The ONSPEED System Abbreviated User's Manual

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System Performance

The system measures AOA throughout the flight envelope to an accuracy of .1 to .25 degrees actual at 2 G's or less and within .5 to <1° degree actual at 6 G's. It handles G onset rates of at least 2 G's per second (≥ 64 FPS gust load). It uses the difference between two pressures to derive AOA. Damping is a function of digital to analog conversion, system logic, and pilot adjustable smoothing. The proper combination of responsiveness and damping is required for smooth system performance during maximum performance maneuvering or in turbulent flight conditions. Automatic calibration utilizes body angle AOA (difference between fuselage reference line and relative wind).

Energy Management

"Energy" is power from the engine converted into some combination of airspeed and altitude. There are three energy states: positive, neutral, and negative. Energy is positive if thrust exceeds drag for a given condition (G times weight, or "G weight"). No tone, or fast tone correlates with a positive energy condition. When energy is positive, the airplane can go up, speed up or some combination of both. If thrust and drag are balanced for a given G weight, the airplane is ONSPEED. If drag exceeds thrust for a given G weight, energy is negative; and the airplane will go down, slow down or some combination of both. Energy state is conveyed to the pilot with three tones.

AOA Tone Pattern

A series of tones to provide AOA and energy cues to the pilot. An intermittent 400 Hz tone begins as the airplane reaches L/D_{MAX} (maximum lift to drag ratio) AOA. As AOA increases, the pulse rate of the tone increases until the airplane achieves an ONSPEED condition (1G V_{REF}, minimum power required, 0 P_s). A solid 400 Hz tone is heard when the airplane is ONSPEED. The ONSPEED band is ± ½ to 1° AOA and 5 kts wide at 1G (i.e., ± 2.5 kts either side of optimum AOA). As AOA increases, the solid tone transitions to an intermittent 1600 Hz

tone. Pulse rate increases as AOA increases. A 22 pulse per second stall warning is provided (Fig 1).

Normal Operation

System is active when power is applied. Adjust volume, as desired. Short press to disable ("ONSPEED DISABLED" voice warning) or enable ("ONSPEED ENABLED" voice warning). Long press to insert Data Mark ("DATA MARK" voice warning).

Optional M5 Visual Display

The left button increases brightness. The center button cycles display options: energy display (AOA + IAS and G), AOA-only, IMU attitude (not safe for flight-test use only), deceleration/IVVI and historic G. The right button decreases brightness. The lower (yellow) chevron lights with the fast tone. The green doughnut lights when the airplane is ONSPEED. The upper (red) chevron lights with slow tone and flashes for stall warning. The AOA display also includes a trend indicator that moves up and down as AOA increases and decreases. When the AOA trend indicator is aligned with the two balls adjacent to the lower chevron, the airplane is at L/D_{MAX} AOA. The numbers in the upper chevron are % lift. L/D_{MAX} occurs at 50% lift and ONSPEED occurs at 60% lift (Fig 1).

Performance AOA Cues

AOA is not affected by G, gross weight, or density altitude. L/D_{MAX} AOA is designed into the airplane. L/D_{MAX}, stall and ONSPEED AOA are constant. The tone automatically compensates for changes in G, gross weight, and density altitude. ONSPEED AOA is equal to 1.73 x L/D_{MAX} AOA and correlates with 1.3 V_S at 1 G (i.e., a normal approach AOA). IAS for ONSPEED varies with G throughout the flight envelope (Fig 3). The system senses flap position and automatically compensates to provide accurate AOA in all configurations.

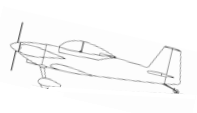
Energy Display AOA Cue	AOA % V_S	AOA % Lift	Aural Cue	Attitude
	<1.10 V_S	90	Stall Warning	
	1.11-1.2 V_S	56-90	Slow	
	1.2-1.25 V_S	55	Slightly Slow	
	1.25-1.35 V_S	60	ONSPEED	
	1.36-1.4 V_S	65	Slightly Fast	
	>1.4 V_S	51-64	Fast	
	N/A	50	L/D_{MAX}	

Fig 1. Basic AOA tone pattern, visual display and % lift indications

L/D_{MAX} (Start of 400Hz Fast Tone)
Yellow chevron lit. Trend indicator aligned with pips on visual display. 50% lift. 1.5 pulse per second, increases to 8.2 PPS as AOA increases.
Energy is positive: thrust exceeds drag.

L/D_{MAX} is used for:
Best Range
Best Range Glide
Best Rate of Climb (approximate)

ONSPEED (Solid 400Hz Tone)
Green doughnut lit. Trend indicator in green doughnut. 60% lift.
Energy is neutral: thrust and drag are balanced

ONSPEED is used for:
Approach and Landing
Optimum maneuvering (0 P_S/maximum sustained turn rate)
Maximum Endurance Glide
Best Angle of Climb

Slow Tone (1600Hz Tone)
Red chevron lit. 1.5 to 6.2 PPS as AOA increases. **Energy is negative: drag exceeds thrust. Reduce AOA, add power or both.**

Stall Warning (22 PPS 1600Hz Tone)
Red chevron flashes. >90% lift. Within 1.5-2° of stall (5 kts at 1G): **reduce AOA → DON'T STALL**

Flying the Tone

Approach and landing. Configure and slow to an ONSPEED condition. The 400Hz fast tone will begin at L/Dmax and pulse rate will increase as the airplane slows. The tone will go solid ONSPEED. Maintain ONSPEED throughout approach. Transition to slightly slow condition during flare. Once ONSPEED, control AOA with pitch (Fig 2). Control glideslope with power.

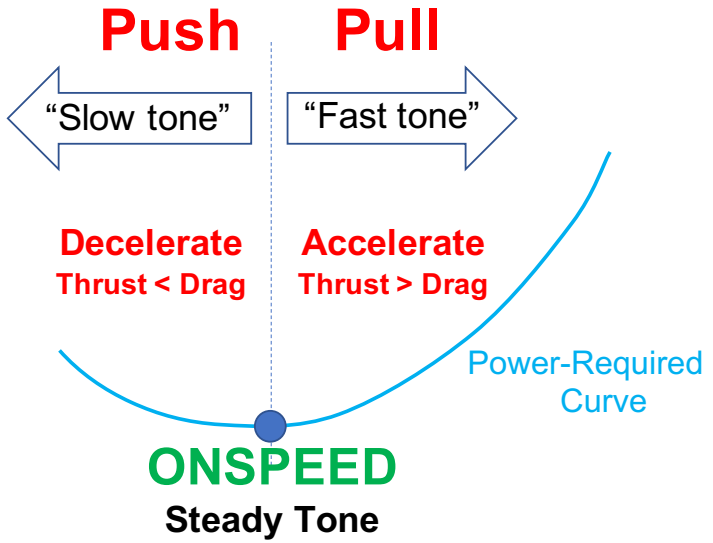


Fig 2. Adjusting pitch to control AOA based on tone cues

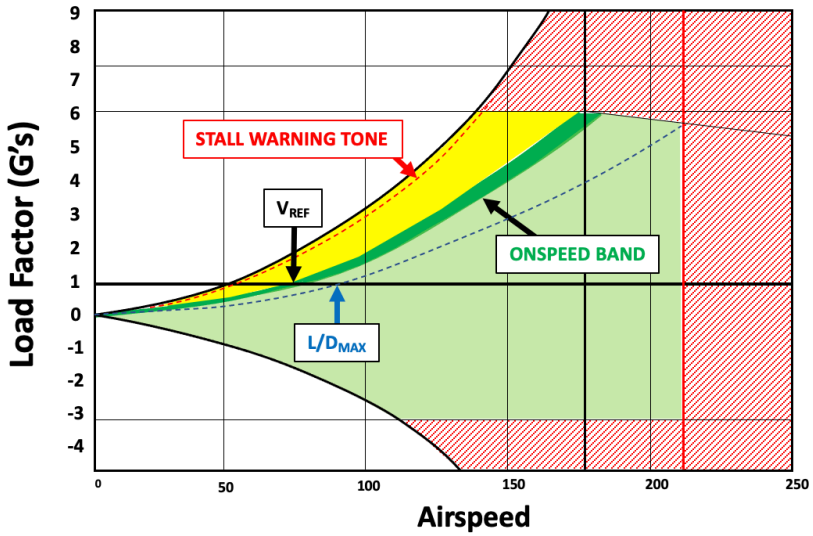


Fig 3. Flight Envelope with AOA cues superimposed. Yellow area is slow tone. The area between ONSPEED and L/D_{MAX} line is fast tone.

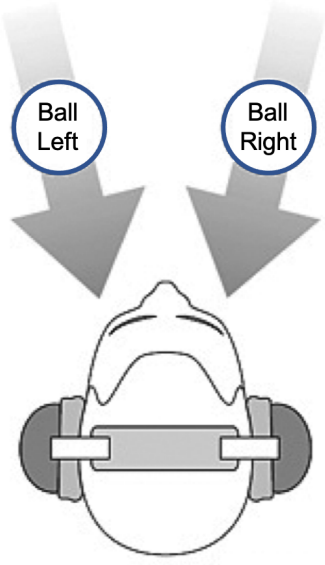
Maneuvering flight. AOA should be adjusted using pitch inputs regardless of attitude (Fig 2). Unless a negative energy state is desired, maintain ONSPEED AOA or faster for maneuvering. Fig 3 shows the ONSPEED band overlaid on the flight envelope.

Low Altitude Power Loss. Maintain an ONSPEED condition for best overall glide, turn and energy performance for emergency landing.

Stall Warning. A minimum of 1.5 to 2° actual AOA warning is desired. This is depicted by the dashed red line in Figure 5. This correlates with FAR 23 "not less than 5 knots of warning" at 1G. Warning is a 22 pulse per second 1600 Hz tone. Volume automatically increases as the airplane decelerates into the slow tone and approaches stall. The red chevron on the optional visual display flashes during stall warning.

3d Audio

If equipped with a stereo intercom or audio mixer, the tone pattern moves left and right in the sound field with the slip/skid ball. The pilot "steps on the tone" to coordinate rudder.



Overload Warning System (OWS)

"G LIMIT" voice warning occurs when the airplane reaches programmed limits. If the airplane is rolling under G greater than 15°/sec (default), allowable G is reduced by 33%. This is referred to as "asymmetric maneuvering" or "rolling G." Asymmetric G limits are not usually published by the manufacturer. 33% is the maximum reduction in allowable G permitted by FAR 23 design criteria. If roll rate is less than 15°/sec, "symmetric" (published) G limits are applied. Roll rate can be adjusted. Do not exceed 20% of maximum roll rate.

Airspeed Warning

A chime is heard at V_{NO} (maximum structural cruising speed, top of the green arc on a properly marked airspeed indicator). Chime interval is pilot selectable.

NORMAL PROCEDURES

1. Appropriate bus switch – ON
2. Volume – ADJUST
    a. Flashing LED normal
3. Disable tone – SHORT PUSH
    a. "ONSPEED DISABLED" warning
    b. LED extinguishes
4. Enable tone – SHORT PUSH
    a. "ONSPEED ENABLED" warning
    b. LED flashes
5. Insert Data Mark – LONG PUSH
    a. "DATA MARK" warning

M5 OPTIONAL VISUAL DISPLAY NORMAL CHECKLIST

1. Brightness – AS DESIRED
    a. Bright – Right button PRESS
    b. Dim – Left button PRESS
2. Display – SELECT
    a. Center button – PRESS to cycle

CONNECT TO WIFI GATEWAY

1. Power – APPLY
    a. Appropriate bus switch – ON, or
    b. Battery or USB port on a laptop computer – CONNECT to micro-USB port on the FlyONSPEED box
2. Connect to ONSPEED network
    a. Password – angleofattack
3. Open browser
    a. Address: Onspeed.local

WIFI POST-FLIGHT DATA DOWNLOAD

1. Connect to WiFi Gateway
2. Select TOOLS > LOG FILES
3. SINGLE CLICK on file to download
    a. File downloads to browser at 5 MB/min
    b. LED "freezes" during download (off or on)

DELETE LOG FILES

1. Connect to WiFi Gateway
2. Select TOOLS > FORMAT SD CARD

TURN DATA LOGGING ON/OFF

1. Connect to WiFi Gateway
2. Select SETTINGS > SYSTEM CONFIGURATION
    a. Scroll to "SD Card Logging"
    b. ENABLE or DISABLE
3. Red SAVE Button at bottom of page – SELECT

ABNORMAL PROCEDURES

HARD REBOOT

1. 1 Amp Circuit breaker - CYCLE

SOFT REBOOT

1. Connect to ONSPEED network
    a. Password – angleofattack
2. Open browser
    a. Address: Onspeed.local
3. TOOLS > REBOOT

ARDUINO/TEENSYDUINO IDE SET-UP CHECKLIST

CAUTION: newer versions of software have not been tested. Do NOT change TX buffer size.

1. Install Arduino 1.8.16 software: www.arduino.cc/en/software/OldSoftwareReleases.
2. Open Arduino software > SAVE FILE > close
3. Install Teensyduino 1.55 software.
    a. For Windows: www.pjrc.com/teensy/td_155/TeensyduinoInstall.exe
    b. For Mac: www.pjrc.com/teensy/td_155/TeensyduinoInstall.dmg
4. Increase RX buffer size available to the PRJC Teensy 3.6 to 8192.

Windows:

a. C:\ProgramFiles(x86)\Arduino\hardware\teensy\avr\cores\teensy3\serial1.c
b. Scroll down to serial1
c. Change permissions: Right click > PROPERTIES > SECURITY. Select USER. Select EDIT. Add checkmarks in all Permissions. Select OK.
d. Change
    a. #define SERIAL1_RX_BUFFER_SIZE 64
    b. To
    c. #define SERIAL1_RX_BUFFER_SIZE 8192
    d. Save text file
    e. Repeat for serial2.c, serial3.c and serial4.c files

Mac:

a. Applications > Teensyduino, right click > Show Package Contents
b. Contents > Java > hardware > teensy > avr > cores > teensy3
c. Scroll down to serial1.c
d. Right click on serial 1.c
e. Select OPEN WITH TextEdit
f. Change
    i. #define SERIAL1_RX_BUFFER_SIZE 64
    ii. To
    iii. #define SERIAL1_RX_BUFFER_SIZE 8192
    iv. Save text file
    v. Repeat for serial2.c, serial3.c and serial4.c files

5. The basic Arduino/Teensyduino IDE software installation is now complete.

DOWNLOAD ONSPEED SOFTWARE AND FIRMWARE FROM GITHUB

Current system software and firmware is distributed via GitHub.

CAUTION: Delete/replace "libraries" folder with each update. Do not copy/paste.

1. www.github.com/flyonspeed/OnSpeed-Gen2
2. Click green CODE button
3. Download zipped file
4. Move downloaded file to desired location and unzip
    a. Folder named OnSpeed-Gen2-master will be created.
5. Open the SOFTWARE folder inside the OnSpeed-Gen2-master folder
    a. Open the ARDUINO folder
6. Navigate to DOCUMENTS using File Explorer (Windows) or Finder (Mac)
    a. Open the ARDUINO folder
    b. Find the LIBRARES folder
        i. Delete the current LIBRARIES folder
        ii. Move new LIBRARIES folder from the SOFTWARE folder into the ARDUINO folder in Documents

PRJC TEENSY 3.6 SOFTWARE SETTINGS

1. OnSpeed-Gen2-master folder
    a. SOFTWARE > OnSpeedTeensy_AHRS folder
    b. Scroll down to OnSpeedTeensy_AHRS.ino file
    c. Click on the file: The Arduino/Teensyduino IDE opens
        i. Change settings prior to upload, as required

"//" = "comment out" or "turned off"

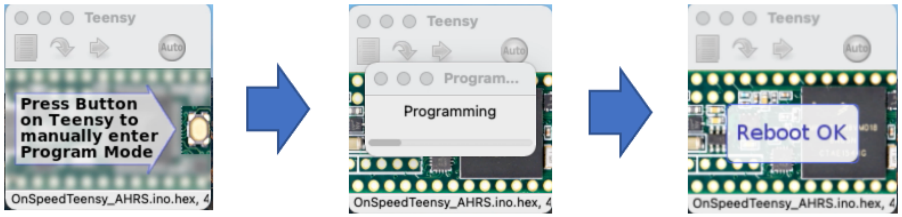
LOGDATA_PRESSURE_RATE	50Hz (normal) data recording rate.
//LOGDATA_IMU_RATE	208Hz data recording rate. Test use only.
//IMUTYPE_LSM9DS1	Original 9-DOF IMU (not suitable for IMU-based auto calibration)
IMUTYPE_ISM330DHCX	New 6-DOF IMU (required for IMU-based auto calibration)
NOBOOMCHECKSUM	Required for SpinGarage Featherweight Air Data Boom with unmodified software (as delivered from factory). Comment out for modified boom firmware. Test use only.
ASYMMETRIC_GYRO_LIMIT	Roll rate in deg/sec to establish an asymmetric G condition (15°/sec default, ≤ 20% max roll rate)
log raw counts for boom	If these lines are commented in, alpha, beta, dynamic and static pressure are recorded as raw counts. Test use only.

PRJC TEENSY 3.6 UPDATE (Via Cable)

CAUTION: If cable is disconnected during upload sequence, it will be necessary to disassemble the ONSPEED box and press the reset key.

NOTE: During upload, LED freezes (on or off). This is normal. LED operation will resume after reboot at end of upload.

2. OnSpeed-Gen2-master folder
    a. SOFTWARE > OnSpeedTeensy_AHRS folder
    b. Scroll down to OnSpeedTeensy_AHRS.ino file
    c. Click on the file: The Arduino/Teensyduino IDE opens
3. Set board to Teensy 3.6
    a. Tools > Boards > Teensyduino > Teensy 3.6
    b. USB TYPE: Serial
    c. CPU SPEED: 180 MHz
    d. OPTIMIZE: Faster
4. Connect the laptop to the ONSPEED micro-USB port using cable
    a. LED pulses
5. UPLOAD (Sketch > Upload or Green circled arrow button)
    a. Software COMPILES and then UPLOADS. Progress bar in the lower green bar at the bottom of the Teensyduino window. Compiling and uploading may take up to two minutes.
    b. The Teensy boot loader icon appears during load in a separate window. It also shows load progress.



5. "Done Uploading" appears on the left side of the lower green band in the Arduino/Teensyduino window. Reboot OK appears on the Teensy boot loader app window and normal pulsing LED operation resumes when upload is complete.
6. Disconnect cable

OnSpeed_AHRS Fails to Compile

1. Ensure cable is connected correctly.
2. Try upload again.
3. Check board type is set correctly.
4. Verify Libraries folder in Documents was updated.

ONSPEED WiFi GATEWAY FIRMWARE UPDATE (Via WiFi)

CAUTION: Only one device should be connected to the ONSPEED network at a time. Disable WiFi on other devices in range.

NOTES: WiFi updates use .bin file downloaded from GitHub in the ONSPEED SOFTWARE folder. **It is *not* necessary to use the Arduino/Teensyduino IDE to update.** On Macs, .bin files have a zip file icon. This is normal.

1. Power up the ONSPEED system using ship's power, a laptop or battery connected to the micro-USB port.
2. Connect to ONSPEED network
    a. Password: angleofattack
3. Open internet browser on laptop
    a. For Windows: type 198.163.0.1 in the address line
    b. For Mac: type onspeed.local in the address line
4. The ONSPEED WiFi Gateway home page opens
5. Select TOOLS > UPGRADE WIFI
    a. Select CHOOSE FILE
        i. OnSpeed-Gen2-master folder > SOFTWARE folder > OnSpeedWiFi folder
        ii. Select OnSpeedWiFi.ino.pico32.bin file
    b. Select UPLOAD
        i. May take up to 60 seconds. Progress bar will appear. Be patient.
        ii. If web page locks, refresh
6. Teensy and WiFi version numbers appear on the top line of the ONSPEED WiFi Gateway home page.
7. Reboot system by removing power after updating Firmware.

OPTIONAL M5 VISUAL DISPLAY FIRMWARE UPDATE (Via WiFi)

NOTES: WiFi updates use .bin file downloaded from GitHub in the ONSPEED SOFTWARE folder. **It is *not* necessary to use the Arduino/Teensyduino IDE to update.** On Macs, .bin files have a zip file icon. This is normal.

1. Power up the M5 Display using ship's power, a laptop or battery connected to the USB-C port on the left side of the display.
2. Momentarily press the red reset button on the left side of the display
    a. System reboots
    b. Fly ONSPEED Display opens for 3 seconds
3. Press center button within 3 seconds
    a. The FIRMWARE UPGRADE SERVER display opens
    b. Software version displayed in lower left screen
4. Connect the laptop to the OnSpeedDisplay network
    a. Password: angleofattack
5. Open internet browser on laptop
    a. For Windows: Type 192.168.0.2 in the address line
    b. For Mac: Type display.local/upgrade in the address line
6. The M5 Display WiFi upgrade page opens
    a. Select CHOOSE FILE
        i. OnSpeed-Gen2-master folder > SOFTWARE > OnSpeed_M5_display folder

ii. Select OnSpeed_M5_display.ino.m5stack_core_esp32.bin file

b. Select UPLOAD
   i. Monitor upload progress on M5 display. Upload takes 30-40 seconds. Be patient.

7. Display reboots when upload is complete. If the ONSPEED box is also powered, a normal display will appear. If only the M5 display is powered, a "NO DATA" with red X display will appear.

SYSTEM CONFIGURATION SET-UP CHECKLIST

NOTE: Build a flap curve for each flap setting used. The system accommodates up to five flap positions. If EFIS data recording isn't required/desired for flight test, recording should be DISABLED since the SD card will eventually fill up and testing with a full card hasn't been conducted.

1. Connect to WiFi Gateway
   a. Master Switch – ON
   b. Appropriate bus switch – ON, or
   c. Battery or laptop – CONNECT to micro-USB port on FlyONSPEED box
2. Connect to ONSPEED network
   a. Password: angleofattack
3. Open browser
   a. Address: onspeed.local (Apple) or 192.168.0.1 (Windows/android)
4. Select SETTINGS > SYSTM CONFIGURATION
   a. AOA Smoothing: 10
   b. Pressure Smoothing: 15
   c. Data source: Sensors (default)
   d. Flap Curve 1
      i. Flaps UP, enter degrees
      ii. Simulate air load on flaps by lifting the trailing edge of flaps
      iii. Sensor Value READ
      iv. Verify SENSOR VALUE window populates
         1. Specific value varies
   e. ADD NEW FLAP POSITION, as required
   f. Repeat procedure in (d) above, as required
   g. Flight Test Boom: DISABLED (unless equipped)
   h. Airspeed Calibration: DISABLED
      i. This is an advanced function used for flight test or to adjust IAS on the optional visual display.
      ii. Enabling airspeed calibration will open correction curve windows.
   i. Pressure Ports Orientation (direction the quick release pressure ports are pointing)
      i. UP, DOWN, LEFT, RIGHT, FORWARD, AFT, as appropriate
   j. Box Top Orientation (direction the top of the box is pointing)
      i. UP, DOWN, LEFT, RIGHT, FORWARD, AFT, as appropriate
   k. Serial EFIS Data: AS DESIRED
   l. EFIS TYPE: SELECT
   m. Calibration Data Source: AS DESIRED
      i. EFIS Recommended, if equipped. EFIS should be aligned with fuselage reference line.
   n. Volume Potentiometer: ENABLED
      i. Low Vol. Value
         1. Twist knob full counterclockwise and READ
      ii. High Vol. Value
         1. Twist knob full clockwise and READ
   o. Mute Below IAS (KTS): AS DESIRED
      i. Not more than V_R (rotation speed) -10 KTS recommended
   p. 3D Audio: AS DESIRED

q. Positive G Limit: AS DESIRED
    i. Positive G limit -0.5 G recommended
r. Negative G Limit: AS DESIRED
    i. Negative G limit +0.5 G recommended
s. V_{NO} Warning Chime (KTS): AS DESIRED
t. Serial Out Format: ONSPEED
u. Serial Out Port: AS DESIRED
    i. Optional modified M5 Visual Display requires output from Serial 3 in RS-232 format
    ii. Serial 1 is not applicable for V3 hardware.
v. SAVE settings

SENSOR CALIBRATION CHECKLIST

CAUTION: Prior to performing sensor calibration, confirm ONSPEED box orientation settings in the SYSTEMS CONFIGURATION menu are correct (See SYSTEM CONFIGURATION SET-UP CHECKLIST).

NOTES: No-wind conditions or aircraft in closed hangar. 10 Minute system warm-up. Required for initial installation. Recommended with software update.

The following measurements are necessary:

Pitch	_____	(deg)
Roll	_____	(deg, - for left, + for right)
Pressure altitude	_____	(ft)

- Pitch: digital level on the fuselage reference line (FRL) used for leveling when weighing the aircraft. Set EFIS pitch equal to FRL reading (if equipped).
- Roll: digital laterally across the cockpit
- Pressure altitude: set the altimeter to 29.92.

1. Connect to WiFi Gateway
    a. Master Switch – ON
    b. Appropriate bus switch – ON, or
    c. Battery or laptop – CONNECT to micro-USB port on FlyONSPEED box
2. Connect to ONSPEED network
    a. Password: angleofattack
3. Open browser
    a. Address: onspeed.local (Apple) or 192.168.0.1 (Windows/android)
4. Select SETTINGS
5. Select SENSOR CALIBRATION
    a. Enter Pitch
    b. Enter Roll
    c. Enter Pressure Altitude
6. Red Calibrate Sensors Button – SELECT
    a. System will calibrate sensors and output bias data. To verify new calibration: select SETTINGS > SENSOR CALIBRATION and verify pitch, roll, and pressure altitude are nearly identical to what was input during calibration. Exit the page when complete.

AOA CALIBRATION CHECKLIST

WARNINGS: Calibration requires a fall stall. Recover at or above 1500’ AGL. Aircraft loaded within weight and balance limits. Hand fly (no autopilot).

CAUTION: Sensor calibration must be complete before in-flight calibration (See SENSOR CONFIGURATION SET-UP). Consider using an assistant.

NOTES: Align EFIS zero pitch with fuselage reference line If using EFIS as calibration source. Disable screen lock on phone/tablet: airplane mode, WiFi ON, Bluetooth OFF. Smooth air. Not necessary to maintain precise altitude, $\pm$ 500’. Do NOT chase deceleration arrow: Prioritize a smooth increase in pitch over deceleration rate.

1. Climb to test altitude
2. Optional M5 visual indicator, center button: DECELERATION display.
3. Connect to ONSPEED WiFi Gateway
    a. Phone/Tablet set-up: Airplane mode, Bluetooth OFF, WiFi ON, screen lock DISABLE
    b. Network: ONSPEED
    c. Password: angleofattack
    d. Open Browser
        i. Address: onspeed.local (Apple) or 192.168.0.1 (Windows/android)
4. Select SETTINGS > SYSTEM CONFIGURATION
    a. If EFIS equipped: Select EFIS as calibration source (scroll down)
    b. Scroll to Flap Curve 1
    c. Flaps UP
    d. Flap position READ
    e. Slow to V_{FE} or less and **repeat for each flap setting**
    f. Scroll to bottom of SYSTEM CONFIGURATION page: select red SAVE button
    g. Verify Configuration Saved
5. Select SETTINGS > AOA CALIBRATION WIZARD
    a. Enter max gross weight
    b. Enter test gross weight
    c. Enter flaps up best glide speed (KIAS)
    d. Enter positive G limit
    e. Select CONTINUE
6. Review calibration instructions
    a. Select CONTINUE
7. Establish a trimmed condition at V_{NO}.
    a. If airplane cannot achieve V_{NO} in level flight, accelerate to V_{MAX} (level maximum speed, wide-open-throttle)
8. Select RECORD
    a. Button changes to red and says STOP! when calibration logic is active.
9. Smoothly reduce throttle to IDLE
10. Smoothly increase pitch as airplane decelerates to stall:
    a. Smoothly increase pitch using primarily visual references.
    b. It is NOT necessary to maintain precise altitude.
        i. $\pm$ 500 feet of start altitude is sufficient, airplane may climb or descend during calibration
    c. **Do not chase deceleration rate**. Steadily increase back pressure as airplane slows. Be patient.
        i. Arrow will NOT be in the green band during initial deceleration, that's fine
        ii. The **rate** at which you pull back increases as the airplane slows down
    d. Stop trimming no later than 1.3 x V_S and use back pressure to stall.
    e. Turn off deceleration display and hold altitude using steadily increase back pressure if difficulty is encountered.
11. When stall is detected, the red STOP! Button will change back to a blue RECORD button and lower portion of page will populate.
    a. Screenshot calibration results
    b. SAVE DATA TO FILE
    c. SAVE CALIBRATION, as desired after assessment

ASSESS QUALITY OF CALIBRATION

1. R^2 value .98 or higher.
2. Relatively smooth line on graph.
3. Concave curve or linear trend line.
4. Repeat until good calibration is achieved.

ASSESS QUALITY OF SETPOINTS

1. Check fast tone starts at Flaps UP L/D_{MAX}
2. Check stall warning provides at least 5 kts/mph warning at 1G
3. Check ONSPEED band captures 1.3 x stall speed

4. Repeat assessment for each flap curve
5. To assess the quality of a set point
    a. Slowly decelerate to set point (start of fast tone, ONSPEED fast, ONSPEED slow or stall warning)
        i. Use very slow declaration rate (1/2 kt per second or less)
        ii. Compare tone change with IAS
    b. Slow below set point and slowly accelerate to check tone changes at desired airspeed.
        i. Compare tone change with IAS
    c. Repeat, as desired

ADJUST SET POINT METHOD 1 (Read Live AOA)

1. Connect to ONSPEED WiFi Gateway
    a. Network: ONSPEED
    b. Password: angleofattack
    c. Open browser, Address: onspeed.local (Apple) or 198.168.0.1 (Windows/android)
2. Select SETTINGS > SYSTEM CONFIGURATION
3. Scroll to flap curve appropriate for configuration
4. Establish trim condition
    a. Desired airspeed at 1G, aircraft trimmed: speed, altitude and power stable
5. Press USE LIVE AOA button
    a. System will input measured AOA at trim condition
6. Scroll to bottom of SYSTEM CONFIGURATION page and press SAVE

ADJUST SETPOINT METHOD 2 (Adjust AOA Angle)

1. Connect to ONSPEED WiFi Gateway
    a. Network: ONSPEED
    b. Password: angleofattack
    c. Open browser, Address: onspeed.local (Apple) or 198.168.0.1 (Windows/android)
2. Select SETTINGS
3. Select SYSTEM CONFIGURATION
4. Scroll to flap curve appropriate for configuration
    a. Adjust angle down for faster or up for slower for desired set point
        i. Try .1 deg adjustment per KT at L/D_{MAX} and .2-.3° ONSPEED or STALL WARNING
            1. Decrease angle for faster
            2. Increase angle for slower
            3. As speed approaches ONSPEED/stall, AOA increases rapidly, so a larger change may be required
        ii. Stall warning of less than 5 KTS/MPH is not recommended
    b. Repeat as desired
5. Scroll to bottom of SYSTEM CONFIGURATION page and press SAVE