
Engine Run Timer	✓	✓
Flight Timer	✘	✓
AoA	✘	✓
Attitude	✘	✓
Density Alt	✘	✓
True Airspeed	✘	✓
Slip / Skid	✘	✓
G-Meter	✘	✓
Battery Operation	✘	✓
Audio Alerts		
Timer Alert	✓	✓
AoA Alert	✘	✓
G Limit Alert	✘	✓

Table 1 - Functional Dependencies

👉 The unit model and associated part number is shown on the splash screen on power-up.

3. Operating Limits

⚠️ *The AV-20 and AV-20-S are supplemental systems and may not be used as a substitute for any system on a certified aircraft. No operational credit may be taken for installation of this equipment.*

The following operational limitations are applicable:

Operating Limits	
Angle of Attack Range	0° to +30°
Angle of Attack Resolution	1°
Angle of Attack Operation	+35 to +300 Knots Indicated
Angle of Attack Accuracy	2.5°
Density Alt Range (Accuracy)	-1,000 to +25,000 Feet (± 500ft)
TAS Range (Accuracy)	+35 to +300 Knots (± 20 kts) True
Attitude Angle	No Limits
Attitude Rate Limit	±250 Degrees / Second
Attitude Accuracy	1° Static, 2.5° Dynamic
G Alert Limits	± 8 g
OAT Range	-40°C to + 70°C
OAT Accuracy	±4°C
Slip / Skid Range (Accuracy)	±7° (±2°)
Bus Voltage Range	7 to 35 Volts
Bus Voltage Accuracy	±1.0 Volt
Clock Accuracy	± 1 Second/Day
Timer Accuracy	± 1 Second/Hour

Table 2 - Operating Limits

👉 *Refer to the AV-20 Installation Manual for Instructions for Continued Maintenance & Operation.*

4. Power-On Stabilization

The AV-20-S model incorporates precision air data and inertial sensors that are temperature-sensitive. These sensors are thermally stabilized by an internal heater. During power-on, the heater warms the sensors to the operating temperature; thus, they require a few moments to stabilize.

During this power-on stabilization period, AoA, Attitude and Air Data-related parameters are not available. These values will be flagged on each page, as described in the User Interface section of this document.

Typical stabilization time is between 30 seconds and 1 minute, depending on the ambient starting temperature of the unit. If the unit takes longer than 60 seconds to perform the power-on stabilization, a hard calibration should be performed (See section 6.6.10).

5. User Interface Overview

5.1. User Interface Controls

Controls for the AV-20 consist of three bezel-mounted momentary-push buttons. The functionality of the buttons changes based on the current mode. User interface components are as follows:
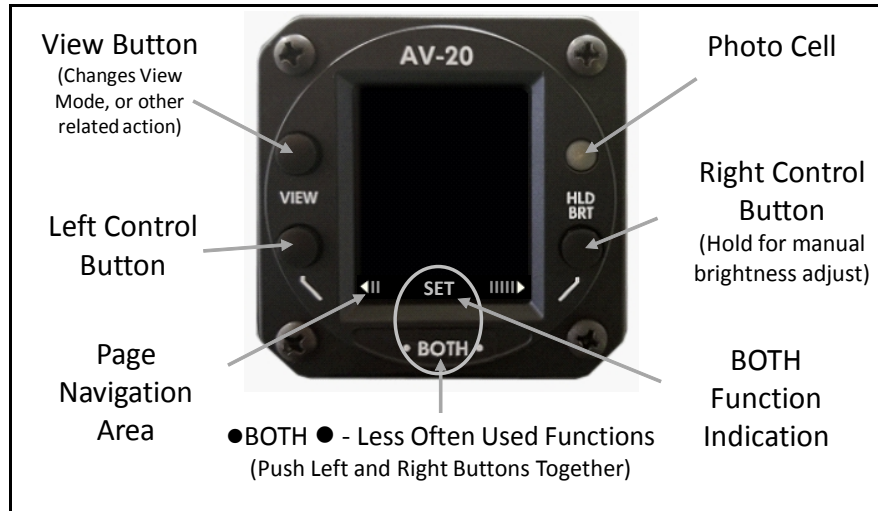
5.2. Page Navigation

The Left and Right Control Buttons navigate through the different pages. The position of the displayed page is shown graphically at the bottom of the page as a set of bars on the left and right sides. The following graphic indicates that there are two pages to the "left" and five pages to the "right".

5.3. View Button

The VIEW button selects different viewing options for the current page, or performs another function relative to the page selected.

5.4. Left & Right Push

Momentarily pushing both the LEFT and RIGHT control buttons together performs various tasks that are rarely used, such as setting values. If this option is available for a given display, the function name will be displayed centered above the ⬤BOTH⬤ text on the bezel.

EXAMPLE: The following image shows that a SET function can be performed by pressing both control buttons:

If no text appears in this area, no action is assigned to the ⬤BOTH⬤ command for this page.

5.5. Splash Screen

The system splash screen is displayed on power-up. The unit model (AV-20 or AV-20-S) is shown, along with the software version number. The unit also displays the splash screen momentarily on power-down.

5.6. Screen Brightness

Pressing and holding the lower right button will display the screen brightness page. By default, the screen is set to auto brightness mode and will utilize the light detected by the photocell to set the screen brightness.

Pressing either the up or down arrows will transition the unit to manual mode.

When in manual mode, pressing the up or down arrows will adjust the screen brightness. Pressing the right button will accept the value. Pressing ●BOTH● will revert to auto mode.

6. Main Pages

6.1. Clock Combo Page

The Clock Combo Page displays multiple items of information as shown below. The VIEW button sequences through available data in the upper field. Note that the screen layout and available data will vary based on model and connected sensors.

Density altitude, true airspeed and AoA are not available during power-on stabilization. Temperature units can be configured to C or F in the setup pages.

CLOCK COMBO PAGE

VIEW Toggles upper field contents:
- **Local Time**
- **GMT Time**
- **Density Altitude***
- **True Airspeed***

* -S Model, with OAT probe connected

Angle Of Attack

BOTH Sets Time (When Local or GMT is displayed)

●BOTH● enters the clock set function when either the local time or GMT time is being displayed in the upper field. The set mode allows the current GMT time to be set, along with a local time offset. If time has been lost due to failure of the internal keep-alive battery, the time will flash.

CLOCK SET MODE

Left upper and lower button increment or decrement the current field (Hours, Minutes, Seconds, Local offset)

Holding either will clear field to zero

Currently highlighted field will flash

Right button increments flashing field to next position

BOTH Accepts Value

Clock combo page layout with base AV-20 model, no temperature probe installed, only time and bus voltage available for display.

**CLOCK COMBO PAGE
AV-20 BASE, NO OAT**

Modified screen layout: Only Local and GMT Time, no VIEW options

6.2. FE Time - Flight Time, Engine Time Page

The FE Time page displays (F)light Time and (E)ngine Run Time. These timers are automatically started and stopped based on measured data. The Flight Time counter runs when the airspeed speed goes above 40 Kts. The Engine Run Time counter runs when the bus voltage goes above the basic battery float level (alternator is running).

FE TIME PAGE

VIEW Toggles the highlighted field, shown in white

Flight Time only available on the –S model

BOTH Clears Highlighted Field to zero

Either timer can be independently set to zero by selecting it and clearing the value.

Only the engine run time is available on the base AV-20 model, as airspeed measurements are not available.

6.3. User Timer Pages

Two identical user timers are available. Each operates independently of the other and each can be configured for counting up from zero or counting down from a user-set value.

6.3.1. Count-Up Mode

In the power-on default state, each timer is a count-up timer. The timer is started by pressing the VIEW button with the adjacent start icon ▶. When running, this icon changes to a pause indicator ‖. Pressing the VIEW button again will pause the timer.

When the timer is paused, pressing and holding the VIEW button will clear the timer to zero.

6.3.2. Count-down Mode

Count-down Mode is activated by setting a user-defined value to count down from. This is accomplished by pressing ●BOTH● to set a value.

When a non-zero value has been set by the user, the timer automatically becomes a count-down timer. If the set value is changed back to zero, the timer automatically becomes a count-up timer again.

TIMER SET MODE

Left upper and lower button increment or decrement the current field (Hours, Minutes, or Seconds)

Holding either momentarily will clear all fields to zero

Currently highlighted field will flash

Right button increments flashing field to next position

BOTH Accepts Set Value

Once the set value is accepted, this value is loaded into both the upper (active) and lower (Set Value) fields on the timer page.

The lower Set Value allows the same timer value to be reloaded without having to manually set the value again.

☞ When the timer is stopped, holding the VIEW button will reload the previously set count-down time.

TIMER PAGE COUNT-DOWN MODE

VIEW Starts or pauses the counter

When stopped, holding VIEW will reload the set value shown here

Timer Number

Timer Mode

Reload allows previously set value to be used again

Once the timer is started and the value runs down to zero, a timer alert will be generated.

6.3.3. Mode Transition

Once in the count-down mode, the timer can be changed back to a count-up timer by setting a value of zero. This can be done manually, or a shortcut can be used by entering the set mode and holding either of the left buttons down momentarily. This will clear the HH:MM:SS value to all zeros, making the timer a count-up timer again.

Timer 1 and Timer 2 operate completely independently of each other and can be set with different values and operate as either a count-up or count-down.

6.4. AOA/G Meter Page

The AoA/G Meter Page has four view modes, selected by pressing the VIEW button:

- Large AoA Display
- Large Graphical G-Meter Display
- Large Textual G-Meter Display
- Dual Graph Mode

6.4.1. Large AoA Display Mode

The Large AoA Display mode shows a highly visible indication of the current AoA, scaled by the configured upper and lower AoA limits (calibration points).

EXAMPLE: If the upper AoA limit has been configured to +12 degrees (near stall), the upper bar on the display will correspond to this value. If the lower (normal cruise) AoA limit has been set to +3 degrees, the lower bar will correspond to this value.

The calibration points are different for each aircraft and are configured in the setup pages.

AOA/G METER LARGE AOA MODE

Current AoA, scaled to calibration limits

Peak AoA levels

Corresponds to upper pre-stall angle

Corresponds to lower cruise angle

BOTH Clears Peak Values
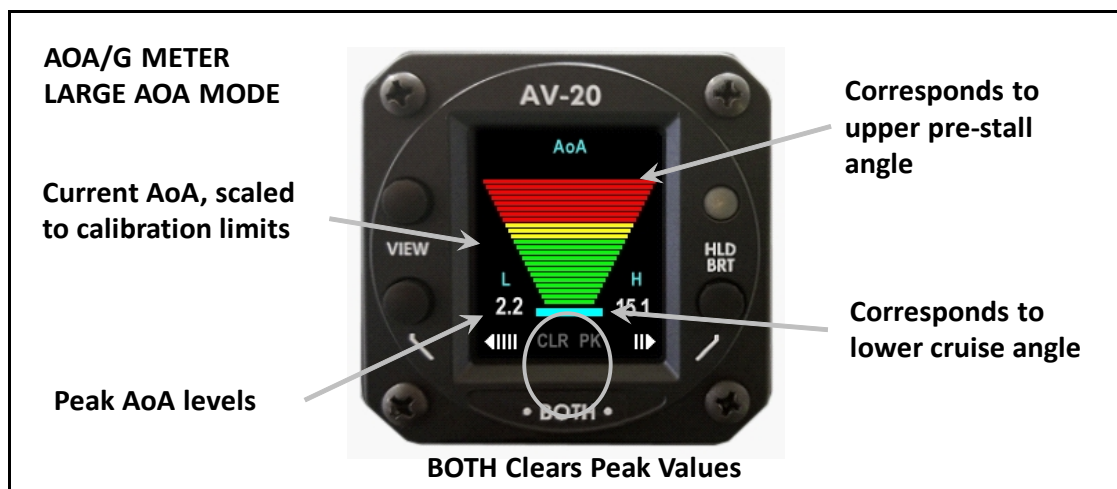
During power-on stabilization, the cyan lower bar will blink, indicating that no valid AoA can be determined. This applies to all color-coded AoA indications provided on different pages.

Alerts will be generated just prior to the AoA reaching the upper calibration point.

This display can be configured to automatically pop up when the AoA limit alert occurs.

6.4.2.   Large G-Meter Display Mode

The Large G-Meter Display Mode shows an easily readable indication of the current G load, scaled by both the configured upper and lower G limits. Both positive and negative values are displayed on the same graph, making the visible indicator an "absolute" G limit indication.

*EXAMPLE: If the upper G limit has been configured to +4 G, the **upper** bar on the display will correspond to +4 G. If the lower G limit has been set to -2 G, the **upper** bar on the display will correspond to -2 G as well.*

The display is scaled appropriately (and differently if needed) for positive and negative G operations. From the pilot's perspective, when the meter indicates near-maximum values, operational limits are being approached.

The positive and negative G limits are configured in the setup pages.

AOA/G METER LARGE G MODE

Current G Load, scaled to calibration limits

Peak G levels

Corresponds to absolute G limit, Positive or Negative G's, scaled to configured limits

BOTH Clears Peak Values

Alerts will be generated just prior to the G load reaching the upper calibration point.

This display can be configured to automatically pop up when the G-limit alert occurs.
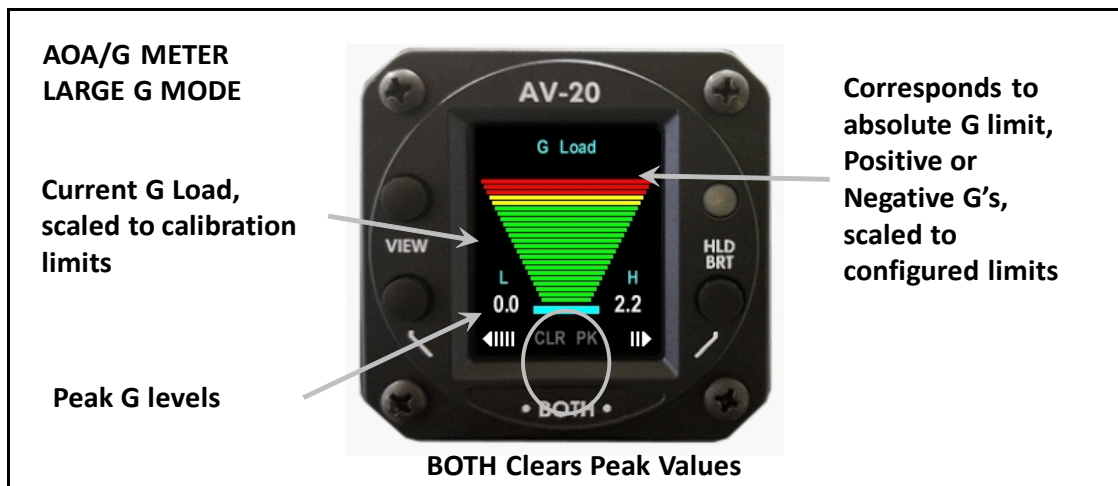
A large textual version is also available showing the current G load:

AOA/G METER LARGE TEXT MODE

Current G Load

Peak G levels

BOTH Clears Peak Values
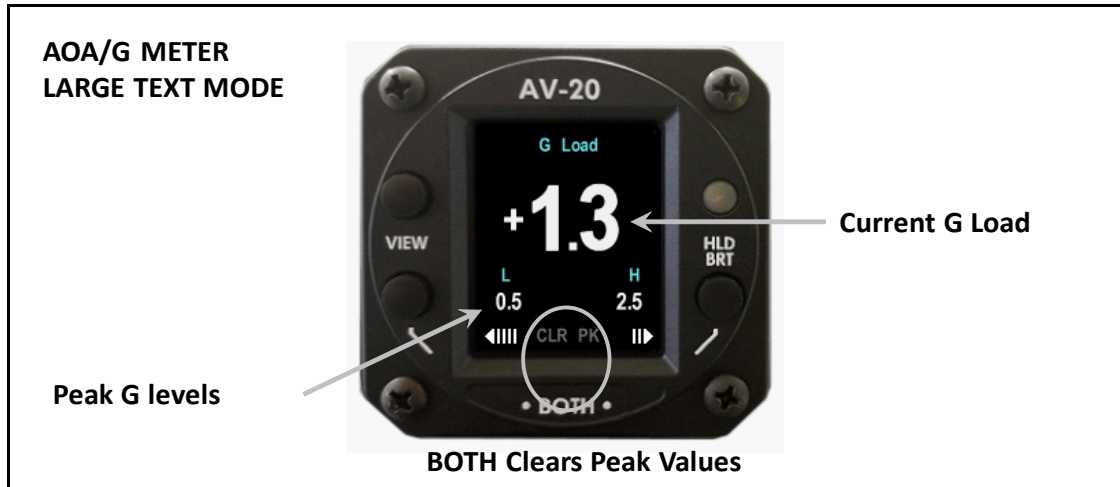
6.4.3. Dual Graph Mode

The dual graph mode is primarily utilized for determining the best upper and lower AoA calibration points and can be helpful for fine-tuning those thresholds.

The left side of the display shows the current G load, along with the peaks experienced during the current flight.

The right side of the display shows the current AoA, along with the peaks experienced during the current flight. Additionally, the configured upper and lower calibration limits are shown as red and green tic marks. This indicates where the aircraft's current AoA is relative to those calibration points.

AOA/G METER DUAL GRAPH MODE

Positive G-Peak (Cyan Tic)

Current G Force (White Arrow)

Negative G-Peak (Cyan Tic)

Calibrated Alert Limits (Red and Green Tics)

Current AoA (Cyan Arrow)

AoA Peaks (Cyan Tics)

BOTH Clears All Peak Values
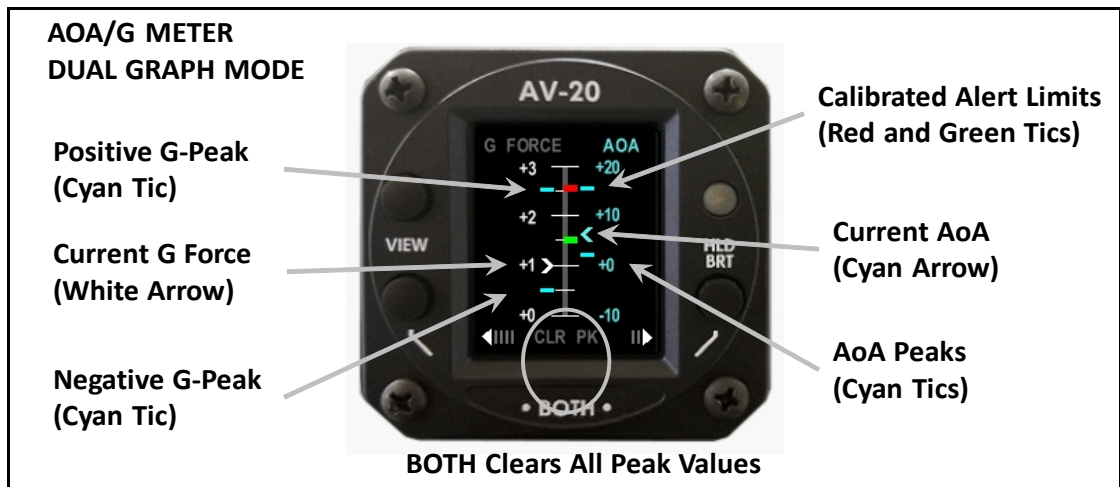
To utilize the dual graph mode as an aid for determining the desired calibration points, the peaks can be cleared while slowing and approaching the pre-stall condition.   Slowly approaching the stall point will record the peak positive AoA.

Slowly returning the aircraft to normal cruise mode will then record the peak lower AoA.

These two angles can then be entered as the AoA Limits in the setup pages.

6.5. Attitude Page

The Attitude Page provides a small thumbnail presentation of roll and pitch, with a slip/skid and AoA overlay option.

The PSYNC will set the current pitch angle to indicate as zero pitch, and can be used to trim out pitch offsets relative to other equipment on the aircraft.

VIEW toggles presentation of AoA and slip/skid on and off. During power-on stabilization, the aligning message appears.

AI PAGE

VIEW toggles AoA and Slip/Skid overlay on or off

During power-on stabilization, aligning will be presented

Small AoA Indicator

During power-on stabilization, the cyan bar will flash, indicating no AoA availability

Slip / Skid

BOTH Syncs pitch-zero to current pitch
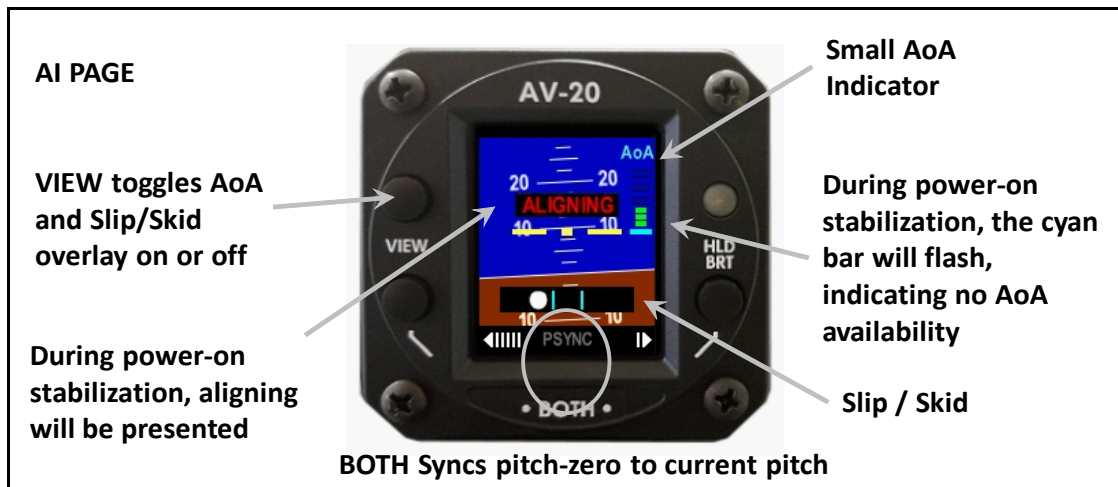
This display can be configured to automatically pop up when power is lost during flight.

6.6. Setup Pages

The Setup Pages allow an assortment of options to be configured by the pilot.

👉 Note that some options are not available during flight and will be disabled if airspeed or ground speed is above 40 Kts. Disabled options will be shown in gray and cannot be selected.

6.6.1. Setup – Top Level Menu

The top-level menu is shown by default and is presented in a disabled state (all options grayed out).

Pressing ●BOTH● activates the menu for navigation. The left buttons scroll the highlighted field up and down, while pressing SEL will enter the highlighted setup page. (Additional menu items may be located off the lower screen area)

Pressing ●BOTH● again will disable (exit) the menu.

SETUP PAGE
TOP LEVEL MENU

Scrolls selected field up or down

Right button enters the highlighted sub-page

BOTH Activates or Exits the menu

6.6.2.   Setup – System Info

System information can be viewed via the setup menu.

SETUP
SYSTEM INFO

6.6.3.   Setup - Page Enable

The Page Enable allows each function / page of the unit to be individually enabled or disabled. When disabled, the function / page will not be shown, reducing the time required to navigate to any specific page.

EXAMPLE: A given user may not require dual timers and may disable the second timer page for convenience.

SETUP
PAGE ENABLE

State of the page is shown:

Enabled = green check
Disabled = red x

When page is disabled, it will not show up during page navigation

Right button toggles state of the selected item

6.6.4. Setup – Audio Alerts

Audio alerts can be individually enabled or disabled. When disabled, the visual alert will still appear, but no aural alert will be generated. (See Alerts section of this document for more details on the alerting feature.)

**SETUP
AUDIO ALERTS**

Enable or disable the individual audio alerts

Right button disables or enables the alert.

6.6.5. Setup – Audio Volume

The Audio Volume for alerts can be adjusted to levels 1 thru 10. An aural test message will be generated until the level is accepted.

**SETUP
AUDIO VOLUME**

Volume Up and Down

An audio test message will be played once the level is adjusted

Accepts volume

6.6.6. Setup – OAT Trim

The OAT sensor can be trimmed to account for variations in probe characteristics or to match other equipped gauges. The NEW value shows the currently measured OAT with the offset applied.

SETUP
OAT TRIM

Offset to be added to measured value

Adjust offset up or down

Corrected value shown

6.6.7.   Setup – Miscellaneous Options

The Misc Options menu allows for miscellaneous options to be set as follows:

- Blue Background on all pages (versus a black background)
- Temperature units set to C (versus units in F)
- Time units in 24 hour mode (versus 12 hour AM/PM)
- TAS in Knots (versus MPH)
- G Popup enabled – Transitions to large G indicator when alert occurs
- AoA Popup enabled – Transitions to large AoA indicator when alert occurs
- AI Popup enabled – Transitions to Attitude Indicator if power lost in flight

SETUP
MISC OPTIONS

Current state of the individual option

Right button disables or enables the option.

6.6.8. Setup – AoA Limits

AoA Limit / calibration points allow the upper and lower angles for display to be set. The upper angle represents the angle just prior to aircraft stall, and corresponds to the top red bar on the AoA indicator. The lower angle represents the normal cruise angle, and correlates to the bottom-most AoA bar.

The angles set can by determined by monitoring the actual AoA just prior to a stall, and then setting that value in the setup page.

6.6.9. Setup – G Limits

G limits allow the desired G limits to be configured. Normal flight is 1G, not 0G.

6.6.10. Setup – Hard Calibration

Hard Calibration performs an internal recalibration of the inertial gyros and may be required from time to time.

☛ The Hard Calibration function re-zeros the internal inertial sensors and may be required from time to time. Refer to the Instructions for Continued Maintenance & Operation in the Installation Manual for criteria on when to perform a Hard Calibration.

⚠ Note that the Hard Calibration cannot be performed in flight. This function is disabled when airspeed is above 40 Kts. The aircraft must be stationary during the calibration procedure.

SETUP
HARD CALIBRATION

Abort Calibration

Proceed with Calibration

7. Audio and Visual Alerts

Audio and visual alerts are generated under various limit conditions. A visual alert appears as a colored annunciator that is displayed in the upper left corner of the screen, regardless of the unit's mode or currently displayed page. Aural alerts are implemented via the audio output and require that the unit be interfaced to the aircraft audio panel.

G-Load and AoA alerts have multiple stages, allowing pilot awareness prior to a full alert being generated. These pre-warning alerts occur slightly prior to reaching the actual set limit.

7.1. Alert Prioritization

Each alert type is prioritized as follows:

Priority	Alert Type	On-Screen Indication	Audio Indication
1	G Load Pre-Warning 1	GLOAD	Single Tone
	G Load Pre-Warning 2	GLOAD	Dual Tone
	G Load Exceeded	GLOAD	"G Limit"
2	AoA Pre-Warning 1	ANGLE	Single Tone
	AoA Pre-Warning 2	ANGLE	Dual Tone
	AoA Exceeded	ANGLE	"Angle"
3	Timer 1 Count Down	TIMER 1	Chime
4	Timer 2 Count Down	TIMER 2	Chime

If either the G Load pop-up option or the AoA pop-up option is enabled (see Misc Setup), the display will automatically transition to the dedicated AoA or G page.

> Note that for the audio alert feature to function, the unit must be interfaced to the aircraft's audio system.

ACTIVE ALERT

Visual Indicator

Clears alert and
mutes audio

7.2.   Clearing Alerts

When an alert condition is present, pressing the VIEW button will clear the visual alert
and mute the associated audio. If there are multiple alerts occurring simultaneously,
clearing one alert will then allow the lower-priority alert to be displayed.

☞ The audio section of the unit is not powered by the internal battery; thus, in
the event of power loss or removal of power to the unit, audio alerts will not
be generated.