

# FlightView EFIS User Guide

Falken Avionics, LLC

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PLEASE CHECK BACK REGULARLY FOR UPDATES. IF YOU NEED  
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# FlightView Features & Functions

## Flight Instruments

- Altimeter
- Airspeed Indicator
- Attitude Indicator
- Slip / Skid Ball
- Heading Indicator (HSI)
- Ground Track
- Course Pointer
- Course Deviation Indicator
- Outside Air Temperature
- True Airspeed
- Density Altitude
- Ground Speed
- GPS Altitude
- Local and Zulu Time
- Flight Duration

## Engine Instruments

- RPM
- Manifold Pressure
- Oil Pressure
- Oil Temperature
- Cylinder Head Temperature (CHT)
- Exhaust Gas Temperature (EGT)
- Voltage
- Amperage
- Fuel Level (Left / Right)
- Fuel Pressure
- Fuel Flow
- Fuel Totalizer

## Transponder

- Set squawk code
- IDENT
- Change operating mode
- Altitude encoder

## VFR Navigation

- Moving Map
- Nearest Airport Navigation
- Direct-To Navigation
- Flight Plan Navigation
- Database of US Airports, Navigation Aids, Waypoints
- NMEA output to popular autopilots
- ETA / ETE estimator
- Automated waypoint / destination briefing

## Situational Awareness Features

- Air Traffic (ADS-B)
- Traffic Alert
- NEXRAD Weather Radar (ADS-B)
- Terrain Profile View
- Terrain Alert / Warning
- Airspace Map Display
- Current / Upcoming Airspace
- Runway Assistant
- Fuel Tank Switch Reminder
- Engine Anomaly Alert
- Runway Incursion Alert
- Descent Rate Alert
- Airspeed Decay Alert
- Altitude Alert
- Unusual Attitude Alert

## VHF Communications

- Nearest airport frequency
- Flight-plan airport frequencies
- Recent frequencies
- One-touch for active airport

## FlightView EFIS User Guide



FlightBox Pro, FlightBox EM, FlightBox ADC



Core system with display in a Ram mount.



FlightView installed in an RV-6A.

## About FlightView

Welcome, and thank you very much for using FlightView. This guide is intended to help you install, configure, and fly with FlightView. Before we jump into the technical details we need to cover a bit of important background information.

## How FlightView Differs

The term EFIS (Electronic Flight Information System) is applied to a wide variety of products. Some are basically attitude indicators with a few auxiliary functions. Others include a much broader feature set. FlightView fits into the latter category. It incorporates a full set of flight instruments, navigation tools, engine management utilities, and situational awareness functions that together make up an “operating system” for an airplane.

FlightView continually collects and processes data from a network of sensors, receivers, and databases. The data is processed by the Flight Data Computer - the central hub of the system - and then distributed to displays, recorders, annunciators, and various legacy avionics components.

## What FlightView Is Not

FlightView is sometimes mistaken for an Electronic Flight Bag (EFB) application. While it does share some functionality with popular EFB apps, the FlightView application is fundamentally different. Where EFB apps focus on flight planning and aeronautical information, FlightView focuses on flight operations and real time decision making. Most users will probably want to use both FlightView and an EFB application.

## System Overview

### FlightView App

FlightView is an iPad application. When used with FlightBox Pro and FlightBox ADC, it converts an Apple iPad into a flight display system, providing a complete set of flight and engine instruments, VFR navigation capabilities, and controls for popular COM radios. When used with FlightBox EMS or a compatible third-party system, it also displays EMS data. FlightView communicates with the rest of the system over a Wifi and / or wired Ethernet connection. FlightView is available from the App Store.

Because FlightView is simply an app running on an iPad, you can easily add multiple displays to your aircraft. Purchase an additional iPad from Apple or an Apple reseller and install the application. The FlightView system currently supports up to three active FlightView displays plus two devices running EFB applications.

## FlightBox Pro

FlightBox Pro<sup>1</sup> is the hub or core of the system. It receives data from many different sources and relays that data to the FlightView displays. FlightBox Pro includes a dual-band ADS-B receiver, AHRS (attitude) sensor, and barometric altimeter. A USB GPS receiver is included with each Pro, offering super-precise WAAS position information<sup>2</sup>. Additional devices such as air data computers, engine monitors, radios, and transponders are connected to the Pro through simple USB connections.

## FlightBox ADC

The FlightBox Air Data Computer (ADC) connects to your aircraft's pitot and static sources to measure airspeed, altitude, and outside air temperature. FlightView uses the data from the ADC to calculate true airspeed and density altitude. The ADC also includes a magnetometer (digital compass) that provides magnetic heading information. A FlightView installation may include up to two ADC units for redundancy.

## FlightBox EMS

The FlightBox Engine Monitoring System (EMS) connects to standard engine probes to provide a full set of engine information including RPM, manifold pressure, oil temperature and pressure, voltage, amperage, fuel pressure, flow, and level, and up to 8 channels each of exhaust gas temperature (EGT) and cylinder head temperature (CHT).

## Third Party Components

FlightView supports a number of popular third-party systems. Most third party interfaces require only a FlightLink USB-to-RS232 cable. Supported systems include:

---

<sup>1</sup> The FlightBox Pro model used in the FlightView system is technically the "FlightBox Pro EXP", which is only intended for use in Experimental aircraft.

<sup>2</sup> The GPS included with the FlightView system is WAAS augmented and typically accurate to within 3 meters. However it does not meet the requirements for use as an ADS-B Out position source.

## Autopilots

FlightView can send navigation data to any autopilot that supports industry-standard NMEA commands. Deeper integration and full remote control functionality is available for TruTrak / BendixKing autopilots.

## COM Radios

FlightView can automatically tune many popular COM radios that support the “SL-30/40” serial command set. This includes Garmin’s SL-30, SL-40 and GTR-200 series, but also includes radios from VAL, Trig, and other manufacturers.

## Transponders

FlightView is currently compatible with transponders from Trig, Dynon, and uAvionix. The transponder interface allows you to set the squawk code, change the operating mode, and trigger an IDENT directly from the FlightView interface.

For aircraft with legacy transponders that support RS-232 input, FlightView can replace an altitude encoder<sup>3</sup>, sending data over a FlightLink cable in industry-standard Icarus format.

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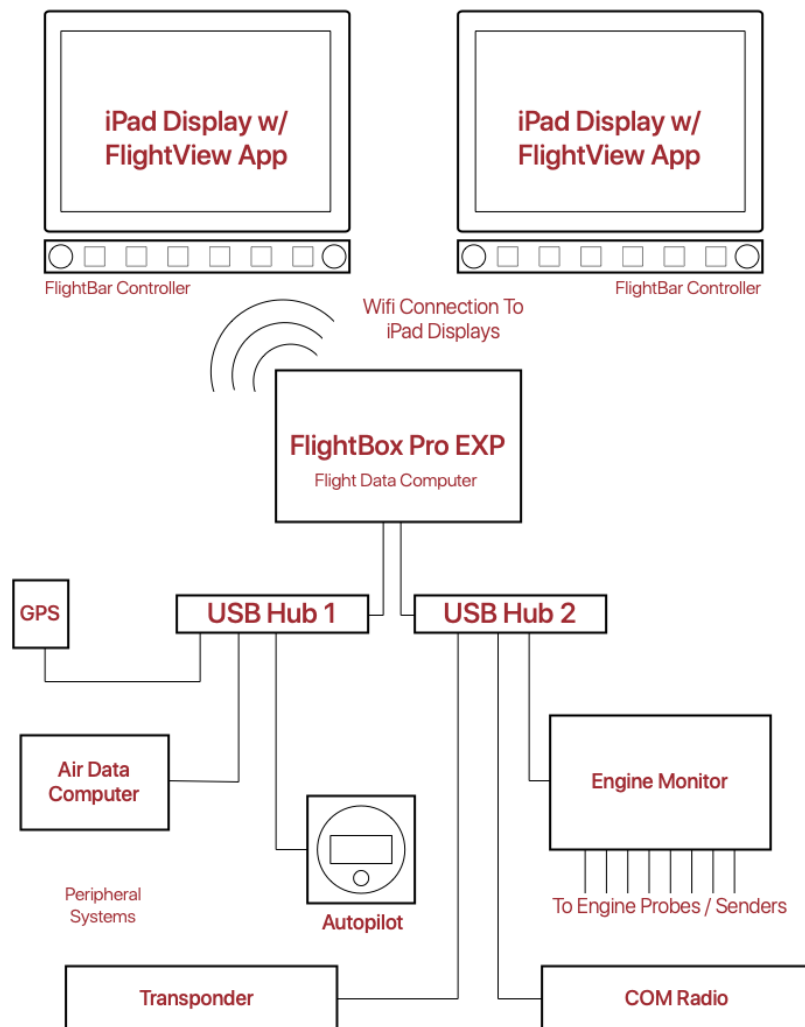
<sup>3</sup> Depending on the source of air data. The current Falken Avionics ADC does not tie into the static system and therefore may not qualify as a legal source of altitude information.

# Part I: Planning Your System

## FlightView Architecture

The FlightView system is made up of three major components:

1. Display: iPad w/ FlightView App
2. Flight Data Computer: FlightBox Pro
3. Peripherals: ADC, EMS, autopilot, radios, etc.



## What Components Do You Need?

### Core System

A minimal FlightView system consists of an iPad and a FlightBox Pro (flight data computer) with a USB GPS receiver and an Air Data Computer (ADC) which provides information from the pitot / static system. The ADC and the GPS both connect to the FlightBox Pro via USB. Additional devices can be connected using a standard USB 2.x hub.

### Engine Monitor

Most installations also include an engine monitor. FlightView supports the FlightBox EMS engine monitor which currently works with all traditional (Lycoming, Continental) aircraft engines and most auto-conversions. Work is underway to add support for newer aircraft engines with Electronic Control Units (ECU) including Rotax and UL Power engines.

### iPad Mount

Most installations will require a mount for the iPad. The system will work with virtually any iPad mount, but Falken Avionics recommends the use of a mount with active cooling. Apple builds iPads to operate in a specific and rather narrow range of temperatures (32°F - 95°F). Active cooling helps prevent the iPad from overheating and shutting down. Three options for mounts with active cooling are:

1. Falken Avionics FlightDock - permanent mount
2. Guardian Flush Mounts - permanent mount, requires a separate avionics fan
3. X-Naut Active Cooling Mount - portable mount

### FlightLink Integrations

The FlightView system supports connections to a number of third party peripherals including COM radios, autopilots, ELTs, transponders, and UAT ADS-B transmitters. These devices all integrate using FlightLink cables which connect to RS-232 ports / pins on the peripherals and to USB ports on the FlightBox (or an attached USB hub).

### FlightBar - Tactile Controls

FlightView is built to take advantage of the power of the iPad's multi-touch interface. However, in turbulent conditions using a touch screen can be challenging. Falken Avionics offers a companion product called FlightBar that adds two knobs and six "hard" buttons.



## Display (iPad) Selection

FlightView supports any iPad model capable of running iOS 13 or later. It is recommended that users avoid models released prior to 2017 as those older systems are quite slow, which can degrade the performance of FlightView.

## Engine Probes / Senders

Installations that include the Falken Avionics engine monitor will also require a set of engine probes and senders. These can include thermocouples for exhaust gas temperature (EGT) and cylinder head temperature (CHT); oil pressure and temperature sensors fuel pressure, flow, and level senders; amperage shunt; manifold pressure sensor.

Note that most installations will also require some number of additional parts including thermocouple wire, adel clamps, terminal strips, ferrules, and standard hardware (screws, nuts, etc.) to complete the installation.

## Backup Flight Instruments

As with any EFIS, it is strongly suggested that aircraft equipped with FlightView also include appropriate backup instrumentation. At a minimum, a secondary source of altitude and airspeed is recommended.

# Part II: Hardware Installation

## Installing Core Components

The following sections describe installing the core components of FlightView. These include the FlightView App, FlightBox Pro, ADS-B Antennas, FlightBox ADC, and optional components.

### Installing FlightBox Pro

FlightBox Pro serves as the core or hub of the FlightView system. It includes a set of receivers, sensors, and interfaces that provides data to and accepts commands from the FlightView display application. As was noted in the Planning Your System section, the FlightBox Pro uses a combination of Wifi, USB, and (optionally) Ethernet to communicate with other components of the FlightView system.



A FlightBox Pro Installation.

### Installation Procedure Overview

1. Find a suitable location for the FlightBox Pro.
2. Mount the FlightBox Pro to suitable secondary structure in the aircraft.
3. Mount and connect the ADS-B antenna(s).
4. Mount and connect the USB hub(s)
5. Mount and connect USB GPS receiver

### 6. Connect to ship's power

## Locating The FlightBox Pro

Install the FlightBox Pro in a location that:

- 1) Is square with the major axes of the aircraft (required for proper AHRS performance).
- 2) Provides adequate ventilation to the FlightBox (does not cover vents or fan)
- 3) Does not block the Wifi signal between the FlightBox Pro and the display(s).
- 4) Includes adequate space for the power connector, ADS-B antenna leads, and USB ports.

**Orientation:** The FlightBox Pro can be mounted in any orientation so long as the axes of the box are square (+/- ~5°) with the major axes of the aircraft.

**Weight:** The FlightBox Pro weighs approximately 12 ounces and can safely be mounted to virtually any available sub-structure.

**Accessibility:** As with any avionics component, mount the FlightBox Pro in such a way that it may be removed for service with minimal effort.

**RF Access:** The FlightBox Pro needs to have radio frequency access to the other components of the FlightView system. Do not mount it in a location that blocks radio frequency (RF) access. For example, do not place the system in the empennage of your aircraft if the empennage is isolated from the cabin by a metal door or access panel.

**Spacing For Connectors:** Allow approximately 2 inches of space on either side of the FlightBox Pro to allow for power, antenna, and USB connections and for ventilation.

## Mounting The FlightBox Pro

The FlightBox Pro is built to be mounted using four (4) standard #6 or #8 machine screws. The edge rails allow the screws to be mounted in convenient locations. Use either nut plates or locking nuts (Nylocs) to affix the system.

Because the FlightBox Pro contains the sensors for the AHRS, make sure that it is attached firmly to the aircraft's structure. If not, it may vibrate in a way that reduces the accuracy of the AHRS.

## Mounting and Connecting ADS-B Antennas

The FlightBox Pro connects with ADS-B antennas using standard SMA connectors. The system has two SMA female jacks - one for 1090 MHz and another for 978 MHz. These are typically connected to antennas in one of two ways.

### External ADS-B Antenna

The preferred method of connection is to use a single externally mounted L-band (transponder / DME / ADS-B) antenna which connects to the FlightBox Pro using a splitter.

#### ▲ IMPORTANT

Mount the ADS-B receiver antenna at least four (4) feet from any active (transmitting) L-band antennas. This includes any antenna connected to a transponder, DME, or ADS-B out transmitter. ADS-B receiver antennas mounted too close to transmitting antennas can block reception and may damage the receivers in your FlightBox system.

In this case follow the antenna manufacturer's instructions to safely install the antenna. Also order or fabricate the RG58 coaxial cable that connects the antenna (typically using a BNC connector) to the splitter. Two short SMA male to SMA male "pigtail" cables to connect the splitter to the SMA female jacks on the FlightBox Pro are also required.

#### Installation Process:

1. Mount antenna in accordance with manufacturer's instructions
2. Fabricate or purchase a length of RG58 coaxial cable to run from the antenna to the FlightBox Pro.
  - a. Use a connector appropriate to the antenna (typically BNC) on the antenna end of the cable.
  - b. Use a male SMA connector on the splitter end of the cable.
3. Connect the antenna to the splitter using the cable.
4. Connect the splitter to the 1090 MHz output on the splitter to the 1090 MHz input on the FlightBox Pro using an SMA male / SMA male pigtail cable.
5. Connect the splitter to the 978 MHz output on the splitter to the 978 MHz input on the FlightBox Pro using an SMA male / SMA male pigtail cable.

### Internally Mounted ADS-B Antennas

The other option for ADS-B reception is to use a set of internally (inside the cabin) mounted antennas connected to the SMA jacks on the FlightBox Pro. Falken Avionics offers a kit which includes the antennas, a mounting bracket, and extension cables to connect the antennas to the FlightBox Pro.

If the internally mounted antennas are used, place them in a location that provides line-of-sight access to ground towers and other aircraft - most commonly in or near a window. Due to the polarization of ADS-B signals, the antennas will need to be mounted vertically.

#### Installation Process:

1. Connect the antennas to the extension cables.
2. Mount the antennas in the mounting bracket.
3. Mount the mounting bracket in the aircraft, typically in a window or other location with acceptable reception from both ground and airborne transmitters.
4. Connect the extension cable from the 1090 MHz antenna to the 1090 MHz input on the FlightBox Pro.
5. Connect the extension cable from the 978 MHz antenna to the 978 MHz input on the FlightBox Pro.

*Pro Tip: mark the cables or the SMA connectors to indicate which goes to 1090 and which goes to 978.*

### Mount and Connect USB Hub(s)

FlightView uses USB connections to simplify the installation and connection process. The FlightBox Pro has two available USB ports. Since the typical installation requires more than two available ports, most require the use of a USB hub(s) to accommodate the additional peripheral devices. In most cases the hubs may be simple unpowered / bus-powered devices ( the hub(s) do not require a separate power input).

#### ▲ IMPORTANT

Note that the small unpowered hubs provided with the FlightView system **cannot** be used to power or charge iPads, phones, or other devices that draw significant current. They should **only** be used with the FlightLink connectors. Plugging a high-current device into an unpowered hub will cause the system to shut off the USB bus, disabling all connected devices including the GPS, ADC, and EMS.

Each FlightView system ships with a single unpowered four-port hub. (Additional hubs can be purchased from Falken Avionics or Amazon.com.) The included hub has a built-in 6" cable. The hub can be mounted several ways. In our experience it is generally best to bond the hub to a small section of aluminum L channel using double-sided tape. The aluminum channel can then be attached to aircraft substructure with #4 or #6 screws.

#### Installation Process:

1. Mount hub(s) to channel with heavy duty 3M double stick tape
2. Mount channel to aircraft secondary structure using standard aircraft hardware.
3. Connect USB cables to USB ports on the FlightBox Pro

### Pro Tip: USB Hubs

The four port mini USB hubs included with / sold by Falken Avionics for use with the FlightView system are great for installations that only require a limited number of FlightLink connections. More complex installations may require more USB ports. Users are welcome to source their own larger USB 2.x hub (**USB 3 hubs are NOT supported**).

Falken Avionics recommends using a powered hub for any installation that requires more than four FlightLink connections. Industrial USB hubs are available which can operate directly from ship's power (typically they can handle 9v - 36v). Industrial hubs typically include mounting flanges. Be sure to mount the hub in a way that leaves enough space for the FlightLink connectors.



*A Tripp Lite U223-007-IND 7-Port Rugged Industrial USB 2.0 Hi-Speed Hub*

FlightView has been tested with up to 14 total USB devices connected via two 7-port USB hubs, and with 10 devices connected using a single 10 port USB hub. Be sure to thoroughly test any new configuration prior to using it in flight.

## Mount And Connect GPS Receiver

The GPS receiver module included with FlightView needs to be mounted in a location that provides solid reception from overhead (satellite) transmitters. The most common location for this is on the glare shield, but other locations will also work. The cable from the receiver needs to be run to an available USB port on the FlightBox Pro or a USB hub connected to the FlightBox Pro.

The GPS receiver includes a 5' USB cable. If required, this can extend this an additional 6.6 feet (2 meters) using a standard USB extension cable. It is **not** recommended to use longer USB extension cables as the voltage drop will begin to impact GPS reception.

## Connect the FlightBox Pro To Ship's Power

The FlightBox Pro accepts DC power ranging from 12v to 28v. Like any avionics component, it should be connected to the avionics bus using its own circuit protective device (circuit breaker

or fuse). The system draws approximately 0.75 amps at 12v. It is recommended to use a 2 amp breaker or fuse and 22 AWG or greater aircraft wire.

### ▲ IMPORTANT

Falken Avionics recommends the use of a circuit breaker that can be manually opened / closed in flight. This includes various types of breaker switch, Klixon-style breakers, and breakers controlled by an electronic circuit breaker system like the Vertical Power VPX. The use of a manually controllable breaker allows you to power cycle the system, if necessary, without shutting off other avionics components.

### Installation Process

1. Install a 2 amp circuit protective device (fuse or circuit breaker) on the avionics bus.
2. Connect the black wire from the included FlightBox Pro power connector to a ground point.
3. Connect the red wire from the included Flight Box Pro EXP power connector to the circuit protective device.
4. Firmly insert the barrel of the power connector into the jack on the FlightBox Pro.
5. Tighten the barrel screw lock.

### Pro Tip: Powering The FlightBox Pro On The Bench

It is often useful to power up the FlightBox Pro and other components “on the bench” prior to installing them in the aircraft. This can easily be done using any reliable 12v - 28v power supply, including a car battery or [inexpensive benchtop supply](#). If you’re comfortable with electronics you can repurpose a 12v DC transformer as long as it can deliver 1 amp or more.

#### **DO NOT USE A CAR BATTERY CHARGER OR “MINDER”.**

To power up the system:

1. Determine which output from the power supply is positive (+) and which is negative (-).
2. Connect the positive (+) to the red lead on the FlightBox Pro wiring harness.
3. Connect the negative (-) to the black lead on the FlightBox Pro wiring harness.
4. Connect the wiring harness to the FlightBox Pro, making sure that it is fully inserted and the barrel screw lock is tightened.
5. Power on the DC power supply.



## Installing FlightBox ADC

FlightBox Air Data Computer (ADC) is the sensor module that relays air data (airspeed, altitude, outside air temperature, etc.) to the FlightView system. It also includes a compass module which will eventually be used to provide magnetic heading information. (The calibration routines for the compass module are currently under development and will be released at a later date.)



The ADC connects to the pitot and static lines on your aircraft to measure dynamic and static pressure. It includes a small probe which is installed through the hull or in an outside air vent to measure outside air temperature. It connects to FlightView using a FlightLink (USB / modular) cable.

Because the ADC also includes a compass module, we recommend mounting it in a location that has minimal magnetic interference - non ferrous metal (iron, steel) hardware or structure and no electrical

cabling.

### Power

The ADC is powered over the FlightLink connection by the FlightBox Pro or USB hub. The FlightLink cable used with the ADC includes a ferrite choke on the cable. Do not remove this as it may result in electromagnetic interference (EMI) which may impact VHF COM radios.

### Cable Length

The FlightLink cable included with the system is 6' in length. If a shorter cable is required, the cable may be shortened and a new RJ-12 6P6C jack may be crimped to the shortened cable. See the pinout diagram in Appendix X for details. If the cable is shortened or extended the ferrite choke must be re-attached as close to the RJ-12 plug as possible.

### USB Extension Cable

The use of a USB extension cable is discouraged. If a USB extension cable is used it must be connected to the FlightBox Pro using a powered USB hub. Failure to follow this requirement will result in the failure of the ADC and / or the FlightBox Pro. Note that the use of a USB extension cable may increase electromagnetic interference (EMI) which may impact VHF COM radios.



## Installation Process

1. If necessary, install adapter fittings in the pitot and static inputs on the ADC. The fittings are  $\frac{1}{8}$ " NPT. Adapter fittings are available for all commonly used pitot / static plumbing.
2. Mount the ADC to secondary aircraft structure, preferably in an area with little to no magnetic interference, using stainless or brass #6 screws.
3. Connect the pitot line to the pitot input on the ADC.
4. Connect the static line to the static input on the ADC.
5. Connect the modular plug on the ADC FlightLink cable to the jack marked "NET 1" on the ADC.
6. Connect the USB plug on the FlightLink cable to an available USB port on the FlightBox or a USB hub connected to the FlightBox.

## Installing The Engine Monitor

The FlightBox EMS is the data acquisition component of the FlightView engine monitor. It reads analog signals from the various engine probes and senders and converts them into a digital format that FlightView can analyze and display.

**NOTE: FlightBox EMS should only be mounted on the cold (cabin) side of the firewall. It is not rated to operate on the hot (engine) side, and may fail if exposed to the temperatures commonly found in that area.**

### Data Connection

FlightBox EMS connects with the FlightBox Pro using a FlightView EMS cable. Connect the RJ-12 plug to the NET1 or NET2 port on the EMS. Connect the USB plug to an available USB port on the FlightBox Pro or a USB hub connected to the FlightBox Pro.

**NOTE: Be very careful not to connect the FlightView ADC cable to the EMS. Doing so will back-feed ship's power to the FlightBox Pro, destroying it and all USB peripherals connected to it. This damage is not covered by the standard system warranty.**

### Power Connection

The FlightBox EMS requires a separate connection to ship's power and to ground. The device draws very little power and it is permissible to connect it to the same circuit breaker as the FlightBox Pro with the caveat that a failure in the EMS power wiring could result in the FlightBox Pro being powered off.

### EMS Probes

The FlightView EMS can connect with many off-the-shelf probes. Falken Avionics has tested a number of readily available probes and senders and have built calibration code into FlightView to match.

**NOTE: If your installation requires probes other than the standard probes listed below, you will need to create a custom calibration for your sensor. See Appendix A for details on custom calibrations.**

Tested probes for the engine monitor are sold by Aircraft Spruce. To order, use the part numbers listed below. (Prices listed are circa 2020 and are subject to change.)

## FlightView EFIS User Guide

Part Description	Spruce PN	Spruce Price ***
EGT Probe, Hose Clamp 0.7" - 1.25"	10-01171	\$36
EGT Probe, Hose Clamp 1.0" - 2.25"	10-01169	\$36
EGT Probe, Hose Clamp 1.0" - 1.75"	10-05079	\$36
CHT Probe, Bayonet Mount 3/8-24 UNF	10-01170	\$38
CHT Probe, Ring Terminal, 12mm	10-01845	\$25
Manifold Pressure Sensor, 0 - 60 InHg	10-01171	\$65
Oil Pressure Sensor, 0 - 150 psi	10-04823	\$86.75
Oil Temperature Sensor, 100 - 240F	10-01173	\$20.00
Fuel Pressure, Carbureted, 0 - 15 psi	10-04820	\$85.00

Fuel Pressure, Fuel Injected, 0 - 50 psi	10-04825	\$85.00
Amperage Shunt, 0 - 60 amps	10-01178	\$15.70
Fuel Flow Transducer, 0 - 70 gph	10-01196	\$194.00

## EMS DIP Switch Settings

The FlightBox EMS circuit board is equipped with a 10 position DIP switch block which enables / disables pull-up resistors for various inputs. DIP switches should be set prior to installation as the switch block is not easily accessible once the system has been mounted.

Generally speaking, a pull-up resistor is required for passive / resistive sensors - those that signal a value by varying the resistance. These are often "single wire" sensors, with the engine or airframe serving as the ground.

Generally speaking, pull-up resistors are not required for powered sensors. Powered sensors usually have three wires (power, ground, and sense). Many modern pressure sensors (oil pressure, manifold pressure, fuel pressure) and flow sensors are powered and do not require the pull-up to be enabled.

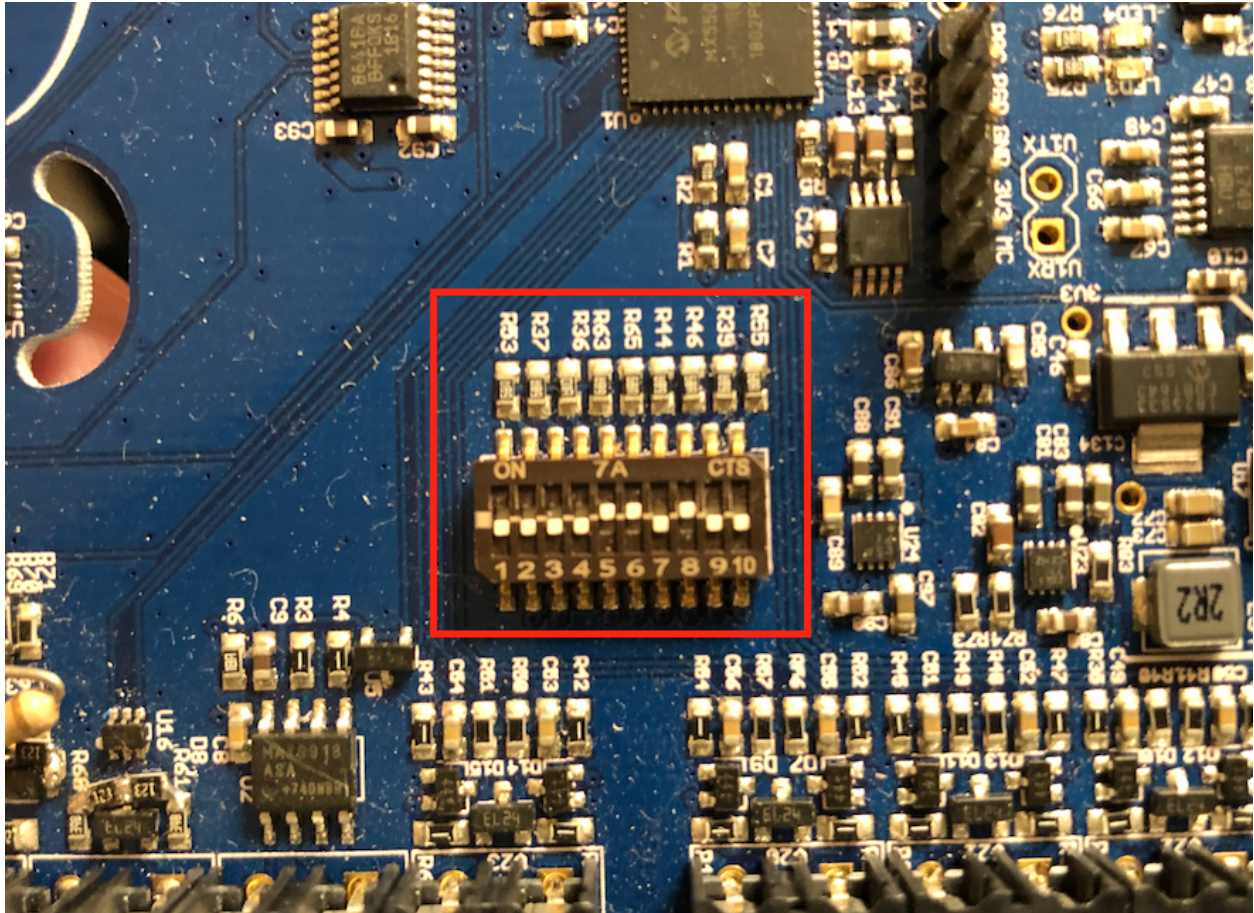
**NOTE: The system is shipped with the DIP switches set for use with the recommended set of sensors. Changes to the configuration are required only if using non-standard sensors. Contact Falken Avionics with any questions regarding DIP switch configuration.**

## Accessing The DIP Switch Block

To access the DIP switch block the top must be removed from the EMS. To do this, remove the four screws on the corners, then gently lift the narrow edge of the cover from the side opposite the power input and RJ-12 jacks. The cover should pop loose and slide over the connections at the opposite end.

## Adjusting The DIP Switches

The DIP switches are very small. To adjust them, use a fine-tip screwdriver, tooth pick, or similar to gently push the white switch tabs up / down as needed. Do not apply excessive pressure to the switch tabs as they could break.



DIP switches set to enable pull-up resistors for fuel L (5), fuel R (6), and oil temp (8).

## Switch Settings

Switch 1: Reserved - Do not change. Leave in the off position.

Switch 2: Fuel Pressure. Leave this in the default (OFF) position if using a Kavlico 5 volt pressure sensor. Switch this to the ON position only if using a resistive / passive pressure sensor.

Switch 3: Oil Pressure Pull Up - 500 ohms: Leave this in the default (OFF) position if using a Kavlico 5 volt pressure sensor. Switch this to the on position only if using a resistive / passive pressure sensor.

Switch 4: Oil Pressure Pull-Down - 100 ohms: Leave this in the default (OFF) position if using a Kavlico 5 volt pressure sensor. Switch this to the on position only if using a resistive / passive pressure sensor.

Switch 5: Fuel Level Left: Leave this in the default (ON) position if using a standard one-wire resistive float sender. Switch this to the OFF position only if using a powered sensor.

Switch 6: Fuel Level Right: Leave this in the default (ON) position if using a standard one-wire resistive float sender. Switch this to the OFF position only if using a powered sensor.

Switch 7: Manifold Pressure: Leave this in the default (OFF) position if using the standard GM 5 volt manifold pressure sensor. Switch this to the ON position only if using a passive sensor.

Switch 8: Oil Temperature: Leave this in the default (ON) position if using a standard one-wire resistive oil temperature sender. Switch this to the OFF position only if using a powered sensor.

Switch 9: AUX 1: Leave this in the default (OFF) position if using a powered sensor. Switch to the ON position if using a passive resistive sensor.

Switch 10: AUX 2: Leave this in the default (OFF) position if using a powered sensor. Switch to the ON position if using a passive resistive sensor.

## Locating The FlightBox EMS

FlightLink cables for FlightBox EMS are approximately six feet long. The FlightBox EMS must be located close enough to the FlightBox Pro (or to the USB hub connected to the FlightBox Pro) that the FlightView cable can reach. The use of USB extension cables is not recommended.

The location should allow access to the inputs on the outside of the chassis. Keeping a clear space of 1.5" - 3" around the perimeter of the FlightBox EMS will allow for easy access to the spring clip connectors used to connect probes and senders.

[ Image: FlightBox EMS mounted ]

## Mounting The FlightBox EMS

1. Attach the mounting feet to the FlightBox EMS using the provided #4-40 machine screws.
2. Mount the FlightBox EMS to secondary aircraft structure using #6 or #8 machine screws and either nutplates or locking ("nylock") nuts.

## Connecting The FlightBox EMS To Power

1. Connect the PWR + connection on the EMS to ship's power using a 1 amp circuit protective device. This may be on either the avionics or main bus.
2. Connect the PWR - connection on the EMS ***directly to either the negative (-) battery terminal or to an available grounding point on the engine.***

NOTE: Following step 2 step is critical - failure to create a "home run" ground link can result in inaccurate readings from sensors and probes.

[ Image: wiring diagram showing connection to aircraft power ]

## Installing Engine Probes

Most aircraft engine probes include installation instructions. I number of the senders / probes used with FlightView have been repurposed from the automotive industry and do not include installation guidance. The following general instructions should assist the installer. Please contact Falken Avionics or an EAA technical counselor for additional information and assistance in installing probes.

## Connecting Engine Probes To The FlightBox EMS

The design of FlightBox EMS is intended to eliminate some of the larger challenges that typically plague engine monitor installations. Rather than requiring the installer to fabricate a complex wiring harness using Sub-D connectors and pins, FlightBox EMS uses industrial spring clamp connectors. This makes the process of connecting a probe

### Use Aircraft-Grade Wire

As with all avionics, wires used to connect probes and senders to the EMS should be aircraft-grade, Tefzel-coated, and appropriately sized.

### Use Ferrules

It is recommended that the terminal ends of wires be crimped into a ferrule - a small metal band that strengthens the wire and makes it easier to insert it into the wire jacks on the FlightBox EMS.



Ferrules and a ferrule crimper can be purchased from a hardware store online retailer. A kit with the crimping tool and a large number of ferrules [can be found on Amazon.com](https://www.amazon.com) for as little as \$25.

### Inserting / Releasing Wires

The FlightBox EMS uses industrial spring clamp connectors to connect wires from sensors and probes. To connect a wire to a terminal, simply push the wire into the terminal socket. The wire will engage the spring clamps and be securely locked in place.

To release the wire, press the square release button located immediately above the wire and gently pull the wire out of the socket.

### Thermocouple Wire

Connections to thermocouples **must** use the appropriate thermocouple wire (there are different types) for all thermocouple connections. EGT probes use K type. CHT probes use J type. Failure to use the right type of wire will result in significant inaccuracies in the displayed temperature.

### 5 Volt Powered Probes

Several of the probes used with FlightBox EMS require a 5 volt excitation charge to operate. The FlightBox EMS provides a stable 5v source which can be used for this purpose. As most installations include several 5 volt sensors, it is recommended that the installer add a two pole terminal block or strip that can be used to connect multiple sensors.



The 5 volt port on the EMS includes both positive (+) and negative (-) terminals. It is highly recommended that the ground lines from all 5 volt sensors be connected to the EMS ground (-) terminal (by way of the terminal strip) rather than to the airframe or other grounding point. Using any other grounding point can result in erroneous readings, ground loops, and possibly damage to the sensors.

### Exhaust Gas Temperature Probes

Exhaust Gas Temperature (EGT) is measured using K-type thermocouples. Any properly made K type thermocouple may be used, including both grounded and ungrounded models. EGT probes built for use in aircraft are typically attached to each of the engine's exhaust outputs using a hose clamp mount.

#### Installation Overview

**Note:** *If manufacturer's instructions are available those should be used instead of this general procedure. Falken Avionics cannot be held responsible for any damage or injury that may occur as the result of improperly installed probes.*

The probes are installed by first drilling a hole in the exhaust manifold for each probe. Care should be taken that the holes are as small as possible (i.e. as close to the diameter of the probe as possible) to prevent exhaust leakage.

Holes should be drilled a minimum of two (2) inches from the cylinder head's exhaust port flange. For high compression engines use a minimum distance of five (5) inches.

Each hole should be located at the same distance from the exhaust port flange to maintain consistency in reporting. Any significant difference in the distance can impact readings.

#### General Installation Procedure

1. Locate the hole to allow enough clearance between the probe and any surrounding objects including the engine cowl.
2. Drill the hole.
3. Open the hose clamp and carefully insert the probe tip into the hole.
4. Re-join the clamp and tighten.
5. Use edel clamps to secure the probe wires.
6. Connect the wires from the probe to the FlightBox EMS using K-type thermocouple wire.
7. Connect the red lead from the probe to the appropriate TC - port on the EMS.
8. Connect the yellow lead from the probe to the appropriate TC + port on the EMS.

## Cylinder Head Temperature Probes

Cylinder Head Temperature (CHT) probes are J-type thermocouples. By default the first 8 TC ports on the EMS are configured for J type (CHT) connections. (This can be changed if needed.)

**Cylinder Head Well Probes** - Most purpose-built aircraft engine cylinders include well ports into which spring-loaded thermocouple probes may be installed. In some cases the probes screw directly into threads in the well, while in other cases an adapter is used to connect probes with bayonet connectors.

**Washer-Style Probes** - Auto conversions and some older aircraft engines do not have wells for probes. In this case the next best option is to use washer-style probes. These are mounted to the cylinder head under the spark plug.

**J-Type Thermocouple Wire Extensions** - In order for CHT sensors to operate properly they must be connected to the EMS using J-type thermocouple wire. It is acceptable to use crimp-on wire connectors (quick disconnect spade lugs) to connect probes. It is also acceptable (recommended) to use ferrules on the terminal end of the thermocouple wires. Do not attempt to solder thermocouple wires.

### General Installation Procedure

1. Install the CHT probe as is appropriate for the engine.
2. Use edel clamps to secure the probe wires.
3. Connect the wires from the probe to the FlightBox EMS using J-type thermocouple wire.
4. Connect the red lead from the probe to the appropriate TC - port on the EMS.
5. Connect the white lead from the probe to the appropriate TC + port on the EMS.

## Kavlico Fluid Pressure Sensors (Oil, Fuel)

Fluid pressure sensors are used to measure oil and fuel pressure. Most aircraft oil systems use a standard 150 PSI probe. Fuel systems, however, vary depending on the type of feed involved. Gravity fed fuel systems (typically found on high-wing aircraft) with carbureted intakes use a 0 - 5 PSI probe. Pump-fed fuel systems used on engines with carbureted intakes use a 0 - 15 PSI probe. Aircraft with fuel injected intakes commonly use a 0 - 50 PSI probe.

If in doubt what pressure rating to use, contact your kit manufacturer, engine manufacturer or an EAA technical counselor.

### Installation Overview

Pressure sensors should generally be connected to either a sensor manifold (see image below), mounting block, or to a dedicated spur line supported by an adel clamp. Pressure sensors should never be connected directly to the engine. Engine vibration can quickly damage the sensor and sensor failures can result in a loss of pressure. Loss of pressure on a fuel or oil line can result in injury or death.

[ Image: sensor manifold with Kavlico sensors installed ]

Where possible, sensors should be installed behind (in-line after) a flow restriction fitting. (Pressure sensors are not affected by changes in line diameter.) Incorporating a flow restriction point can prevent a catastrophic loss of fluid in the event of a sensor failure.

The Kavlico line of pressure sensors tested for use with FlightBox EMS are 5v powered devices and should only be powered from the 5v output on the FlightBox EMS. **Under no circumstances should they be connected directly to ship's power.**

### Installation Procedure

**Note:** *If manufacturer's instructions are available those should be used instead of this general procedure. Falken Avionics cannot be held responsible for any damage or injury that may occur as the result of improperly installed probes.*

1. Using appropriate aircraft (AN) fittings, connect the sensor to the manifold, mounting block, or spur line.
2. If using a spur line, secure it to the airframe using an adel clamp.
3. Connect the included wiring coupler to the sensor.
4. Connect the red wire to the 5 volt + port on the EMS.<sup>4</sup>
5. Connect the black wire to the 5v - port on the EMS.<sup>4</sup>
6. Connect the green wire to the PRES O or PRES F port on the EMS.

### Datcon Oil Temperature Sensor

Crush washer. Unpowered single-wire sensor.

### Amperage Shunt

An amperage shunt measures the amount of electrical current flowing through a circuit. It can be placed at one of several points in the aircraft's electrical system depending on what value the user wishes to monitor.

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<sup>4</sup> If you have more than one 5v sensor, connect a terminal strip to the 5v + and - ports on the EMS then connect the 5v sensors to the terminal strip.

### Installation Overview

**Caution:** The shunt is connected in-line to ship's power and the exposed metal element is carrying current. Be **very** careful to prevent any metal (or other) part of the aircraft from touching the metal band, as that will cause a massive short circuit and may result in a fire and / or significant damage to aircraft systems.

Determine which of the following three options provides the information desired:

Option 1: Place the shunt in-line between the battery and everything else (alternator and load) to measure battery draw and feed. This can be positive or negative. Value is positive when there's drain on the battery and negative when the battery is charging from the alternator. In this configuration (which appears to be the most common) the user can use the resulting value to know if the aircraft is operating off of the battery or the alternator.

Option 2: Place the shunt in-line between alternator and main bus to measure system load only. This will always be a positive value. It does not provide any indication of the source of the power - it could be from either the battery or the alternator. It only represents the power used by systems - it does not indicate how much power (if any) the battery is pulling from the alternator to charge itself.

Option 3: Place the shunt between the alternator and everything else to measure total load on the alternator. This also will always yield a positive value. In this case the value will represent the full load on the alternator which includes both power going to run aircraft systems and to charge the battery.

### Installation Procedure

1. Mount the shunt securely to secondary aircraft structure in such a way that no metal parts will come into contact with the shunt plate.
2. Use 1/4" ring terminals to connect the incoming and outgoing power connections. (A)
3. Use #8 ring terminals to connect the pickup leads to the small pickup terminals. (B)
4. Connect the pickup leads to the AMPS + and - terminals on the FlightBox EMS.

### Resistive Fuel Tank Level Senders

Resistive fuel senders usually require the pull-up power to be activated on the EMS. Connect the fuel tank sender signal wire to the FUEL L or FUEL R input on the EMS as is appropriate.

Reminder: The fuel tank senders **must** be calibrated prior to use. See section \_ below for details on creating calibration data for each tank.

Note: Capacitive “plate” style senders are not directly supported. Aircraft equipped with capacitive senders will require a capacitive-to-resistive converter for each tank.

### Manifold Pressure Sensor

5v powered sensor. Power from FlightBox EMS 5v port. Connect to the engine’s intake manifold using tubing that won’t collapse as pressure falls.

### RPM: Standard Aircraft Magnetos

Connect the primary (“P-lead”) line from the magneto to the RPM 1 or RPM 2 input. Add a 5 watt 10K ohm resistor as close as possible to the point where the wire connects to the P-lead pickup. The connection can be directly on the P-lead terminal on the magneto, or can be tied to the P-lead input at the ignition switch.

Caution: Be aware that if the magneto P-lead is accidentally shorted to the aircraft’s ground (i.e. airframe) the magneto will stop operating. The use of the in-line resistor prevents the signal line going to the EMS from being able to short the P-lead.

### RPM: Electronic Ignition Systems

If the electronic ignition system has a tach output, connect it to either the RPM 1 or RPM 2 input. Usually no special precaution is required.

### Fuel Flow Transducer

FlightView currently supports the use of the Electronics International (EI) FT-60 (aka “Red Cube”) or FT-90 (aka “Gold Cube”) fuel flow transducer. These are certified aircraft parts and are shipped with detailed installation instructions.

#### Power

The power lead from the FT-60 or FT-90 transducer should be connected to ship’s power. The transducer is rated for 8 - 30v. If the transducer is connected to the same circuit protective device (breaker or fuse) as the FlightBox EMS, it is recommended that a 1 amp fuse be placed in-line to prevent a failure of the transducer’s power lead from taking the EMS offline.

#### Return Fuel Flow

If the aircraft uses a fuel injected engine which returns unused fuel to the tank, a second fuel flow sender is required. Measurements from the return fuel flow sender are subtracted from the measurements of the main fuel flow sender to provide an accurate indication of fuel consumption. The signal lead from the return fuel flow sender should be connected to the “FF 2” input on the EMS.

### Installation Procedure

1. Follow the manufacturer's instructions for installing the fuel flow sender.
2. Connect the red lead to ship's power, preferably through a connection to the aircraft's avionics bus.
3. Connect the black lead to ground, preferably at the avionics grounding block.
4. Connect the \_\_\_\_ (white or yellow?) signal wire to the FF 1 input on the EMS.
5. If a return fuel flow sender is used, connect the signal wire from the return fuel flow sender to FF 2 input on the EMS.

### Non-standard / Custom / User-Defined Sensors

User-defined sensor definitions allow the installer to use a non-standard sensor or sender as long as the relevant calibration data is available. User-defined sensor definitions were introduced as of FlightBox Pro EXP firmware update 2.3r1 and version 0.4r17 of the FlightView App. For details on creating custom sensor definitions, see Appendix A.

## Extending FlightLink Cables

In some cases it may be necessary to extend a FlightLink cable. FlightLink cables use a standard USB A connector to connect with the FlightBox. The USB connector converts the signals to standard RS-232 format. The RS-232 signal can be transmitted over a much greater distance than a USB signal so rather than using a USB extension it is generally a better practice to extend the cable coming out of the USB adapter.

FlightLink cables that tie to legacy and third-party avionics terminate in a set of bare wires, allowing the installer to easily connect the cable to the third party wiring harness. FlightLink cables for the Air Data Computer (ADC) and Engine Monitoring System (EMS) terminate in an RJ12 6 position / 6 conductor (6P6C) plug which is inserted into the matching jack on the device. RJ12 6P6C plugs and crimping tools are readily available at electronics stores or from online retailers.

## Bare Wire FlightLink Cables

These cables can easily be extended up to 20' using standard wire splicing techniques. Falken Avionics recommends the use of shielded multi-conductor wire for extending FlightLink cables. The shield helps reduce the chance of radio interference (EMI). FlightLink cables all use a standard color code:

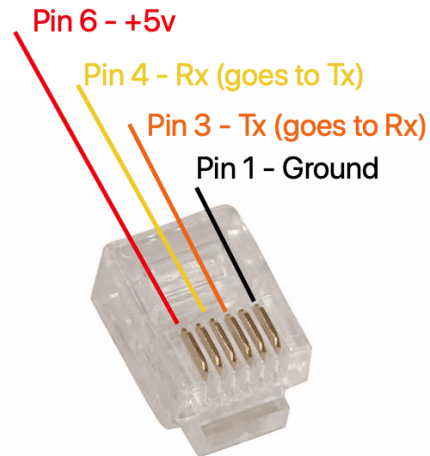
Black	Ground - connect to ground on destination hardware
Yellow	RS232 Receive (Rx) - connect to Tx on destination hardware
Orange	RS232 Transmit (Tx) - connect to Rx on destination hardware
Red	+5v at up to 200 mA - DO NOT CONNECT
Green	RS232 Ready To Send (RTS) - not used
Brow	RS232 Clear To Send (CTS) - not used

## ADC and EMS FlightLink Cables

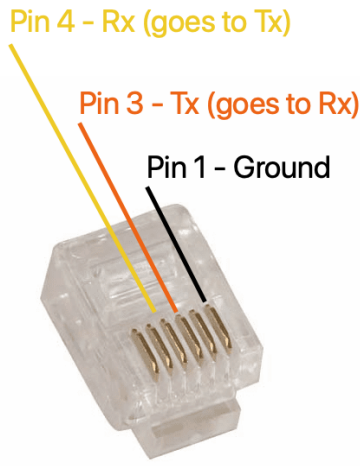
The ADC and EMS cables use the same basic RS232 interface as bare wire cables. There are important differences between the ADC and EMS cable and they are **NOT** interchangeable. The ADC cable provides power to the air data computer via the RJ12 interface, while the ADC requires a separate connection to ship's power.

### ADC FlightLink Pinout

Pin 1 - Ground (Black)
Pin 2 - No Connection
Pin 3 - Transmit (Orange)
Pin 4 - Receive (Yellow)
Pin 5 - No Connection
Pin 6 - +5v (Red)



## EMS FlightLink Pinout

<p>Pin 1 - Ground (Black)</p> <p>Pin 2 - No Connection</p> <p>Pin 3 - Transmit (Orange)</p> <p>Pin 4 - Receive (Yellow)</p> <p>Pin 5 - No Connection</p> <p>Pin 6 - No Connection</p>	
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Pro Tip: When crimping an RJ12 plug onto the wires, use some unconnected scraps of 24 - 28 gauge wire for the "No Connection" slots. This makes it much easier to get the wires in the right places.

If crimping to a standard 6 conductor FlightLink cable, it is permissible to use the green and brown wires in the Pin 2 and Pin 5 positions. Do NOT connect the red wire (+5v) for any cable other than the ADC FlightLink.

## Installing Optional Components

Installing FlightDock (iPad Mount)

Please refer to the [FlightDock and FlightBar installation guide](#).

Installing FlightBar (Knobs / Buttons)

Please refer to the [FlightDock and FlightBar installation guide](#).



## 3rd Party Integrations

### COM Radios

FlightView currently includes remote tuning capabilities for the Apollo / Garmin SL-40 and SL-30, the Garmin GTR-200 and GTR-200b, the Trig TY91, the VAL Avionics 2KR COM, and other COM radios that speak the SL-30 or SL-40 protocol.

FlightView interfaces with these radios using a COM 1 or COM 2 (a maximum of two radios are currently supported) FlightLink interface cables. These cables are "bare wire" - the installer will need to connect the Transmit, Receive, and Ground lines to the appropriate pins on the radio.

### Transponders

FlightView currently supports remote control of the Trig TT21 and TT22 transponders. When interfacing with the TT21 or TT22, FlightView acts as the controller - the Trig TC20 control head is not used. It is not possible to connect both the TC20 and FlightView to a TT21 or TT22 transponder.

FlightView interfaces with the transponder using a FlightLink cable. The cable is available in either bare wire form or wired to connect to the control head port on the factory-built wiring harness. The FlightLink cable used for the TT2x line uses the RS-485 protocol and requires a 120 Ohm terminating resistor to be wired across the A and B lines at or near the TT2x transponder. The terminating resistor comes installed on FlightLink cables that are built to connect to the factory harness. Bare wire installations (where the installer fabricates their own harness) will require the installer solder the included resistor between the A and B lines.

### Autopilots

FlightView supports most any autopilot that can receive navigation information over RS-232 in industry-standard NMEA format. Additional features are available when FlightView is paired with the TruTrak Vizion / BendixKing XCruze autopilot.

For generic autopilot connections, an NEMA output FlightLink cable is required. For TruTrak / BK XCruze installations, a special FlightLink cable is used. Both are shipped as bare wire cables. The installer will need to connect the Transmit, Receive, and Ground lines from the NMEA cable to the appropriate pins on the autopilot.

## Bare Wire Instructions

For all RS232 bare wire cables:

FlightLink - Orange - TX <====> RX On Device  
FlightLink - Yellow - RX <====> TX On Device  
FlightLink - Black - Ground <====> Ground on device

For the RS485 bare wire cable for the Trig TTxx transponders or the Trig TY91 VHF COM radio (*without* the TC90 control head):

FlightLink - Yellow - TMAP A <====> TMAP A On Device  
FlightLink - Blue - TMAP B <====> TMAP B On Device  
FlightLink - Black - Ground <====> Ground on device

Note that if a ground pin is not available, it is generally acceptable to wire the ground to the "shell" ground for the device (i.e. the DB-XX connector's metal housing).

# Part III: Software Installation

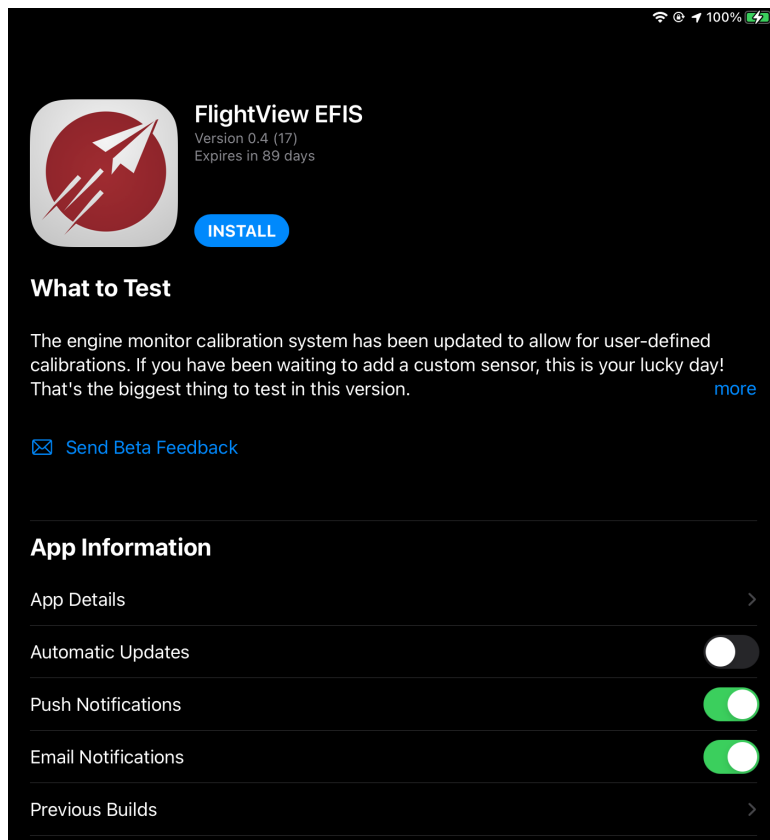
## Installing The Application

The next step is to install the FlightView application on an iPad running iOS 13.0 or later. Installing the FlightView app will *eventually* be done from the Apple App Store. However, the app is currently under development and the latest version should be downloaded from Apple's TestFlight utility.

## FlightView Installation

1. Connect the iPad to a router with Internet access.
2. Open the App Store application and search for TestFlight. (Or [click this link in Safari on the iPad.](#))
3. Install the TestFlight application.
4. Open this link in Safari on your iPad: <https://testflight.apple.com/join/0PfmZHOf>

This will launch TestFlight and invite you to join the beta for FlightView. Tap the Install button to download and install the application.



### Launch the Application

Once the application is installed, launch it by tapping the Open button in TestFlight or by tapping the application icon on the desktop. NOTE: Please keep the iPad connected to the Internet (do not connect to the FlightBox wifi network yet) to complete the onboarding process.

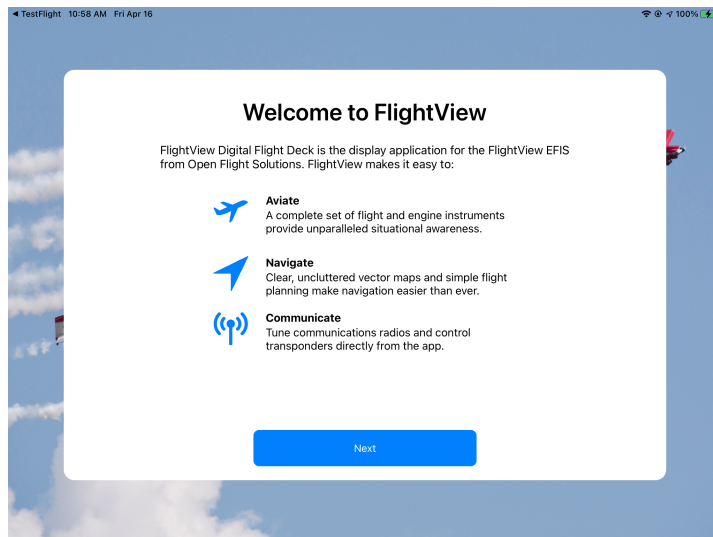
Note that you do not need to open TestFlight to launch the FlightView application - an icon has been installed on the desktop. TestFlight is only required to install the application and to update to new versions.

### First Launch

The first time a new version of the app is launched, TestFlight will display a message "From The Developer". Please take a moment to review the note - it will frequently include a brief list of changes, updates, and in some cases known issues.

### Setup Assistant

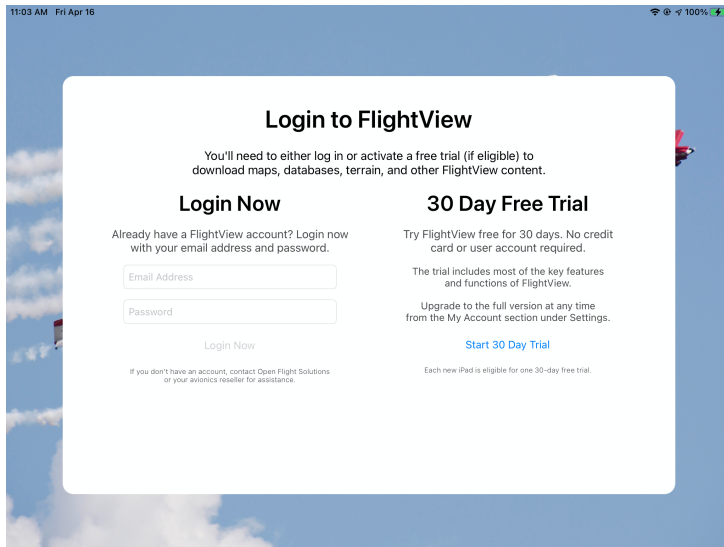
The first time the FlightView application runs, it will open to the Setup Assistant, a set of steps that walks through the process of installing required databases and configuring the application for use.



The first screen in the Setup Assistant is simply a welcome screen. To continue with the setup, tap the **Next** button.

If your iPad is not connected to the Internet via Wifi, the app will ask that you check your connection. Once you have Internet connectivity established, return to the app and it will advance to the Login screen.

### Login Screen



The Login screen allows you to log into the FlightView app. If you do not yet have an account, please [request credentials using this link](#) on the Falken Avionics website.

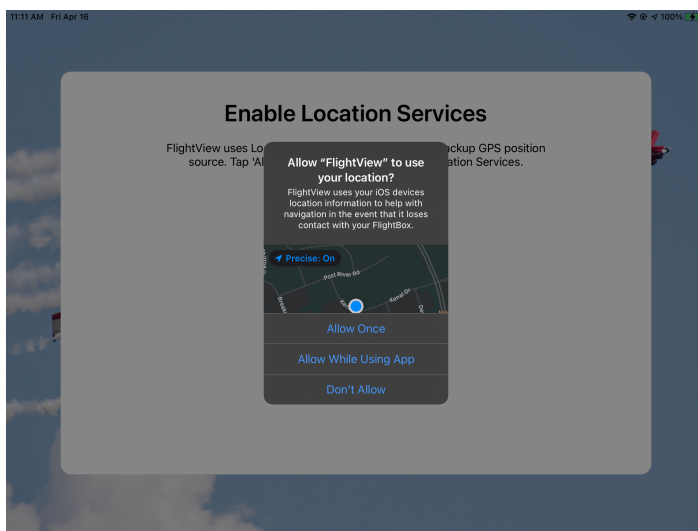
To log in, tap on the Email Address field and enter the email address from your credentials.

Tap in the Password field and enter the password from your credentials.

Tap the **Login Now** button to continue.

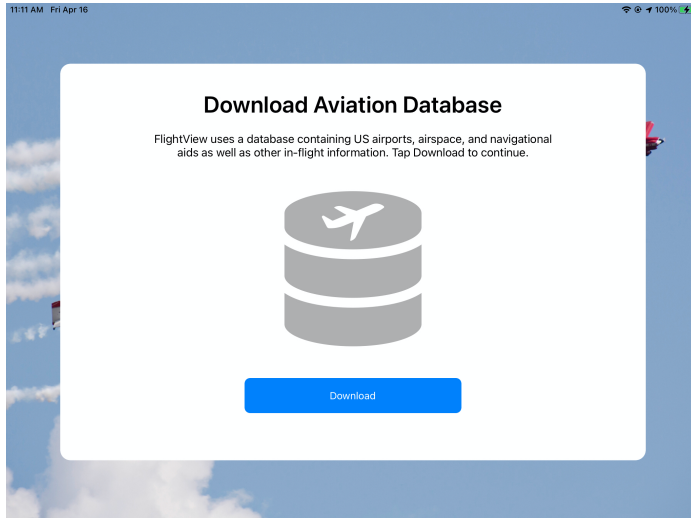
One 30 day free trial of the FlightView app is available for each iPad. The trial is generally used only to test out the basics of the application prior to purchasing a FlightView system. The trial includes a number of limitations and is not recommended for use in an aircraft under normal circumstances.

### iOS Permissions



The Setup Assistant will next step through a series of permission requests. FlightView makes use of a number of key subsystems of the iPad, including Location Services, Push Notifications, Bluetooth Accessories, Speech Recognition, and Music Library Access. It is recommended that you grant permission to each of these.

## Database Download

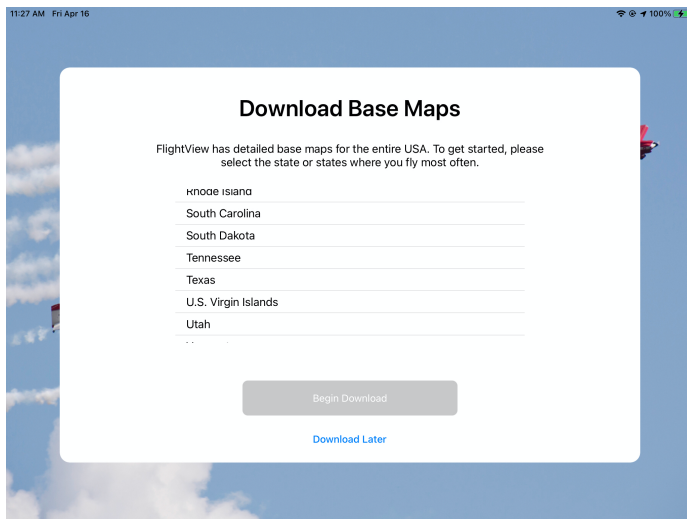


The next step is to download the roughly 90 mb monthly aviation database. This file contains a complete set of US aviation data: airports, airspaces, navigation aids, obstacles, runways, frequencies, etc.

Updates to this database will be published each month. Operating with an out-of-date database is not recommended, as the FAA regularly makes changes.

Click **Download** to continue.

## Base Maps Download

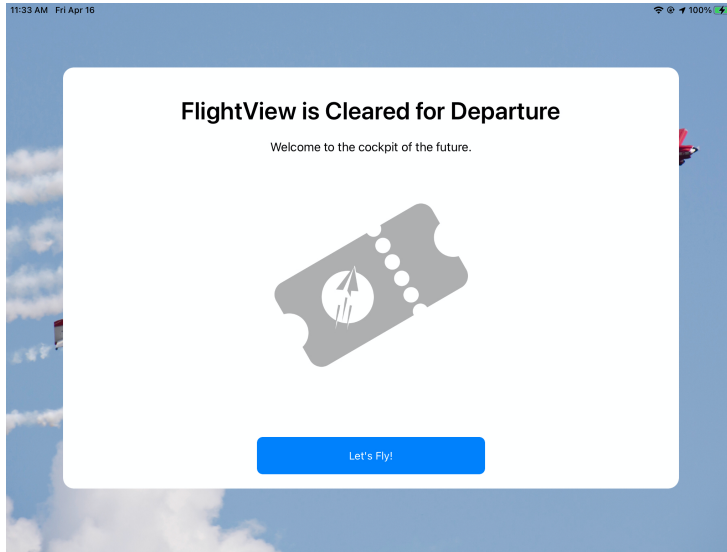


FlightView uses detailed base maps to display local features and terrain. Select the state or states where you operate by tapping them. A download icon will appear on the right side of selected rows.

When you've selected all the states you want, tap the **Begin Download** button.

Keep in mind that you can later download additional states and regions from the Download menu.

### Setup Complete

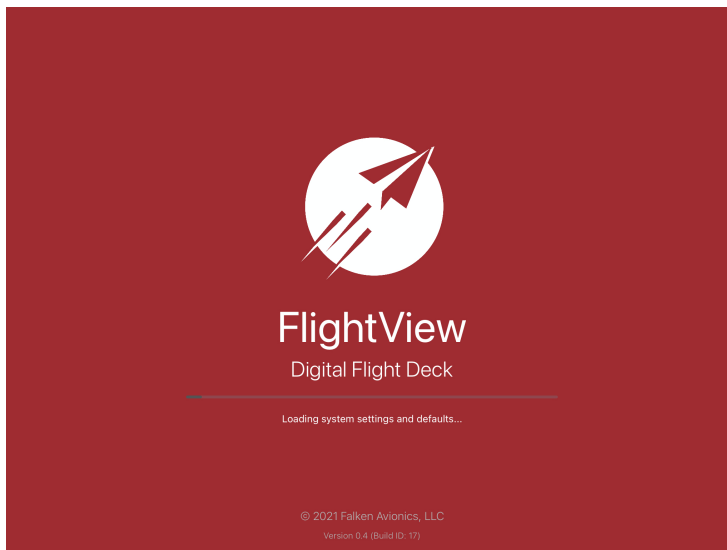


When all maps and terrain data have been downloaded, the Setup Assistant will display the completion screen.

Tap the **Let's Fly!** button to exit the Setup Assistant and begin using FlightView.

The FlightView app will only run the setup assistant the first time the application is started. All future startups will begin with the normal startups screen:

### Startup Screen



The startup screen will show for a period of time while various system services are initiated.

## Configuring The iPad For Use In The Cockpit

Before using FlightView, it is important to understand a few key differences between it and other iOS apps, and some important differences in the way the iPad is used.

### iOS Updates

Apple regularly releases updates to the iOS operating system and core applications. Falken Avionics recommends that you disable the automatic update feature of the operating system and only install system updates after they have been vetted and determined to have no negative impact on FlightView.

### One Trick Pony

First, a word of caution. Falken Avionics highly recommends using **dedicated** iPads as cockpit displays. In other words, the use of a “daily driver” iPad that is loaded with other apps, photos, and personal information is highly discouraged. That is not to say that nothing else can be loaded: other aviation applications are generally fine. Music and some limited number of photos are also acceptable.

In general, iOS is quite good at making sure that applications behave and preventing them from having a negative impact on the overall system. However, each additional app represents one more variable that cannot be tested in the lab.

### Apple ID

As an extension of the above, consider creating a unique Apple ID for use on FlightView iPads. This prevents the FlightView iPads from being configured with certain private data, avoids automatically installing unnecessary apps, and maintains a separate Keychain. One alternative Apple ID can be used across all iPads used with FlightView.

### Guided Access Mode

iOS includes a feature called Guided Access which essentially locks one app into the foreground. While this feature is generally intended to be used to create a “kiosk” device, it can also be used to make the iPad a better flight interface. Guided access prevents the user from inadvertently exiting or backgrounding the app by pressing the home button or through a touch gesture.



## Wifi Network Management

The networking subsystem in iPads is built to attempt to associate with any recognized network if the current network disconnects. This feature is useful in normal operating environments but may pose a problem when using the iPad in the cockpit, especially if more than one device is advertising a Wifi connection.

If for some reason the iPad were to lose connectivity to the FlightBox Wifi network and associate with another network, the FlightView application would stop receiving data. The iPad would then have to be manually reassociated with the FlightBox Wifi network to reestablish the data stream that drives the app.

To prevent this from happening, it is advisable to a) not install devices that offer Wifi access point services, and b) use the "Forget This Network" function in the iOS Wifi configuration to delete automatic recognition of all Wifi SSIDs other than the FlightBox SSID.

## Disabling PIN For Faster Access

By default, Apple requests that the user create a 6-digit security PIN that is used to unlock the iPad. This feature is advisable on any iPad used with normal personal or business applications, but can make accessing FlightView challenging, especially in turbulent conditions. If the iPad is exclusively dedicated as a flight instrument, consider disabling the PIN. Alternatively, consider shorting it to 4 digits (the shortest option permitted in iOS) and possibly using a simple repetitive code: 1111, 9999, etc.

## Updating FlightView Component Firmware

The FlightView app manages firmware updates to the FlightBox Pro and other component systems. The app checks for firmware updates on a periodic basis. If an update is available, the app downloads it in the background. When it next connects to a FlightBox Pro it will notify the user that the update is ready to install.

# Part IV: The FlightView App

On first launch the FlightView user interface opens to a split-screen view, showing the Primary Flight Display (PFD) on the left, and the Multifunction Display (MFD) on the right. Several key features are unavailable as the system is not connected to the FlightView hardware.



When operating in "offline mode" (i.e. without a connection to other FlightView systems), the app will operate in a reversionary mode. It will use iOS Location Service, Core Motion services, and other onboard systems to provide basic instrumentation and situational awareness functions.

Note that the display may be slightly different depending on the model of iPad used.

As the first-launch display is not representative of the full FlightView application, this section will use a more representative display with a live connection to a complete FlightView system:



This presents a more standard view of the FlightView user interface, again operating in split-screen (PFD / MFD) mode. In this image the Engine Bar is displayed, showing the current readings from the EMS.

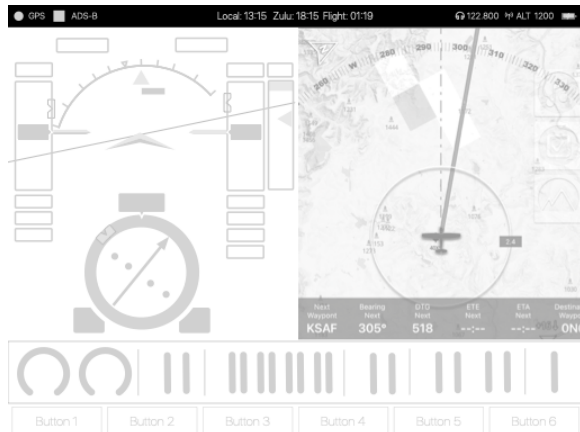


## Display Overview

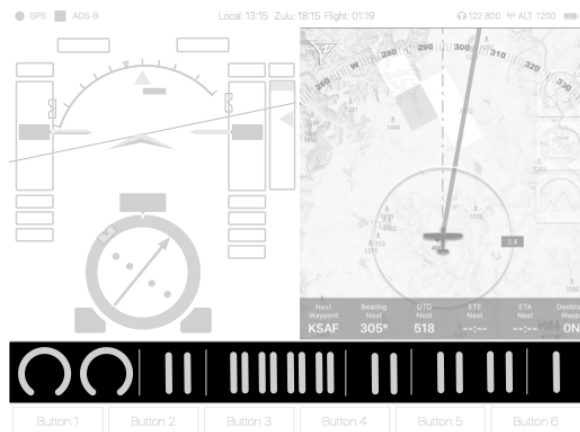
The display application is separated into three content areas. The Status Bar (located at the top), the Button Bar (at the bottom) and the main content area in the middle. The Status Bar and Button bar are displayed at all times. The information displayed in the Main Content Area changes depending on the way you configure the application.

# FlightView EFIS User Guide

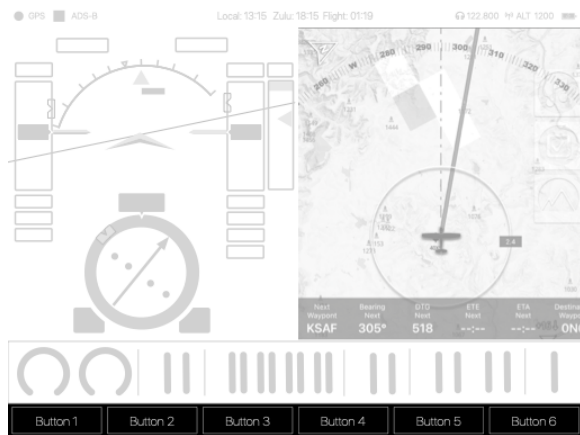
## Status Bar



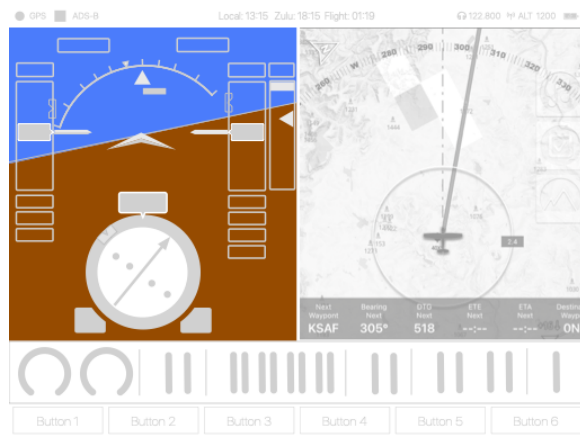
## Engine Bar



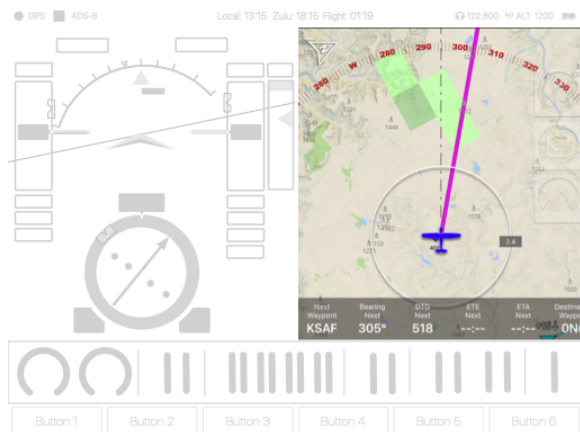
## Button Bar



## Primary Flight Display (PFD)



## Multifunction Display (MFD)



## Full Screen and Split Screen Modes

Each iPad can operate in either full-screen mode, where the entire screen is dedicated to one of the two major functions (PFD and MFD) or in split-screen mode, where the screen is divided 50/50 and both major content types are displayed simultaneously.



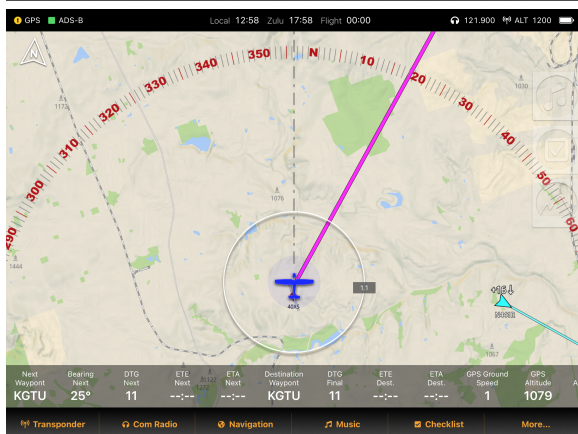
### Split Screen Mode

This is the default mode, and the most commonly used. It divides the screen in half, dedicating one side to PFD functions and the other to MFD functions. The sides are assignable by setting the Primary Side and Primary Function as described below.



### Full Screen PFD

In this mode, the full screen is dedicated to the Primary Flight Display. A small moving map can be displayed as an inset in the lower left corner. The full screen PFD view also includes a G-meter which is displayed to the left of the airspeed tape.



### Full Screen MFD

In this mode the full screen is dedicated to the Multifunction Display. This option is generally used only if multiple iPads are installed in the cockpit.



## Primary Function / Primary Side

Each FlightView display (in other words, each iPad) is configured with a Primary Function and is assigned a Primary Side. The primary function can be either PFD or MFD. Even displays that are configured to operate in split-screen mode have a primary function. FlightView treats the primary function as "protected" - it attempts to prevent any secondary content from covering it.

Secondary content is made up of screens which are not displayed at all times: COM Radio, Transponder, Autopilot, Navigation, etc. These screens are temporarily placed on the non-primary side of the display when activated.

## Protected Content In Split-Screen Mode

In split-screen mode, secondary functions are displayed by replacing the non-primary function with the secondary screen. For example, if the display is set PFD as its Primary Function and left-side as its Primary Side, tapping the COM radio button will cause the MFD (located on the right-side) to be replaced by the COM radio screen. The Primary Function (the PFD) is protected and remains in place.



When the radio is dismissed, the MFD returns to the unprotected side.

## Protected Content In Full Screen Mode

In full-screen mode, secondary functions are displayed by shrinking the primary function to half-screen side and placing it on the Primary Side. The secondary screen is temporarily displayed on the non-primary side. When the secondary function is dismissed, the screen returns to its normal full-screen layout.

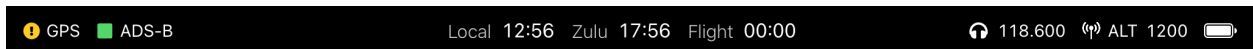
## FlightView EFIS User Guide



Note that when a full screen display is temporarily reduced to split-screen, some items are removed. In the above example, the mini-map on the PFD is hidden as it does not fit on the half-screen version of the PFD.

## The Status Bar

Located at the top of the screen, the status bar provides an always-on view of basic system functionality.



The left hand side of the Status Bar shows hardware interface status. The center section of the Status Bar shows clock and flight time information. The right-hand side shows battery status and, if enabled, COM radio and transponder settings.

## Status Bar Icons

The status bar uses shape and color codes to indicate status. Square / green indicates everything is working as expected. Yellow indicates some level of degraded operation. Red indicates an error or a service that is offline.



Nominal / good reception - everything is operating nominally.



Marginal / limited reception - some level of operational degradation.



Error / offline / no reception - system failed or feeding unreadable data.

## Hardware Status Indications

The left side of the Status bar show status indicators for FlightBox connectivity (FBX), ADS-B reception (ADS-B), and GPS reception (GPS).

### FlightBox Connection



Indicates the status of the connection between the FlightView app and the FlightBox Pro hardware installed in the aircraft.

- Red triangle indicates that the connection is offline (no connection). This could be because the iPad is not connected to the FlightBox wifi network or because of a fault on the FlightBox.
- Green square indicates a valid connection to the FlightBox.

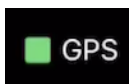
### ADS-B



Indicates the status of the ADS-B traffic and weather receivers.

- Red triangle indicates no ADS-B input on either band or radio not responding.
- Yellow circle indicates limited reception - either no data on one band or no uplink data from ground towers.
- Green square: reception on both bands with uplink data from one or more ground tower.

### GPS



Indicates the status of GPS reception.

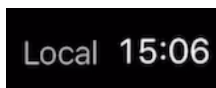


- Red triangle indicates no GPS lock.
- Yellow circle indicates non-precision GPS lock (> 20 meters horizontal accuracy)<sup>5</sup>.
- Green square indicates solid, high precision GPS lock (< 20 meters horizontal accuracy)

## Clocks & Timers

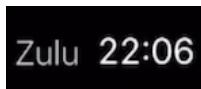
The central portion of the Status Bar shows a local clock, a zulu-time clock, and a flight timer.

### Local Time



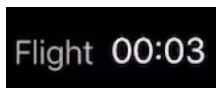
Current local time. This may vary from the standard iPad clock time if the FlightView app has detected a change in time zone based on GPS data.

### Zulu Time



Current Universal Coordinated Time (UTC). Also known as Greenwich Mean Time (GMT).

### Flight Timer



Duration since the FlightView system detected takeoff. Time is calculated between takeoff and landing. If the app is restarted mid-flight, this value may be inaccurate.

## Radio, Transponder, and Battery Status

The right side of the status bar displays the status for up to two COM radios, one transponder, the iPad battery, and a thermal stress indicator.

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<sup>5</sup> A yellow circle is also displayed if the FlightView app is using data from the iPad's onboard GPS rather than the main GPS receiver on FlightBox.

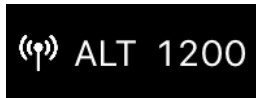
## Com1 / Com 2 Status



Indicates the status for either one or two communications radios integrated with the FlightView system. If the radio is offline, the frequency value is set to “xxx.xxx” and both the frequency value and icon are displayed in red. If the radio is online and communicating with FlightView, the data is displayed in white and frequency value represents the active frequency for the radio.

If two radios are active, the left icon and frequency value represent Com 1 and the right icon and frequency value represent Com 2.

## Transponder Status Indicator



Indicates the transponder's current mode and squawk code. If the transponder interface is offline or the transponder is not operating, the transponder icon, mode, and squawk values are displayed in red. Transponder status will only appear if a transponder integration is installed and active.

Tapping the transponder status indicator causes the transponder to send IDENT for ~20 seconds. While in IDENT mode, the indicator will display in green.

## Thermal Stress Indicator



In the event the iPad battery monitor detects a high level of thermal stress (high temperatures which could lead to a shutdown if not handled) FlightView will display a thermometer icon next to the battery indicator. A yellow thermometer indicated moderate thermal stress. A red thermometer indicates significant thermal stress.

**If you see this icon, immediately take steps to cool your iPad.**

Note that transitions from nominal to moderate and moderate to significant are accompanied by an aural (audio) alert.

## Battery State Indicator



Indicates the charge and connection state of the iPad battery. A green background and lightning bolt indicate that the device is charging. A white background without the lightning bolt indicates that the device is not charging. The interior section of the icon indicates the level of charge.

## The Button Bar

The button bar is the primary navigation interface for the app. When the app launches the button bar loads the main button menu which includes six buttons. The first five buttons control access to various features while the final button, labeled “More...” loads an additional page of buttons.



First / main page of buttons.

To access the second page of buttons, press the last button (labeled “More...”). To return to the main page of buttons, tap the first (“Back”) button.

## Button Assignments

The list of buttons displayed depends on what features are enabled. For example, if the aircraft has two COM radios that are connected to FlightView, the button bar will have buttons for **Com 1** and **Com 2**. However, if only a single radio is connected the button bar will only have a single button labeled **Com Radio**. If no radios are integrated the button bar will display a single button that reads **Com Freq**.

## Buttons For Secondary Screens

Some buttons toggle various FlightView features while others load secondary screens into the Main Content area. For example, tapping the **Com Radio** button will cause FlightView to load the Com Radio screen. When the Com Radio screen loads, FlightView replaces the buttons with a new set that are specific to the Com Radio screen:



When a secondary screen like Com Radio, Transponder, or Autopilot is displayed, the first button always becomes the **Back** (exit) button. Tapping the **Back** button will dismiss (hide) the secondary screen and return to the main view.

In the example above, other buttons serve as shortcuts to Com radio features. Tapping Nearby will load a list of the nearest airports. Tapping Recent will load a list of recently used frequencies.

## The Display Menu

The Display Menu allows the user to reconfigure some aspects of the display without having to page through the settings system. To access the Display menu, tap **More...** → **Display**.

### Night Mode / Day Mode Toggle

This button toggles between day and night mode, overriding the current setting. If the display is operating in Night Mode, the button will offer "Day Mode" and vice versa. The setting will remain in place until changed by the user - automatic day / night transitions are suspended.

### EMS Toggle

This button toggles the EMS bar on and off. If the EMS bar is displayed, tapping the button hides it. If the EMS bar is hidden, tapping this button shows it. Changes made using this button do not survive application restart. (To change the default status of the EMS bar, see the Appearance page in Settings.)

### Split Screen / Full Screen Toggle

This button toggles between full-screen mode and split-screen mode. If the display is operating in full screen mode, tapping Split Screen will cause it to transition to split-screen mode. If the display is operating in split screen mode, tapping Full Screen will cause it to transition to full-screen mode. Changes made using this button do not survive application restart. To change the default screen mode, see the Appearance page in Settings.

### MFD / PFD Toggle

This button, available only in full-screen mode, toggles to the other full screen mode display. If the application is operating in full-screen PFD mode, tapping Show MFD will replace the PFD with the full-screen MFD. If the application is operating in full-screen MFD mode, tapping Show PFD will replace the MFD with the full-screen PFD. Changes made using this button do not survive application restart. To change the default full-screen mode, see the Primary Function and Split Screen At Startup options on the Appearance page in Settings.

## Swap Button

This button, available only in split-screen mode, causes the PFD and MFD sections to swap places. Changes made using this button do not survive application restart.

## The Map Menu

The Map Menu allows the user to control a number of layers and functions on the MFD's moving map.

### Street Map Toggle

The Street Map button toggles between the normal aviation map view (relatively stripped down with land features, major highways and railways at higher resolutions) and a view that includes full civil detail. Street Map mode can be useful for identifying the area of which the aircraft is flying. Changes made using this button do not survive application restart.

### NEXRAD Toggle

The NEXRAD button toggles on / off the NEXRAD weather overlay.

### Traffic Toggle

The Traffic button toggles on / off the display of air traffic.

### North Up / Track Up Toggle

This button toggles between the default Track Up mode and North Up mode. In Track Up mode, the map is oriented to show the aircraft's ground track at the top of the view. In North Up mode, the map is oriented to show true north at the top of the view.

## Button Bar Example: Accessing Settings

The installation process requires frequent access to the Settings screen. Settings is a secondary item (not something normally used in flight) and is therefore on the second page of the main button menu. To access Settings:

1. Tap the **More...** button (last button on the first page of the main menu).
2. Tap the **Settings** button (last button on the second page of the main menu).

This will load the Settings screen. Once all Settings changes are complete, dismiss the Settings screen and return to the main display by tapping the **Exit** button.

The Settings screen may also be accessed by selecting the **Menu** button and then selecting Settings.

## Button Bar and FlightBar

If the optional FlightBar hardware interface device is installed and active, the buttons on the FlightBar will automatically map to and control the functions listed on the corresponding Button Bar label.

## Primary Flight Display

The main content area is made up of all the screen items between the bottom of the Status Bar and the top of the Button Bar. The FlightView app supports a number of different layout options. It can be configured to show a full-screen PFD, full-screen MFD, or a split screen showing both MFD and PFD.

In split-screen mode the user can select the display order: MFD | PFD or PFD | MFD. If an engine data source is installed, the display can include the engine data bar. The display also includes two elements which are fixed, the status bar at the top and the button bar at the bottom.

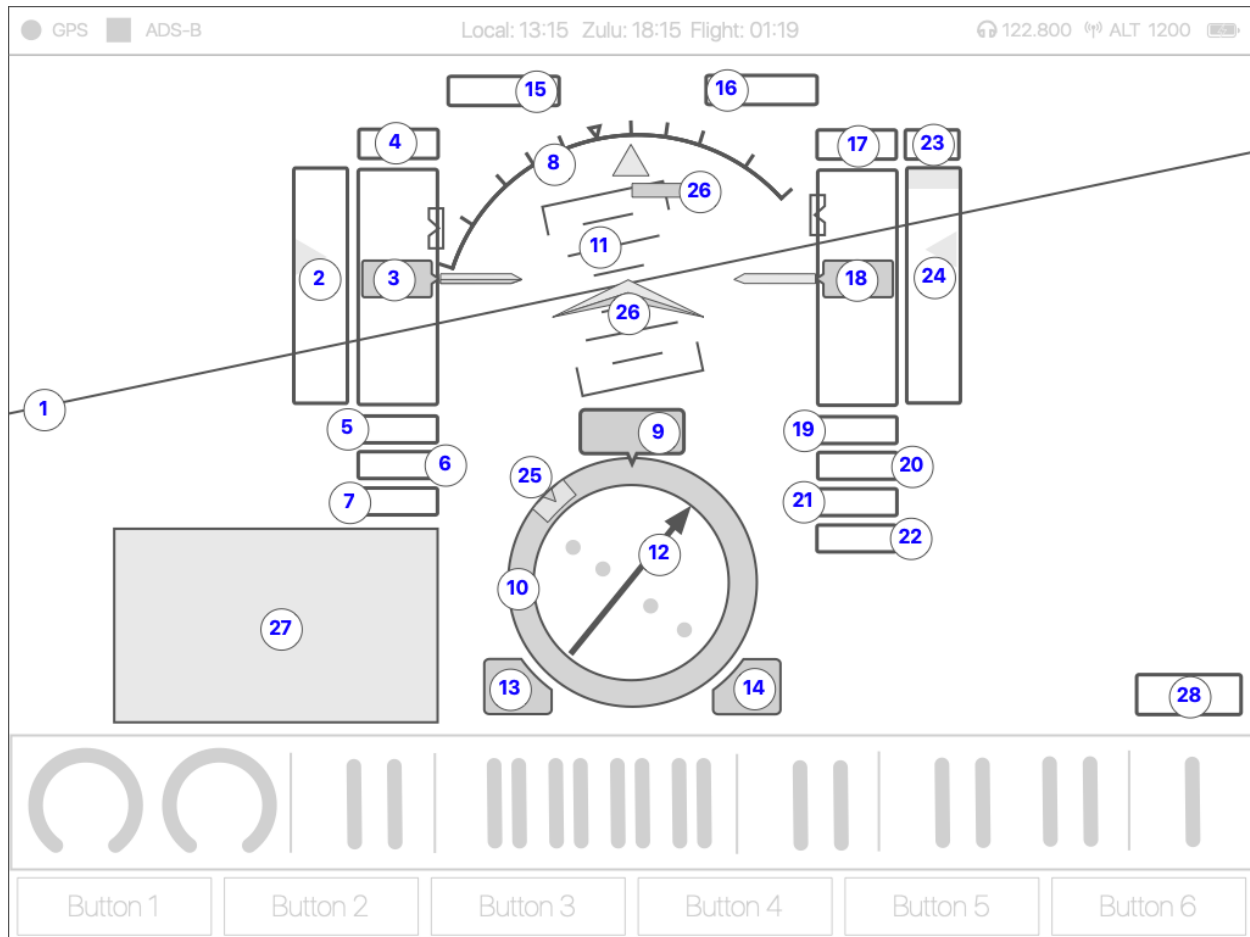


This image shows FlightView configured to display the PFD in full-screen mode with the EMS bar enabled and the mini-map inset active.

The layout at application startup is controlled by settings found on the Appearance page but can be temporarily overridden using buttons on the Display menu, accessible from the Button Bar.

To access these options, tap:  
**More... → Display**

## PFD Controls & Indicators



- |                              |                                |
|------------------------------|--------------------------------|
| 1. Horizon Line              | 16. Autopilot Vertical Mode    |
| 2. G-Meter                   | 17. Altitude Bug Setting       |
| 3. Airspeed Tape             | 18. Altitude Tape              |
| 4. Airspeed Bug Setting      | 19. Altimeter Baro Setting     |
| 5. True Airspeed             | 20. GPS Altitude               |
| 6. Ground Speed              | 21. AGL Altitude               |
| 7. Outside Air Temperature   | 22. Density Altitude           |
| 8. Roll Indicator            | 23. Vertical Speed Bug Setting |
| 9. Track Indicator           | 24. Vertical Speed Indicator   |
| 10. HSI Compass              | 25. Track Bug                  |
| 11. Pitch Ladder Indicator   | 26. Slip/Skid Indicator        |
| 12. Course Pointer / CDI     | 27. Inset Content              |
| 13. Track Setting Indicator  | 28. Active Knob Function       |
| 14. Course Setting Indicator | 29. Static Attitude Pointers   |
| 15. Autopilot Lateral Mode   | 30. Static Roll Pointer        |

## PFD Screen Elements

### (1) Attitude Display

The PFD displays the aircraft's attitude using the horizon line (1) which bisects the background of the display, showing the top  $\frac{1}{3}$  as sky (blue) and the bottom  $\frac{2}{3}$  as ground (brown) in level flight. The Horizon Line, Roll Indicator (8), and Pitch Ladder (25) all move to indicate the attitude as received from the AHRS subsystem of the FlightBox Pro.

The Static Attitude Pointers (29) serve as the fixed reference for a level pitch attitude and the Static Roll Pointer (30) serves as the fixed reference for a level roll attitude.

### (3) Airspeed Indicator Tape

The vertical tape stack on the left-hand side of the PFD view shows aircraft speed information. The main tape (3) shows indicated airspeed (IAS). This is represented by the large numeric value in the center of the tape. The tape also indicates ongoing change in airspeed by moving the tape scale up or down as airspeed increases or decreases.

#### Flap Speed Range

Critical airspeed-related metrics are shown as stripes on the right-hand side of the tape. A white line indicates the range at which flaps may be deployed and ranges from  $V_{SO}$  to  $V_{FE}$  as configured in the Aircraft Configuration.

#### Operating Speed Ranges

A green stripe indicates the normal operating range for the aircraft, which is defined by speeds between  $V_S$  and  $V_{NO}$ . A yellow stripe indicates the range between  $V_{NO}$  and  $V_{NE}$ . A red stripe indicates any speed above  $V_{NE}$ .

### (4) Airspeed Bug Value

This indicator shows the current target airspeed as set by the pilot. Tapping this indicator displays the virtual scroll controller, allowing the user to adjust the target airspeed value. (Note that if a FlightBar controller is connected to the iPad, the tap function is disabled and the target airspeed is adjusted using the FlightBar control knob.)

If a target airspeed value is set, a bug indicator (cyan rectangle with a notch) appears on the right inside edge of the airspeed tape. The bug indicator is positioned based on the bug value as set in the airspeed bug setting indicator (4) and moves with the tape background scale.



## (5) True Airspeed

True airspeed (airspeed corrected for altitude, temperature, and humidity) is displayed in the True Airspeed Indicator box (5). True airspeed is only available if the Air Data Computer is connected to the FlightView system. If the air data computer is offline or not reading an outside air temperature (OAT) value, the True Airspeed indicator is marked as failed.

## (6) Ground Speed

Ground speed is displayed in the Ground Speed indicator (6). Ground speed is derived from GPS data and is available if the FlightView GPS receiver is connected and has a valid lock, or if the iPad's internal GPS receiver is online and has a valid lock.

## (7) Outside Air Temperature

Outside air temperature (OAT) is displayed in the outside air temperature indicator (7). Like true airspeed, OAT depends on a working connection to the FlightView system. If the FlightView system is offline, the OAT indicator is not displayed. If the FlightView system is online but OAT data is not available from the Air Data Computer, the indicator is displayed as failed.

## (9) Track Indicator

The Track Indicator displays the aircraft's ground track in either true or magnetic degrees depending on the Headings & Bearings setting in the Appearance configuration.

Tapping the Track Indicator causes the virtual scroll controller to display, allowing the user to set the desired track value - represented by the Track Bug (11) and in the Track Setting Indicator (13). If a FlightBar controller is connected to the iPad, this function is disabled and adjustments to the desired track are made using the FlightBar.

## (10) HSI Compass

The HSI compass indicates the current ground track of the aircraft and serves as the pointer scale for other indicators including the Course Pointer and CDI (12) and the Track Bug (11).

## (11) Track Bug

The Track Bug (11) visually indicates the assigned target ground track.

## (12) Course Pointer and CDI

The course pointer (12) visually indicates the relative bearing to the active waypoint. If no course is active, the Course Pointer and CDI are not displayed. The center section of the magenta arrow moves left or right of the center of the indicator to indicate the current

cross-track deviation, if any. The white circular dot indicators are scaled to 1 nautical mile. The aircraft icon represents the position of the ownship aircraft.

### (13) Track Setting Indicator

The Track Setting Indicator displays the current target ground track in either true or magnetic degrees as set by the user.

Like the Track Indicator (9), this indicator may be tapped to activate the virtual scroll controller to set the desired target track value. If a FlightBar controller is connected to the iPad, this function is disabled and adjustments to the desired track are made using the FlightBar.

### (14) Course Setting Indicator

The Course Setting Indicator displays the current bearing to the next waypoint in true or magnetic degrees. If no course is loaded, the indicator value is not shown.

### (15) Autopilot Lateral Mode

If a TruTrak or BendixKing xCruze autopilot is installed and active, this indicator appears and shows the current lateral mode. If the autopilot has a lateral mode armed, the indicator also shows that in light gray. If the autopilot is offline or if no autopilot is present, this indicator is hidden.

### (16) Autopilot Vertical Mode

If a TruTrak or BendixKing xCruze autopilot is installed and active, this indicator appears and shows the current vertical mode. If the autopilot has a lateral mode armed, the indicator also shows that in light gray. If the autopilot is offline or if no autopilot is present, this indicator is hidden.

### (17) Altitude Bug Setting

This indicator shows the current target altitude as set by the pilot. Tapping this indicator displays the virtual scroll controller, allowing the user to adjust the target altitude value. (Note that this function is disabled if a FlightBar controller is connected, in which case the FlightBar is used to set the value.)

If a target altitude value is set, a bug indicator (cyan rectangle with a notch) appears on the left inside edge of the altitude tape. The bug indicator is positioned based on the bug value as set in the altitude bug setting indicator (4) and moves with the tape background scale.

### (18) Altitude Indicator Tape

The vertical tape stack on the right-hand side of the PFD view (18) shows altitude information. The main tape shows barometric MSL altitude unless operating under reversionary mode. This

is represented by the large numeric value in the center of the tape. The tape also indicates ongoing change in altitude by moving the tape scale up or down as altitude increases or decreases.

### (19) Altimeter Baro Setting

The Altimeter Baro Setting displays the current altimeter offset value (also known as the Kollsman window value or QHN) as set by either the pilot or by the automatic altimeter update system.

Tapping this indicator displays the virtual scroll controller, allowing the user to set the current value. (Note that this function is disabled if a FlightBar controller is connected, in which case the FlightBar is used to set the value.)

### (20) GPS Altitude

This indicator displays the current estimated MSL altitude as determined by the FlightView GPS or, if operating in reversionary mode, the iPad GPS.

### (21) AGL Altitude

This indicator displays the current altitude above ground level (AGL). This value is dependent on having terrain information for the current location installed and active.

### (22) Density Altitude

This indicator displays the current density altitude as calculated by the Air Data Computer using the current outside air temperature. If air data is not available, this indicator is hidden. If OAT information is not available this indicator shows as failed.

### (23) Vertical Speed Bug Setting

This indicator shows the current target vertical speed as set by the pilot. Tapping this indicator displays the virtual scroll controller, allowing the user to adjust the target vertical speed value. (Note that this function is disabled if a FlightBar controller is connected, in which case the FlightBar is used to set the value.)

### (24) Vertical Speed Indicator

This indicator displays the current vertical speed in hundreds of units per minute (where units are either feet or meters). When climbing or descending, a real-time vertical speed value is displayed at either the top (climbing) or the bottom (descending) of the tape.

### (25) Pitch Ladder

An element of the attitude display, the pitch ladder rotates with the background to indicate roll and the sliding scale moves up or down to indicate pitch. Major increments are indicated every 10 degrees. Minor increments are indicated every 2.5 degrees.

### (26) Slip/Skid Indicator

This indicator shows the coordination of flight by indicating any slip or skid (uncoordinated motion around the vertical axis) as a deviation from the centerpoint. In coordinated flight the rectangle is centered directly below the static roll pointer triangle (30).

### (27) Inset Content Display

The inset content area is used to display a miniature moving map and (in future releases) other content.

### (28) Active Knob Function

This indicator, only displayed if a FlightBar is connected to the iPad, indicates the active function for the right-hand knob. Clicking the knob cycles to the next adjustable setting. Turning the knob increments or decrements the selected value.

### (29) Static Attitude Pointers

The static roll pointers - the chevron in the center and the two windward-facing pointers located on either side near the tapes - represent the level point for the aircraft. Aligning the horizon line (1) with these indicates a level roll and pitch attitude.

### (30) Roll Pointer

The roll pointer indicates the aircraft's roll position relative to the roll indicator (8). The roll pointer also serves to indicate the center point for the slip/skid indicator (26).

## A Note On The PFD In Split-Screen Mode

In split-screen mode, the PFD is reduced to use only one half of the width of the screen. While in split screen mode the PFD does not display the G-meter tape (2) or the inset content view (27). All other functions appear but are scaled to fit the reduced space.

## Multi Function Display (MFD) View

The Multifunction Display (MFD) provides navigation and situational awareness information. The MFD includes a moving map and an optional terrain profile view.

## MFD Controls & Indicators

### (0) Moving Map

The entire background of the MFD is presented as a moving map. By default the map depicts major geographic features (rivers, lakes, ponds, parkland). At higher zoom levels (i.e. when zoomed in) the map also shows terrain hill-shade, major highways, and railroads.

The map has day and night modes which change the color scheme to better display in high or low ambient light situations. It also has a Street Map mode which overlays roads and identifiers for municipalities, states, etc. The day and night modes automatically toggle based on the current location and time of day. An override function is available from the Map menu, as is the toggle for the Street Map mode.

Note that detailed features depend on downloading the Base Map for a given state. Without a base map, the system displays a low-resolution background map which contains only significant geographic features.

### (1) Ownship Icon

The Ownship Icon represents the aircraft. In track-up mode, the icon has a fixed orientation towards the top of the screen. In north-up mode, the icon rotates while the underlying map maintains a fixed attitude with true north at the top of the screen.

The icon is displayed in either blue or green. Blue is the default color. Green indicates that the ADS-B receiver is detecting the ownship in the uplink data stream from one or more ground stations.

A two-minute track vector indicator is drawn from the aircraft's current location to its location two minutes ahead given no change to track or

### (2) Distance Ring

The distance ring is used to estimate distances. The text field on the right-hand side of the ring indicates the distance between the aircraft and the circle scribed by the ring. The distance is updated whenever the map zoom is changed.

### (3) Course Line

The course line indicates the current course. The active leg is depicted in magenta. Upcoming legs are depicted in blue. Completed legs are depicted in gray.

### (4) Centerline

The centerline, visible only in track-up mode, represents the aircraft's track across the ground on the current ground track.

### (5) Compass Ring

The compass ring shows the current ground track of the aircraft when the MFD is operating in track-up mode.

### (6) North Arrow

The North Arrow rotates to point to the north. Tapping the North Arrow toggles the position lock of the MFD moving map. When unlocked, the North Arrow is outlined in red. When locked, the North Arrow is outlined in white.

### (7) Obstacles

When the aircraft is operating at lower altitudes the MFD displays obstacle icons for buildings, towers, and other man-made objects the tops of which are within 1000 vertical feet of the aircraft and more than 150 feet AGL.

Obstacles are presented in light gray unless they pose an immediate threat, in which case they are displayed in yellow (warning) or red (danger).

### (8) Traffic Target

The MFD displays traffic targets that are within the range defined under Map Options. The default values are +/- 3000 vertical feet and within a 15 nautical mile radius. Traffic targets include the relative altitude in hundreds of feet (i.e. a target that shows as +4 is 400 feet above the ownship).

Targets are typically displayed in cyan but will transition to yellow or red to indicate a potential conflict.

If there is a relative altitude change underway -- if either the target is changing altitude or the ownship is changing altitude -- the relative altitude indicator displays a directional arrow. An

upward-pointing arrow indicates the target is climbing. A downward-facing arrow indicates the target is descending.

If available, the target will also include an identity indicator: either a call sign or a registration number. If the aircraft has a US civilian registration, tapping the icon will display a pop-up window providing additional information about the aircraft.

### (9) Airspace Indicator

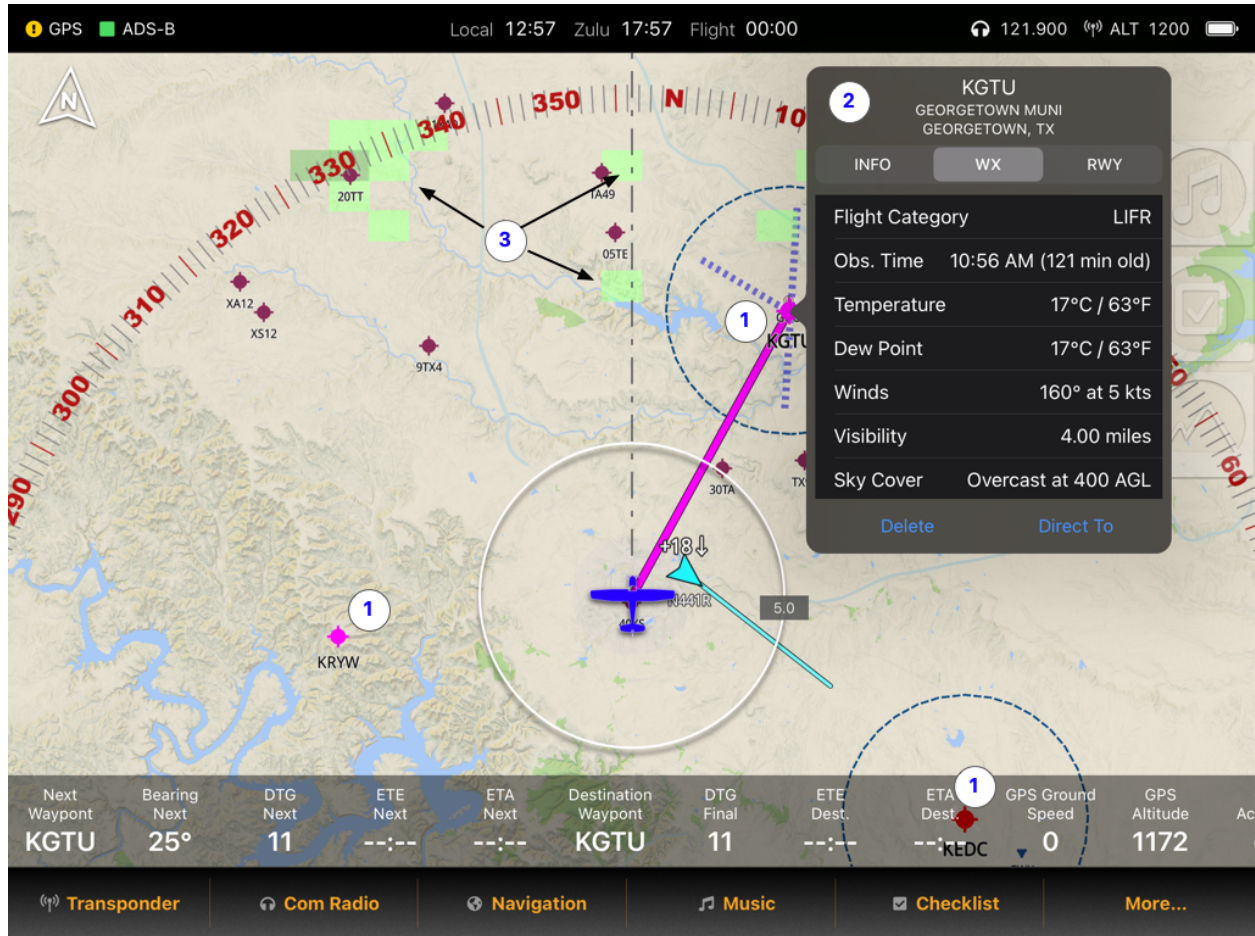
The Airspace Indicator lists airspaces around or ahead of the ownship aircraft. These include controlled airspaces for classes B, C, and D as well as military operation areas, prohibited areas, restricted areas, and other special use airspaces.

### (10) Navigation Information Bar

The navigation information bar presents key information about the active course, including the active waypoint, the destination, estimated time of arrival, estimated time en route, distance, and bearing.

When operating in split screen mode or on smaller iPads, the Navigation Information Bar can be scrolled left to right to reveal additional information.

If the next waypoint or destination waypoint is an airport, tapping the Next Waypoint or Destination Waypoint item will activate the briefing system and will display the Airport Information overlay.



## (11) Airport

The MFD moving map automatically displays airports within the area of the map. At high zoom levels (i.e. zoomed in) it shows all airports including private and unimproved airports. At lower zoom levels it selectively reduces the airports displayed based on classification (B, C, D, E), public / private use, control tower activation, etc.

Airports are indicated by a dot with cross bars. By default the airport icon is drawn in burgundy. If flight category information is available from an on-site METAR station, the icon is colored based on the flight category. Green = VFR, Blue = MVFR, Red = IFR, Magenta = Low IFR.

If an airport is the final destination in a flight plan, the map will display dashed lines indicating the extended centerlines of the airport's runways. At higher zoom levels these will be tagged with the runway identifiers.



## (12) Airport Information Popup

Tapping an airport opens the Airport Information pop-up window. This provides details about the airport, the current METAR if available, and a list of runways. It also includes buttons that allow the user to create a direct-to course to the airport or to add the airport to the current flight plan. If the airport is already in the current flight plan, a button allows the user to remove it.

To dismiss (hide) the Airport Information Popup, tap anywhere on the map.

## (13) NEXRAD Weather Radar

The MFD moving map automatically displays NEXRAD radar data received via ADS-B. (Note: the current version of the FlightView app does not display radar data from Internet sources, it *only* displays radar data received over ADS-B.)

Radar data is coded to indicate the strength or intensity of precipitation. Green is light, yellow moderate, red is heavy, and magenta indicates hail or heavy snow.

FlightView can display both regional and CONUS (continental United States) NEXRAD information. At higher zoom levels the map displays the more detailed regional data. At lower zoom levels it displays the CONUS data.

# Map Operations

## Zoom Level

To adjust the zoom level of the map, use two fingers to "pinch" (zoom out) or "spread" (zoom in).

If a FlightBar is connected to the iPad, the zoom level can be adjusted using the knob. In split screen mode the zoom level is adjusted using the knob on the same side of the screen as the MFD. In full-screen mode the right knob is used for zoom.

## Panning

To pan around the map, the map must first be unlocked by tapping the North Arrow. (When in free pan mode, the North Arrow displays with a red background.) Once unlocked, use one finger to pan the map within the MFD window. To return to locked mode, tap the North Arrow again.

## Long Press

To retrieve information about a location on the map, press and hold until the Select Map Feature dialog box appears. The Select Map Feature box will show the touch point as a set of coordinates and will list airspace and features at or near the touchpoint.

## Briefing Bar

To receive a briefing on the upcoming waypoint or the destination waypoint, tap on either the Next Waypoint or Destination Waypoint item in the Navigation Info Bar. This will display the briefing bar on the right-hand side of the map and will initiate an audio briefing on the selected point.

The briefing bar displays the following information about the waypoint:

- Point Name / Type - the name and type of the waypoint.
- Elevation - the MSL elevation of the airport in feet
- ATIS Frequency - if the airport is equipped with an ATIS or AWOS system the frequency is shown.
- Tower or CTAF Frequency - if the airport is tower controlled, the tower frequency is displayed. If the airport is uncontrolled the CTAF frequency is shown.
- Flight Category - current flight category at the waypoint. Only available if METAR data is available for the waypoint.
- Winds - current surface winds at the waypoint. Only available if METAR data is available for the waypoint.
- Ceiling - shows the current ceiling height at the waypoint. Only available if METAR data is available for the waypoint and if a ceiling is indicated in the METAR.
- Available Runways - shows available runways at the destination airport. If METAR wind data indicates an optimal runway, that runway will appear in green.

Note that not all items are available at all times for all airports. Weather is dependent on ADS-B METAR data.

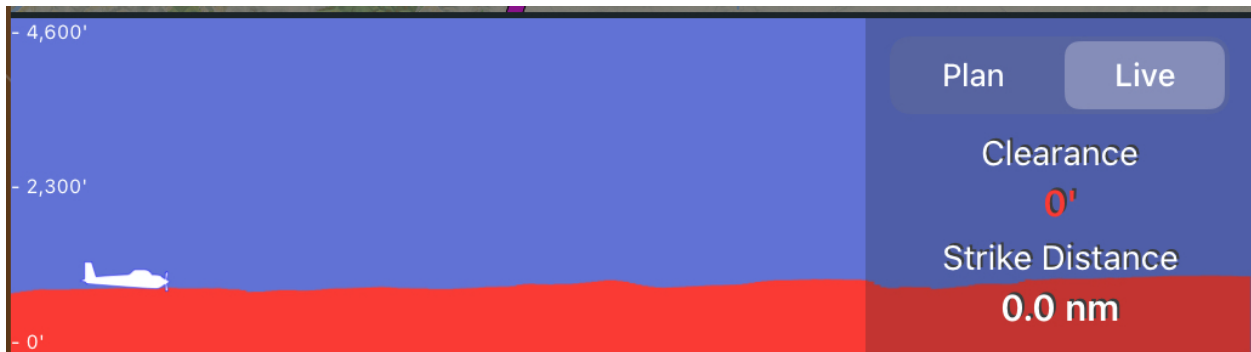
The data is displayed for a total of 60 seconds. At the same time that the data is displayed the system will speak a verbal version of the briefing.

## Button Bar Map Button

The **Map** button (located on the second page of buttons) causes the Button Bar to load the Map Submenu. The **Map** button is accessed from the Button Bar by first pressing the **More** button, then selecting **Map**.

## Terrain Profile View

The integrated terrain monitoring system attempts to help the pilot avoid conflicts with terrain. It does this using a detailed terrain database which must be installed from the Downloads section of the Settings screen.



The terrain monitoring algorithm is pessimistic - it monitors a corridor one mile wide centered on the aircraft's current location. It uses the highest points found along that corridor to determine whether an alert should be generated.

## Terrain Data Required

Terrain data must be installed for the Terrain Profile View and Terrain Alert system to operate. It is recommended that users load data for all regions in which they intend to operate.

## Enabling / Disabling The Terrain View

The Terrain Profile View is toggled on / off using the Terrain Profile icon - the transparent icon in the shape of a mountain that appears on the edge of the screen.

When enabled, the terrain view takes up approximately 1/3 of the available vertical space on the MFD. It can be toggled on / off using the terrain view icon, located on the edge of the display.

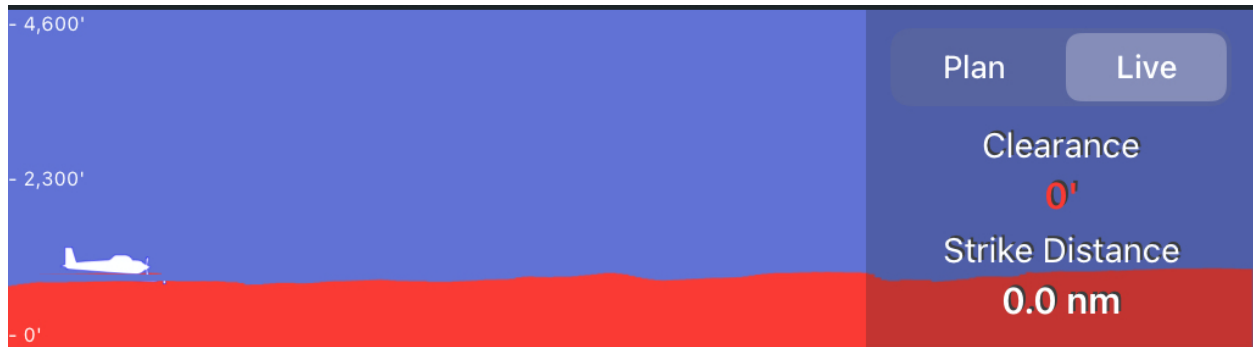
Note that disabling the terrain view does not disable the Terrain Alert system.

## Terrain Profile Modes

The terrain profile view supports two operating modes: Live and Plan. Live mode provides a detailed real-time view of the terrain immediately ahead of the aircraft. Plan mode shows a profile of the active flight plan. If no plan is loaded the system defaults to Live mode. If a course is loaded the profile view displays a selector that allows the user to toggle between Plan and Live modes.

## Live Mode

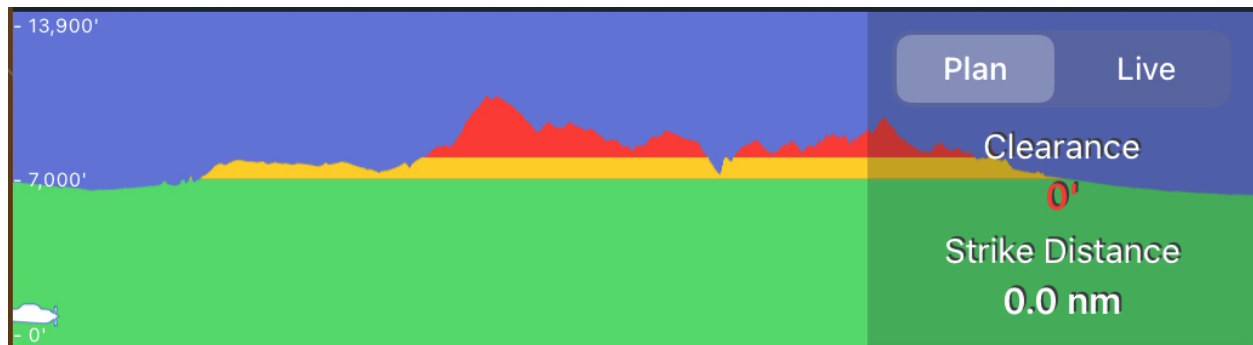
Live mode shows the profile for the next ten (10) nautical miles along the current ground track. The display is updated every 1 - 30 seconds (the refresh rate depends on the class of iPad in use - faster iPads have higher refresh rates).



In Live mode, the airplane represents the “ownship” aircraft (i.e. “you”) and is anchored at the left-hand side of the display. To the left of the ownship icon is a scale indicating geometric altitude. The image displays a maximum of 3500’ of sky above the highest terrain feature. If the ownship is more than 3500’ above the highest feature the icon will appear at the top of the profile view regardless of altitude.

## Plan Mode

Plan mode shows the profile for the currently loaded flight plan. The profile is generated when the plan is entered and remains in place until the plan is changed or deleted.



In Plan mode, the ownship icon moves both vertically and horizontally. As the aircraft proceeds along the course, the icon is moved from left to right to indicate the current location. The icon moves vertically to indicate the aircraft’s altitude relative to the terrain. The color coded profile image is updated when the ownship altitude changes by more than 100’.

## Flying vs. Ground Operations

When on the ground the system will display data useful for selecting safe altitudes. When flying, the system will operate in a more tactical mode intended to prevent terrain-related accidents.

### Ground Operations

On the ground, the Live mode view displays a profile for the last valid ground track. If the application has just started and no previous valid ground track is available, the display defaults to 0° True. The ownship icon indicates the estimated height above the ground, which should be 0'. However, the AGL indication and the "Clearance" value may vary slightly depending on GPS accuracy.

The Plan view shows a profile for the active flight plan. The color coding, ownship position, Clearance value, and Strike value are all set based on the PFD's Altitude Bug value. Adjusting the Altitude Bug will cause the Terrain Profile to refresh. To find a safe altitude, simply adjust the bug value until the entire profile is displayed in green.

The Clearance value indicates the clearance (or lack thereof) relative to the Altitude Bug value. A negative clearance value - displayed in red - indicate a conflict.

The Strike value indicates the distance from the start of course to the first terrain conflict. A Strike value of 0 indicates no conflicts exist at the target altitude.

### Flight Operations

In flight, the profile is colored to indicate the relative altitude of terrain ahead in both Live and Plan modes. The ownship icon position, color coding, Clearance value, and Strike value are all calculated using the current GPS altitude.

The Clearance value indicates the aircraft's current estimated height above ground level. The Strike value indicates the distance from the current location to the first detected terrain conflict.

## Terrain Alert System

The terrain alert system generates aural and visual alerts to indicate impending terrain conflicts. It activates after takeoff once the aircraft has leveled out at cruising altitude. It remains in operation until the aircraft enters the landing phase.

The alert system operates by monitoring the elevation along a one mile wide corridor extending from the aircraft's current position to a point five air minutes<sup>6</sup> ahead along the current ground track. Any conflicting terrain within three (3) air minutes results in a "Caution" alert. Any conflicting terrain within 1.5 air minutes results in a "Warning!" alert.

When a terrain alert is active a visual alert indicator is displayed in the top center of the display. The visual alert can be dismissed by tapping the "X" on the right-hand side of the alert. If not manually dismissed the alert will dim after 15 seconds and will be removed when the alert condition (i.e. terrain conflict) is resolved<sup>7</sup>.

Aural alert messages will be played every 15 seconds until the alert condition (i.e. a terrain conflict) is resolved. If the alert condition progresses from the Caution level to the Warning level, the Warning alert will be played immediately.

Users can disable / enable terrain alerts from the Settings menu.

## GPS and Terrain

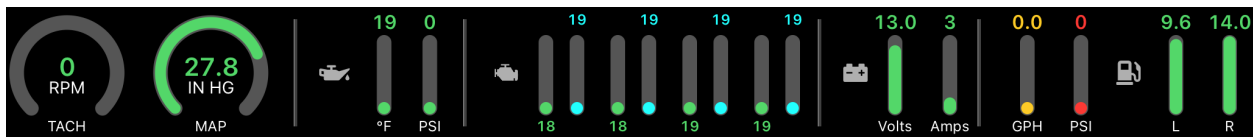
The terrain system uses GPS altitude and thus the accuracy of the data presented on the profile view depends on the accuracy of the GPS. If the accuracy drops below a minimum threshold, the terrain view will be disabled.

## Terrain Color Coding Key

The terrain profile view shows terrain more than 1000' below the ownship altitude in **green**. Terrain that is less than 1000' below but more than 100' below is shown in **yellow**. Terrain less than 100' below the current altitude - or above it - is shown in **red**.

## Engine Monitor Bar

The Engine Monitor System (EMS) provides information about the aircraft's engine. The data is displayed via a series of bar and / or circle gauges on a bar located directly below the main content area and above the button bar.



<sup>6</sup> One "air minute" is the distance the aircraft will travel over the ground in one minute at its current ground speed. An aircraft with a ground speed of 120 nm/hr will cover 2 nm in one minute and 10 nm in 5 minutes.

<sup>7</sup> Unless a higher priority alert is issued, in which case the original alert will be immediately replaced.

## EMS Gauges

The EMS Bar uses two graphical formats for gauges: circle gauges and line gauges:

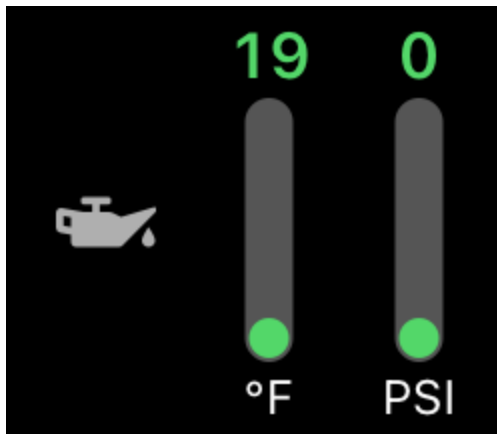
### Circle Gauge



Circle gauges include a digital representation of the value in the center with a caption that indicates the unit and a label that identifies the function at the bottom.

Values on a circle gauge increment in a clockwise fashion: progressing from left to right.

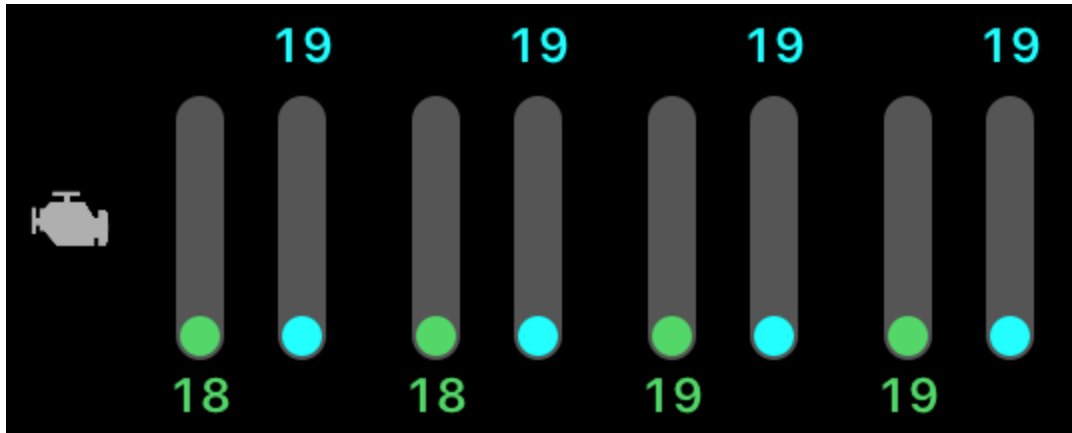
### Line Gauge



Line gauges include two labels, one above the gauge indicator and another below. In this example the digital value is displayed at the top of the gauge and a unit indicator caption is located below. This is the standard layout for line gauges other than cluster gauges (see below).

Line gauge value indication progresses from the bottom of the gauge to the top as the value increases.

## Cluster Gauge



In some cases, line gauges are assembled into clusters to represent repeated values - in the above example, four cylinders each with cylinder head temperature and exhaust gas temperature. In this case the CHT values are placed at the bottom and the EGT values at the top to more easily accommodate larger digital values (i.e. three and four digit numbers).

## Caution and Warning Indication

The EMS Bar depicts the status of each gauge based on user-defined limit settings. The limits are configured in the Engine Display options under Aircraft Configuration in the Settings menu. (See the next section for detail on adjusting settings.)

The FlightView EMS takes a unique approach to displaying engine metrics. Most engine monitors break the gauge display into sections indicating nominal operation (green), caution zones (yellow) and danger zones (red). That approach makes the scan of the engine bar somewhat more complicated, as the user must find the pointer and determine where it is currently resting on the scale.

The FlightView EMS bar takes a more pragmatic approach and displays the entire gauge indicator - the inner colored section of the gauge - in the status color. This allows the user to scan the entire EMS bar with a glance. If nothing is yellow or red, the engine is operating in a nominal condition.



## EMS Functions

### Default Gauges

**RPM** - Displays the current engine speed in rotations per minute (RPM). If two RPM inputs are in use the display indicates the faster of the two inputs. If the difference between the two inputs is greater than 100 RPM a fault indicator will be displayed.

**Manifold Pressure** - Indicates the current manifold pressure in inches of mercury (In Hg).

**Oil Temperature** - Indicates the current oil temperature in degrees fahrenheit or centigrade depending on the system units configuration.

**Oil Pressure** - Indicates the current oil pressure in PSI.

**Cylinder Head Temperatures (CHT)** - Indicates the current cylinder head temperature for each monitored cylinder in degrees fahrenheit or centigrade depending on the system units configuration.

**Exhaust Gas Temperatures (EGT)** - Indicates the current exhaust gas temperature for each monitored cylinder in degrees fahrenheit or centigrade depending on the system units configuration.

**Volts** - Indicates the system bus voltage.

**Amps** - Indicates the current load as registered by an ammeter shunt. The specific measured value depends on the placement of the shunt in the electrical system.

**Fuel Flow** - Indicates the fuel flow in gallons or litres per hour depending on the system units configuration.

**Fuel Pressure** - Indicates the fuel pressure in PSI.

**Fuel Levels** - Indicates the measured quantity of fuel in the tanks (left and right) in gallons or litres depending on the system units configuration.

### Additional Gauges

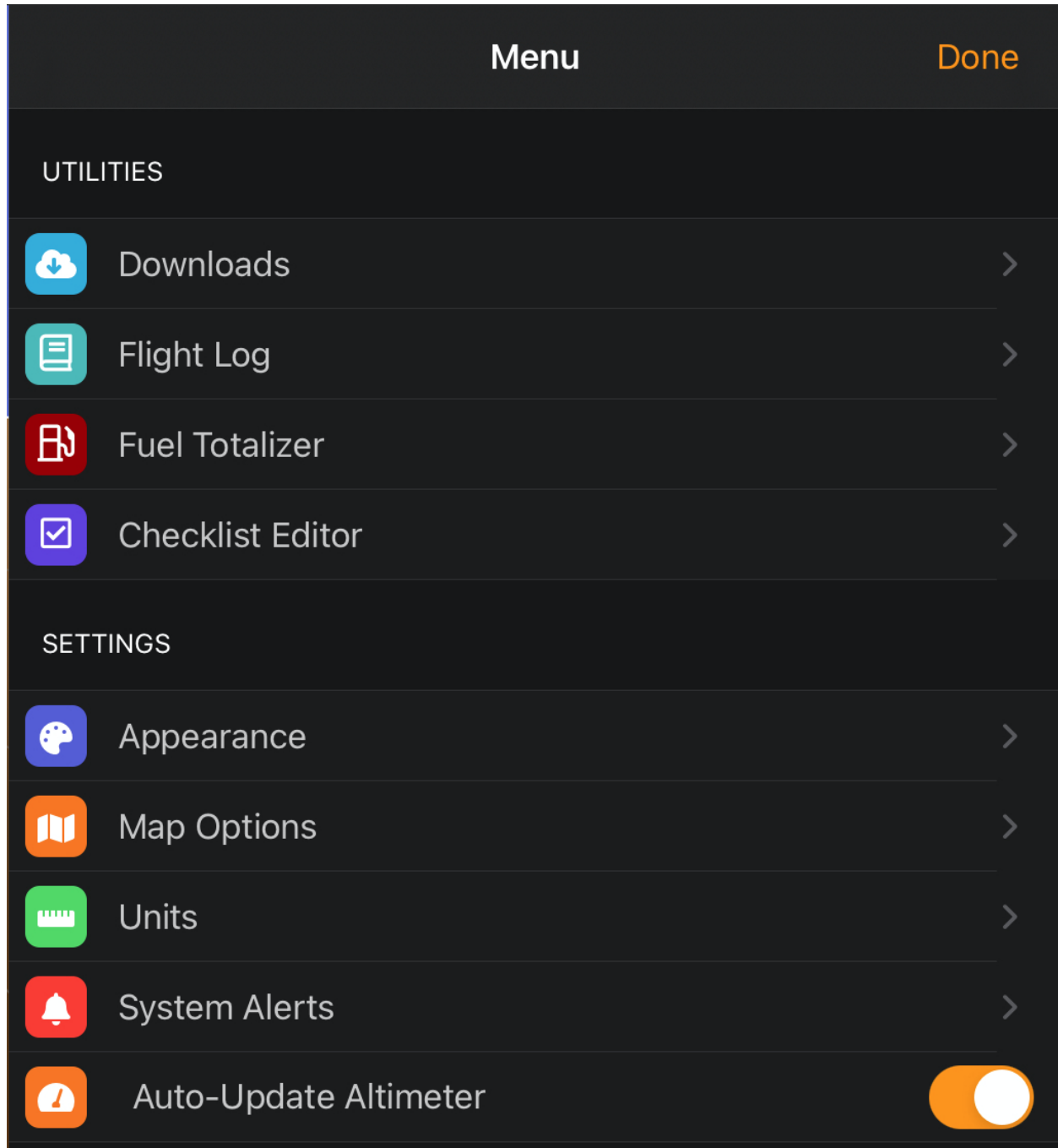
A number of additional gauges can be added to the EMS Bar. These are somewhat less common and do not come with a default input (i.e. port on the EMS box). These typically require

some additional configuration in both the Engine Monitor section of System Hardware and in the Engine Display section of Aircraft Configuration.

- Fuel Tank 3 (Header Tank)
- Carburetor Temperature
- Coolant Temperature
- Turbine Intake Temperature
- PRSU Temperature
- Propeller RPM

# Part V: Configuring FlightView

The FlightView system is configured using the FlightView application. To access the system settings menu, tap the following Button Bar buttons: **More...** → **Menu**



The setup process for FlightView involves setting various parameters associated with the aircraft (the “aircraft profile”) and adjusting the settings on the FlightView app to display as best suits the installation.

## Accessing Setting

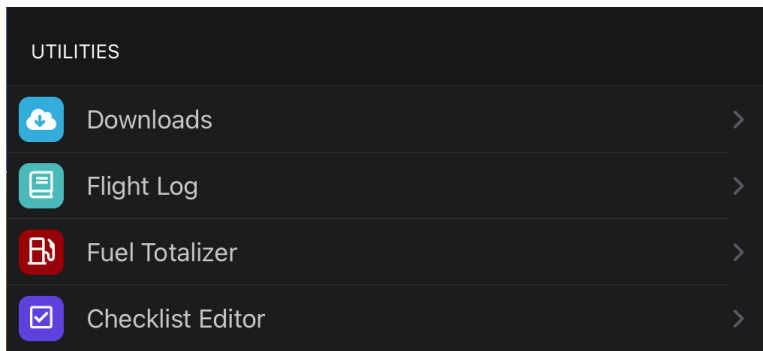
Configuration options are available from the FlightView app and can be accessed from the Button Bar by tapping **More...** then **Menu**. This loads the main menu of configuration options.

A limited number of options are only available from the web interface on the FlightBox Pro. To access these options, use a web browser and direct it to 192.168.10.1 - the IP address of the FlightBox. (Note that future updates to the FlightView app will eliminate the need to access the web interface.)

## Settings Menu

The settings menu includes the following sections:

### Utilities Section



The utilities section includes:

#### Downloads

This option allows the user to download aviation database updates, base maps, terrain, and other dynamic data.

#### Flight Log

The Flight Log lists a history of flights as recorded by the application. This feature is a work in progress. The current version provides only minimal data about each flight. Future updates will include additional information.

#### Fuel Totalizer

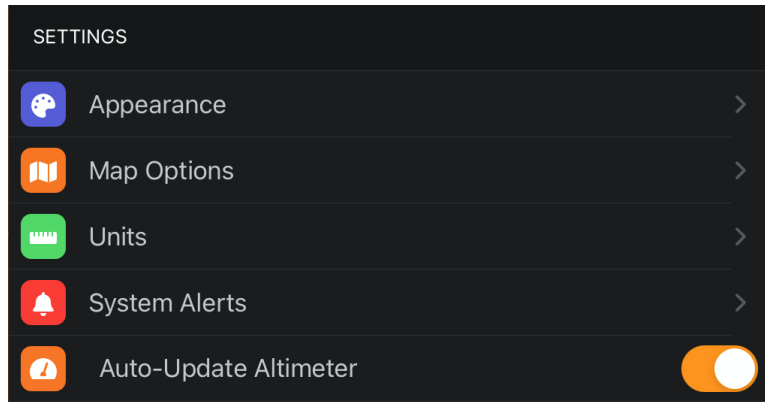
The Fuel Totalizer uses the fuel flow sender and user input to estimate the total remaining fuel onboard. This is intended to be used as a cross reference with the measured fuel from the fuel tank senders. This feature is also a work in progress.

## Checklist Editor

The Checklist Editor allows the user to create and modify checklists for use with the FlightView checklist function.

## Settings Section

Items in the Settings section control the operation of the local instance of the application (the copy running on an individual iPad). Settings changes do not affect other iPad displays.



The settings section includes:

### Appearance

Controls the layout of the application and various user interaction options. Allows the user to select between split screen and full screen. Configures the primary function of the iPad (PFD, MFD). Configures partner relationships between PFD and

MFD.

### Map Options

Controls the appearance of data on the moving map. Allows the user to set the distance limits for the traffic display.

### Units

Controls the units used to display data in all sections of the application.

### System Alerts

Controls visual and aural alert notifications. Allows the user to enable / disable aural alerts. Allows the user to enable / disable and adjust the timing for tank switch reminders.

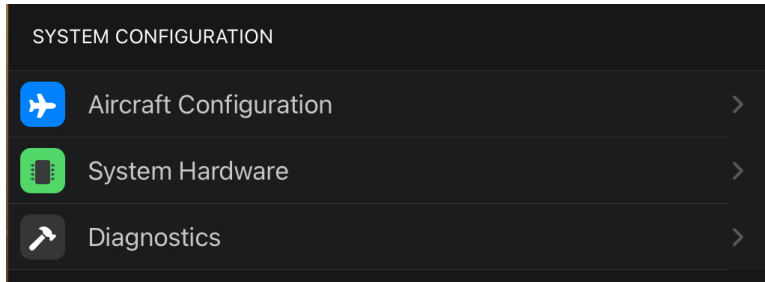
### Auto-Update Altimeter

Enables / disables automatic setting of the altimeter offset based on METAR data.

## System Configuration Section

Items in the System Configuration section control the operation of core elements of the FlightView system - the Flight Data Computer, Air Data Computer, Engine Monitor and any Remote Interfaces installed.

**Note that access to many of the options in the System Configuration section requires the application to be connected to and communicating with the FlightBox and other FlightView hardware.**



This section includes:

### **Aircraft Configuration**

Configures the identity, V-speeds, engine display parameters.

V-speeds are used to set color bands on PFD indicators. Engine display parameters show / hide

various engine instruments and set limits for nominal / caution / warning indications.

### **System Hardware**

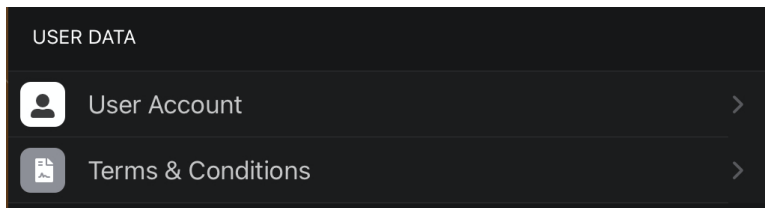
Configure the FlightBox Pro, ADC, EMS, and other hardware. Includes status indication for data sources, iPad health information, configuration of core systems, remote interfaces, and accessories.

### **Diagnostics**

Access, review, and share logs from the iPad and system hardware.

## **User Data Section**

The User Data section includes the following:



### **User Data**

The User Account section includes details on the user's FlightView account and any subscriptions or unlocked functions associated with the account.

### **Terms & Conditions**

Review the terms and conditions under which you are granted a license to use the FlightView system.

### **Acknowledgements**

Credits and acknowledgements to developers of libraries used in the FlightView system.

## Downloads

### Automatic Updates

This option allows the app to regularly check for updates and to automatically download new data in the background.

### Use Mobile Data

This option allows the download system to use a mobile (LTE / 4G / 5G) connection to download data rather than requiring a Wifi connection. This may incur additional charges if the device does not have an unlimited mobile data plan.

### Aviation Database

This option downloads / updates the aviation database. Tap the update button to initiate a download.

### Aircraft Registration Database

This option downloads / updates the aircraft registry database. Tap the update button to initiate a download.

### Base Maps On Device

This section lists base maps that are currently installed on the device. To add base maps, use the Add Base Maps

### Terrain Data On Device

This section lists the terrain data that is currently installed on the device. To add terrain data, use the Add Terrain Data button.

## Flight Log

The current incarnation of the Flight Log is simply a record of each flight, recorded from takeoff to landing. The display section includes the date of the flight, the origin and destination airports and the duration.

Note that the application currently records a much richer set of data, including a track log (GPS points recorded once per second), alerts, phase transitions, and other flight data. Future updates to FlightView will allow the user to download the data for use on mapping systems like Google Earth and third party flight visualization and debriefing services like CloudAhoy.

## Fuel Totalizer

The screenshot shows a dark-themed interface titled "Fuel Onboard" with an orange "X" icon in the top right corner. It features two columns: "Totalizer Value" with a value of "21.5" and "Measured Value" with a value of "0.0". Below these is a "New Value" section with a value of "0.0". Under "New Value" are two sets of buttons: the first set has "-" and "+" buttons next to the value "1.0", and the second set has "-" and "+" buttons next to the value "0.1". At the bottom left, it says "Full (20.0 Gallons)" in orange, and at the bottom right, it says "Save / Done" in orange.

The Fuel Totalizer allows the user to enter the actual amount of fuel onboard and uses fuel consumption data from the fuel flow sender to continually decrement that amount. This provides a secondary source of fuel information.

To adjust the amount of fuel onboard, tap the + and - buttons under New Value, then tap Save / Done.

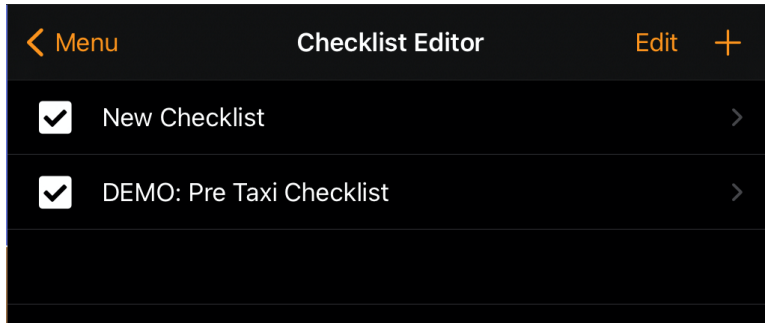
To cancel, tap the X icon in the upper right-hand corner.

Note that the Fuel Totalizer feature requires a working fuel flow transducer connected to the EMS.

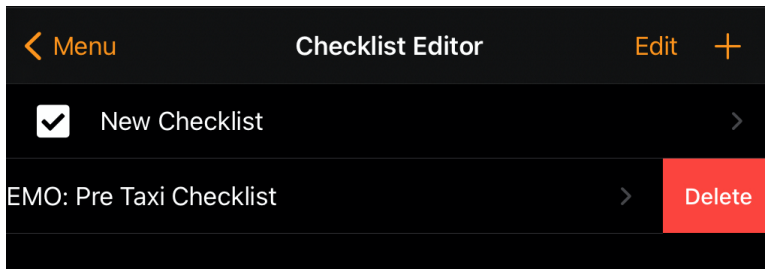
## Checklist Editor

The Checklist Editor allows the user to create and modify checklists. When launched, the Checklist Editor opens to a list of checklists. From this screen the user may create a new checklist, edit or delete an existing checklist, or change the order of lists.



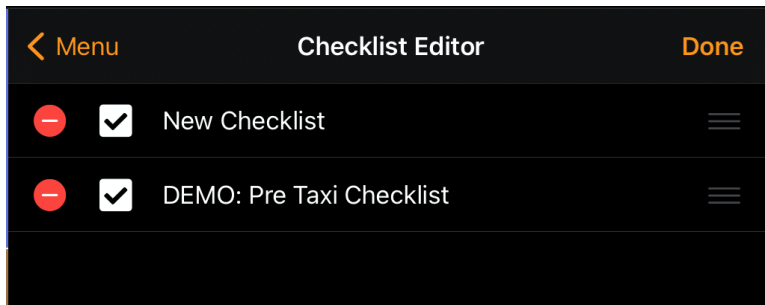


## Deleting An Existing List



To delete an existing checklist, swipe to the left on the list row to expose the Delete button, then tap Delete.

## Reordering Lists



To reorder checklists, tap the Edit button, then use the drag indicators (the three horizontal lines at the right-hand edge of each list row) to drag the lists into the desired order.

Tap Done when complete.

## Creating A New Checklist

The screenshot shows the 'List Editor' interface. At the top, there is a back arrow, the title 'List Editor', and an 'Edit' button with a plus sign. Below this is the 'List Options' section, which includes three fields: 'List Name' (with a placeholder 'Name for the new check list. (Required)'), 'Function' (set to 'Uncategorized'), and 'On Complete' (set to 'End (No Follow-Up List)'). Below the options is the 'List Items' section, which is currently empty.

(1) Tap the "+" button in the upper right corner to open the New List view.

(2) Tap in the **List Name** field and use the keyboard to enter a name for the list.

(3) Tap the **Function** field and select one of the pre-defined functions (optional).

(4) If this is part of a chain of lists, tap the **On Complete** field and select the next list to activate.

(5) To add list items, tap the "+" button in the upper right corner to

launch the item editor.

The screenshot shows the 'Item Editor' interface. At the top, there is a back arrow and the title 'List Editor'. Below this is the 'Item Text' field, which is highlighted with a red box. Below the 'Item Text' field is the 'Item Audio Prompt' field, which is also highlighted with a red box. Below the 'Item Audio Prompt' field is the 'Audio Response Options' field, which is highlighted with a red box. Below the 'Audio Response Options' field is the 'Detail Description' field, which is not highlighted.

(6) Enter the checklist text prompt (e.g. "Brakes set" or "Flaps to 10%") in the **Item Text** field.

(7) If the audio prompt for the item should be different from the Item Text, enter the phrase in the **Item Audio Prompt** field. If left empty, the system will use the value from the Item Text field.

(8) If the spoken response to the item should be something other

than the word "check", enter the alternative response in the **Audio Response Options** field. Note that the audio checklist system will always accept "check", so this is optional.

(9) Tap the back button ("**< List Editor**") to return to the List Editor view.

Repeat the preceding steps (5 - 9) to add additional items to the list. When done, tap the back button ("**<**") to return to the main Checklist Editor screen.

## Editing A Checklist

To edit a checklist, open the list by selecting it in the main Checklist Editor screen.

## Reordering List Items

To change the order of list items, open the list by selecting it in the main Checklist Editor screen, then tapping the Edit button. Use the drag handles on the list items (the three horizontal lines at the right-hand edge of the row) to drag the items into the desired order.

## Appearance

The FlightView display application is quite flexible. It can be configured to display a full-screen PFD, a full-screen MFD (moving map), or a split screen showing both.



Full screen PFD (left) and full screen MFD (right).

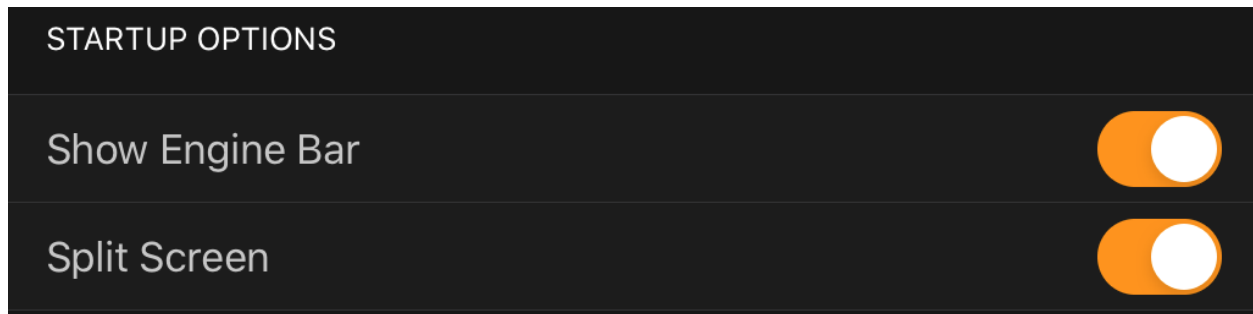


Figure x. Split screen with MFD and PFD.

If an engine data source is available, the app can optionally display the engine bar (seen below the PFD / MFD in the images above).

## Startup Options

Startup options control how the application appears at launch. Note that you can temporarily override the defaults set in the Startup Options section using options in the Display menu. For more information on overriding the startup options, see Section IV on Using FlightView.



### Show Engine Bar

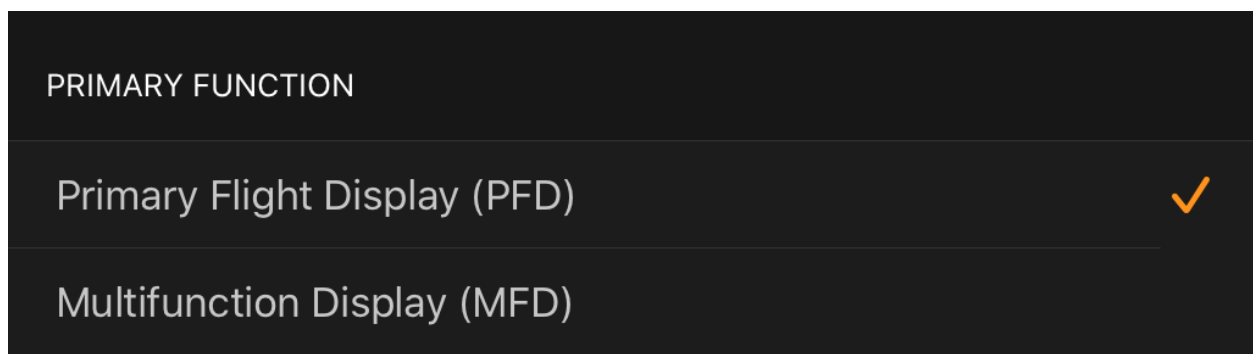
Toggles which controls whether the Engine Bar is displayed when the app starts up. If the toggle is turned off, the Engine Bar can be displayed manually by pressing: More => Display => EMS.

### Split Screen

Determines if the screen is automatically split (50% PFD / 50% MFD) at startup. If switched on, the screen is split. If switched off, the app displays the Primary Function (see below) full-screen.

## Primary Function

This setting determines the main function of the iPad when running the FlightView app. Under most circumstances FlightView will avoid hiding, covering, or obscuring the user's view of the **Primary Function**.



Options for **Primary Function** are “Primary Flight Display (PFD)” and “Multifunction Display (MFD)”. Refer to Figure X above for examples of each.

If the **Split Screen** option is turned off (i.e. full-screen mode) the app will display the selected **Primary Function** across the full width of the screen.

If the **Split Screen** option is turned on (i.e. split-screen mode) the app will display the selected **Primary Function** on the **Primary Side** (see below) of the screen and all secondary content on the other side of the screen.

## Display Location

This setting tells the FlightView system where in the aircraft’s cockpit this iPad is located. This information is used to adjust various display options.

DISPLAY LOCATION	
Pilot Station (Left)	
Multifunction Display (Center)	
Co-Pilot Station (Right)	✓

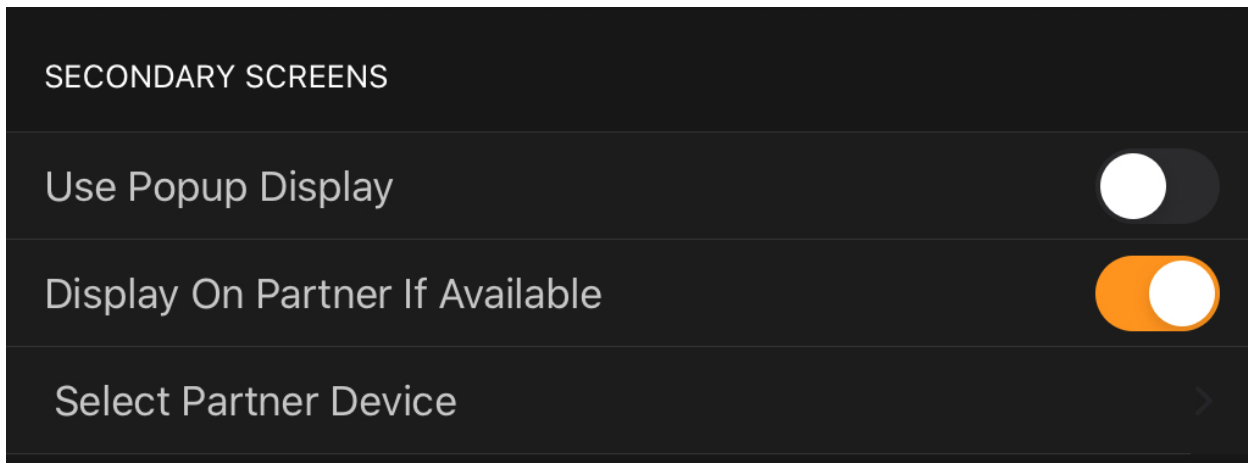
Use **Pilot Station (Left)** for any installation that has only one display or for the iPad centered in front of the left-seat position in a multi-display configuration.

Use **Multifunction Display (Center)** for a centrally located iPad in a two or three display configuration.

Use **Co-Pilot Station (Right)** for an iPad centered in front of the right-seat position in a two or three display configuration.

## Secondary Screens

These settings tell FlightView how to handle temporary secondary content. Temporary secondary content items are screens like the Settings, Transponder, COM Radio, or Autopilot which are displayed only when you are making an adjustment.



If the iPad is running in Full Screen mode, the Primary Function content (the PFD or MFD) is shrunk to half-screen and the secondary content is loaded on the non-Primary side.

If the iPad is configured in Split Screen mode, the system swaps out the default secondary function for the temporary secondary screen. For example, if the iPad is configured to treat the PFD as the Primary Function, then it will temporarily hide the MFD and replace it with the temporary secondary content.

If the installation includes multiple displays (iPads), secondary content can be configured to appear on a “partner” display. This configuration is most useful when using full-screen PFD on the display directly in front of the pilot with the secondary display (located to the right of the pilot) running a full-screen MFD. Tapping the “Transponder” button on the PFD will cause the Transponder display to appear as a “popup” view on the left-hand side of the MFD.

## Use Popup Display

Enable this option to display secondary content in a window that floats above (and partially covers) the primary content. Note that this option is only available if the display is configured for full-screen operation (i.e. the **Split Screen** option turned off).

## Display On Partner If Available

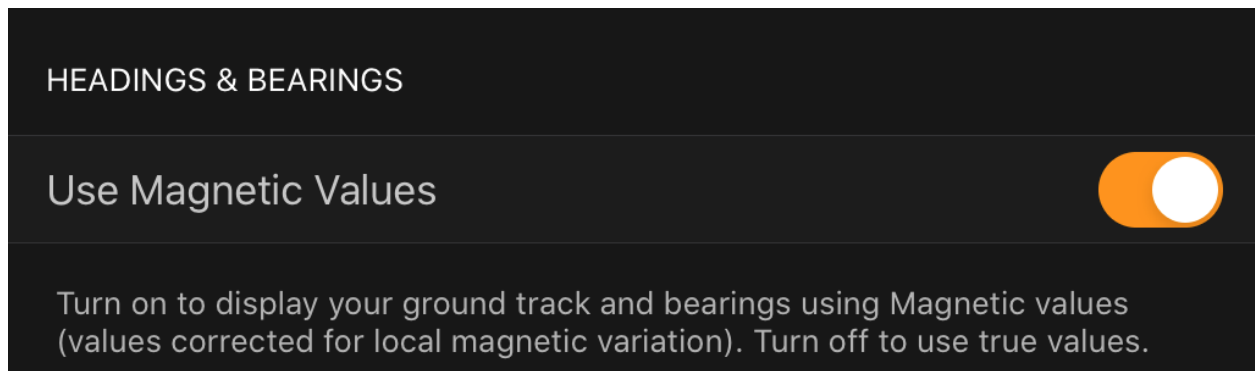
Turn this option on to enable the display of secondary screens on a partner device. Note that when displaying secondary content, the partner device will locate the popup screen on the left-hand side if the request comes from the left-hand (pilot's) device and on the right-hand side if the request comes from the right-hand (co-pilot's) device.

## Select Partner Device

This option will display a list of other iPads running FlightView and connected to the same FlightBox. If no devices are listed, check that all are on the FlightBox Wifi network. (Note that this option is only available if the **Display On Partner If Available** option has been turned on.)

## Headings and Bearings

This option determines if bearings are displayed with reference to true or magnetic values.

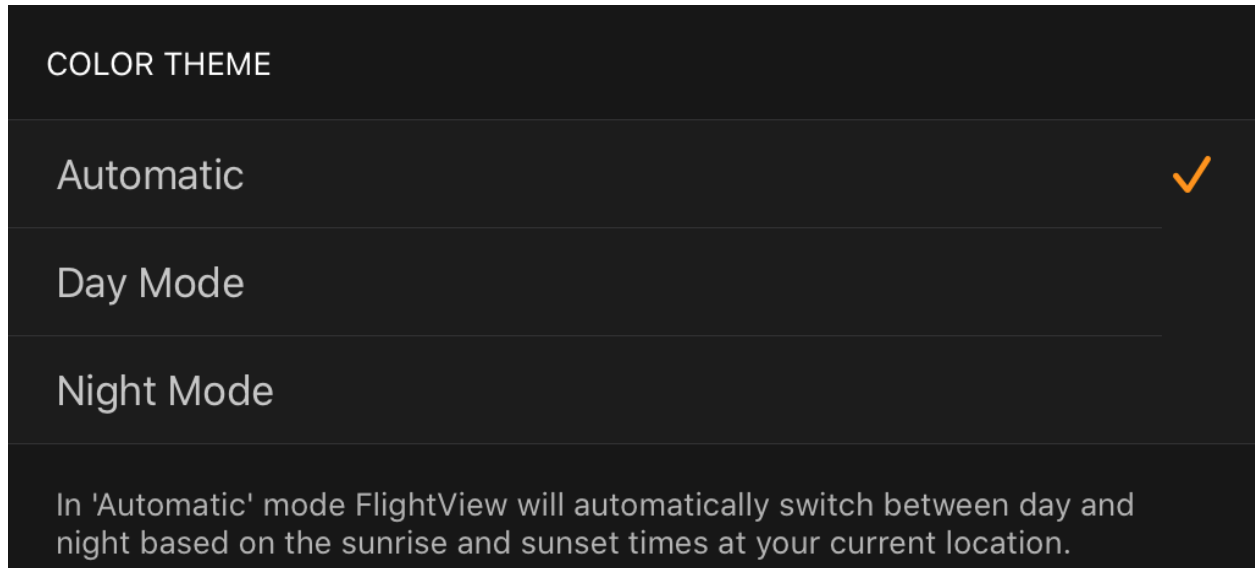


If turned to the 'on' setting, all headings, tracks, and bearings will be displayed in magnetic degrees (i.e. with the local magnetic deviation applied). If turned off, headings, tracks, and bearings will be displayed in true degrees.

This option is generally used to make values shown in FlightView match up with values shown on a magnetic compass or on other avionics that use a magnetic reference.

## Color Theme

This setting controls what display theme is used by the FlightView application.



When set to **Automatic**, FlightView will switch between Day and Night mode based on the aircraft's location, the current date and time. The automatic shift from Day to Night takes place at local civil sunset. The automatic shift from Night to Day takes place at local civil sunrise.

When set to **Day Mode**, the lighter daytime theme is used regardless of the date, time, or location.

When set to **Night Mode**, the darker night theme is used regardless of the date, time, or location.

Note that a theme may be selected manually from the **Display** menu. See the Using Flight View section for details.

## Map Options

Map Options settings control what is displayed on the moving map on the MFD.

## Map Features

These settings configure various navigational elements which can optionally be displayed on the map.



MAP FEATURES	
Show Runway Centerlines	<input checked="" type="checkbox"/>
Show Distance Ring(s)	<input checked="" type="checkbox"/>
Show Navigation Aids	<input type="checkbox"/>

**Show Runway Centerlines**

Toggles the display of runway centerlines for destination airports (i.e. the final airport in the active flight plan). Turning this on causes FlightView to display dashed blue lines that extend approximately three nautical miles in either direction from the centerpoint of each runway .

**Show Distance Ring**

Enables / disables the distance ring displayed on the MFD moving map.

**Show Navigation Aids**

Enables / disables the display of navigation aids on the MFD moving map.

## Show Traffic Within

This setting controls the display of traffic targets on the map. The controls adjust the size of the “puck” of airspace in which targets are reported.

SHOW TRAFFIC WITHIN		
Vertical Distance (Feet)	3000	<input type="button" value="−"/>   <input type="button" value="+"/>
Radius (Nautical Miles)	15	<input type="button" value="−"/>   <input type="button" value="+"/>

**Vertical Distance (Feet):** The vertical height both above and below the aircraft in which traffic will be reported. For example, a setting of 1500 results in reports of targets up to 1500 feet

below the ownship aircraft and up to 1500 feet above the ownship aircraft. Any targets more than 1500 feet above or 1500 feet below will be ignored.

**Radius (Nautical Miles):** The radius of the “puck” in which traffic targets are reported, centered on the ownship aircraft. For example, setting a value of 15 results in targets within 15 nautical miles of the ownship being reported. Any targets more than 15 miles away will be ignored.

## Units

The Units setting page allows the user to select their preferred units for various measured values displayed by FlightView.

Unit Settings	
ALTITUDE	
Feet	✓
Meters	
DISTANCE	
Nautical Miles	✓
Statue Miles	
Kilometers	

**Altitude** - Display altitude in feet (default) or meters.

**Distance** - Display distance in nautical miles (default), statute miles, or kilometers.

**Airspeed** - Display airspeed in knots (default), miles per hour or kilometers per hour.

**Ground Speed** - Display ground speed in knots (default), miles per hour or kilometers per hour.

**Vertical Speed** - Display vertical speed in feet per minute (default) or meters per second.

**Wind Speed** - Display wind speed in knots (default), miles per hour, or kilometers per hour.

**Temperature** - Display temperatures in degrees Celsius (default) or fahrenheit.

**Atmospheric Pressure** - Display atmospheric pressure in inches of mercury (default) or millibars / hectopascals.

**Time Zone** - Display times in local (default) or Zulu (UCT).

## System Alerts

FlightView includes a comprehensive alerting system that monitors many aircraft parameters and generates cautionary and warning messages which are displayed on the screen and also optionally announced over the iPad's sound system. This page allows the user to enable or disable alerts as needed.

**Pro Tip:** If an aircraft is outfitted with multiple FlightView displays, it is generally recommended that one be used as the primary audio interface unless the displays are being used in a true crew environment (pilot / copilot), with each display connected directly to the crew member's headset. Connecting multiple iPads to a mixer or audio panel can result in overlapping aural alerts.

### **Enable System Alerts**

Enables / disables the alert system. If disabled, no visual or aural alerts will be generated.

### **Play Aural Alerts**

Enables / disables aural (audio) alerts. If disabled, no aural alerts will be generated.

### **Traffic**

Enables / disables traffic alerts. If disabled, alerts for potentially conflicting traffic will not be generated.

### **Landing Callouts**

Enables / disables landing callout messages (altitudes) at 500 and 100 feet. Also used to enable / disable callouts from the laser landing system.

### **Landing Gear Reminder**

Enables / disables an aural reminder message to deploy gear when the aircraft is in landing phase and the airspeed drops below  $V_{LO}$ .

### **Terrain**

Enables / disables alerts generated by potential terrain conflicts.

### **Obstacles**

Enables / disables alerts generated by potential conflicts with known obstacles.

### **Runways**

Enables / disables runway incursion safety alerts. Approaching Runway alerts are triggered when the aircraft is within 120 feet of a runway. Entered Runway alerts are triggered when the aircraft enters the runway.

### **Descent Rate**

Enables / disables the rapid altitude change alert which is triggered when the descent rate is greater than 1500' per minute.

### **Airspeed**

Enables/ disables an airspeed warning alert which is triggered when the airspeed decays to within 10 knots of stall speed or accelerates to within 10 knots of  $V_{NE}$ . This alert is automatically disabled when the aircraft is in landing phase.

### **Altitude**

Enables / disables a high altitude oxygen notification that is triggered when the aircraft reaches or exceeds 12,000' MSL.

### **Attitude**

Enables / disables an unusual attitude alert that is triggered when the aircraft's roll attitude exceeds 45° left or right, or its pitch attitude exceeds 20° up or down.

### **Engine Alerts**

Enables / disables alerts generated when the EMS detects engine readings outside of their nominal range.

### **Fuel Tank Switch Reminder**

Enables / disables a reminder to switch fuel tanks on a periodic basis. The Frequency In Minutes value can be used to adjust the interval between reminders.

## Auto-Update Altimeter

If enabled, this option causes FlightView to automatically update the altimeter offset value ("baro setting" or "QNH") based on METAR data received from ADS-B uplink. The system selects the setting from the nearest valid METAR reporting station.

Note that UAT ADS-B uplink reception must be available and operating in order for this feature to work. If operating outside of the United States this feature should be disabled.

## Aircraft Configuration

The aircraft profile is the collection of information that determines how and what FlightView displays. It includes the aircraft's critical speed values (V-speeds), identity, and hardware configuration.

While the profile is edited from an iPad using the FlightView app, the data is actually stored on the FlightBox Pro. This allows the tablet to be moved from one aircraft to another without having to manually re-configure it. It also allows configuration settings to be made once and shared across all connected displays.

To set up an aircraft profile you will need the Pilot's Operating Handbook (POH). If the EMS has also been installed, you will also need the engine manual.

### Connection To FlightBox Required!

To configure the aircraft profile, power on the FlightBox Pro and connect to it from an iPad. For instructions on powering the FlightBox Pro outside of a specific aircraft (for those configuring their system prior to installation), please see the section entitled **Powering FlightBox On The Bench** above.

## Configuring Aircraft Identity / Registration

The aircraft identity configuration is used for several purposes. FlightView uses the aircraft's registration number ("N" number in the United States) and Mode S Identifier to help reduce ADS-B traffic "ghosts" - targets that represent the aircraft the system is installed in (also referred to as "own ship"). If the installation includes a Mode S or Mode ES transponder, the identification data is used in the outgoing responses or squitter messages.

This information can be located online using the FAA registry N-Number Inquiry at [https://registry.faa.gov/aircraftinquiry/nnum\\_inquiry.aspx](https://registry.faa.gov/aircraftinquiry/nnum_inquiry.aspx)

The make and model values are optional and are not currently used. They will eventually be used to help create standard aircraft profiles for various aircraft.

The Home Airport field is optional and will be used to enable a "Home" feature in navigation.

## Configuring Aircraft V-Speeds

V-Speeds are used to set the various limit indicators on the airspeed indicator and as setpoints for various system alerts. The values used here typically come from the Pilot's Operating Handbook (POH) or equivalent for a particular aircraft.

Setting V-Speed Values:

1. In the FlightView app, go to **Menu, Settings, Aircraft Configuration**
2. Select **V-Speeds**.
3. For each V-Speed, adjust the setting to the appropriate value by tapping the - / + buttons. Holding the - / + button increments or decrements the value rapidly.

This task only needs to be performed once upon installation.

## Configuring Engine Display Parameters

The Engine Monitoring System (EMS) collects, analyzes, stores, and displays engine performance information. A limited amount of configuration is required to ensure that the data from the EMS accurately reflects the operation of a particular engine. This section covers the configuration of EMS display options and operating ranges. For details on assigning or calibrating EMS sensors, see "System Hardware" below.

### Cylinders

The FlightView EMS data bar displays exhaust gas temperature (EGT) and cylinder head temperature (CHT) for up to six cylinders. By default, four are enabled. The Cylinders configuration allows cylinders to be enabled or disabled, and to map EMS thermocouples to cylinders.

Typically this configuration only needs to be done once during installation.

### EGT and CHT Toggles

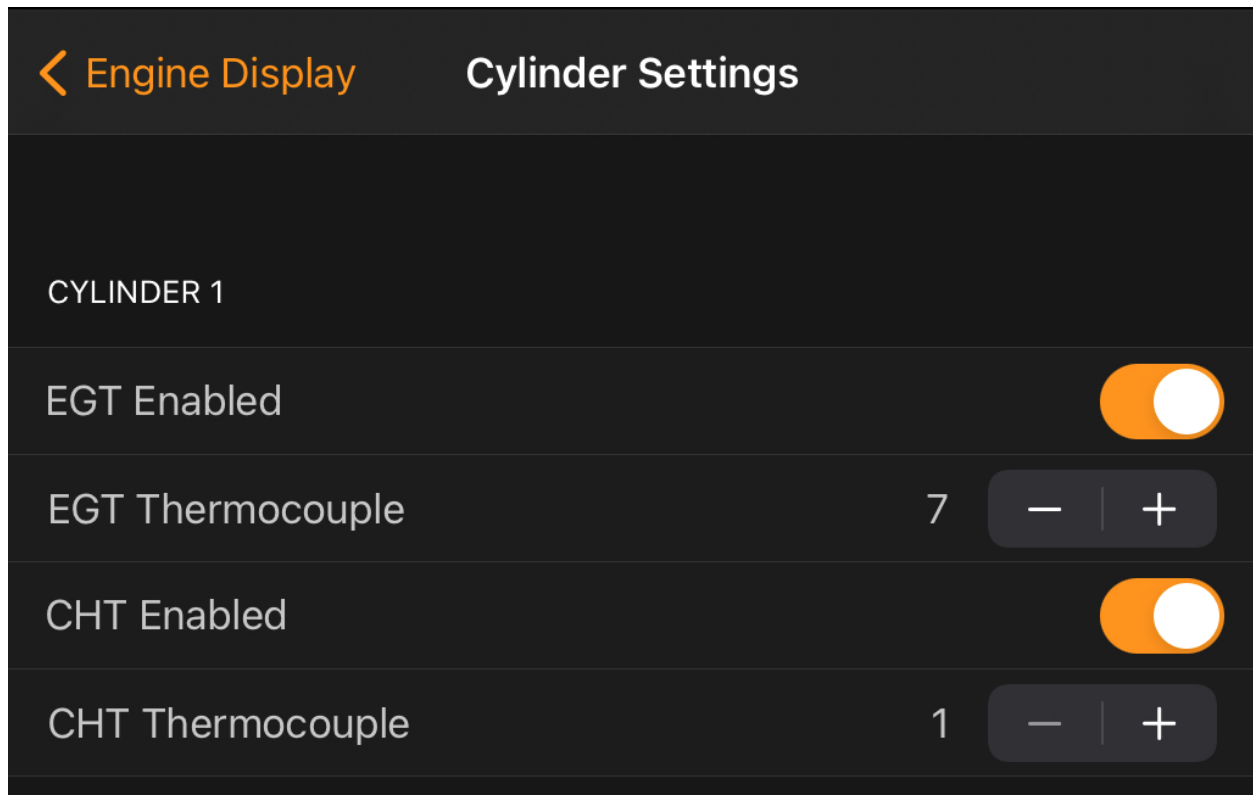
The FlightView EMS bar displays engine cylinder data in a cluster configuration. By default, both EGT and CHT values for each cylinder are displayed. This configuration allows the user to enable or disable cylinders by toggling the EGT and CHT status. A cylinder is disabled (not displayed) if both the EGT and CHT value are toggled off.

Water cooled and other engines that use coolant temperature rather than individual cylinder head temperatures will generally have the CHT option enabled and EGT option disabled.

Traditional air cooled aircraft engines generally have both EGT and CHT enabled. However, some aircraft are equipped with only a single EGT, single CHT, or some combination of EGTs and CHTs. The toggle system allows the user to match their aircraft's setup by enabling and disabling sensors as needed.

## Thermocouple Assignments

The FlightView system supports up to 16 thermocouple devices (temperature sensors) which can be used for exhaust gas temperature (EGT) or cylinder head temperature (CHT) measurement. This configuration option allows the user to associate a thermocouple port on the engine monitor with a specific function (EGT or CHT) and cylinder.



To enable / disable cylinders and to adjust the mapping between EMS thermocouple ports and cylinders:

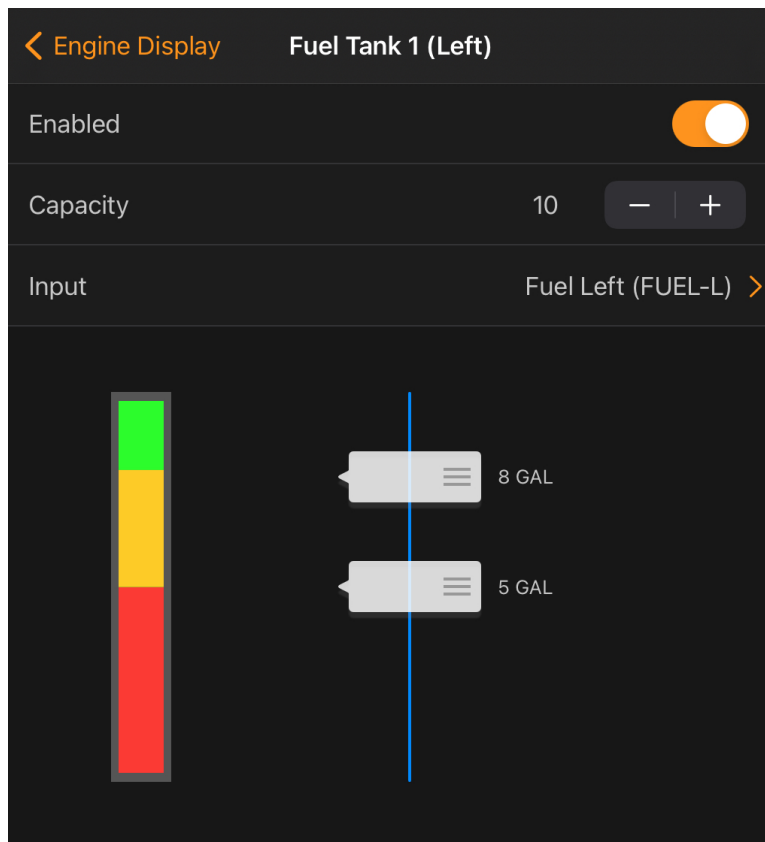
1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select **Cylinders**.
3. Enable the display of exhaust gas temperature for all applicable cylinders by setting the **EGT Enabled** switch to the on position.
4. Enable the display of cylinder head temperature for all applicable cylinders by setting the **CHT Enabled** switch to the on position.
5. Disable any unused cylinders by setting the **EGT Enabled** and **CHT Enabled** switches to the off position.
6. For each enabled cylinder:

- a. If CHT is enabled, set the CHT thermocouple by using the + / - buttons to adjust the **CHT Thermocouple** value to indicate the port that the CHT probe is physically connected to on the EMS.
- b. If EGT is enabled, set the EGT thermocouple by using the + / - buttons to adjust the **EGT Thermocouple** value to indicate the port that the EGT probe is physically connected to on the EMS.

Note that by default thermocouple ports 1 - 8 are configured for J-type thermocouples used for CHT readings while the remaining ports (9 - 16) are configured for K-type thermocouples used for EGT readings. These settings can be changed in the **Engine Monitor** configuration screen under **System Hardware**.

## Engine Gauge Configuration

FlightView uses a simple graphical interface to enable and configure the display parameters for each engine gauge.



**Enabled** - this switch toggles the gauge on / off. If disabled, the gauge will not appear in the Engine Bar.



**Capacity** - this option, available on fuel tanks and other gauges with a fixed upper limit, allows the user to set that limit. This is used to adjust the display of the gauge, and to calculate the total capacity for the aircraft.

**Input** - this option allows the user to select the input (port) on the FlightBox EMS. Default values are assigned for some gauges. Others must be manually selected.

**Value Sliders** - the slider tags allow the user to adjust the values / quantity levels that represent the transition points between various levels of alert. Some gauges have both upper and lower set points, while others have only one or the other.

To adjust the set points, drag the sliders up / down to the appropriate points on the scale. Adjust the gauge to show green for nominal values, yellow for caution values, and red for warning values.

Note that the values assigned using here are used for both the gauge display limits and the alert subsystem.

## Engine Tachometer

The Engine Tachometer display outputs the engine speed in revolutions per minute (RPM). The visual layout format for the tachometer is a circle gauge. This gauge is optional (may be enabled / disabled).

The input for this gauge defaults to using a calculated RPM value (the higher of the two RPM inputs) but can be assigned directly to either RPM 1 or RPM 2.

The tachometer display has only upper limits. The range of the slider is 0 to 12,000 RPM, which allows for measuring geared engines (where the engine RPM is significantly higher than the propeller RPM). The range does not currently support turbojet or turbofan engines.

Setting The Display Limits For RPM:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select **Tachometer**
3. Enable the Tachometer settings by setting the **Enabled** button to **On**.
4. Using the slider buttons, set the upper tag to indicate the warning point and the lower tag to indicate the caution point.
5. The caution point is the value at which the RPM data bar will switch from green to yellow. The warning point is the value at which the indicator will switch from yellow to red.

## Manifold Pressure

The Manifold Pressure gauge displays the current intake manifold pressure in inches of mercury (In Hg). The visual layout for the manifold pressure is a circle gauge. Manifold pressure does not include high or low ranges.

To configure the Manifold Pressure options:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select **Manifold Pressure**.
3. Enable the Manifold Pressure settings by setting the **Enabled** button to **On**.
4. Adjust the Input selection to the appropriate input if the default value is invalid.
5. Disregard the sliders - manifold pressure does not have warning levels.

## Fuel Quantity

The Fuel Quantity gauges indicate the amount of measurable fuel in each of the two main tanks and optionally in a third header or reserve tank. Note that the first two tanks have default inputs but the third (header) is disabled by default and requires a custom (Auxiliary) input.

To configure fuel tank gauges:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select **Fuel Tank 1, Fuel Tank 2, or Fuel Tank 3**.
3. Enable the tank gauge by setting the **Enabled** button to **On**.
4. Adjust the tank capacity to indicate the maximum fuel quantity for the tank in gallons.
5. Adjust the Input selection to the appropriate input if the default value is invalid
6. Use the sliders to adjust the set low fuel caution and warning set points.

## Fuel Flow

The Fuel Flow gauge indicates the rate of fuel consumption in gallons per hour. The visual layout format for Fuel Flow is a vertical line gauge. The gauge has both high and low caution (yellow) setpoints, but no warning (red) setpoints.

To configure the Fuel Flow gauge:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select the **Fuel Flow** option.
3. Enable fuel flow by turning the **Enabled** switch to **On**.
4. Adjust the Input selection to the appropriate input if the default value is invalid.
5. Use the sliders to adjust the low and high fuel flow caution setpoints.

## Fuel Pressure

The Fuel Pressure gauge indicates the current fuel pressure in PSI. The visual layout format for Fuel Pressure is a vertical line gauge. The gauge has both high and low caution (yellow) and warning (red) setpoints.

To configure the Fuel Pressure gauge:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select the **Fuel Pressure** option.
3. Enable fuel pressure by turning the **Enabled** switch to **On**.
4. Adjust the Input selection to the appropriate input if the default value is invalid.
5. Use the sliders to adjust the low and high fuel pressure caution and warning setpoints.

## Oil Temperature

The Oil Temperature gauge indicates the current fuel pressure in degrees (C or F). The visual layout format for Oil Temperature is a vertical line gauge. The gauge has high caution (yellow) and warning (red) setpoints and a low caution (yellow) setpoint. The oil temperature gauge has a fixed maximum value of 250° F.

To configure the Oil Temperature gauge:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select the **Oil Temperature** option.
3. Enable the oil temperature gauge by turning the **Enabled** switch to **On**.
4. Adjust the Input selection to the appropriate input if the default value is invalid.
5. Use the sliders to adjust the low and high fuel pressure caution and warning setpoints.

## Oil Pressure

The Oil Pressure gauge indicates the current fuel pressure in PSI. The visual layout format for Fuel Pressure is a vertical line gauge. The gauge has both high and low caution (yellow) and warning (red) setpoints. The Oil Pressure gauge has a fixed maximum pressure of 150 PSI.

To configure the Fuel Pressure gauge:

6. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
7. Select the **Fuel Pressure** option.
8. Enable fuel pressure by turning the **Enabled** switch to **On**.
9. Adjust the Input selection to the appropriate input if the default value is invalid.
10. Use the sliders to adjust the low and high fuel pressure caution and warning setpoints.

## Cylinder Head Temperature

The Cylinder Head Temperature gauges indicate the current temperature of the associated cylinder head in degrees (C or F). The visual layout format for Cylinder Head Temperature is a cluster-format vertical line gauge. The gauge has high caution (yellow) and warning (red) setpoints and a low caution (yellow) setpoint. The gauges have a fixed maximum temperature of 500° F.

Note that the enable / disable and input (thermocouple) selection functions for individual cylinders is handled in the Cylinders section described above.

To configure the Cylinder Head Temperature gauges:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select the **Cylinder Head Temperature** option.
3. Use the sliders to adjust the high caution (yellow) and warning (red) setpoints.

## Exhaust Gas Temperature

The Exhaust Gas Temperature gauges indicate the current exhaust gas temperature of the associated cylinder in degrees (C or F). The visual layout format for Exhaust Gas Temperature is a cluster-format vertical line gauge. The gauge has high caution (yellow) and warning (red) setpoints. The gauges have a fixed maximum temperature of 1500° F.

Note that the enable / disable and input (thermocouple) selection functions for individual cylinders is handled in the Cylinders section described above.

To configure the Exhaust Gas Temperature gauges:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select the **Exhaust Gas Temperature** option.
3. Use the sliders to adjust the high caution (yellow) and warning (red) setpoints.

## Voltage

The voltage indication provides visual and audio monitoring of the voltage bus level. The visual layout format for voltage is a vertical line gauge. The gauge has both high and low caution (yellow) and warning (red) setpoints. The gauge has a fixed maximum voltage of 30 volts.

To configure the Voltage gauge:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select the **Voltage** option.
3. Enable the voltage gauge by turning the **Enabled** switch to **On**.
4. Adjust the Input selection to the appropriate input if the default value is invalid.
5. Use the sliders to adjust the low and high voltage caution and warning setpoints.

## Amperage

The amperage indication provides visual and audio monitoring of electrical bus current draw. The visual layout format for amperage is a vertical line gauge. The gauge has only high caution (yellow) and warning (red) setpoints. The gauge has a fixed maximum amperage of 100 amps.

To configure the Amperage gauge:

1. In the FlightView app, go to **More, Menu, Aircraft Configuration, Engine Display**
2. Select the **Amperage** option.
3. Enable the amperage gauge by turning the **Enabled** switch to **On**.
4. Adjust the Input selection to the appropriate input if the default value is invalid.
5. Use the sliders to adjust the low and high voltage caution and warning setpoints.

## Additional Gauges

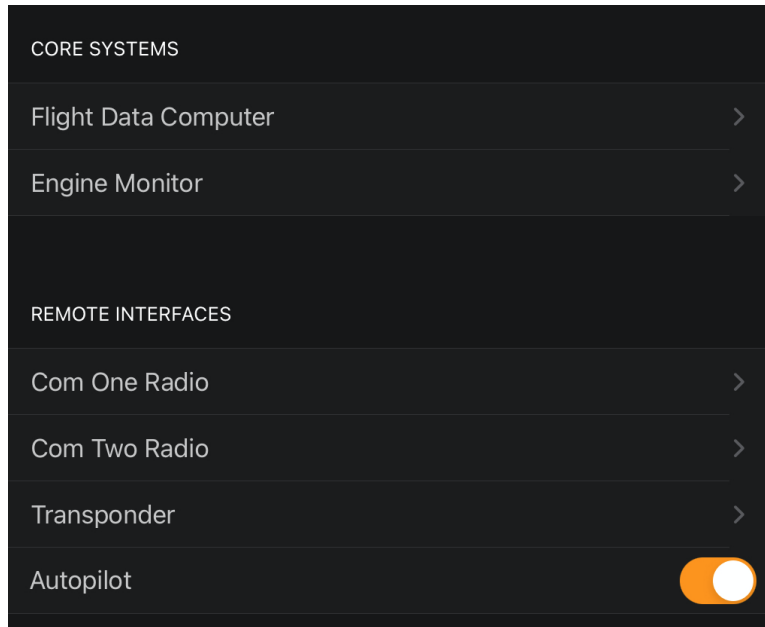
The FlightView engine display has gauges for a number of additional values. These gauges are enabled and configured using the same basic process as the above. However, unlike most of the above gauges, all of the additional items require a custom input configuration and may require a custom calibration. (See below under Hardware Settings → Engine Monitor for details on EMS inputs and calibrations.)

Additional gauges include:

- Carburetor Temperature
- Coolant Temperature
- Turbine Intake Temperature
- PSRU Gearbox Temperature
- Propeller Tachometer

## System Hardware

The System Hardware screen allows the user to access and edit the configuration of remote elements of the FlightView system: the Flight Data Computer, Engine Monitor, Remote Interfaces, and Accessories. It also provides a set of informational and diagnostic values that can be used to verify system operation.



Note that most of the configuration in this section requires a live connection to the FlightView system via the FlightBox Wifi network. Depending on the circumstances of the build, it may be advantageous to perform some of the following configuration steps before permanently mounting the FlightBox and EMS in the aircraft.

### Flight Data Computer (FlightBox)

This option displays the Flight Data Computer (FlightBox) configuration and status screen. Use this to perform firmware updates, check the status of the FlightBox and its ADS-B In, GPS, and AHRS subsystems. This screen also provides access to the AHRS calibration functions.

### Engine Monitor (EMS)

This option displays the Engine Monitor configuration screen. Use this to configure EMS inputs and sensor calibrations, view the current Hobbs time for the engine, and access the EMS Input Monitor.

### Com Radios

The **Com One Radio** and **Com Two Radio** options allow the user to enable / disable and configure optional VHF COM radio interfaces.

## Transponder

The Transponder option allows the user to enable / disable and configure the optional Trig TT2x transponder and ADS-B Out system.

## Advanced Autopilot

The Autopilot toggle allows the user to enable or disable the FlightLink interface to a TruTrak Vision or BendixKing xCruze autopilot. Note that this toggle should remain in the off position to use "basic autopilot" NMEA integration.

## FlightBar

The FlightBar option allows the user to scan for and pair with a FlightBar controller and to swap the orientation if necessary.

## Laser Altimeter

The Laser Altimeter option allows the user to configure the vertical offset of the optional laser landing system.

## Active Data Sources

The Active Data Sources section indicates what data sources are being used to drive the system. Under normal operating conditions, all values should read "FlightBox" followed by the relevant subsystem: GPS, ADC, AHRS, EMS, etc.

ACTIVE DATA SOURCES	
Location	FlightBox GPS
Altitude	FlightBox ADC
Airspeed	FlightBox ADC
Attitude	FlightBox AHRS
Engine Data	FlightBox EMS

If the iPad is not connected to the FlightView system or if some element of the system is offline, the values may indicate another source or no source at all.

If the Status Bar indicates an issue with the Flight Box (FBX) or GPS, this display can be used to help determine what is taking place.

## Display (Local iPad)

The Display section provides a snapshot of the health of the iPad on which the app is running. This information is used to verify that the display is working properly.

DISPLAY (THIS IPAD)	
Device Name	OFS-iPad-1-LTE
App Runtime	00:00:48
Thermal State	Good
Processor Cores	2
Memory In Megabytes	2,028
App Memory Use	248.92
Wifi Network: FlightBox-Pi4DEV	>

All but the last item in the Display list are purely diagnostic. The last item - Wifi Network - allows the user to set a network as the preferred network.

When requesting support from Falken Avionics, users may be asked to take screenshots of the Active Data Sources and Display sections for diagnostic purposes.

## Wifi Network

CURRENT NETWORK	
SSID	FlightBox-Pi4DEV
PREFERRED NETWORK	
SSID	<input type="text"/>
Password	<input type="password"/>
<b>Make Current SSID Preferred</b>	

If a preferred network is set and available but not the current / active network, iOS will ask the user if they would like to join it, and will attempt to maintain a connection to it while the app is running. This can be useful in aircraft with multiple Wifi networks.

To enable this feature:

Tap the **Make Current SSID Preferred** button or type the SSID for the network in the **SSID** field.

If the network is using WPA / WPA2 security, enter the password in the **Password** field.

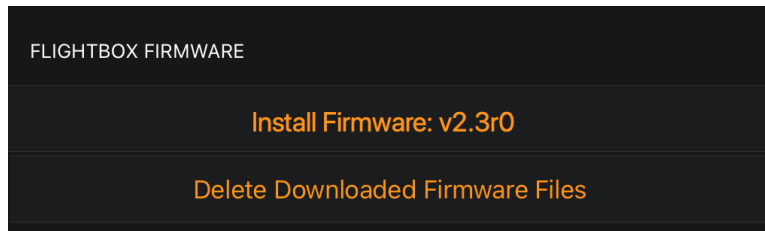
Tap the back arrow to return to the Hardware Settings menu screen.



## Flight Data Computer

The term Flight Data Computer refers to the FlightBox Pro EXP component of the FlightView system. The Flight Data Computer or FDC serves as the hub of the system, creating the Wifi network to which the display iPads connect, and routing data to and from the subsystems.

## FlightBox Firmware



The first element in the FDC configuration is **FlightBox Firmware**. This section is only displayed if firmware has been downloaded to the iPad - a process that happens automatically when the iPad is

running the app and has a valid Wifi Internet connection.

If the FlightBox to which the iPad is connected is running an older version of the firmware, the app will present an option to install the update.

If the FlightBox is up to date, the app will only offer the option of deleting the firmware update file. Note that the app will try to automatically replace it the next time it detects a Wifi Internet connection.

## Installing Firmware Updates

To install the firmware update:

1. Tap the **Install Firmware: v0.0r0** button. A system dialog box will appear prompting the user to confirm or cancel.
2. Tap the YES button to confirm the installation.

Uploading the firmware to the FlightBox can take several seconds depending on the quality of the Wifi connection. Once uploaded, the FlightBox will begin the update process which can take up to five minutes. The FlightBox will reboot twice during the update. During the update iPad may switch to another local Wifi network if one is available, in which case the user will need to reconnect to the FlightBox-XXXX network when the update completes.

**DO NOT POWER OFF THE FLIGHTBOX DURING THE UPDATE PROCESS.**

## Deleting Firmware Files

To delete the firmware update file:

1. Tap the **Delete Downloaded Firmware Files** button. A system dialog will appear prompting the user to confirm or cancel.
2. Tap the YES button to confirm the delete request.

## FlightBox Status

Flight Data Computer	
Delete Downloaded Firmware Files	
FLIGHTBOX	
Status	Connected
System ID	FlightBox
Firmware Version	2.3r1
CPU Temperature	58.4° C
Available Storage	1330 MB
Uptime	93:31:35

The FlightBox Status section provides basic information about the health of the FDC. If the connection to the FlightBox is lost, this section will display only "Disconnected".

In certain cases, Falken Avionics technical support may ask for a screen shot of this page to help diagnose issues or to confirm that the FlightBox is running the proper firmware revision.

## GPS Receiver Status

GPS RECEIVER	
Lock Status	GPS + SBAS (WAAS)
GPS Accuracy	6
Satellites In Solution	10
Satellites Tracked	17
Satellites Seen	11

The GPS Receiver status section provides detailed information about the performance of the FlightView GPS receiver. The values may be used to diagnose GPS or AHRS performance issues.

Note: This screen is only applicable to the FlightView GPS connected to the FlightBox - it does not indicate receiver status

for TN72 position source receivers.)

## UAT and 1090-ES Receiver Status

UAT RECEIVER (ADS-B)	
UAT Messages	0 / 446
Towers	0

This section provides metrics regarding current ADS-B reception on the UAT (979 MHz) band. The UAT Messages value (X / Y) indicates the number of messages received in the last one minute and the maximum number of

messages received in any one minute period.

The Towers value indicates the number of ADS-B ground stations from which the device is receiving messages.

Note that it is normal for UAT message reception to be limited or nonexistent while on the ground. UAT service reception depends on lateral proximity to ground towers and altitude.

## 1090-ES Receiver Status

1090-ES RECEIVER (ADS-B)	
1090 Messages	1924 / 3909

This section provides metrics regarding current ADS-B reception on the 1090-ES band. The 1090 Messages value (X / Y) indicates

the number of messages received in the last one minute and the maximum number of messages received in any one minute period.

## AHRS Sensor

AHRS SENSOR	
Pitch	-1.2°
Roll	-1.1°
Slip/Skid	-1.3°
G-Load	1.0

The AHRS Sensor section indicates the current values for Pitch, Roll, Slip/Skid, and G-Load as read by the AHRS sensors. When fully calibrated, all values should be at or near 0° while in ua-accelerated level flight.

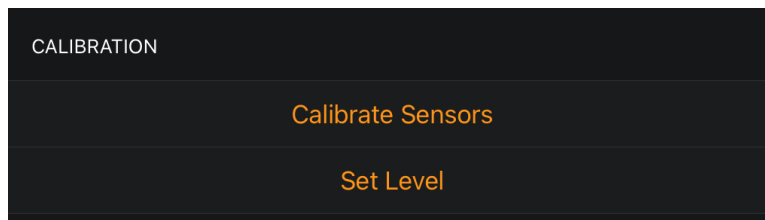
## Configure AHRS

This option opens the AHRS configuration screen.

## AHRS Configuration

The FlightBox Pro's AHRS system uses a combination of GPS data and sensor data from an inertial measurement unit (a combination of microelectromechanical accelerometers and gyroscopes) to determine the aircraft's attitude. The AHRS Configuration screen allows the user to run internal calibration functions, manually fine-tune the calibration, and set the orientation of the FlightBox in the aircraft.

## Calibration



## Calibrate Sensors

The Calibrate Sensors button runs an internal calibration routine that measures and compensates for sensor drift. MEMS sensors (the type of sensors used in the AHRS IMU) tend

to drift over time as the internal temperature of the sensor changes. Use the calibrate Sensors button to re-center the AHRS if it sags or slews.

## Set Level

The Set Level button is used to set the level attitude condition for the AHRS. Ordinarily the level value only needs to be set on initial installation or if the aircraft experiences a significant change in the center of gravity due to passenger and cargo load.

## Notes On Calibration

Getting an optimal level set can require multiple tries. The AHRS algorithm uses a set of filters to compensate for vibration and other sub-optimal inputs. These factors can make it difficult to acquire an accurate representation of a level, unaccelerated condition. If necessary, try running the Set Level function again.

Note that the optimal time to use both of the Set Level and Calibrate Sensors buttons is while the aircraft is in unaccelerated (level, constant power) flight on a smooth day. An initial setting can be captured with the aircraft stopped on the ground, but that does not allow the algorithm to account for engine vibration, off-axis mounting distortions, or other factors that will affect the performance of the sensors.

Note also that extreme changes in temperature can have some impact on the attitude estimate generated by the AHRS. If the calibration and level set are done on a particularly hot or cold day, attitude estimates may be off when operating under significantly colder or hotter conditions. If the attitude reading changes between flights due to a major change in outside temperature, run the Calibrate Sensors function. If the error persists, re-run the level set.

## Fine Tune

FINE TUNE		
Pitch Offset	0.00	<input type="button" value="−"/> <input data-bbox="878 1457 927 1499" type="button" value="+"/>
Roll Offset	0.00	<input type="button" value="−"/> <input data-bbox="878 1524 927 1566" type="button" value="+"/>

The Fine Tune controls allow the user to enter an adjustment of up to + / - 5 degrees for both the pitch and the roll axis. To adjust the fine-tune values, tap the + and - buttons.

## Orientation: Direction of Flight

ORIENTATION: DIRECTION OF FLIGHT
Select the side of the FlightBox Pro which is facing forward (towards the nose of the airplane).
Top Forward
Bottom Forward
Power / USB Jacks Forward
Antenna Jacks Forward
Fan Forward
Vent Forward

This option only needs to be set once when initially installing a FlightBox Pro system<sup>8</sup>.

The AHRS algorithm needs to know which face of the FlightBox is pointing in the direction of flight (towards the nose of the airplane). To set this, use the list of options displayed to indicate which side of the FlightBox Pro is facing towards the front (nose) of the airplane.

For example, if the FlightBox is mounted on the back of the pane, with the top (the side with the logo and LEDs) facing forward, select the first option: Top Forward.

If it is mounted laying down on a horizontal plane with the back facing towards the ground and the cooling fan facing towards the nose, select: Fan Forward.

This setting should be configured after the FlightBox is installed in the aircraft. If the orientation does not immediately adjust to reflect the proper attitude, tap the Calibrate Sensors button to force a full calibration and activate the new orientation.

## Engine Monitor

### Engine Times

View and set Hobbs and Tach time values

---

<sup>8</sup> Unless the box is unmounted and remounted in a different orientation.

## EMS Input Monitor

View real-time raw values (volts, ohms, pulse frequency, thermocouple reading) from the EMS.

## Ignition

Set the number of pulses per revolution for each installed ignition system.

## Analog Inputs

The FlightBox EMS device has a total of 8 standard analog inputs. Analog inputs are:

1. Fuel Pressure (PRES F)
2. Oil Pressure (PRES O)
3. Fuel Level Left (FUEL L)
4. Fuel Level Right (FUEL R)
5. Manifold Pressure (MPR)
6. Oil Temperature (OT)
7. Auxiliary 1 (AUX 1)
8. Auxiliary 2 (AUX 2)

The first six have default functions assigned to them. (These functions can be overridden if desired.) The remaining two are listed as Auxiliary and can be used to provide additional functionality as selected by the user.

Analog Inputs may either use a standard sensor definition - one that corresponds to one of the stock sensors suggested by Falken - or may use a custom sensor definition and calibration.

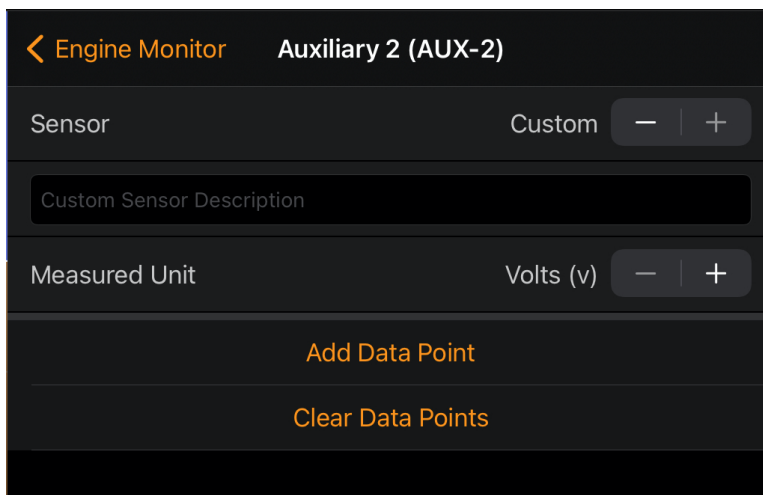
To use one of the standard sensors, simply select the appropriate model from the list. To use a custom or user-defined sensor, select the last option: Custom.

PRO TIP: All of the Kavlico fluid pressure sensors listed are linear (ratiometric) with a voltage input range from 0.5v at 0 PSI gauge pressure to 4.5v at maximum measured gauge pressure. For example, the 15 PSI sensor reads 0.5v at 0 PSI and 4.5v at 15 PSI. This is a common pattern used by many pressure sensor manufacturers, which allows the Kavlico definitions to be used with identically structured / rated sensors from other manufacturers.

## Custom Sensor Definitions

Custom sensor definitions are used in cases where the user selects a sensor module other than the stock sensors, or for certain sensors - like fuel level floats - which do not have precise factory settings.

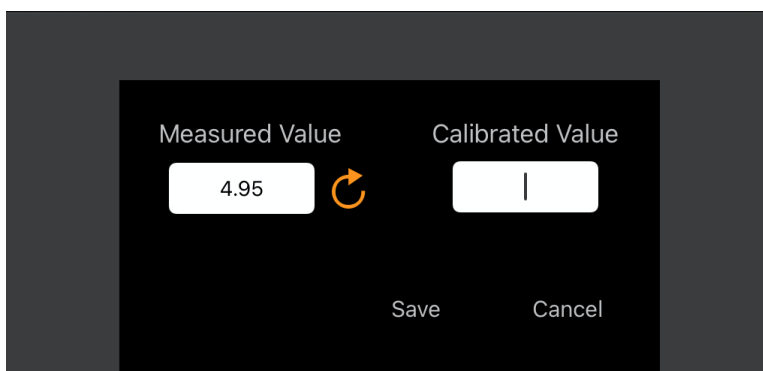
Pro Tip: For a deep dive on the process of collecting calibration data, please refer to Appendix A. This section covers the process of entering a sensor definition into the FlightView app, but Appendix A explains in depth what that data is, where to find it, how sensors interact with the FlightView EMS hardware, and much more.



The screenshot shows the 'Auxiliary 2 (AUX-2)' configuration screen. At the top, there is a back arrow and the text 'Engine Monitor'. Below this, the 'Sensor' field is set to 'Custom' with minus and plus buttons. A text input field for 'Custom Sensor Description' is present. The 'Measured Unit' is set to 'Volts (v)' with minus and plus buttons. At the bottom, there are two buttons: 'Add Data Point' and 'Clear Data Points'.

### Entering a Custom Sensor Definition

- (1) Advance the **Sensor** selector to the Custom option. (Custom is always the last item in the list of options.)
- (2) Tap in the **Custom Sensor Description** text field and use the on screen keyboard to enter a description of the sensor connected to the input.
- (3) Use the **Measured Unit** input to select between Volts and Ohms as the unit of measurement for the sensor data.
- (4) Tap the **Add Data Point** button to open the data entry dialog box.



The screenshot shows a dialog box with two input fields: 'Measured Value' containing '4.95' and 'Calibrated Value' which is empty. A circular arrow icon is between the fields. At the bottom are 'Save' and 'Cancel' buttons.

- (5) The system will automatically enter the current measured value for the input in the Measured Value.



If entering data from a datasheet, replace the measured value with the value from the datasheet. If calibrating "live", leave the measured value.

(6) Enter the corresponding calibrated value in the **Calibrated Value** text field.

(7) Tap **Save** to add the data point or **Cancel** to return to the main screen without saving.

(8) Repeat steps 4 through 7 to add all remaining data points.

## Fuel Pressure

The Fuel Pressure input (PRES F) supports a wide range of fluid pressure sensors ranging from 5 PSI to 50 PSI, plus custom sensors defined by the user. The sensor range used is based on the type of fuel system installed in the aircraft.

Options include:

- None - input is disabled
- Kavlico 5 PSI - a Kavlico 5 PSI pressure sensor for gravity-fed, carbureted engines
- Kavlico 15 PSI - a Kavlico 15 PSI pressure sensor for pump-fed, carbureted engines
- Kavlico 20 PSI - a Kavlico 20 PSI pressure sensor for gravity-fed, carbureted engines
- Kavlico 30 PSI - a Kavlico 30 PSI pressure sensor for fuel injected engines
- Kavlico 50 PSI - a Kavlico 50 PSI pressure sensor for fuel injected engines
- Custom - a custom sensor definition will be provided by the user.

Note the Pro Tip above about using the Kavlico sensor options for sensors from other manufacturers that use the same 0.5 - 4.5 linear voltage range.

## Oil Pressure

The Oil Pressure input (PRES O) supports several fluid pressure sensors ranging from 80 PSI to 150 PSI, plus custom sensors defined by the user. The sensor range used is based on the engine manufacturer's specifications for oil pressure range.

Options include:

- None - input is disabled
- Kavlico 80 PSI
- Kavlico 100 PSI
- Kavlico 150 PSI
- Custom - a custom sensor definition will be provided by the user.

Note the Pro Tip above about using the Kavlico sensor options for sensors from other manufacturers that use the same 0.5 - 4.5 linear voltage range.

## Fuel Level (Left and Right)

Fuel Level inputs (FUEL L and FUEL R) support any standard resistive "float" fuel sender. If the aircraft is outfitted with capacitive pickup "plates", an adapter is required to convert the capacitance into a resistance. There are no standard sensor definitions for fuel senders. Each tank must be individually calibrated. The process described below covers all general cases, but please refer to Appendix A for a detailed overview of sensor calibration.

## Calibrating Fuel Tank Sensors

Begin with the tanks empty.

- (1) Select the appropriate fuel tank input from the Engine Monitor menu.
- (2) Enter an identifier for the tank in the **Custom Sensor Description** field.
- (3) Adjust the **Sensor** value to Custom.
- (4) Enter a description ("Left Tank Float" or "Right Tank Float") in the description field.
- (5) Adjust the **Measured Unit** value to Ohms.
- (6) Tap the **Add Data Point** button.
- (7) Leave the **Measured Value** as determined by the system.
- (8) Enter the total amount of fuel in the tank for the **Calibrated Value** (0 on the first pass).
- (9) Save the data point.
- (10) Add a known quantity of fuel - *no more than two gallons* - to the tank.
- (11) Repeat steps 6 - 10, each time recording the total amount of fuel in the tank for the **Calibrated Value**. Discontinue when the **Measured Value** no longer changes.

< Engine Monitor Fuel Left (FUEL-L)	
Sensor	Custom - +
Left Float	
Measured Unit	Ohms (Ω) - +
Measured: 45 Ω	Calibrated: 14.0
Measured: 57 Ω	Calibrated: 13.0
Measured: 75 Ω	Calibrated: 12.0
Measured: 85 Ω	Calibrated: 11.0
Measured: 92 Ω	Calibrated: 10.0
Measured: 99 Ω	Calibrated: 9.0
Measured: 109 Ω	Calibrated: 8.0
Measured: 121 Ω	Calibrated: 7.0

The resulting calibration will look similar to the screenshot to the left.

Depending on the aircraft tank configuration the sensor may "max out" (reach the end of its ability to move) before the tank is completely filled. In this case the tank has a maximum measurable fuel quantity that is less than the total quantity (or usable quantity).

Repeat the process for the second tank. Note that copying the values from one tank to the other is not advisable.

## Manifold Pressure

The Manifold Pressure (MPR) input supports two predefined calibrations for GM absolute pressure sensors and custom user-defined sensors.

Options include:

- None - no sensor connected
- GM 1 BAR MAP sensor
- GM 2 BAR MAP sensor
- Custom

## Oil Temperature

The Oil Temperature (OT) input supports a predefined calibration for a Datcon oil temperature sensor and custom user-defined sensors.

Options include:

- None - no sensor connected
- Datcon 02037-00 fluid temperature sensor
- Custom

## Auxiliary (1 and 2)

The two Auxiliary inputs (AUX 1 and AUX 2) can be used to interface with any standard analog sensor that supports a sense output between 0v and 5v. All sensor definitions / calibrations are custom.

Options include:

- None - no sensor connected
- Custom

## Pulse Counter Inputs

The FlightBox EMS has two general purpose pulse counters (FF1 and FF2). By default these are used for fuel flow measurement, but may be repurposed to measure other pulse generators. See Appendix A for detailed information on pulse counter sensors, pulse generators, and integrating them with FlightView.

Options include:

- None
- EI FT-60 Red Cube
- EI FT-90 Gold Cube
- EI FT-180 Black Cube
- Custom

## Custom Pulse Counter Configuration

The screenshot shows the 'Pulse Config' screen. At the top, there's a back arrow and 'Engine Monitor' in orange, followed by 'Pulse Config'. Below this is a 'Sensor' dropdown menu currently showing 'Custom' with minus and plus icons. Underneath is a text input field containing 'FloScan Sender'. Below that are two input fields: 'K-Factor' with the value '32180' and 'Time Factor' with the value '3600'.

Custom pulse counter definitions require a K-Factor and a Time Factor.

The K-Factor is the number of pulses that represent a unit quantity - for example, one gallon.

The Time Factor allows the value measured to be scaled from Hz (units per second) to other units.

Common Time Factor values for various units include:

- Hz - 1
- RPM - 60
- GPH - 3600

## Thermocouple Inputs

The FlightBox EMS has a total of 16 thermocouple inputs, typically used for EGT and CHT.

The screenshot shows the 'Thermocouple Inputs' screen. At the top, there's a back arrow and 'Hardware Settings' in orange, followed by 'Engine Monitor'. Below this is a section header 'THERMOCOUPLE INPUTS'. Underneath is a list of three thermocouple inputs: 'Thermocouple 1', 'Thermocouple 2', and 'Thermocouple 3'. Each input is currently set to 'J (CHT)' and has minus and plus icons next to it.

By default the first 8 are configured for J-Type (CHT) thermocouples and the second 8 are configured for K-Type (EGT) thermocouples.

The Thermocouple Input configuration allows the user to switch between these two types.

## Diagnostics

The Diagnostics page includes a number of functions that can be used to diagnose issues with a FlightView system. Users may be asked by Falken Avionics technical support to retrieve data from or take screenshots of the tabs on the Diagnostics page.

Under normal circumstances, users should not need to change any settings or options on the Diagnostics page. Doing so may have a negative impact on system performance.

### User Account

Something about user account

### Terms & Conditions

Terms and conditions info here.

### Acknowledgements

Acknowledgement info here.

# Part VI: Using FlightView

## Flying With FlightView

The basics of flying with FlightView are roughly the same as with any modern glass cockpit system with the notable exception of the display unit. In some cases it may be practical to leave the iPad installed in the aircraft between flights. In other cases - especially if the weather is notably hot or cold - the iPad will need to be mounted in the panel before flight and removed after.

## Startup Up The Aircraft

Ideally, the FlightBox Pro and FlightBox EMS will both be connected to an avionics bus and can be brought online after the engine has started.

1. Mount the iPad in the FlightDock or other panel mount and connect it to an appropriate power supply.
2. Perform preflight inspection as per the aircraft's POH.
3. Start the aircraft engine.  
Power on the avionics bus.

At this point the FlightBox Pro EXP and other hardware will boot up. After 30 to 60 seconds the FlightBox Wifi network will be enabled and available.

1. Wake and unlock the iPad.
2. Verify that the iPad's Wifi is connected to the FlightBox Wifi network.
3. Launch the FlightView application<sup>9</sup>.

## Verifying FlightView Operation

While still at the startup point, take a moment to verify that the application is communicating with the rest of the FlightView system and that the system is operating correctly.

1. Check the left-hand side of the Status Bar and verify that the FlightBox (FBX) error indicator is not visible and that the GPS status indicator is displaying as a green square
  - a. Note that the GPS may take several seconds to achieve a valid lock, and that GPS performance in a hangar is generally very poor.

---

<sup>9</sup> If the app has been in the background for quite some time it may take 60+ seconds before it attempts to connect to the FlightBox. You may wish to kill and restart it rather than waiting.

- b. Note that the ADS-B indicator may not show as 5x5 (green square) until the aircraft is airborne and receiving from one or more ground stations.
2. If the system includes VHF COM radio or transponder integration, verify that the COM Radio and Transponder indicators on the top right-hand side of the Status Bar are indicating nominal operation (i.e. icon and values in white).
3. Verify that the Ownship icon on the MFD moving map or PFD mini-map shows the aircraft in the proper location.
4. Verify that none of the instruments are displaying as failed (large red X across them) and that all values are within expected ranges.

Once operation of the FlightView system has been confirmed, continue with the standard set of preflight checklists and safety verifications. Confirming that FlightView is online and working is not a substitute for performing all of the standard, required checks.

It may be advisable to include the above checks in the aircraft checklist - either a traditional paper list or the integrated checklist function of the FlightView app.

If any of the above checks fail, do not operate the aircraft and refer to the Troubleshooting section for suggestions on possible solutions.

## Operate Using Standard VFR Scan

FlightView is a powerful tool and can provide a great deal of information about the operation of the aircraft. However, the ultimate responsibility for safe operation rests with the pilot. Users of FlightView should make every effort to develop a healthy and safe VFR scan, focusing outside the aircraft most of the time.

During the first few flights following the installation of FlightView it may be necessary to fine tune the attitude display to compensate for various inertial effects and / or changes in temperature. Do not be surprised if the attitude display requires adjustment while in flight.

**FLIGHTVIEW IS A VFR SYSTEM - DO NOT OPERATE IN INSTRUMENT  
METEOROLOGICAL CONDITIONS (IMC) USING FLIGHTVIEW**

## Navigating With FlightView

FlightView allows the pilot to enter a course or flight plan<sup>10</sup> using several simple methods. The plan can be entered as a direct-to destination, by loading a set of known waypoints in the Flight Plan page, or by tapping and selecting points on the MFD's moving map display.

Once loaded, FlightView uses the course information to display navigation cues on the PFD and MFD. Cues include course pointer information in the HSI and course line information ("the magenta line") on both the MFD moving map and the mini-map on the PFD.

FlightView automatically sends navigational information to an autopilot if connected. Basic autopilots can generally follow the lateral course information output by FlightView. The more advanced xCruse / Vizion autopilot supports additional features and modes.

## Loading A Course

### Accessing The Navigation Menu

The navigation menu is accessed using the button bar. To load the navigation menu, tap the button labeled "Navigation".

The navigation menu presents four options: Nearest, Direct-To, Flight Plan, and a toggle button for Landing mode. The first three options load views that allow the user to configure the course as desired. The Landing button toggles FlightView between the normal operating mode and landing mode.

### Nearest

The Nearest button loads a page that lists the nearest airports in order of distance from the current location. Tapping any of the listed airports causes the navigation system to immediately load a course directly to the selected airport.

45.92

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<sup>10</sup> The two terms are used interchangeably in this document and refer specifically to a set of waypoints defined in FlightView's internal navigation subsystem.



## FlightView EFIS User Guide



### Direct-To

The Direct-To button loads a page that allows the user to enter an airport, navigation aid, waypoint, or fix using its FAA or ICAO designation. In cases where names overlay, the navigation system selects in that order: airport, navaid, waypoint.



The designator is entered using the iPad on-screen keyboard, which automatically displays when the Direct-To screen is loaded. If the PFD is loaded, FlightView arranges the screen such that the key elements of the PFD are not obscured.

Once a valid destination is entered, the Go buttons on the screen and on the keyboard will be enabled. Tap Go to load the destination. FlightView will plot a course from the current GPS location to the destination. The Direct-To screen will automatically be unloaded when the new course is loaded.

To cancel (not load the new destination), tap the Cancel button or the Done button.

To clear any text in the destination entry field, tap the large X surrounded by a circle.

If the keyboard is inadvertently hidden by tapping the keyboard retract button, tap the text entry field for the destination and it will be re-loaded.

If a Bluetooth keyboard is paired with the iPad, the on-screen keyboard will not appear and the course should be entered using the Bluetooth keyboard.

## Flight Plan

The Flight Plan page allows the user to enter their flight plan as a set of waypoints. The waypoints are each entered using the Add Waypoint screen, which operates using the exact same process as the Direct-To page.



Waypoints are added to the plan by tapping either the "Add Waypoint" button on the screen or the Add Waypoint button on the Button Bar.

The plan can be edited by tapping any of the waypoints, which loads a dialog box that allows the user to delete the waypoint, replace the course with a direct-to course to the waypoint, insert a new waypoint before the selected (tapped) waypoint, insert a new waypoint after the selected waypoint, or cancel.



The Button Bar includes buttons that allow the user to reverse the plan, clear the plan, or add a waypoint.

To exit the Flight Plan page, tap either the Exit button or the Done button.

## Landing Mode Toggle

Landing mode is a convenience function that lets the navigation subsystem know that the aircraft is in the process of landing. This automatically disables certain alerts, and adjusts the tolerance for other alerts.

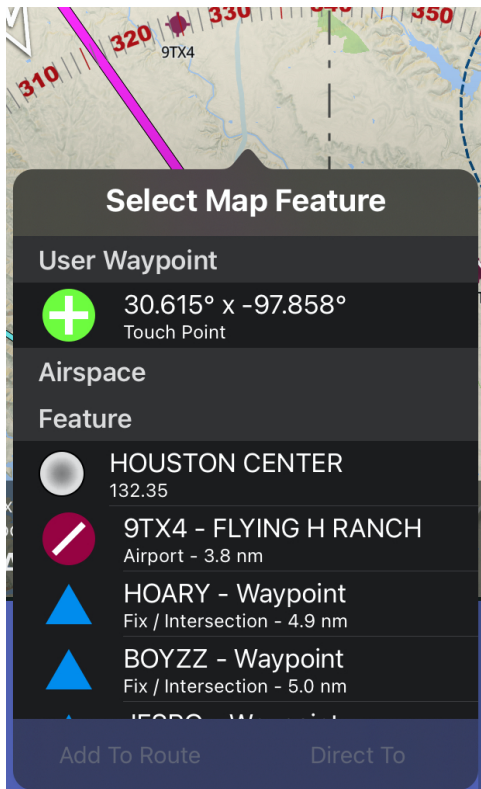
Note that the Landing mode button is redundant if the aircraft is operating with a loaded flight plan. If a plan is active, the system will automatically recognize the transition from en route phase to landing phase and activate the landing mode.

## Touch Screen Navigation

In many cases it may be useful (and easier) to configure the flight plan visually. The FlightView app allows the user to do this by tapping on the Moving Map feature of the MFD.

The touch navigation process is very simple: tap on a spot on the map and the app will load either a feature dialog (showing details about the airport, navaid, etc.) or a feature selection dialog. The system selects the Feature Dialog if the tap is close to an aviation feature and displays the Select Map Feature dialog box if no features are within a short distance from the touch point. (Note that if the tap is close to a Traffic Target the MFD may display the Aircraft Details dialog instead.)

### Select Map Feature Dialog



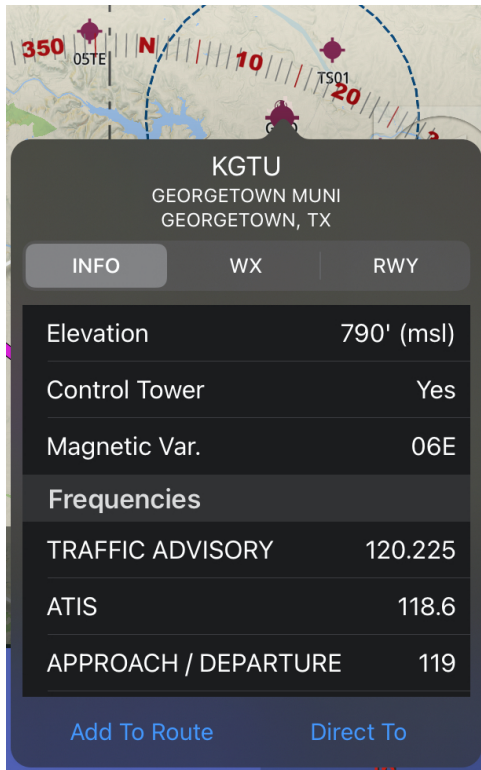
The Select Map Feature dialog allows the user to select one of the items listed in the scroll window. (Airspace features and Center features may not be selected.) Tapping a selectable feature enables the two buttons at the bottom of the dialog box: **Add To Route** and **Direct To**.

To navigate to the spot tapped, select the top item in the list under User Waypoint (subheading indicates this as Touch Point) then select either **Add To Route** or **Direct To**.

To select any of the named features, scroll down the Feature list, tap the feature, and select **Add to Route** or **Direct To**.

To dismiss the dialog box, tap on the map.

## Map Feature Dialog



The Map Feature dialog box displays various details of the tapped feature. To navigate to the selected Feature, tap either **Add To Route** or **Direct To**.

To dismiss the Feature dialog box, tap on the map.

### Navigation Data Bar

## Navigating Using FlightView PFD and MFD

When a course is loaded, FlightView automatically distributes it to all connected display units, replacing any existing course. The displays store the course and update to reflect the new destination.

### PFD Navigation Controls

- Course Indicator (CRS)
- HSI Compass
- Course Pointer
- Course Deviation Indicator

### MFD Navigation Controls

- Course Line
- Navigation Information Bar

### Secondary Impacts Of Courses

Course-Related Frequencies in COM Radio  
Phase-of-Flight Management  
Terrain Profile Display

## Using The COM Radio Interface

FlightView supports remote control of a number of popular 3rd party COM radios. Some of these are blind-mount or "headless" radios without any kind of display or controls, while others are traditional panel mount VHF COM transceivers. FlightView interfaces with all of these using one of several FlightLink COM cables.<sup>11</sup>

In the case of blind-mount radios like Trig's TY91 (without the optional control head) and the VAL Avionics COM 2KR, FlightView is the only controller for the radio and is used to set both the active frequency and other basic parameters (volume, squelch, etc.). Traditional panel mount VHF COMs, on the other hand, can be controlled from either the radio or FlightView.

While COM radio integration may seem to be unnecessary, it can significantly reduce the cockpit cognitive load by presenting the pilot with a list of frequencies identified by function.



<sup>11</sup> See the Hardware Installation section for detail on connecting radios, and the COM Radio section under System Hardware Settings for details on configuring the radios.



### Accessing The COM Radio Screen

The COM Radio interface is displayed by tapping the **Com Radio** button on the Button Bar. In aircraft with no COM radio integration, this shows as "Com Freq." for communications frequency lookup. In aircraft with two COM radios, the buttons read "Com 1" and "Com 2". A single integrated radio appears as "Com Radio"

### COM Radio Functions

(1) Active Frequency annunciator. The large digits represent the active frequency in megahertz. The value below the frequency indicates the function if available.

#### (2) Frequency Quick-Load Buttons

Tapping any of the active (orange) Frequency Quick-Load buttons immediately activates the associated frequency. The frequency is also displayed in the Active Frequency annunciator as reference for users with no COM radio integration.

#### (3) Manual Entry Buttons

Tapping one of these buttons places the Com Radio screen in manual entry mode and the entered digit is displayed in the Active Frequency annunciator. Continue entering digits (all frequencies require 6 digits) until the desired frequency has been entered. The Active Frequency annunciator will briefly flash green to indicate success and the entered frequency will be activated.

#### (4) Search Bar

Tapping the Search Bar will open the search overlay and will display the iPad keyboard, allowing the user to enter an airport designator. Airports matching the entered designator will appear in the scroll box below the text input field. To select an airport, scroll down and tap the matching row. This will load a second overlay that allows the user to select the function (ATIS, tower, ground, CTAF, etc.) to activate.

#### (5) Nearby Button

The nearby button deploys the selector overlay in Nearest Airport mode. To use one of the listed airports, tap the associated row, then select the desired function from the function selector.

#### (6) Recent Button

The Recent button deploys the selector overlay in Recent mode, showing the most recent frequencies used. Tap the desired row and the frequency will be activated.

#### (7) Plan Button

The Plan button loads a list of frequencies that are associated with the active flight plan. If the aircraft is closer to the origin point, it loads frequencies associated with the origin airport. If it is closer to the destination point, it loads frequencies for the destination airport.

#### (8) Emergency Button

The Emergency button tunes the radio directly to 121.500 - the emergency / guard frequency.

Frequency Lookup vs Tuning

Dual COM Radio Configuration (COM 1 / COM 2)

Detecting Faults In COM Integration

Using FlightBar with COM

## Using The Transponder Interface



Setting The Squawk Code

Setting The Mode

IDENT Function

Detecting Faults With Transponder Integration

Using FlightBar with The Transponders

# Using The Autopilot Functions

## Autopilot Integrations

FlightView supports two levels of autopilot integration: a basic mode that works with most digital autopilots, and an advanced mode that works only with the BendixKing xCruze and TruTrak Vizion lines.

The basic integration requires a FlightLink NMEA output cable to connect with the autopilot. The advanced integration requires a BK/TruTrak-specific FlightLink cable. For more information on interfacing with autopilots, see the Hardware Installation section above.

To use the advanced mode, the Autopilot option under System Hardware should be enabled. For details, see the Configuring FlightView section above.

## Basic Autopilot

FlightView supports ground track and basic lateral navigation features of most modern digital autopilots. If the autopilot can understand industry-standard NMEA navigation information it should work with FlightView.

For basic autopilot support all that is required is the FlightLink NMEA / Autopilot integration cable. There are no user interface functions in the FlightView app for basic autopilot functionality as all control inputs are handled by the autopilot controller. Do not turn on the Autopilot option under System Hardware as this is used only by the TruTrak / xCruze advanced integration.

In basic autopilot mode control of the autopilot is handled from the autopilot's control panel. When a course is active, the autopilot interface will automatically send the necessary course and course deviation data to allow the autopilot to follow the course. If no course is loaded, the autopilot interface will forward basic NMEA position information to the autopilot which will allow it to follow a ground track.

### Basic Autopilot Operations

The operational details depend on the particulars of the autopilot installed. In most cases, the autopilot's control head will allow the user to set a ground track to follow and will also offer a "NAV" mode which allows the autopilot to follow the active flight plan as output by the autopilot over the NMEA interface.

### Autopilot NMEA Messages

The FlightView basic autopilot interface will output the following NMEA sentences (messages) to the autopilot. To insure compatibility, check with the autopilot manufacturer to verify that it can make use of the sentences provided.

## Advanced Autopilot

FlightView has a much deeper level of integration with the TruTrak Vizion / Gemini and BendixKing xCruze family of autopilots. It can control the autopilot mode, and supports both lateral and vertical operations using GPS steering (GPSS).

Manual Mode

Full Mode

Altitude Preselect

## Using FlightView Checklists

## FlightView FlightLog

## FlightView Fuel Totalizer

Note: the Fuel Totalizer function is still under development and should not be relied upon at this time.

### Troubleshooting

#### No FlightBox Wifi Network

#### Intermittent Loss Of Data

### Attitude Indicator / AHRS

The attitude indicator is showing an incorrect orientation (as in, upside down or at a 90° angle).

This simply means that the orientation has not been set to match the actual orientation of the FlightBox in the aircraft. Go to More => Settings => System Hardware => Flight Data Computer and scroll down to AHRS Configuration and select Set AHRS Orientation.

# Appendices

## Appendix A: Custom Sensor Definitions

Custom sensor definitions tell the EMS how to translate the signals it receives from a sensor into a value that can be displayed on the engine bar. You can create definitions for analog sensors (sensors that output a voltage to indicate a value) or pulse counter sensors (sensors that output a sequence of pulses to indicate a value).

It is useful to understand the basics of these sensor types when building a custom sensor definition.

### Analog Sensors

Analog sensors work by outputting a voltage that the analog-to-digital converter in the EMS can read. The EMS then converts the measured value to a calibrated value in some useful unit (like gallons or degrees or PSI) using calibration data. Analog sensors are very common in aircraft, frequently being used to measure things like pressures, temperatures, and fuel levels.

### Analog Sensor Types

Analog sensors fall into two categories: passive and active (aka powered). The FlightView EMS supports a subset of both passive and active.

#### Passive Sensors

Passive sensors do not require input power. They are made from materials that change their electrical properties in response to changes in the environment. The EMS supports **resistive** passive sensors: those that change their electrical resistance to indicate their value. (There are other types of passive sensors - capacitive, for example - that measure other electrical properties, but the EMS does not have the circuitry to support those.) ***To read resistive analog sensors, the pull-up resistor for the input to which the sensor connects must be enabled using the corresponding DIP switch on the EMS.***

#### Active Sensors

Active sensors require power (either 5v or 12v) and use some active means to measure a value and generate an output. The FlightView EMS supports active analog sensors that output values between 0 and 5 volts. ***Unless otherwise noted by the manufacturer, the pull-up resistor for the input to which an active sensor is connected should be disabled.***

## Analog Sensor Example: Thermistor

Many temperature probes are based on a sensor called a thermistor. Thermistors change their electrical resistance in response to changes in temperature<sup>12</sup>. The EMS reads this as a voltage which varies between 0 volts and 5 volts which indicates a resistance that between 25,000,000 ohms and 0 ohms<sup>13</sup>. (The EMS Diagnostics screen can display both the voltage and the resistance values - to see the resistance, check the "Resistive Sensor" option.)

To convert the measured values (either volts or ohms) into useful information we need to know how they correlate with temperature. This requires calibration data, which is simply a set of voltage or resistance values and the associated temperature readings:

```
...
3.94v / 1858 Ω = 8°C
3.71v / 1438 Ω = 12°C
3.52v / 1189 Ω = 19°C
3.29v / 962 Ω = 22°C
3.04v / 776 Ω = 31°C
...
```

In the case of a thermistor, that range generally starts at or near 0°C (freezing) and goes up somewhere above 100°C (boiling). The Datcon sensor we recommend as the oil temperature sensor for Lycoming and Continental engines offers accurate temperatures from 100°F - 240°F (37.8°C to 115.6°C) which is a pretty good match for the range of oil temps seen in those engines.

So why not just use the bottom and top value pairs like this:

```
3.94v = 37.8°C
0.06v = 100°C
```

That won't work because thermistors are *non-linear*: the relationship between voltage and temperature isn't a straight line - it's a curve. To try to provide reasonable accuracy, we need to create a map (called a "lookup table") that allows us to display an accurate value at any point along that curve. The EMS reads the voltage / resistance, finds the closest points in the lookup table, then interpolates between those two points to get an accurate estimate of the temperature.

For example, if the voltage input is 3.16v and the lookup table contains:

```
2.83v = 35° C
3.04v = 31° C
3.29v = 22° C
3.82v = 19° C
```

<sup>12</sup> Some increase their resistance as the temperature increases, while others decrease their resistance as the temperature increases. Either type works.

<sup>13</sup> This is done using a circuit called a voltage divider. For this to work, the pull-up resistor for the input must be enabled. See the sections on Analog Inputs below.



The algorithm selects the two points that bookend 3.16v (3.29v and 3.04v) then uses linear interpolation to estimate the temperature at 26.68° C.

Note that some sensors do have a perfectly linear response (i.e. a straight line) and can be defined using only the bottom and top values. The Kavlico pressure sensors we use are linear, with values ranging from 0.5v at 0 PSI and 4.5v at whatever the maximum pressure is for the gauge. In that case the lookup table is really simple. Here's what it looks like for the 150 PSI oil pressure sensor:

$$\begin{aligned}0.5\text{v} &= 0 \\4.5\text{v} &= 150\end{aligned}$$

That's it. Linear sensors are great, but most inexpensive analog sensors are not linear and require a more detailed lookup table to generate an accurate result.

## EMS Analog Inputs

The EMS has a total of eight analog inputs that can be used with custom sensors: Aux 1, Aux 2, Oil Pressure, Fuel Pressure, Manifold Pressure, Oil Temperature, Fuel Left, and Fuel Right. All analog inputs can measure voltages between ground (0v) and +5v. If you are using a powered sensor (one that requires a 5v "excitation" charge) the range

### Pull-Ups and Pull-Downs

In many cases, analog sensors require the input to which they connect to be either pulled up (defaulted to 5v) or pulled down (defaulted to ground) using a resistor of a known resistance. All analog inputs on the EMS have integrated 500 ohm pull-up resistors which can be enabled / disabled using the DIP switches on the EMS main board. (See the User Guide for details on DIP switch configuration.)

The Oil Pressure sensor input also offers a pull-down resistor. If your application requires a pull-down resistor and you wish to use one of the inputs you will need to turn the pull-up off and supply your own resistor.

### Aux 1 and Aux 2

The two auxiliary inputs are both "available" for custom sensors - the EMS does not assign them any predefined function. Where possible, we suggest using the aux inputs before repurposing any

## Calibrating Analog Sensors

Some sensors come with calibration data provided by the manufacturer. Other sensors do not. If the sensor you have does not come with a calibration table, you will need to perform a manual calibration. The details of this depend on the type of sensor.

### Using Manufacturer Calibration Data

The easiest way to get calibration data is from the manufacturer of the sensor. Most sensors sold to the general public<sup>14</sup> come with a data sheet. The data sheet for an active sensor with a fixed output range (e.g. 0.5v - 4.5v) should include a voltage-to-value (temperature, pressure, etc.) table. Resistive sensors should come with a table of resistance values in Ohms.

Note that sensors with a linear response (also called a ratiometric response) may not include a table, as the calibrated value (pressure, temperature, etc.) is exactly proportional to the output voltage. In this case all you need are the sensor's working range (e.g. 0 PSI - 150 PSI) and the output voltage range (e.g. 0.5v - 4.5v).

With a data table from the manufacturer, all you need to do is create the "Table" entry for your sensor with the provided data and add the appropriate "Unit" indicator.

Here's a snippet of the datasheet for our 50 PSI Kavlico fluid pressure sensor - a linear (ratiometric) sensor:

Output Signal

0.5...4.5 VDC Ratiometric

We have a built-in profile for this sensor, but if you were to create one as Custom it would look like:

Sensor:	Custom
Description:	Kavlico-50PSI
Measured Unit:	Volts (v)
Measured: 0.500v	Calibrated: 0.0
Measured: 4.500v	Calibrated: 50

Here's the calibration table from a non-linear Delphi temperature sensor data sheet:

---

<sup>14</sup> Some OEM and aftermarket sensors which are available from auto supply resellers do not include data sheets. If you cannot find an official data sheet, you will need to manually calibrate your sensor.

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*Note: Temperature Sensor Calibration Resistance Guaranteed by 100% Automated Calibration Certification.*

Temp (°C)	Res (Ohms)	Res (±%)	Ref Acc (±°C)	Temp (°C)	Res (Ohms)	Res (±%)	Ref Acc (±°C)	Temp (°C)	Res (Ohms)	Res (±%)	Ref Acc (±°C)
-40	100865	4.87	0.70	25	2795	2.50	0.60	90	241.8	2.10	0.70
-35	72437	4.64	0.70	30	2240	2.45	0.60	95	207.1	2.21	0.70
-30	52594	4.43	0.70	35	1806	2.40	0.60	100	178.0	2.31	0.80
-25	38583	4.21	0.70	40	1465	2.36	0.60	105	153.6	2.42	0.80
-20	28582	4.00	0.70	45	1195	2.31	0.60	110	133.1	2.52	0.90
-15	21371	3.80	0.70	50	980	2.27	0.60	115	115.7	2.61	0.90
-10	16120	3.60	0.60	55	809	2.23	0.60	120	100.9	2.68	1.00
-5	12261	3.40	0.60	60	671	2.19	0.60	125	88.3	2.75	1.00
0	9399	3.21	0.60	65	559	2.15	0.60	130	77.5	2.80	1.10
5	7263	3.06	0.60	70	469	2.11	0.60	135	68.3	2.84	1.10
10	5658	2.92	0.60	75	395	2.07	0.60	140	60.3	2.87	1.20
15	4441	2.78	0.60	80	334	2.04	0.60	145	53.4	2.89	1.20
20	3511	2.64	0.60	85	283	2.00	0.60	150	47.5	2.90	1.20

This turns into quite a bit of data entry, but provides a very accurate representation of the sensor's output. When entering the data into FlightView, make sure the unit option is set correctly. In this case, the unit is Ohms.

Here's the sensor definition that you would enter into FlightView:

```

Sensor:           Custom
Description:      Delphi Temp Sensor
Measured Unit:    Ohms (Ω)

Measured: 48 Ω    Calibrated: 150
Measured: 53 Ω    Calibrated: 145
Measured: 60 Ω    Calibrated: 140
Measured: 68 Ω    Calibrated: 135
...

```

### Manually Calibrating A Sensor

If there is no data sheet available for your sensor, you will need to perform a manual calibration to create the measured-value-to-calibrated-value table.

Going back to the thermistor example, if the range according to the manufacturer is 100°F to 240°F you will need to connect the sensor to the EMS and monitor the voltage on the input as you heat or cool the sensor while collecting the voltage (available on the EMS Diagnostics page). You'll need to use a thermometer to measure the temperature.

### Example: Passive Temperature Sensor

Connect the output of the sensor to the Aux 1 input on the EMS<sup>15</sup>. Connect the sensor's ground terminal (or the body of the sensor if there is no ground terminal) to the ground port on the EMS. Because this is a passive sensor, enable the pull-up resistor by switching on the associated DIP switch on the EMS.

Power on your FlightBox and EMS. Connect to it from the iPad and launch the FlightView app. Go into Menu => System Hardware => Engine Monitor => EMS Input Monitor. This will show you the raw input values for each port on the EMS. With the sensor connected, Aux 1 should show somewhere between 0 and 5v.

Attach the sensor to the inside of a small metal can or cooking pot (perhaps using a C clamp). Fill the can with enough oil that the probe end of the sensor is fully immersed.

Place a kitchen thermometer in the oil so that the tip of the thermometer is at the same depth as the sensor probe. If possible, set the thermometer to record in Celsius, as that's the scale used for temperature values in FlightView.

Place the can on a hot plate or stove and begin warming the oil. When the oil temperature reaches the minimum rated temperature for the sensor, note the voltage and resistance:

100F = 3.215v / 901 ohms

As the temperature rises, continue to note the voltage. A voltage at each degree is ideal but you can skip a degree or two without sacrificing much in the way of accuracy. Continue this process until the oil reaches the sensor's maximum range. You will end up with a log that looks like:

```
100F = 3.215v / 901 ohms
102F = 3.04v / 776 ohms
106F = 2.89v / 685 ohms
108F = 2.77v / 621 ohms
...
234F = 0.32v / 34 ohms
237F = 0.24v / 25 ohms
240F = 0.06v / 6 ohms
```

At this point you have everything you need to create a definition. Because this is a passive / resistive sensor you will want to use the Ohms value rather than the voltage when creating the input definition in FlightView.

---

<sup>15</sup> This can also be done using a multimeter rather than the EMS and FlightView. To collect calibration data for a powered sensor, simply measure the output voltage relative to aircraft ground. To collect data from a passive / resistive sensor, measure the resistance in Ohms.

### Example: Fluid Pressure Sensor

This follows the same basic pattern as the temperature sensor: you'll need to exercise the sensor across its full range while monitoring the voltage. In most cases you can use air pressure rather than pressurized oil for the calibration process.

Start by connecting the pressure sensor to an input on the EMS. If using a powered sensor (i.e. one with a 5v input) make sure the DIP switch for the pull-up resistor is turned off. Check with the manufacturer's instructions for details.

Connect the pressure input on the sensor to an air compressor with an output pressure indicator and a variable pressure output. Start out with the output at zero and slowly adjust it upwards, noting the pressure and voltage at each step:

```
0 psi = 0.45v / 49 ohms
2 psi = 0.62v / 71 ohms
3 psi = 0.78v / 92 ohms
5 psi = 1.02v / 128 ohms
6 psi = 1.16v / 144 ohms
...
20 psi = 2.52v / 508 ohms
23 psi = 2.88v / 679 ohms
25 psi = 2.95v / 720 ohms
```

Continue this process until the pressure is at the maximum operating pressure for the sensor. Be careful not to over-pressure the sensor, as this can damage it.

Because this is a powered sensor rather than a passive / resistive sensor, you will want to use the Volts values rather than the Ohms values when creating the input definition in FlightView.

### Example: Flap Position Sensor

A flap position sensor is really just a slide potentiometer (variable resistor) with hardware to link it to the flap rigging. As the flaps are extended, the slide moves and the output changes. The process here is predictable: install the position sensor, retract the flaps, then measure the output voltage as you extend them.

The new flap position display uses an angle value between 0 and 90. The indicator shows the position using a graphical representation of a flap at the detected angle, and as a value in degrees. To make this work with your position sensor, you will need to create a lookup table that correlates voltage or resistance with position.

The wiring specifics vary depending on the sensor you're using. For the common Ray Allen POS-12, connect the orange wire to the +5 output from the EMS, connect the blue wire to the EMS ground, and connect the green wire to an analog input. Be sure the pull-up for that input is disabled - with the +5 connected, the POS-12 operates as a powered sensor.

Start with the flaps in their fully retracted position and note the voltage the input is receiving:

$$0 = 1.65\text{v}$$

If your flaps are the type that have pre-set positions / detents, advance the flaps to the first position. Record the position value in degrees and the voltage:

$$10 = 2.2\text{v}$$

Now repeat that process for the remaining positions / detents:

$$20 = 3.16\text{v}$$

$$30 = 3.92\text{v}$$

If your flaps don't have presets, advance them about  $\frac{1}{3}$  of the full travel. Measure the angle using a protractor. Record the angle and the voltage. Repeat this at  $\frac{2}{3}$  and at full.

$$12 = 2.2\text{v}$$

$$21 = 3.22\text{v}$$

$$35 = 4.15\text{v}$$

You now have the data you need to create the definition.

### Other Analog Sensors

This same basic pattern applies to other kinds of analog sensors and senders. You can use it to calibrate an additional fuel tank float, a flap position pickup, or even a basic potentiometer. Depending on the characteristics of the sensor, you may need to adjust the DIP switches to enable or disable the pull-up resistor.

### Entering The Sensor Definition

Once you have the data you need to create an

## Pulse Counter Sensors

The other type of sensor that the EMS can read is a pulse counter. Pulse counters are connected to sensors that generate pulses (on / off patterns) to indicate a value. The pulses can simply be counted, or they can be counted on a periodic basis to give you a frequency.

Raw pulse counts are useful for measuring things like fuel consumption. The standard "Red Cube" fuel flow meter sends one pulse for every  $\frac{1}{68000}$  of a gallon that flows through it. That number - 68,000 - is known as the "K-factor" for that sensor. 68,000 pulses = 1 gallon. So if the EMS gets 329,294 pulses during a flight, it calculates that the engine has burned 4.84 gallons. This is the basis for the fuel totalizer feature.

The EMS can also display real-time fuel flow in gallons-per-hour (GPH). It uses the number of pulses it measured in the past second to estimate the current fuel flow. For example, if the EMS measures 91

pulses per second (91 Hz), that can easily be converted to GPH. First, convert it to hours by multiplying it by the number of seconds in an hour (3,600). You get 327,600 pulses. Now divide that by the K-factor (68,000) and you get a current fuel flow of 4.82 GPH. If you want to make it a bit more accurate (at the cost of a slower response) you can average that over several seconds.

### Pulse Counter Inputs

The EMS has four pulse counter inputs: RPM1, RPM2, FF1 and FF2.

We recommend using RPM1 and RPM2 only for engine tachometer functions. The RPM inputs provide only frequency values, so they cannot be used for totalizer-type functions. Both are hardened to handle pulses from magneto P-leads and can accept signals from 8v to well over 200 volts. Magneto pulses are horribly messy - they have a main pulse followed by “ringing” follow-up pulses. The circuitry and software are built to factor out these secondary pulses. This works in most cases but there are a very wide range of magnetos, so sometimes the output can be a bit noisy.

The FF1 and FF2 inputs are generally intended for fuel flow sensors but can be used for other pulse generators. Both are “pulled up” using a 5.6k resistor and expect the sensor to ground the input to indicate a pulse. Before purchasing a sensor that indicates a value using pulses, make sure it can be configured to signal in this format. The FF1 and FF2 inputs cannot be used to read pulse generators that signal by pulling the voltage high.

### Pulse Counter Definition

To use either FF1 or FF2 to read from a pulse generator you need to know the K-Factor and the Time Factor.