

## Alpha Systems AOA Calibration Overview

The calibration of the Alpha Systems AOA has **3 simple steps**

- 1.) (On the Ground) **Zero** calibration
- 2.) (In-flight) Optimum Alpha Angle (**OAA**) calibration
- 3.) (In-flight) **Cruise** calibration

Included in this manual are the definitions for each step and associated flow chart to assist the pilot for easy step by step calibration.

### The Brightness / Mode button

The brightness button is the white push button used for 2 functions:

- 1) Changing the brightness of the LED's
- 2) Operates as a **MODE** switch to enter into, change from OAA to Cruise and exit the calibration steps. **(By depressing the Brightness button for greater than 6 seconds.)**

### The CAL button

The **CAL** button is located just beneath the last 2 Green LED's and is recessed underneath the front case and is marked (**CAL**). The button can be depressed with a Pen or a PDA pointer.

**It is recommended**, to make calibration easier, that the pilot flies the aircraft and a second person follow the calibration procedure, enter the appropriate set points for the instrument. **At ALL times, flying the aircraft in a safe manner controlled by the Pilot -in- Command at safe altitude to maneuver the aircraft in slow flight.**

### Step 1: (On the Ground) Zero calibration

The first step after the system installation and electrical connections are completed is to verify electrical and pressure **Zero** set point. When the unit is first turned on for the first time, **All** LED's will flash, this indicates the unit needs to have the (On the ground) **Zero** calibration procedure completed. The ground **Zero** calibration set point can be reset at any time after the initial calibration however **ALL** in-flight set points **OAA and Cruise must** be reset and the other identified in-flight values correlated to the LED's illuminated.

### Step 2 and Step 3: (In-Flight) Calibration of Optimum Alpha Angle (OAA) and Cruise.

The Alpha Systems AOA has two "Calibrated" set points, **OAA** and **Cruise** in-flight, calibrated by the pilot at safe altitude. These 2 set points will be calibrated in-flight to the airplane by the pilot, which will correlate the appropriate number of LED's for each angle of attack dynamic and amount of available lift.

### After the calibration set points are complete

After the AOA has been successfully calibrated, the pilot is to identify other in-flight reference points such as: Max climb angle, Stall, Best glide, Best climb and others of the LED's that correspond to those values using the aircrafts AOA range from Cruise up to Stall, instantaneously responding to the changing AOA showing the amount of available lift at ALL angles of attack.

To match aircraft's AOA to a flight value:

i.e.) **Best Glide**, Determine aircraft's exact Best Glide airspeed number, identify aircraft's weight and compensate for Density altitude values, add or subtract to give the pilot an accurate number. Fly aircraft to the designated Best Glide number.... When holding that calculated airspeed, count the number of LED's that are on. That AOA (represented by LED's) will always be the same Best Glide AOA from then on, regardless of gross weight changes, density altitude, and attitude.

## Alpha Systems AOA Calibration Procedure

- From the factory, the unit is **NOT CALIBRATED**, The installer / pilot **MUST** complete **BOTH** the **(On the ground)** and the **(in-flight) OAA** and **Cruise** calibration procedures.
- After installation is complete, when power is applied for the first time, **ALL** LED's on the AOA DISPLAY should continuously flash on and off, indicating a **non-calibrated** system.

### Step 1) Calibrating the Zero Pressure Point (On the Ground)

This must be done in a zero pressure condition, preferably in a calm environment such as a hanger or no wind environment.

While depressing the **CAL** button on the AOA DISPLAY, apply power to the system.

Continue to depress the **CAL** button for about 8 to 10 seconds after power has been applied.

If **NO** LED's are illuminated **or** if all LED's stop flashing after a few seconds indicates the zero offset pressure value at the sensor is good and will be stored to system EEPROM and used as the system zero pressure point. **(See note below)**

After releasing the **CAL** button, the AOA DISPLAY will enter its inactive Display mode which is indicated by the Blue and the last Green LEDs blinking on and off 5 times. The unit is not functional at this time and no display will occur until the "in-flight" calibration is entered, both setpoint values are successfully entered, and the calibration mode is exited, allowing in-flight AOA display.

**Before the unit becomes functional, the operator must calibrate the in-flight set points, (OAA, Cruise) of the system. Go to Step 2.**

### Failure to complete ground calibration

If all LED's on the AOA DISPLAY continue to flash on and off, the **zero** pressure value from the sensor is too high, which indicates something is wrong electrically or mechanically with the system, or something in the environment is affecting the system. The system will flag the bad zero offset and continue to flash **ALL** LED's, even if the system is powered off and on, until an acceptable **zero** set point has been detected by repeating the above procedure.

To isolate the failure between mechanical or electrical, the air hoses should be disconnected from the AOA interface module and the above operation repeated.

If the condition persists, then the failure is electrical and the AOA interface module should be returned for an authorized repair.

If the setting is successful, then the failure is mechanical such as a blockage in the air hoses, etc.

Once the mechanical failure is fixed, the above operation should be repeated.

**Note:** This is a power on procedure.

Because there is a power on settling time for the electronics, all LEDS on the AOA DISPLAY may flash several times before the system electronics stabilize and then stop flashing for an acceptable/valid zero pressure point.

**Step 2) Calibrating the Optimum Alpha Angle Set Point (In-Flight calibration)**

The system must be put in the **Optimum Alpha Angle (OAA)** Set Point Mode which will be identified by the **Blue LED** blinking on and off 3 times, and will continue to blink twice every 6 seconds until a valid **OAA** value is entered.

Once completing the initial **OAA** and **Cruise** calibrations, entering into **OAA** calibration mode will be identified by the Blue LED blinking 3 times, the unit will remain functional with the previous **OAA** value until a new set point is entered.

The Calibration Mode can be entered on the ground or in the air.

**To enter the calibration mode:**

**Press and hold** the **Brightness** button (**>6 sec.**) until the **Blue LED** blinks ON /OFF 3 times and will continue to blink twice every 6 seconds until a valid OAA value is entered.

Release the **Brightness** button.

The system has entered the **Optimum Alpha Angle (OAA)** set-point calibration mode.

- Aircraft is flown at the **Optimum Alpha Angle (OAA)**:
  - 1.) Aircraft is at a safe altitude for slow flight maneuvers,
  - 2.) Minimum controllable flight, lower power setting, (such as a down wind or landing pattern power setting),
  - 3.) Able to hold altitude, 0 vertical speed (small climb OK), **not descending / 0 SINK**,
  - 4.) Full aileron, elevator and rudder control, pilot to identify the **OAA** set point by pitching back slowly until no longer able to climb, but holding altitude with full control of the airplane.

**To enter the Optimum Alpha Angle (OAA) set point:**

Press and release the **CAL** button on the AOA display when the aircraft is flown at **OAA**

**Note:** *This operation can be repeated as many times as desired as long as the system is in the Optimum Alpha Angle Calibration Mode.*

**If the setting was successful:**

The AOA DISPLAY will save the new set point in the system and the display will become active. This set point must be verified by the pilot to identify correlation for the Optimum Alpha Angle (**OAA**) of his or her airplane to the display indicating all red, blue light, and the flickering of the first yellow LED's are ON at the **OAA** flight condition of the aircraft. The value will be lost if power is turned off before completing the **ENTIRE** calibration procedure.

**Continue on to Step 3**

**If the setting is NOT successful:**

The AOA DISPLAY remains inactive or returns to an inactive state, discards the attempted set point (**value out of range**).

The system will flash LED's to give feedback for the pilot to know which direction the angle of the AOA probe needs to move, allowing for proper full scale AOA values.

**If the last Red and the Blue LED flash simultaneously 3 times at a rapid rate**

**This indicates that the set point is too low.**

The probe angle needs to be changed to an **increased angle** to the wing.

If setpoint is unsuccessful after several attempts, the aircraft should be landed and the probe repositioned so the angle between the wing and the probe is **increased** by 5 to 10 degrees (**away from wing**), and the in-flight (**OAA**) calibration procedure should be retried.

**(Return to Step 2)**

**Or the Blue and first Yellow LED flash simultaneously 3 times at a rapid rate**

**This indicates that the set point is too high.**

The probe angle needs to be changed to a **decreased angle** to the wing.

If setpoint is unsuccessful after several attempts,

The aircraft should be landed and the probe repositioned so the angle between the wing and the probe is **decreased** by 5 to 10 degrees (**toward wing**), and the in-flight (**OAA**) calibration procedure should be retried.

**(Return to Step 2)**

**NOTE:** If the **OAA** setpoint was NOT successful and the **Brightness** button is depressed (**>6sec.**), the Blue LED will blink ON and OFF 3 times and continue to blink twice every 6 sec. to indicate the system will remain in the **OAA** setpoint calibration mode, a valid **OAA** value must be entered to continue on to step 3.

**Step 3) Calibrating the Cruise Set point (In-Flight Calibration)**

The system must first have the **OAA** setpoint entered successfully, Next, be put into the **Cruise** Set Point mode which will be identified by the last **Green** LED blinking ON / OFF 3 times after holding the **Brightness** button down for (**>6 sec.**).

**When at a normal cruising speed, power and straight and level attitude, holding altitude,**

Press and hold the **Brightness** button (**>6sec.**) until the last **Green** LED blinks ON / OFF 3 times. Release the **Brightness** button. The last green LED will continue to blink twice every 6 seconds until a valid Cruise value is entered.

The system exited **OAA** set point mode and entered into the **Cruise** set point mode.

**To set the Cruise Set Point, Fly aircraft at safe altitude:**

- Increase power to a cruise power setting
- Allow aircraft to level off, Cruise attitude, holding altitude

Press and release the **CAL** button on the AOA display. (This button is recessed and is located beneath the last 2 green LEDs)

**If the setting is successful,**

The AOA DISPLAY will save the new **Cruise** set point in the system, illuminating the last **Green LED**.

**Note: This operation can be repeated as many times as desired as long as the system is in the Cruise Calibration Mode of operation.**

**To Exit calibration Mode**

If the cruise setpoint was successful, by depressing the **Brightness** button (**>6sec.**), the system will exit the calibration mode, entering its self test, LED illumination routine, all LED's are illuminated one by one upwards and then extinguishing one by one to a fully functional Display Mode. Both values, **OAA** and **Cruise** have been **stored**, representing the range from **OAA** to **cruise**, and a range from **OAA** up to **Stall**.

**Calibrations of the Setpoints are complete!!!! The linear range of AOA for your aircraft is represented by the 16 LEDs of the Alpha Systems AOA display. As the number of LEDs turn on, instantaneously and repeatably displaying the amount of available lift!!!!**

**If the setting is NOT successful,**

The AOA DISPLAY discards the attempted set point and the following event occurs.

**The first 2 Green LED's flash simultaneously 3 times at a rapid rate.  
This indicates that the set point is too low.**

If the cruise setpoint was not successful and the **Brightness** button is depressed, (**>6sec.**) the last Green LED will blink ON and OFF 3 times and the system will remain in the Cruise setpoint calibration mode.

**NOTE:** Both **OAA** and **Cruise** set points **must** be entered and **must** be valid values before exiting from the calibration mode, before the values are stored and the system can be used.

If power is removed before completing the **ENTIRE** calibration of; 1.) **OAA** , 2.) **Cruise**, 3.) Storing the in-flight values, by depressing the **Brightness** button (**>6 sec.**), **All previous in-flight values are lost and the in-flight calibration procedures must be re-done.**



## Setting the Brightness of the LED's while on the Ground

**Before Power is turned ON**, depress the **Brightness button** on the AOA DISPLAY, turn power **ON**. Continue to depress the **Brightness button** for about 4 seconds once power has been applied.

The system will enter its Self test causing the LED illumination routine. All LED's are illuminated one by one upwards and then one by one downwards ending with all the LED's being illuminated.

**The system is now in Brightness calibration mode.**

With a light applied directly to the photo diode on the AOA DISPLAY, press and release the **Brightness** button until the AOA DISPLAY is at its maximum brightness. You'll know when it's max because going past it will cause the brightness of the LED's to return to the minimum level. There are 16 brightness steps that are sequenced through increasing brightness at each step.

Wait about 5 seconds for the unit to store the setting then remove the light away from the Display.

The LED's brightness will change to the lower brightness level unless the low light setting was set to maximum brightness or the cockpit is in daylight.

Next, cover the photo diode on the AOA DISPLAY with your thumb or a piece of black electrical tape, press and release the **Brightness** button on the AOA DISPLAY unit until it's at a minimum or lowest level. Wait 5 seconds for the unit to store the setting than remove your thumb or tape.

Observe that the LED's brightness level changes from dim to bright when light is applied and removed from the photo diode on the AOA DISPLAY.

Remove power, wait a few seconds and re-apply power.

The system will enter its self test, LED illumination routine in which all LED's are illuminated one by one upwards and then one by one downwards, The system enters the active mode if calibration has been completed or the in-active display mode, needing **OAA** and **Cruise** calibration.

## LED brightness adjustment when active

To change brightness when the unit is active, simply push and release the **Brightness** button until the desired brightness level is reached, there are 16 brightness levels and a photo cell to detect "**night time**" and "**Day time**" ambient light levels and automatically switches to the stored level. The new brightness levels will be stored on powered off.

## AOA Display (In Calibration Mode) LED Definition

### - All LED's flash continuously

- The system is not calibrated
- The attempted zero pressure offset value at the sensor is too high, which indicates something is wrong electrically or mechanically with the system or something in the environment is affecting the system

### - The Blue LED and the last GREEN LED flash simultaneously 5 times at a rapid rate

- The Optimum Alpha Angle (**OAA**) and **Cruise** set points need to be calibrated

### - The Blue and the last Red LED flash simultaneously 3 times at a rapid rate

- The attempted (**OAA**) Optimum Alpha Angle set point is too low / reposition AOA probe.

### - The Blue and first Yellow LED flash simultaneously 3 times at a rapid rate

- The attempted (**OAA**) Optimum Alpha Angle set point is too high / reposition AOA probe.

### - The first 2 Green LED's flash simultaneously 3 times at a rapid rate

- The attempted cruise set point is too low

### - The Blue LED blinks on and off 3 times and continues to blink every 6 sec.

- The system has entered the Optimum Alpha Angle (**OAA**) Calibration Mode and no valid **OAA** value has been entered / initial calibration has not completed.

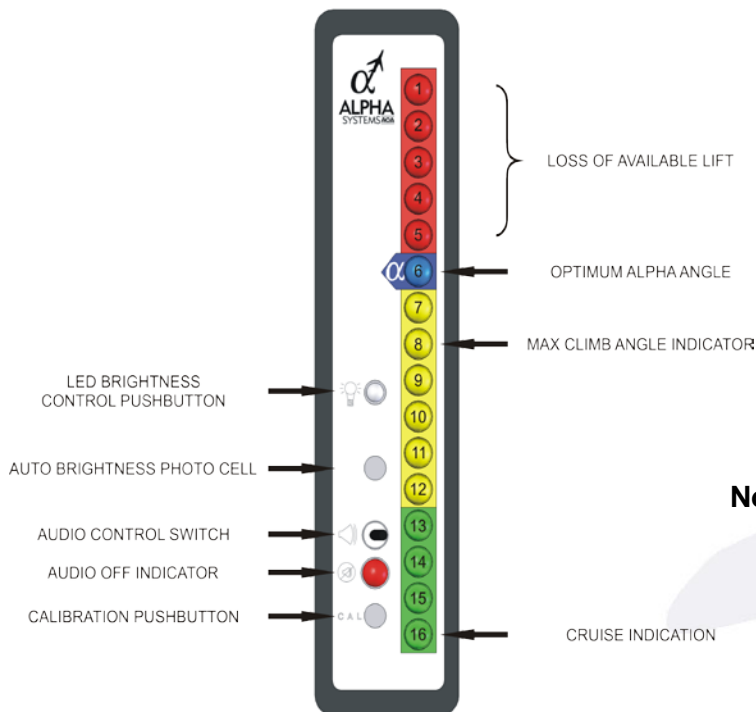
### -The Blue LED blinks on and off 3 times then unit is functional

- A previous valid **OAA** has been entered, unit is functional and in the **OAA** calibration mode, when the **CAL** button is pushed the unit enters the new value (if valid) and the rest of the in-flight calibration procedure **must** be completed.

### - The last Green LED blinks on and off 3 times

- The system has entered the Cruise Set Point Calibration Mode

- Notes:**
- 1.) If The power is turned off during the **OAA** or **Cruise** calibration procedures, the pilot must re-enter the calibration mode and start over with **OAA** setpoint calibration.
  - 2.) It is not necessary to do the ground calibration once a successful value was entered.
  - 3.) If both the **OAA** and the **Cruise** set points have been previously set and the **Brightness** button is depressed for (**>6 sec.**), (entering calibration mode) you can **exit** the calibration mode without changing the previously set **OAA** and **Cruise** values by simply depressing the **Brightness** button again for (**>6 sec.**) returning the unit to functional mode.
  - 4.) Once the **CAL** button is pushed, **when in the calibration mode**, the operator must complete the **ENTIRE** calibration process, the system deletes the previous values, both valid **OAA** and **Cruise** set points, (aircraft must be flown, set points entered), then exiting to functional mode by depressing the **Brightness** button for (**>6 sec.**) storing the new values and putting the unit in operational mode.



### Optimum Alpha Angle

Optimum alpha angle (**OAA**) is achieved during an in flight calibration maneuver with the pilot taking the aircraft to safe altitude. **A.)** At minimum controllable flight, (slow flight) and at a lower power setting. **B.)** Pilot able to hold altitude, not in a decent, ZERO SINK, as close to 0 vertical speed as possible. **C.)** FULL aileron and rudder authority. The pilot is to identify the **OAA** for the unit to display all Red, 1 Blue and the flickering of the first Yellow.

### Cruise Indication

After calibration of the "cruise" set point (the final green LED on the bar graph) and when the aircraft is in cruise (angle of attack), all LED's will turn off and the final Green LED will remain on.

- Notes:**
- 1.) Numbers on each LED is for reference only, actual LED's on the display will indicate appropriate color when on and clear or no color when off.
  - 2.) Vertical display shown, Horizontal and 2 ¼ Round displays have same controls and functions.

### Max Climb Angle

(The second Yellow LED), when all Red, Blue and the first 2 Yellow Led's are ON is the indication of the aircrafts maximum angle of attack that allows continued climb.

### Stall Indication

After the calibration is complete, the pilot will identify how many Red LEDs identify the "Stall" angle of attack for his or her aircraft. The corresponding number of Red LED's of the Stall is dependant on the coefficient of lift and the angle of attack for each airplane. Once identified, the number of Red LED's will always indicate the aircrafts stall.

### LED Brightness Button (Multiple Functions)

- This button is marked with a "light bulb" in the middle of the Yellow LED's and when depressed and released, repeatably will step through 16 levels of brightness. When the maximum brightness level is reached, the brightness returns to the minimum and steps up each time the button is depressed.
- This switch is also used to enter and exit the **Calibration mode, when depressed for longer than 6 seconds**. It also switches between different calibration set points, (**OAA**), (**Cruise**), stores the set points and back to **operational mode**.
- Before power is turned on**, if the switch is depressed and held, turning power "on" forces the display to turn on all LED's after a count up then down of the LED's. This allows the pilot to set the 2 brightness presets, "day time" and "night time" levels on the ground, ( all LED's illuminated).

### Audio Control Switch

This switch, when turned towards the LED's, turns the Audio warning tone off. The audio warning tone comes ON when the angle of attack decreases to within 2 Yellow LED's of the Optimum Alpha Angle (**OAA**). The tone is present for a short time as the angle of attack continues to decrease. There is a beeper in the control module that generates 110 Db tone.

### Audio Beeper

The black round beeper on the control module emits a tone of 110 Db and can be heard in most cockpits even with noise cancellation headsets on. The audio beeper can be turned off by the Audio Control switch on the display.

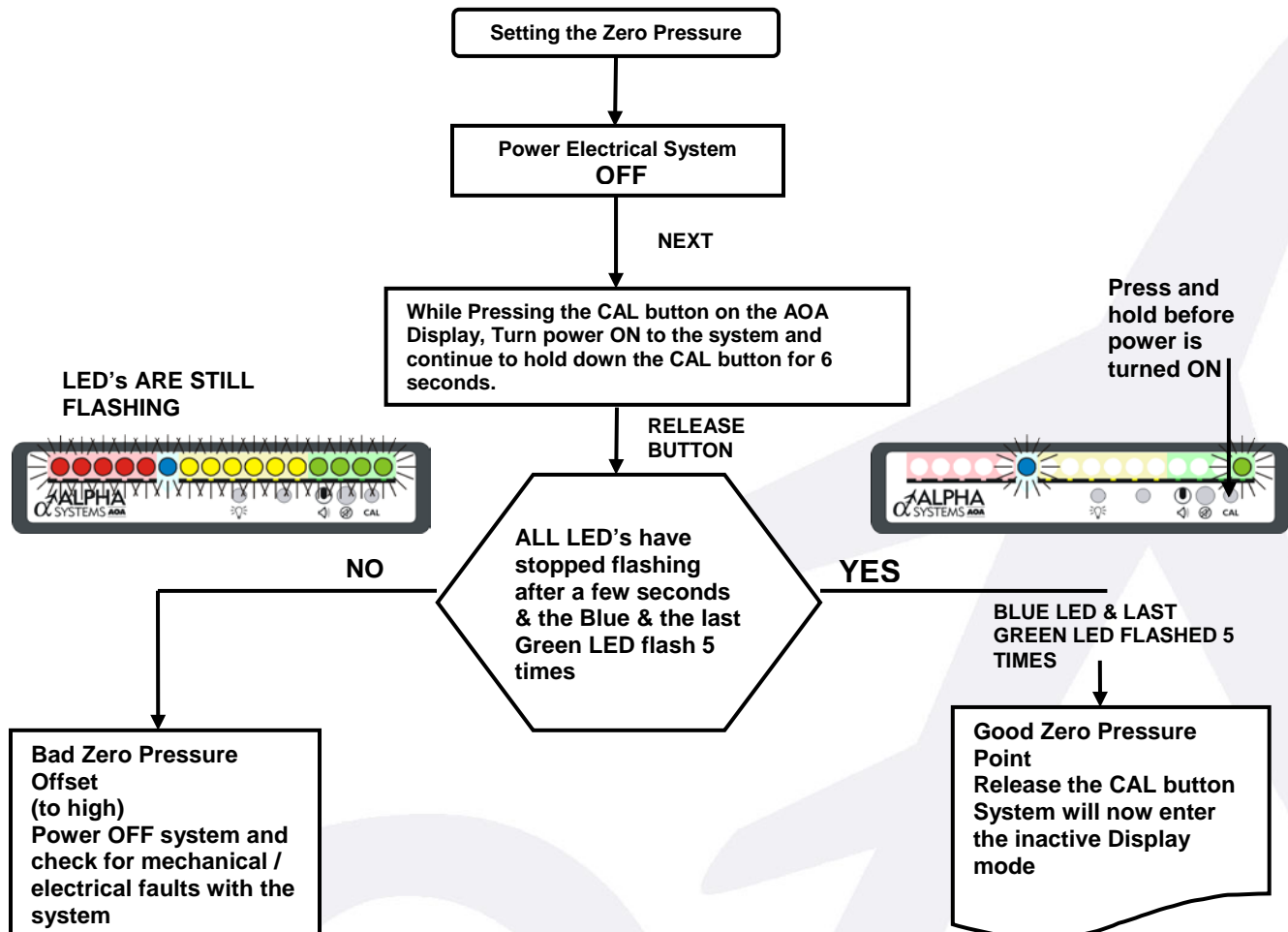
### Auto brightness Photo Cell

The photo cell is in the middle of the AOA display and automatically detects the ambient light which will switch from "day time" brightness preset to "night time" brightness preset automatically.

### Calibration Button

The calibration button is the recessed push button across from the last Green LED and is marked "**CAL**". This button is used to enter selected calibration set points during the calibration procedures.





**Causes:**

- Air Hose is kinked
- Air Hose is obstructed by foreign matter
- Electrical failure with the system

**To isolate failure:**

Disconnect the air hoses from the AOA interface module and repeat the procedure.  
 If the condition is gone, the failure is mechanical  
 If the condition persists, the failure is probably electrical related.

**Step 1: Complete**

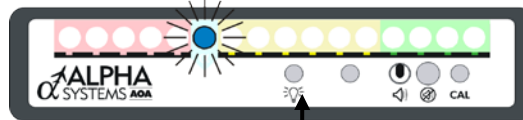
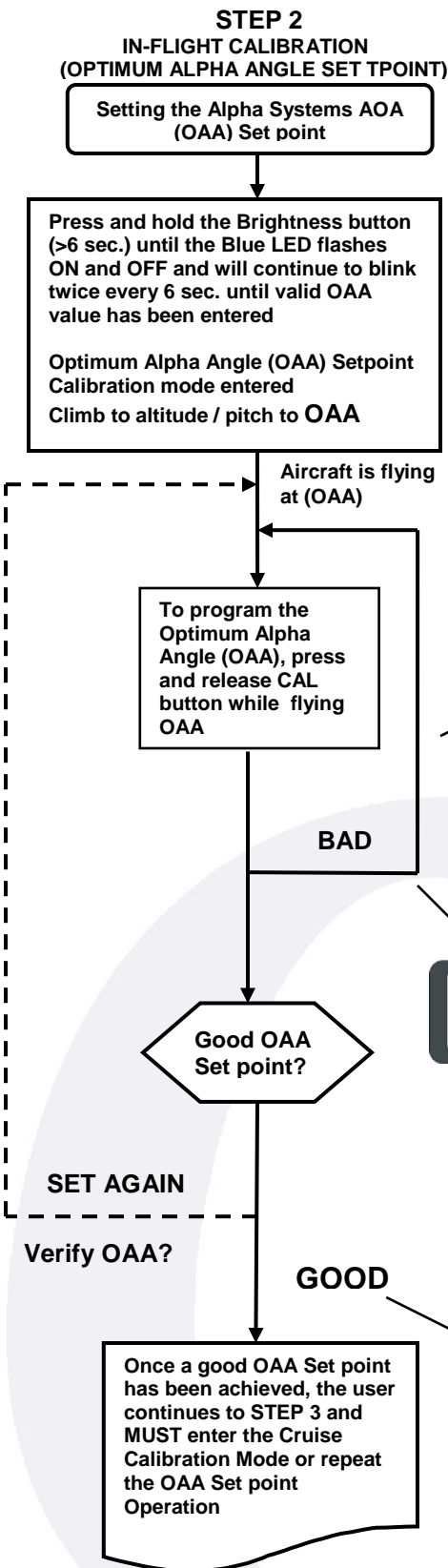
After the unit has accepted the ground calibration value, the Blue LED and the last Green LED on the AOA Display will flash 5 times to indicate that the **OAA and Cruise** set points need to be calibrated. The AOA Display is set to **INACTIVE** until the In-Flight Calibration **Step 2** is entered.

**Step 1: (On the Ground) Zero calibration overview**

After the system installation and electrical connections are completed, this step will verify electrical and pressure zero set points. When the unit is first turned on for the first time, **All** LED's will flash indicating the unit needs to have the Zero calibration procedure completed. The (On the ground) **Zero** calibration set point can be reset at any time after the initial calibration however, **ALL** in-flight set points **must** be reset and identified.

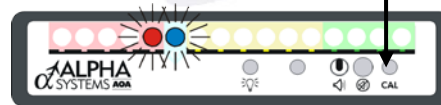
In-Flight calibration requires the pilot to climb to a safe altitude for slow flight maneuvers. Aircraft will be put into the flight condition of Optimum Alpha Angle (OAA): Aircraft is at the **Optimum Alpha Angle (OAA)**:

- 1.) Aircraft is at a safe altitude for slow flight maneuvers,
- 2.) Minimum controllable flight, lower power setting, (such as a down wind or landing pattern power setting),
- 3.) Able to hold altitude, 0 Vertical Speed, **not descending, ZERO SINK**,
- 4.) Full aileron, elevator and rudder control, pilot to identify the set point by pitching back slowly, to a pitch no longer able to climb but able to hold altitude with full control of the airplane.



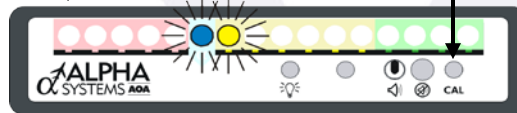
Press and hold (>6 sec.) Brightness button until Blue light flashes 3 times

Push to calibrate when flying OAA



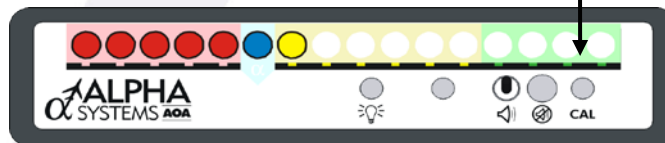
**Bad Set point Low:**  
Setpoint too low – the last RED and the BLUE LED flash ON and OFF and the display will remain inactive  
The probe should be repositioned so the angle between the wing and the probe is **increased** by 5 degrees (toward vertical)

Push to calibrate when flying OAA



**Bad Set point high:**  
Setpoint too high – the BLUE and the first YELLOW LED flash ON and OFF and the display will remain inactive  
The probe should be repositioned so the angle between the wing and the probe is **decreased** by 5 degrees (toward horizontal)

Push to calibrate when flying OAA



**Good OAA Set point**  
The display will become operational with the new OAA value, typically illuminating All Red, Blue, Flickering Yellow **GO TO STEP 3**

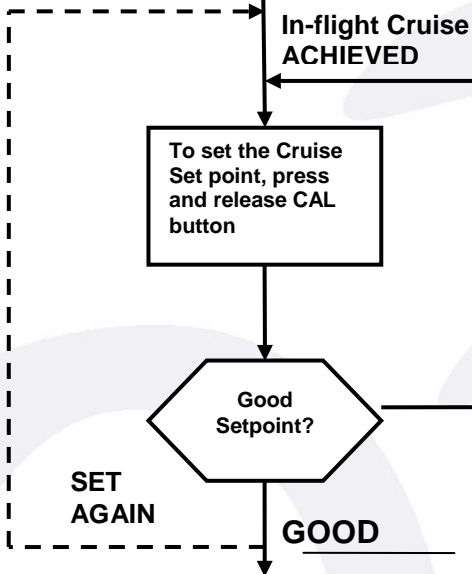
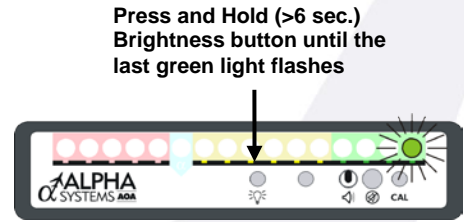
**Note: 1.)** When unit is in the Optimum Alpha Angle (OAA) set point mode, and the **Brightness** button is pressed and held (>6 sec.) with no **OAA** value entered, the **Blue** LED will flash ON and OFF 3 times and continue to blink twice every 6 sec. indicating that **OAA** has NOT been set. The AOA system will remain at the Optimum Alpha Angle (OAA) set point mode until a valid value has been entered.

**Step3**  
(CRUISE SETPOINT)  
IN- FLIGHT CALIBRATION

The pilot must fly the aircraft at a cruise condition, straight and level, holding altitude at Cruise power. This correlates the aircrafts in-flight cruise AOA to the display LED by the indication of last Green ON.

Setting the Alpha Systems AOA Cruise Set point

Press and hold (>6 sec.) the Brightness button until the last Green LED flashes ON and OFF and will continue the blink twice every 6 seconds until valid value (Cruise Setpoint mode entered)



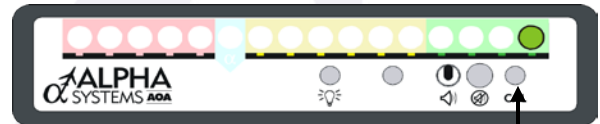
**Bad Setpoint:**

Setpoint too low – the first 2 GREEN LED's flash ON and OFF, Either the aircraft is not in Cruise or value out of range.



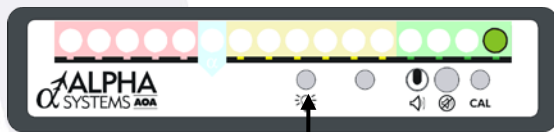
**Good Set point:**

The display will change to represent the new Cruise set point, typically illuminating only the last GREEN LED, operator can set it again or exit, storing the values, putting the system in functional mode.



**Note:** this sub-step must be taken in order to complete the calibration process **storing** the values, and puts the AOA system in an operational display mode when powered on.

To exit calibration mode, press and hold the Brightness button (>6sec.) until the LED's on the AOA Display start to illuminate one by one upwards then extinguish one by one (This completes calibration)

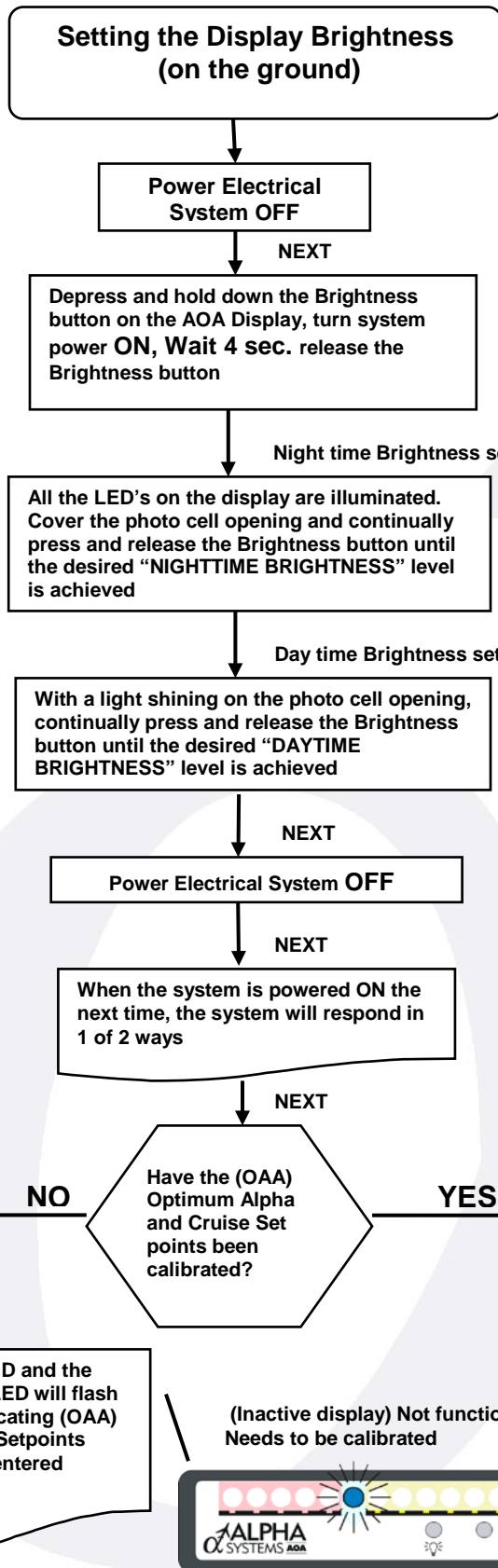


Press and Hold (>6 sec.) Brightness button to store **Cruise** and **OAA** values, System enters Operational Mode. The last Green LED will be ON, aircraft is at Cruise

Operational Display Mode  
Identify other In-flight values

**Note:** When in **Cruise** Calibration mode, if the **Brightness** button is pressed and held (>6 sec.) and a good **Cruise** setpoint has **NOT** been entered, The last Green LED will flash ON and OFF. The AOA system will remain in **Cruise** set point mode. The system forces the operator to set the value for **Cruise**; the operator **must exit** the calibration sequence to have the AOA system store the identified values for the systems to give the appropriate AOA reference and corresponding LED's and available lift.

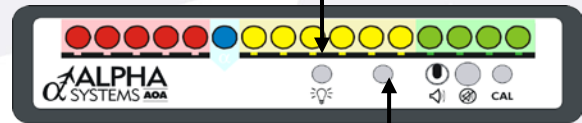
TO RE-CALIBRATE IN-FLIGHT SETPOINTS (RE-ENTER STEP 2) (OAA), PRESS AND HOLD THE BRIGHTNESS BUTTON (>6 sec.) UNTIL THE BLUE LED FLASHES ON AND OFF (GO TO STEP 2 FLOWCHART)



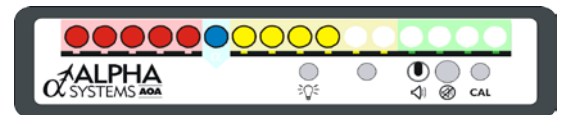
The brightness levels on the display **CAN** be pre-set on the ground which forces all LED's on by following this procedure. Both the "day time" and "night time brightness levels can be adjusted and set.

**Both levels can be changed in the cockpit, in flight, at any time.** There are 16 brightness levels, cycling through to the maximum, then starts over from the lowest.

Press and release until desired brightness.



Cover Photo Cell here for "DARK" setting or shine light for "DAYTIME" setting



(COMPLETELY FUNCTIONAL) Setpoints have been entered and when in-flight will display the AOA of the aircraft as previously set.