FS8 Co-Pilot™

Advanced Radio Control Receiver System featuring Digital Signature Recognition, Failsafe Operation, Infrared Flight Stabilization and Full Telemetry

User's Guide

Note: Read this manual carefully before using FS8 Co-Pilot™.

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FMA Direct

Introduction

About FS8 Co-Pilot™

FS8 Co-Pilot™ combines a high-performance failsafe receiver with infrared flight stabilization.

Built-in receiver

- Interference Check, which determines the presence of a transmitter operating on your channel, as well as interference from any source on any frequency that affects receiver operation.
- Digital Signature Recognition, a new technology that enables FS8 Co-Pilot™ to reject severe interference and to reconstruct corrupted frames.
- Servo Failsafe, which enables FS8 Co-Pilot™ to take control of the aircraft when a signal isn't present.
- System status and performance data output, which provides information about how your radio system operated during range checks and flights.
- Universal operation: works with negative shift (Futaba, Hitec) and positive shift (JR, Airtronics) FM PPM transmitters.
- Full range, full performance. Can be used in aircraft ranging from park flyers to IMAA-legal aircraft to helicopters.

Built-in flight stabilization

- Controls roll and pitch for any kind of RC aircraft: conventional fixed wing airplanes, flying wings, electric powered planes, giant scale models and helicopters. Returns aircraft to level attitude when you center the transmitter sticks.
- Infrared sensors operate in nearly all weather conditions.
- Learns about your transmitter and its controls. Setup is easy because there are no switches to set.
- Can be turned on and off, and adjusted, from your transmitter via an assigned channel.
- Can be automatically activated when receiver enters Failsafe Mode.
- Works with optional Vertical Sensor:
  - Flight stabilization knows when the aircraft is inverted.
  - Enables full 3D aerobatics display in the Co-Pilot Viewer software during playback from the optional Flight Recorder.
  - Simplifies daily field calibration for large aircraft.

Note: FS8 Co-Pilot™ is a unique product—it's quite different from other radio control equipment you may have used. Since new concepts are involved, take your time and work through the manual carefully.

Other features

- Works with your FM PPM transmitter, or your PCM transmitter set to PPM.
- Works with all aircraft configurations, including dual aileron servos, quad flaps, elevons, V-tail, complex transmitter mixes, digital servos and CCPM.
- Includes Co-Pilot Viewer Software for detailed receiver and flight stabilization data analysis. Displays every FS8 Co-Pilot™ operating detail. (Requires Serial Interface Module, available separately, and a Windows 98 or later PC.)
- Compatible with FS Flight Recorder (available separately), which records receiver and flight stabilization data during multiple flights (up to 97 minutes total). Download data from the Recorder, then play back using Co-Pilot Viewer Software.

About failsafe operation

In the event of signal loss or overwhelming interference, the receiver takes control of the servos, and puts the aircraft into a predictable flight pattern. Each servo channel can be set to apply one of two options when corrective action is required:

- **Last Good Frame Hold.** If the receiver concludes that a transmitter frame is defective—and cannot be repaired—it pulls the last good frame from memory and applies it to the servos in place of the defective frame. The receiver continues applying the last good frame until it once again detects a clean frame. Random glitches, which show up as servo jitter, are the most common signal problem in radio control systems. By repairing bad frames or (in the worst case) using the last good frame, FS8 Co-Pilot™ eliminates nearly all servo jitter.
- **Servo Failsafe Preset Positions.** This option goes one step further than Last Good Frame Hold by proactively moving servos to positions set by the pilot during radio system setup. Servo Failsafe Preset Positions, for example, can cut the throttle and put the plane into a gentle circle. Any channel in FS8 Co-Pilot™ can have a Servo Failsafe Preset Position. Setting Failsafe Preset Positions is easy—your transmitter is the interface for the procedure.

About flight stabilization

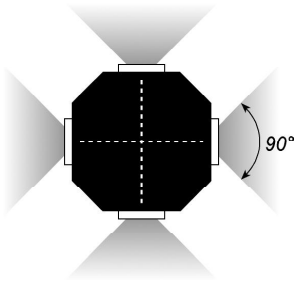
FS8 Co-Pilot™ "looks" at the horizon with infrared heat sensors (this same technology is used in thermal imaging cameras). The Earth is warm (even when covered with snow) below the horizon, while the sky is cold above the horizon. FS8 Co-Pilot™ "sees" this temperature difference. When FS8 Co-Pilot™ senses changes in aircraft attitude relative to the infrared horizon, it sends corrective signals to keep the aircraft level.

Flying with FS8 Co-Pilot™ is easy. When you center the control stick, FS8 Co-Pilot™ automatically returns the aircraft to level flight. FS8 Co-Pilot™ works over a wide range of weather conditions. A simple calibration adjusts FS8 Co-Pilot™ to the local environment, and sensitivity controls change FS8 Co-Pilot's responses to match pilot skills.

FS8 Co-Pilot™ is an excellent teaching aid because it maintains stable flight while the student develops flying skills (the key is to center the sticks to regain control). Advanced pilots find FS8 Co-Pilot™ is useful for flying—and landing—under windy conditions. Because it responds much faster than you can, FS8 Co-Pilot™ can help tame an unstable aircraft, and is ideal for maintaining control during your first flights with a new model.

If your transmitter has an unused channel, you can control FS8 Co-Pilot™ from the ground. Turn it on when it's needed, and turn it off when it isn't needed. If the channel has proportional control, you can also remotely adjust FS8 Co-Pilot's Pitch and Roll Throw controls.

FS8 Co-Pilot™ uses patented technology to sense the difference in infrared temperature (heat) between the Earth and sky. The sky is always at a relatively lower infrared temperature, while the infrared signature of the Earth is always relatively warmer. FS8 Co-Pilot™ uses two pairs of infrared sensors: one pair points fore and aft, and the other points left and right. When one pair of sensors sees a change in an aircraft's orientation relative to the earth's infrared horizon, FS8 Co-Pilot™ issues signals to the control system to bring the aircraft back into level flight.



When the model is flying above the Earth (even a few feet), each sensor surveys several square miles, all the way to the Earth's infrared horizon. The infrared temperature seen for the Earth is an average of infrared generated from all terrain features. FS8 Co-Pilot™ interprets input from the sensors and applies compensation to the servos controlling roll and pitch.

Other optical flight stabilization systems work with visible light, not infrared. Those systems are strongly affected by changes in cloud cover and other weather conditions, and don't operate well at sunrise, dusk or in the dark. The heat (infrared) radiating from the Earth measured by FS8 Co-Pilot™ provides a more stable and precise reference than light or other phenomena. This gives FS8 Co-Pilot™ much more precision than visible light stabilization systems. For example, FS8 Co-Pilot™ won't cause the aircraft to wander when a cloud comes into view.

Since the infrared environment is not affected by variations in visible light levels, an airplane equipped with FS8 Co-Pilot™ could be flown at night (but we don't recommend this!). Only substantial changes in weather cause gradual variations in infrared temperature throughout a day. Heavy fog, flying through clouds, or snow on the ground cause the infrared signature to vary. Also, as a model flies over the terrain, there is some variation in the average infrared temperature. For this reason, FS8 Co-Pilot™ incorporates a simple calibration procedure (not available in other flight stabilizers) that fine-tunes performance for near-perfect stabilization under all conditions.

Options for controlling flight stabilization

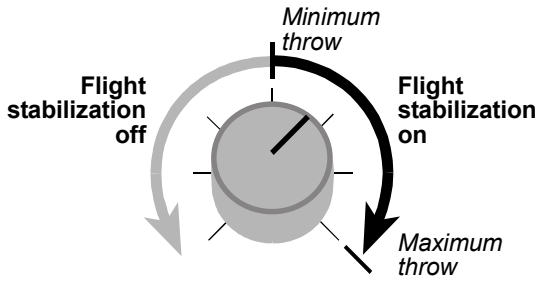
FS8 Co-Pilot™ can be controlled in three different ways. The methods available to you depend on the capabilities of your radio control system.

- **Proportional control.** If your radio system has an unused proportional control channel (usually a knob or lever on the transmitter), it can be assigned to turn FS8 Co-Pilot™ on and off, and to adjust sensitivity during flight. You'll be able to set sensitivity between minimum and maximum—based on flight conditions or desired performance—at any time.

  Examples of proportional control:

  - Adjust FS8 Co-Pilot™ sensitivity while the model is airborne to match a student's skills. As the student gains confidence, for instance, set FS8 Co-Pilot™ to provide less stabilization.
  - Turn FS8 Co-Pilot™ off for aerobatics, then turn it on for landing.
  - If a strong crosswind builds up after the aircraft takes off, dial in more stabilization for better control during landing.

  When configured according to instructions in "Setting up," the transmitter knob works like this:



- **On/off control.** If your radio system has an on/off channel (usually a switch on the transmitter), you can turn FS8 Co-Pilot™ on and off during flights. When FS8 Co-Pilot™ is on, its flight stabilization characteristics are set by the Pitch and Roll Throw controls on the receiver (you can only change this setting when the aircraft is on the ground). When FS8 Co-Pilot™ is off, the aircraft functions as it would without a flight stabilization system (although FS8 Co-Pilot™ still trims the aircraft).

  With on/off control, it's much easier and quicker to move a switch (versus rotating a knob to the right spot with proportional control). This makes it easier to move between aerobatics (without FS8 Co-Pilot™) and straight/level flight (with FS8 Co-Pilot™).

continued

Examples of on/off control:

- An instructor can take off and trim an airplane with FS8 Co-Pilot™ off, then turn it on when giving control to a student.
- You might use stabilization for most flying, then turn it off for aerobatics or inverted flight, and turn it back on again for landing.

- **Manual control.** If your radio system doesn't have any unused channels, FS8 Co-Pilot™ is always on during a flight. Its flight stabilization characteristics are fixed by the Pitch and Roll Throw controls on the receiver. To change sensitivity, you must land the aircraft and manually adjust the Pitch and Roll Throw controls.

Regardless of the option you select, your experience and skill will determine how to best use FS8 Co-Pilot™. It is recommended that you turn off FS8 Co-Pilot™ before attempting unusual attitudes (for example, inverted flight).

FS8 Co-Pilot™ specifications

Operating voltage	+3.5 to +9 volts DC
Operating current	<10 milliamps (servos may draw more current from rapid movement and stabilization)
Weight	With Button/LED Module, supplied cables and optional Vertical Sensor: 1.9 oz.
	With Button/LED Module and supplied cables: 1.8 oz.
Leveling response time	1/60th second
Drift from level	<2° (infrared calibration must be performed)
Flying conditions	Day and night; all weather conditions (rain, fog, sleet and snow may degrade performance)
Humidity	Sensor is sealed; keep windows clean
Remote activation	On/off control or proportional throw adjustment, depending on channel availability of radio system
Aircraft types	Works with all aircraft configurations, including dual aileron servos, quad flaps, elevons, V-tail, complex transmitter mixes, digital servos and CCPM

Safety precautions

General safety precautions

Radio controlled models are not toys! Please observe these general safety precautions:

- Follow all instructions in this manual to assure safe operation.
- If you have not assembled and operated a radio controlled model before, obtain help from an experienced modeler. You will need guidance to successfully assemble, test and operate radio controlled models. One of the best ways to obtain help is to join your local radio control club.
- Never fly radio controlled aircraft near people, buildings, telephone or power lines, cars, trees or other objects on the ground or in the air.
- Never allow a helicopter to fly within 20 feet of you or another person. If a helicopter flies toward you or another person, stop the engine immediately to prevent personal injury.
- Keep your radio controlled models and equipment away from children. Do not allow unauthorized people of any age to operate radio controlled models without proper supervision from an experienced modeler.
- In some areas of the country, you cannot legally operate radio controlled models except at approved fields. Check with local authorities first.
- Observe frequency control. If someone else is operating a radio controlled model on the same channel as your transmitter, **do not turn on your transmitter—even for a short time**. Your transmitter has a channel number marked somewhere on its case. When a model receives signals from two transmitters on the same channel at the same time, it cannot be controlled and will crash—possibly causing personal injury or property damage. **For safety, most RC flying fields have formal frequency control rules. Follow them carefully.**
- Do not operate your radio control transmitter within 3 miles of a flying field. Even at a distance, your transmitter can cause interference.
- Do not operate radio controlled models and equipment in the rain, or at night.
- Protect all electronic equipment from exposure to rain, water, high humidity and high temperatures.
- FMA Direct recommends that you join the AMA. They can help you find a club in your area.

  Academy of Model Aeronautics
  5161 East Memorial Drive
  Muncie, Indiana 47302

  Phone: (800) 435-9262
  Web: www.modelaircraft.org

Safety precautions for flight stabilization:

- FS8 Co-Pilot™ is designed for flight stabilization only. It cannot navigate the aircraft or prevent a stall. You must control the aircraft's flight path.
- FS8 Co-Pilot™ is for recreational use only. Do not install Co-Pilot™ in aerial photographic aircraft where there is a possibility of flying over people.
- You must mount the FS8 Co-Pilot™ Sensor securely. Carefully follow the instructions in "Installing," which tells you to roughen the surface with sandpaper, then clean the surface with rubbing alcohol.
- Keep fuel off the Sensors. Fuel on the Sensors can affect FS8 Co-Pilot™ operation for as long as 10 minutes.
- Perform an infrared calibration at the beginning of each flying session, and repeat the calibration if there are major weather changes. Details are in "At the field."
- Besides your regular preflight check, also check FS8 Co-Pilot™ operation before each flight. Details are in "At the field."
- FS8 Co-Pilot™ derives precision and flexibility from the calibration procedure ("Infrared calibration" in "At the field"). Background information and technical reasoning are provided in "Understanding infrared field calibration" (page 15) and "About infrared field calibration" (page 16). Please read and observe the following guidelines for the best, safest operation with the greatest margin:
  - As nearly as possible, calibrate FS8 Co-Pilot™ over the type of terrain the aircraft will be flying over. For example, do not calibrate over bare dirt if the aircraft will be flying over light vegetation.
  - Grass provides the best, most consistent reference terrain, but snow is the coolest reference terrain.
  - If the flying area has variable terrain, calibrate over the coolest part. This provides a conservative, lower calibration number, and assures a greater margin over warmer reference terrain. Typical infrared temperatures, in order from coolest to warmest are: snow, water, grass, light vegetation, sand, and asphalt or concrete.
  - If you calibrate over an artificially warm medium such as asphalt or concrete, the infrared temperature over anything else will be lower, which reduces the temperature difference (between earth and sky) available for FS8 Co-Pilot™ to work with. If at all possible, don't calibrate over asphalt or concrete.
  - If the aircraft will be flying over patchy snow, calibrate over the snow.
  - A calibration reading of 1 is rare. It is recommended that you not fly using FS8 Co-Pilot™ when a reading of 1 is obtained over the coolest terrain present. **To completely turn off FS8 Co-Pilot™, you must rotate the Throw controls fully counterclockwise or unplug the Roll/Pitch Sensor.**
  - Helicopters require extra precision to hover. For that reason, you should only use FS8 Co-Pilot™ on a helicopter when the calibration reading is 3 or greater.

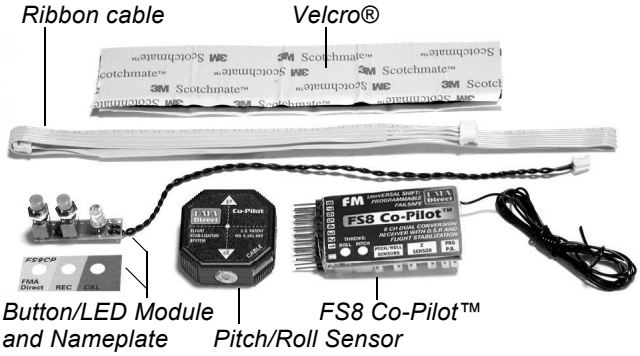
Install

Parts list

☐ FS8 Co-Pilot™ ☐ Ribbon cable

☐ Pitch/Roll Sensor ☐ Velcro®

☐ Button and LED Module with cable and nameplate



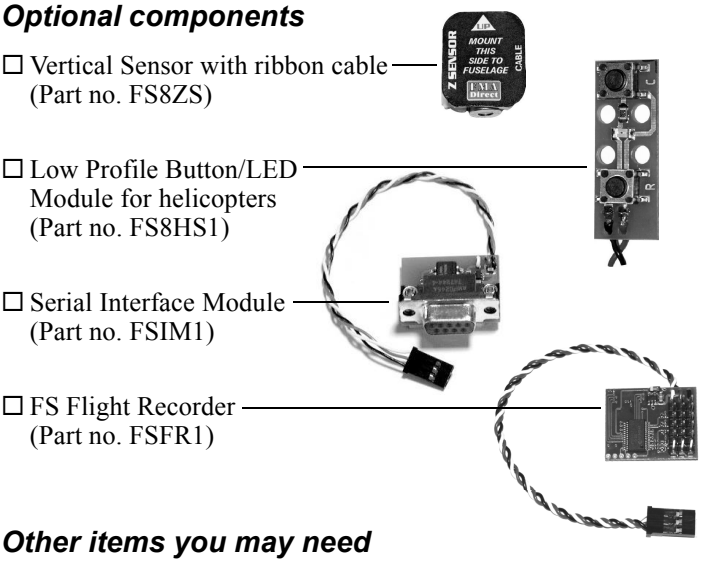
Optional components

☐ Vertical Sensor with ribbon cable (Part no. FS8ZS)

☐ Low Profile Button/LED Module for helicopters (Part no. FS8HS1)

☐ Serial Interface Module (Part no. FSIM1)

☐ FS Flight Recorder (Part no. FSFR1)



Other items you may need

- Elevon Mixer (Part no. MX80). Use an on-board elevon mixer for aircraft with elevons (such as flying wings), when your radio control transmitter doesn't provide elevon mixing.
- 12" (30cm) flat ribbon cable (Part no. 2MMFRC4P2X12)
  18" (46cm) flat ribbon cable (Part no. 2MMFRC4P2X18)
  24" (61cm) flat ribbon cable (Part no. 2MMFRC4P2X24)
  40" (102cm) flat ribbon cable (Part no. 2MMFRC4P2X40)
  - Longer cables enable the Co-Pilot™ Sensor to be positioned properly on engine-powered conventional aircraft having large wingspans (see "Installing Co-Pilot™" for details).
  - Shorter cables reduce weight on smaller aircraft.

  Please measure to determine the correct ribbon cable length for your aircraft!
- Advanced Servo Buffer (Part no. 605SB). Strongly recommended for aircraft with long servo extensions and/or gasoline engines. Works with analog and digital servos. See page 10 for more information.

Before you start

Failsafe and light stabilization work with, and require, a completely installed and correctly operating aircraft radio control system: transmitter, FS8 Co-Pilot™, battery pack and servos. (An airplane with elevons may also need an on-board mixer, if mixing isn't provided in the transmitter.)

Before you work with failsafe settings and flight stabilization, install and set up your entire radio system. Be absolutely certain the radio system operates correctly—and moves the control surfaces in the proper directions—before you get into FS8 Co-Pilot™ set up procedures.

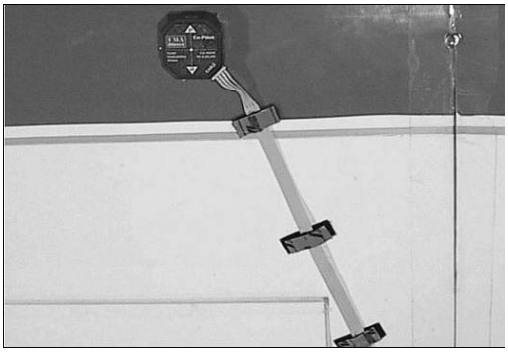
Finally, read and understand the safety precautions on page 5.

Mount the Roll/Pitch Sensor

- If you are installing FS8 Co-Pilot™ on an airplane, go to "Mount the Pitch/Roll Sensor on an airplane."
- If you are installing FS8 Co-Pilot™ on a helicopter, go to "Mount the Pitch/Roll Sensor on a helicopter."

Mount the Pitch/Roll Sensor on an airplane

1. Locate a mounting spot for the Pitch/Roll Sensor, following these guidelines:
   - Pitch/Roll Sensor should be level during flight (a slight tilt caused by mounting the sensor on a wing with dihedral is acceptable).
   - The Pitch/Roll Sensor should have a clear view of the horizon on all sides.
   - The Pitch/Roll Sensor must be away from muffler and exhaust spray (exhaust spray will cloud the sensor's infrared windows and degrade flight stabilization).
   - On a high wing airplane, mount the sensor on top of the wing about halfway between root and tip ribs, at about maximum airfoil thickness, on the side away from the exhaust.



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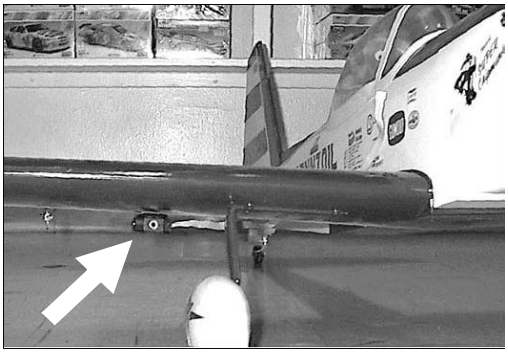
- On a low wing airplane with side or top exhaust, mount the sensor on the bottom of the wing about halfway between root and tip ribs, at about maximum airfoil thickness, on the side away from the muffler.



Tip: You can mount the sensor on the bottom of the fuselage, so its ribbon cable can remain attached, even when you remove the wing. Don't do this, however, if the engine exhausts below the fuselage.

- On a low or mid wing airplane with bottom exhaust, mount the sensor on top of the fuselage, behind the canopy. Rotate the sensor 45° as shown below. (A clear canopy appears opaque to the infrared sensors, and will block their view of the horizon.)

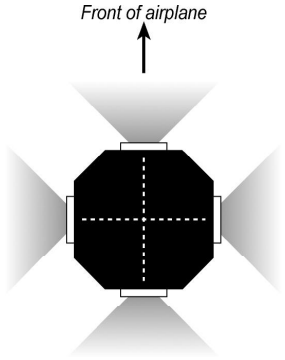
2. Use sandpaper to roughen the surface where the Pitch/Roll Sensor will be mounted. Clean the roughened area with rubbing alcohol and allow to dry.

continued

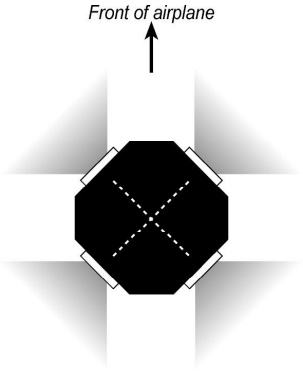
3. Clean the bottom of the Pitch/Roll Sensor with rubbing alcohol and allow to dry.
4. Attach a 1¼" piece of "stiff" Velcro® to the roughened area on the aircraft.
5. Attach a 1¼" piece of "fuzzy" Velcro® to the bottom of the Pitch/Roll Sensor.

WARNING: You must mount the Sensor securely, so it won't come loose in flight. If it comes loose, you may lose control of the aircraft. Other mounting methods can be used, as long as the Sensor remains securely in place during all flight conditions.

6. Mount the Pitch/Roll Sensor in the following orientation:
   - When mounted on an airplane's wing or fuselage, and there is a clear view of the horizon in all directions, one sensor window should face directly forward, like this:



   - When mounted behind an airplane's canopy, two sensors should be angled 45° from the airplane's center line, like this:



   - Orient the cable socket so the cable will route neatly into the radio compartment.

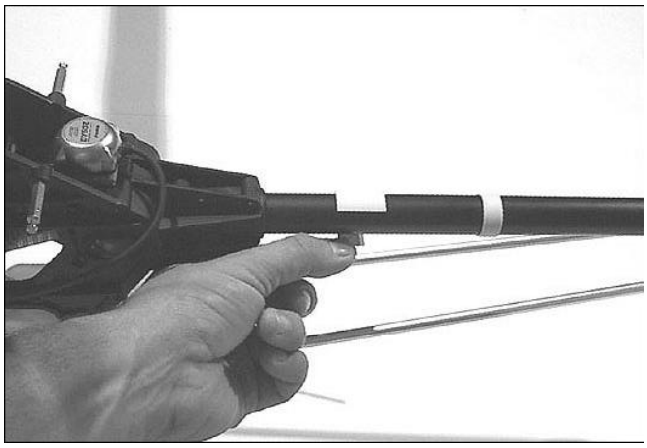
Note: The direction of the "P" arrows (not shown in the above illustrations) on the Pitch/Roll Sensor is not critical. However, the sensor must remain in the same orientation throughout setup, calibration and flying.

7. **IMPORTANT:** Carefully remove the protective stickers from the four sensor windows.

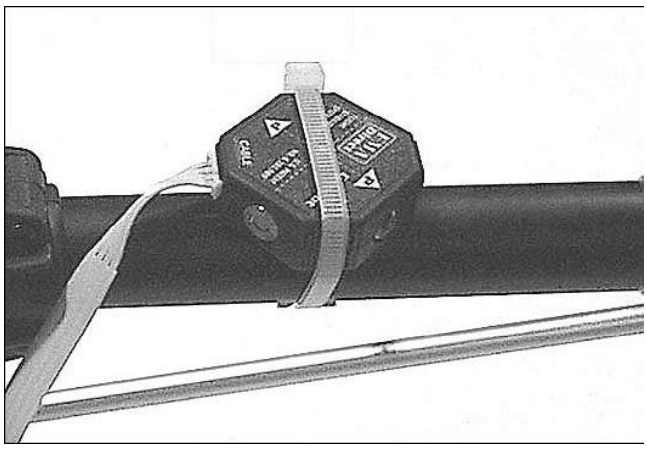
Go to "Mount the optional Vertical Sensor." ➡

Mount the Pitch/Roll Sensor on a helicopter

1. Attach two pieces of double-sided adhesive tape to the top and bottom of the boom behind the swashplate. Do not use Velcro®.



2. Place the Sensor on the top piece of tape with the cable socket facing forward and the windows angled 45° from the helicopter's centerline. The Sensor must be horizontal when the helicopter is sitting on its skids. Secure the Sensor to the boom with a cable tie.



WARNING: You must mount the Sensor securely, so it won't come loose in flight. If it comes loose, you may lose control of the aircraft.

3. **IMPORTANT:** Carefully remove the protective stickers from the four sensor windows.

Go to "Mount the optional Vertical Sensor." ➡

Mount the optional Vertical Sensor

The Vertical ("Z") Sensor enables the flight stabilization system to determine when the airplane is inverted (so the aircraft rolls out from inverted, rather than performing a half loop). A giant scale airplane will need the Vertical Sensor because it can't be easily moved into position (nose straight down or one wing straight down) on the ground for infrared calibration.

- If you want to use the Vertical Sensor, continue in this section.
- If you *don't* want to use the Vertical Sensor, go to "Mount the Button/LED Module."

1. Locate a mounting spot for the Vertical Sensor (typically on side of the fuselage or helicopter cockpit) Follow these guidelines:
   - The windows on the Vertical Sensor must point directly up and down when the airplane is in straight and level flight.
   - The lower window on the Vertical Sensor must have a clear view of the ground. The upper window must have a clear view of the sky.
   - The sensor must be away from the muffler and exhaust spray (exhaust spray will cloud the sensor's infrared windows and degrade calibration).
   - Helicopter blades will not affect the sensor's view.
2. Use sandpaper to roughen the surface where the Vertical Sensor will be mounted. Clean the roughened area with rubbing alcohol and allow to dry.
3. Clean the bottom of the Vertical Sensor with rubbing alcohol and allow to dry.
4. Attach a 1¼" piece of "stiff" Velcro® to the roughened area on the aircraft.
5. Attach a 1¼" piece of "fuzzy" Velcro® to the side of the Sensor marked "Mount this side to fuselage."

WARNING: You must mount the Sensor securely, so it won't come loose in flight. If it comes loose, you may lose control of the aircraft. Other mounting methods can be used, as long as the Sensor remains securely in place during all flight conditions.

6. Mount the Sensor with the arrow pointing directly up when the airplane is in a straight and level attitude.

7. **IMPORTANT:** Carefully remove the protective stickers from the two sensor windows.

Go to "Mount the Button/LED Module." ➡

Mount the Button/LED Module

The Button/LED Module enables you to interact with FS8 Co-Pilot™. You press buttons to tell FS8 Co-Pilot™ what to do, and you read information from the LED.

> **IMPORTANT:** Don't just dangle the Button/LED Module outside the fuselage. Mount it securely where you won't accidentally bump it when you are preparing the aircraft for lift-off or hand launching. When pressed for 1 second, calibration begins—and you don't want to do that when the aircraft is about to fly.

Follow the instructions below for your specific installation.

Mount the Button/LED Module on an airplane

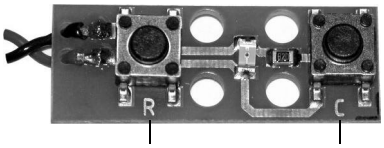
1. Select a spot to mount the Module. It should be convenient to press the buttons, and you must be able to see the LED.
2. Drill three holes in the airplane fuselage or helicopter cockpit.
3. Pull off the red caps from the button shafts.
4. Remove the nuts from the buttons, then remove the nameplate.
5. Insert the buttons and LED into the holes from inside the fuselage or cockpit.
6. Place the nameplate over the buttons and LED.
7. Thread the nuts onto the buttons to secure the Module.
8. Push the red caps onto the button shafts.

Go to "Connect the components." ➡

Mount the optional Low Profile Button/LED Module on a helicopter

1. Select a spot to mount the Module. It should be convenient to press the buttons, and you must be able to see the LED.
2. Attach the Module using two cable ties through the holes in the PC board.

> **Note:** The Low Profile Button/LED Module is laid out and marked differently than the standard nameplate. When you see "REC Button" and "CAL Button" in this manual, substitute "R" and "C" on the Low Profile Module.

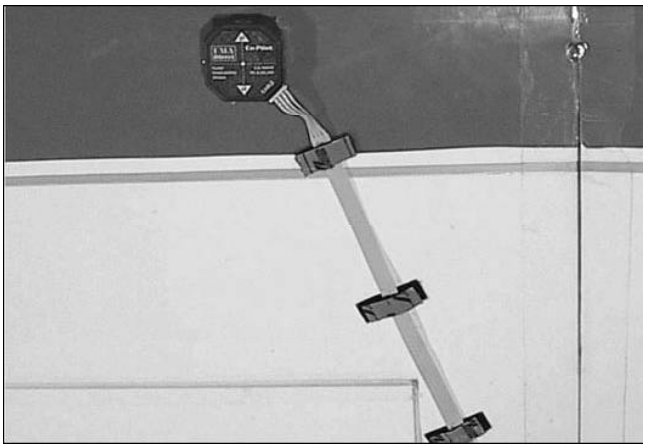


Same as REC Button *Same as CAL Button*

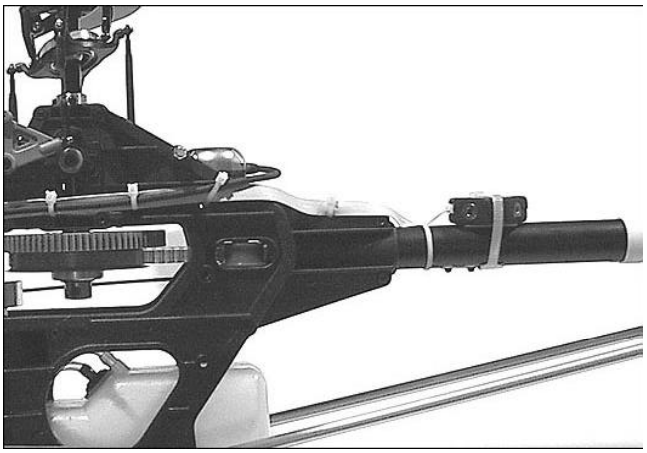
Go to "Connect the components." ➡

Connect the components

1. Install the Pitch/Roll Sensor cable:
   a. Plug one end of a ribbon cable into the socket in the Pitch/Roll Sensor (be sure to line up the tab on the connector with the slot on the socket).
   b. Route the Pitch/Roll Sensor cable toward the radio compartment. Make certain the cable doesn't cover a sensor window.
2. Install the Vertical Sensor cable (if you are using the Vertical Sensor):
   a. Plug one end of the other ribbon cable into the socket in the Vertical Sensor (be sure to line up the tab on the connector with the slot on the socket).
   b. Route the Vertical Sensor cable toward the radio compartment.
3. Secure the sensor cables:
   - For a conventional airplane: Clean more spots. Secure the cables with Velcro, tape or flat cable clamps, as shown in this example:

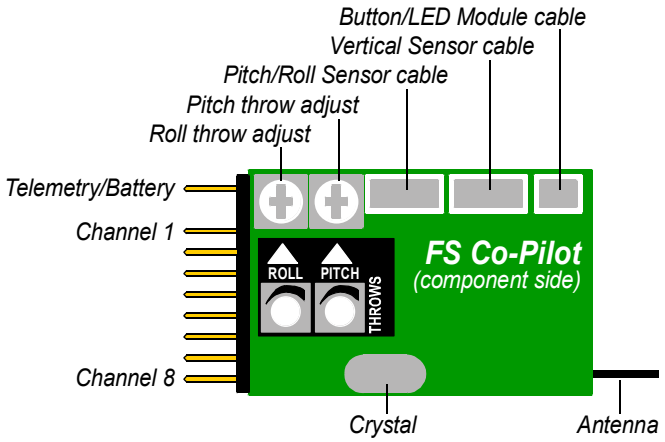


   - For a flying wing: Secure the cables with tape.
   - For a helicopter: Secure the cables with small cable ties, as shown in this example:



continued

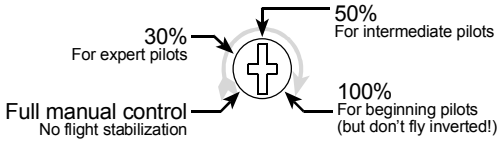
4. Insert an FMA receiver crystal in FS8 Co-Pilot's crystal socket.



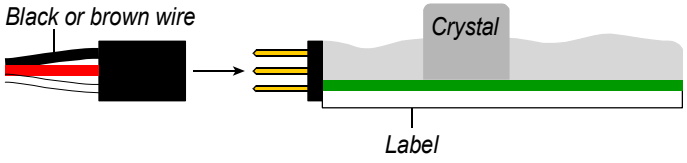
Note: This diagram shows FS8 Co-Pilot™ from the component side of the circuit board (away from the label). You can also use the label to identify component locations and pins.

5. Set the Throw controls:

   - If you will be controlling flight stabilization with a proportional (knob or slider) channel: Turn both Throw controls fully clockwise.
   - If you will be controlling flight stabilization with an on/off (switch) channel...
     or
     If you won't be controlling flight stabilization from the transmitter: Set both Throw controls as shown in the diagram below.



6. Connect the servos to FS8 Co-Pilot™, according to the channel assignments in your transmitter. If you are using an onboard elevon mixer (required for flying wings), follow its instructions to connect it inline with two servos.



Note: Black or brown wires on servo/battery connectors go away from label side of receiver. (*Do not use "old style," pre-"Z-type" Airtronics servo connectors.)* Failure to observe correct servo/battery polarity voids warranty. Damage may result to both receiver and servos.

continued

7. Plug the Pitch/Roll Sensor cable into FS8 Co-Pilot™.
8. Plug the Vertical Sensor cable into FS8 Co-Pilot™.
9. Plug the Button/LED Module into FS8 Co-Pilot™.
10. Connect the switch harness to FS8 Co-Pilot™.
11. Connect the receiver battery to the switch harness. If you *aren't* installing the FS Flight Recorder, you can connect the switch harness to the Telemetry/Battery pins on FS8 Co-Pilot™.
12. Wrap FS8 Co-Pilot™ in 3/8" or 1/2" foam rubber to protect it from vibration.

Note: Failure to use foam rubber to protect FS8 Co-Pilot™ will void your warranty.

13. Place FS8 Co-Pilot™ in the fuselage (or helicopter) and secure it to prevent movement.

Tip: For electric aircraft, keep FS8 Co-Pilot™ at least 1" away from the motor and battery power wires, as these radiate RF noise.

14. Route the antenna so it is fully extended. Do not coil antenna, as this substantially reduces range.

Note: You may cut antenna to as short as 18" without de-tuning the receiver. However, range will be reduced. Be sure to range test and cut off a little bit at a time until antenna reaches desired length.

Go to "Set up the system." ➡

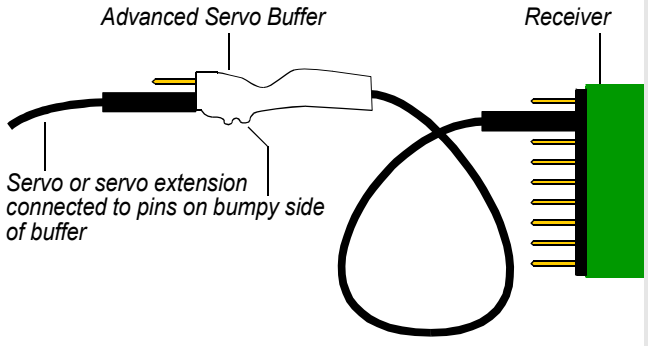
Special installation considerations

For large aircraft with long servo extensions, or for any aircraft powered by a gasoline engine, FMA recommends installing the Advanced Servo Buffer (Part no. 605SB). For use with analog and digital servos, this device:

- Filters out electromagnetic interference generated by gas engine ignition systems.
- Filters out RF interference picked up by long servo wires.

Typical symptoms include multiple failsafes during flights, erratic servo movement or receiver "swamping." The Advanced Servo Buffer is 100% effective in eliminating these problems.

1. Connect the servo wire to the pins toward the bumpy side of the Advanced Servo Buffer.
2. Connect the Advanced Servo Buffer cable to the appropriate pins on the FS8 Co-Pilot™.



Set up the system

Setting up FS8 Co-Pilot™ has three parts:

- **Set up failsafe operation,** in which FS8 Co-Pilot™ learns which channels you want assigned as failsafe channels and the servo failsafe positions for those channels.
- **Set up flight stabilization,** in which FS8 Co-Pilot™ learns which channels are assigned to pitch, roll and remote on/off.
- **Set Auto Trim, in which** you set Auto Trim on or off.

Once FS8 Co-Pilot™ is set up, you normally don't need to repeat the set up unless you change the aircraft's configuration or move FS8 Co-Pilot™ to another aircraft.

Tip: If you have a PC and the optional Serial Interface Module, consider setting up FS8 Co-Pilot™ with help from the FS Co-Pilot™ Viewer Software. The software isn't required for setup, but its graphical displays will help you understand what the receiver is doing. Instructions for installing and running the software are provided in the FS Co-Pilot™ Viewer Software user guide.

Set up failsafe operation

About receiver modes

As long as power is applied, FS8 Co-Pilot™ keeps servo outputs energized. Unlike most receivers, when FS8 Co-Pilot™ detects bad transmitter data, it takes action to put the aircraft in a predictable flight path.

- **Normal Flight Mode** is the regular operating mode. Use Normal Flight Mode for testing, range checking and flying your aircraft. If FS8 Co-Pilot™ receives statistically bad frames for about 1 second, it enters...
- **Failsafe Mode, in** which...
  - Servos set for **Last Good Frame Hold** remain in the positions specified in the last valid frame from the transmitter. As delivered from the factory, all channels are set for Last Good Frame Hold. You can also reset the receiver to this state at any time.
  - Servos set for **Failsafe** move to positions you preset.

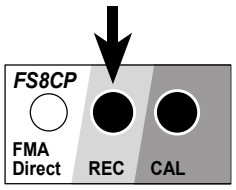
    When FS8 Co-Pilot™ detects good transmitter data, the receiver leaves Failsafe Mode and returns to Normal Flight Mode.
- **Receiver Setup Mode** lets you tell FS8 Co-Pilot™ how to handle each channel when it is in Failsafe Mode. Using a simple procedure (see "Set up the receiver"), you can set any channel to move to a preset Failsafe position during Failsafe Mode. Channels not set for Failsafe remain in their Last Good Frame Hold positions. FS8 Co-Pilot™ stores setup information for each channel. It keeps this information even when power is turned off.

Assign failsafe channels and servo positions

1. Configure your radio system for normal operation:
   a. Turn on your transmitter, then turn on FS8 Co-Pilot™.
   b. Set up your transmitter for correct aircraft operation:
      - Verify control channel assignments
      - Set servo reversing and travel.
      - Program mixes.
      - If you are using an elevon mixer, confirm that elevons are working correctly.
      - **IMPORTANT: Set transmitter dual rates to high while setting up FS8 Co-Pilot™.**
   c. If you will be controlling flight stabilization from your transmitter, decide which channel you will use:
      - For on/off and throw adjustment, use a proportional channel (typically a knob or slider).
      - For on/off control only, use a switched channel.
   d. Turn off FS8 Co-Pilot™.

CAUTION: When setting failsafe positions for an electric aircraft, set throttle to full off, or disconnect motor wires, before you enter Failsafe Mode.

2. **Enter Receiver Setup Mode:** Press and hold the REC Button, turn on FS8 Co-Pilot™, then release the REC Button. This puts FS8 Co-Pilot™ in Receiver Setup Mode:



   - The channel 2 servo shakes two times to confirm.
   - The LED twinkles when FS8 Co-Pilot™ is in Receiver Setup Mode.
   - Servos set for Last Frame Good Frame Hold Mode move slowly back and forth a small amount, while servos set for Failsafe Mode move to failsafe positions and don't move back and forth.

continued

3. Set servo failsafe positions (see guidelines at right). For each channel that will have a servo failsafe position:

   a. On the transmitter, move the stick/control for that channel to the desired failsafe position (watch the control surface or throttle).

      Note: If mixing is programmed in your transmitter for the stick or control, this procedure sets failsafe positions for all channels in that mix.

   b. The LED blinks the number of the channel you moved.

   c. While holding the transmitter stick in the desired failsafe position, press the REC Button 1 time to save the failsafe position.

      Note: If you don't press the button, the channel(s) will revert to Last Good Frame Hold Mode.

   c. Return the transmitter stick/control to neutral (or idle for throttle) before the LED turns on.

      Tip: To change a failsafe position, repeat step 3.

4. Turn off FS8 Co-Pilot™. (Turning off FS8 Co-Pilot™ terminates Receiver Setup Mode and maintains all settings.)

   Note: FS8 Co-Pilot™ remembers Failsafe Mode settings even when it is turned off. You only need to repeat this section if you reconfigure the aircraft, reprogram your transmitter or move FS8 Co-Pilot™ to another aircraft.

Go to "Set up flight stabilization." ➡

Suggested initial failsafe positions

Optimum failsafe positions will depend on your particular aircraft and how it behaves in the air. Start with the settings below, then test and adjust them as needed.

For an airplane, your goal is to have the plane circle and gently descend, without stalling, during a failsafe condition. Good starting failsafe positions are:

- Ailerons: neutral.
- Elevator: neutral or slight up.
- Rudder: moderate right turn.
- Throttle: 1/4 to 1/3.
- Flight stabilization: on

For a helicopter, your goal is a stable hover. Good starting failsafe positions are:

- Roll: neutral.
- Pitch: neutral.
- Collective: hover.
- Yaw: neutral.
- Throttle: 1/4.
- Flight stabilization: on

Other things you can do in Receiver Setup Mode

- *To erase the failsafe position for one channel:*
  1. On the transmitter, move the stick/control for the channel you want to erase.
  2. LED blinks channel number.
  3. Return the stick/control to neutral (or idle for throttle).
  4. Do not press the REC Button.
  5. When the LED turns on, the channel will now enter Last Good Frame Hold when the receiver is in Failsafe Mode. The servo will start to move.

- *To erase failsafe positions for all channels:* Press and hold the REC Button for 10 seconds until channel 2 shakes 1 time. All channels will now enter Last Good Frame Hold when the receiver is in Failsafe Mode.

- *To determine a channel's mode:* Watch servos, control surfaces and throttle:
  - Servos set for Last Good Frame Hold move slowly back and forth a small amount.
  - Servos set for Failsafe move to their preset positions (and don't move back and forth).

Set up flight stabilization

Note: Flight stabilization will not function until it has learned which channels control pitch and roll.

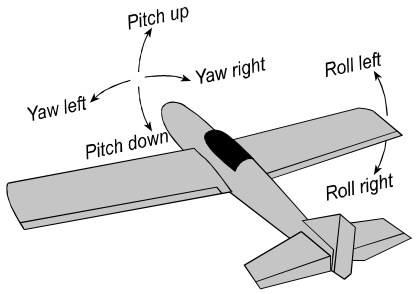
About flight stabilization modes

Flight stabilization has two modes:

- **Normal Flight Mode** is the regular operating mode. When flight stabilization is turned on, it works to maintain your aircraft in straight and level flight. Your transmitter stick movements override FS8 Co-Pilot's flight stabilization. The Pitch and Roll Throw controls on the receiver determine how much stick movement is required to override stabilization. If you assigned a *proportional* transmitter channel for remote stabilization control, that channel adjusts the amount of stick movement needed to override both pitch and roll stabilization.
- **Flight Stabilization Setup Mode** enables flight stabilization to learn which channels control pitch, roll and optional remote on/off. Within Setup Mode are three steps:
  - **Setup Mode 1:** Pitch channel learning, in which flight stabilization determines how to return the aircraft to level pitch (i.e., elevator response).
  - **Setup Mode 2:** Roll channel learning, in which flight stabilization determines how to return the aircraft to level roll (i.e., aileron response).
  - **Setup Mode 3:** Remote on/off channel assignment, in which flight stabilization determines the channel you want to use (if any) for turning flight stabilization on and off.

Getting oriented

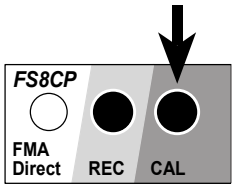
Be sure you know the three axes of motion for an aircraft, and how to control them with your transmitter sticks. Refer back to this diagram if you need help later in this section.



Assign flight stabilization channels

Note: During setup, move only the transmitter stick for the axis being programmed. Do not move other sticks.

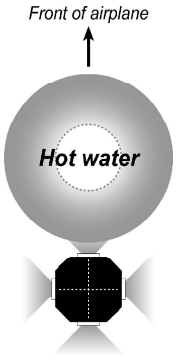
1. Disconnect Vertical ("Z") Sensor cable (if sensor is installed).
2. Turn on your transmitter.
3. Press and hold the CAL Button, turn on FS8 Co-Pilot™, then release the button. This puts FS8 Co-Pilot™ in Flight Stabilization Setup Mode:
   - The channel 2 servo shakes three times to confirm.
   - The LED twinkles (but not continuously) when FS8 Co-Pilot™ is in Flight Stabilization Setup Mode.
   - The LED blinks 1 time (and repeats slowly), indicating FS8 Co-Pilot™ is in Flight Stabilization Setup Mode 1.
4. Assign the pitch channel:



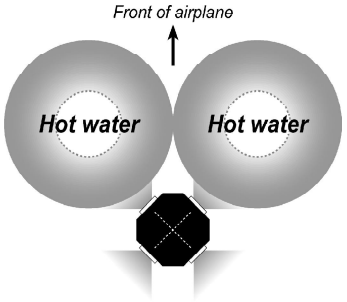
   a. If the Roll/Pitch Sensor has one window facing forward (as shown below, left), fill a *plastic* soda bottle with **hot water** (at least 120°F or 49°C) and cap the bottle.
   or
   If the Roll/Pitch Sensor has two windows facing forward (as shown below, right), fill two *plastic* soda bottles with **hot water** (at least 120°F or 49°C) and cap the bottles. Tape the bottles together.

Tip: You can also use a coffee cup or similar container instead of a soda bottle. If you can close the container, you'll be less likely to spill the hot water. **Do not use shiny metal cans.**

   b. Place the bottle(s) in front of the Roll/Pitch Sensor (as shown below). The servo connected to channel 2 to will "tick" one or two times (then repeat) to tell you how many sensors detect the hot water.



Hot water location for 1 forward-facing sensor window. Channel 2 servo "ticks" one time (and repeats)



Hot water location for 2 forward-facing sensor windows. Channel 2 servo "ticks" two times (and repeats)

IMPORTANT: Verify operation as described above:
- If the sensor has one window facing forward, the servo *must tick only once*.
- If the sensor has two windows facing forward, the servo *must tick twice*.

If this is not the case, flight stabilization setup will be incorrect.

   c. **Slowly** move the elevator (pitch) stick toward you for up elevator (pitch up). Make the motion last at least 2 seconds so FS8 Co-Pilot™ can exactly copy transmitter mixing (if any). FS8 Co-Pilot™ now knows which channel controls pitch, and how it should respond when the aircraft is pitching away from horizontal.

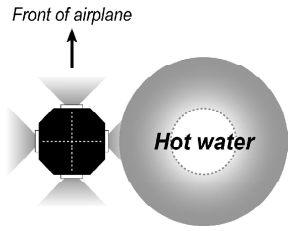
continued

d. Remove the bottle(s) of hot water.

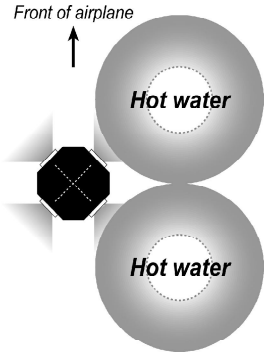
5. Assign the roll channel:

   a. Press the CAL Button 1 time. The LED blinks 2 times (and repeats slowly), indicating FS8 Co-Pilot™ is in Setup Mode 2.

   b. Place the bottle(s) of hot water to the right side of the right-facing one or two sensors (as shown below). The servo connected to channel 2 will cycle one or two times (then repeat) to tell you how many sensors detect the hot water.

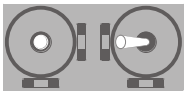


Hot water location for 1 forward-facing sensor window. Channel 2 servo "ticks" one time (and repeats)



Hot water location for 2 forward-facing sensor windows. Channel 2 servo "ticks" two times (and repeats)

   c. **Slowly** move the aileron (roll) stick to the left for left roll. Make the motion last at least 2 seconds so FS8 Co-Pilot™ can exactly copy transmitter mixing (if any). FS8 Co-Pilot™ now knows which channel controls roll, and how it should respond when the aircraft is rolling to the right.



6. Assign the remote on/off channel:

> **Note:** Assigning a remote on/off channel is optional, but recommended.

   a. Press the CAL Button 1 time. The LED blinks 3 times (and repeats slowly), indicating FS8 Co-Pilot™ is in Setup Mode 3.

   b. Move the knob, slider or switch you want to use to control remote on/off. Make the motion last at least 2 seconds. FS8 Co-Pilot™ now knows which channel controls on/off.

   To erase the remote on/off channel assignment (which sets flight stabilization on all the time): Move the previously assigned pitch or roll stick. (FS8 Co-Pilot™ never assigns remote on/off to a pitch or roll stick.)

   c. In Flight Stabilization Setup Mode 3, remote on/off operates proportionally. Adjust servo throws on the transmitter to assure remote on/off functions: moving the transmitter control from one extreme to the other should turn flight stabilization full on and full off.

> *To erase all flight stabilization settings:* Press and hold the CAL Button for 10 seconds. This removes pitch, roll and remote on/off channels learned by FS8 Co-Pilot™.

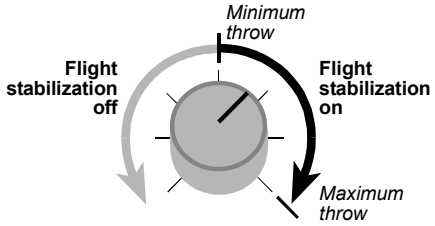
continued

7. Verify flight stabilization operation:

   a. Turn off FS8 Co-Pilot™. (Turning off FS8 Co-Pilot™ terminates Flight Stabilization Setup Mode.)

   b. Turn on FS8 Co-Pilot™ without holding any buttons. FS8 Co-Pilot™ is now in Normal Flight Mode.

   c. If you assigned a channel for remote on/off, make sure the transmitter knob, slider or switch is in the on/max position.



   d. Place the bottle(s) of hot water in front of the forward-facing one or two sensors to simulate the aircraft pitching down. Flight stabilization should respond by making the aircraft pitch up, like this:
   - Conventional airplane: elevator moves up.
   - Flying wing: both elevons move up.
   - Helicopter: swashplate tilts back, and does not tilt left or right.

> **Note:** If the aircraft doesn't respond at all:
> - Flight stabilization may be off. Try moving the control assigned to remote on/off.
> - If the Pitch/Roll Sensor is unplugged, or if setup is incorrect, flight stabilization is disabled.

   e. Place the bottle(s) of hot water to the right of the right-facing one or two sensors to simulate the aircraft rolling to the right. Flight stabilization should respond by making the aircraft roll left, like this:
   - Conventional airplane: left aileron moves up, and right aileron moves down.
   - Flying wing: left elevon moves up, and right elevon moves down.
   - Helicopter (boom parallel to ground): swashplate tilts left, and does not tilt forward or back.

8. Turn off FS8 Co-Pilot™.

9. Check Vertical ("Z") Sensor operation (if sensor is installed):

   a. Reconnect Vertical Sensor cable. Turn on FS8 Co-Pilot™.

> **Note:** If the Vertical Sensor is disconnected while power is on, flight stabilization is disabled (FS8 Co-Pilot™ assumes the sensor is defective).

   b. Place the bottle(s) of hot water above the Vertical Sensor to simulate inverted flight. Pitch stabilization should be reduced when heat is above the Vertical Sensor. Roll stabilization is not affected. Turn off FS8 Co-Pilot™.

> **CAUTION:** Be certain you get the responses described in steps 7d, 7e and 9b. If you do not get these responses, or if pitch and roll stabilization seem to affect each other, repeat flight stabilization setup.

> **Note:** Repeat flight stabilization setup if you reconfigure the aircraft, reprogram your transmitter or move FS8 Co-Pilot™ to another aircraft.

Go to "Set Auto Trim." ➡

Set Auto Trim

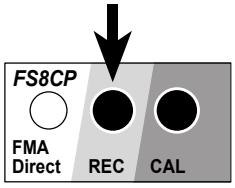
Auto Trim maintains trim settings when you switch FS8 Co-Pilot™ on and off. These guidelines will help you decide whether to use Auto Trim:

- Best for beginners: Auto Trim should be on. Take off with FS8 Co-Pilot™ on, and trim in the air with FS8 Co-Pilot™ on. With Auto Trim on, aircraft stays in trim when FS8 Co-Pilot™ is turned off in the air.
- Best for experts: Auto Trim should be off. Take off with FS8 Co-Pilot™ off, and trim in the air with FS8 Co-Pilot™ off (since Auto Trim is off, it has no effect on trim). After turning on FS8 Co-Pilot™ for emergency recovery, don't trim, or you must retrim when FS8 Co-Pilot™ is off.

1. Turn on your transmitter, then turn on FS8 Co-Pilot™ (so FS8 Co-Pilot™ is in Normal Flight Mode).
2. Determine whether Auto Trim is on or off:
   a. Turn off flight stabilization using the transmitter's remote on/off control.
   b. Place a bottle(s) of hot water in front of the right-facing 1 or 2 windows of the Pitch/Roll Sensor.
   c. Watch the aircraft's roll surfaces (ailerons, elevons or swashplate) as you turn off flight stabilization with your transmitter.
      - If the roll surfaces move slightly, Auto Trim is on.
      - If the roll surfaces don't move, Auto Trim is off.

> **Note:** If the Vertical ("Z") Sensor is installed and you are setting up indoors, the Auto Trim setting probably won't change the pitch surfaces. When indoors, the Vertical Sensor usually sees warmer air above the aircraft (warm air rises to the ceiling), and FS8 Co-Pilot™ assumes the aircraft is inverted.

3. Change Auto Trim as needed (in Normal Flight Mode, not in Setup Mode):
   - To turn Auto Trim on (if it is off): Press the REC Button 6 times.
   - To turn Auto Trim off (if it is on): Press the REC Button 6 times.



FS8 Co-Pilot™ is now set up.

Go to "Understanding infrared field calibration." ➡

Understanding infrared field calibration

This background information will help you understand why you need to carry out the infrared field calibration (described on the next page).

FS8 Co-Pilot's Pitch/Roll Sensor sees for many miles in all directions when the model is airborne. Its field of view will include grass, trees, buildings, pavement, people, cars, clouds, water and many other objects with different infrared emissions. The Sensor detects an average infrared temperature sufficient for FS8 Co-Pilot™ to carry out flight stabilization under nearly all conditions.

During calibration, FS8 Co-Pilot's Pitch/Roll Sensor sees infrared temperatures in the immediate vicinity of the model. This means that you should calibrate over an area representative of the general infrared environment—such as grass—the Sensor will see when the model is airborne. Once calibrated, large variations in terrain or weather can affect FS8 Co-Pilot's ability to stabilize the aircraft. If these occur, you may need to recalibrate.

The calibration procedure recommends that you **not** calibrate, for example, over asphalt (such as a taxiway, runway or parking lot). If you were to calibrate over asphalt, the Sensor would detect the infrared generated by the asphalt—not the average for the larger area in which the model will be flying—resulting in a falsely high temperature difference.

FS8 Co-Pilot™ conveniently tells you about the infrared temperature difference it measures on a relative scale of one (small difference) to ten (large difference). In several years of testing flight stabilization technology, we've made some important observations:

- FS8 Co-Pilot™ rarely measures a difference of 10.
- FS8 Co-Pilot™ even more rarely measures a difference of 1.
- Readings of 1 have only been seen over snow, in fog and when the cloud cover is below two hundred feet. Not many people will fly in those conditions.

What happens if you use FS8 Co-Pilot™ under the worst possible conditions? When FS8 Co-Pilot™ doesn't see a significant difference in infrared temperature, it doesn't issue any compensating signals to the receiver. **If the model is trimmed for stable flight**, it simply responds to your commands as though FS8 Co-Pilot™ weren't in the system. We recommend that you deactivate FS8 Co-Pilot™ (turn the Pitch and Roll Throw controls fully counterclockwise) if it produces a reading of 1 during calibration. Otherwise, you may experience unexpected flight excursions.

What happens if you calibrate over land and fly over water? If you fly near a small lake, the Pitch/Roll Sensor doesn't see much of a change. If you fly over a larger body of water, the Sensor sees a somewhat lower average infrared temperature compared to flying over land. All you need to do in this situation is make sure FS8 Co-Pilot™ measures a moderate to high temperature difference (4 or higher) over land. FS8 Co-Pilot™ sees a 1 unit drop for each 6º of lower temperature difference. For example, if the aircraft is flying over water that is 12º lower than the land where FS8 Co-Pilot™ was calibrated, FS8 Co-Pilot™ has 2 units less temperature difference to work with. If the original calibration number was 5, then the effective calibration number would be 3 over water. However, if FS8 Co-Pilot sees a 2 over land, it would see 0 over water. It is safer to fly over large lakes when the temperature difference is 4 or higher over land.

Go to "At the field." ➡

At the field

When using FS8 Co-Pilot™, you'll need to add two routines to your normal preflight checks:

- **Infrared field calibration** — before your first flight of the day, and any time there is a significant change in the weather.
- **FS8 Co-Pilot™ preflight check** — before each flight, as part of your regular preflight check.

Infrared field calibration

IMPORTANT:

- Calibrate before your first flight of the day, and any time the weather changes significantly.
- Calibrate outside, near the area where you will be flying.
- Calibrate before every flight at night.

Infrared field calibration precautions

Flight stabilization derives precision and flexibility from the calibration procedure. Please read and observe the following guidelines for the best, safest operation with the greatest margin:

- As nearly as possible, calibrate flight stabilization over the type of terrain the aircraft will be flying over. For example, do not calibrate over bare dirt if the aircraft will be flying over light vegetation.
- Grass provides the best, most consistent reference terrain, but snow is the coolest reference terrain.
- If the flying area has variable terrain, calibrate over the coolest part. This provides a conservative, lower calibration number, and assures a greater margin over warmer reference terrain. Typical infrared temperatures, in order from coolest to warmest are: snow, water, grass, light vegetation, sand, and asphalt or concrete.
- If you calibrate over an artificially warm medium such as asphalt or concrete, the infrared temperature over anything else will be lower, which reduces the temperature difference (between earth and sky) available for flight stabilization to work with. If at all possible, don't calibrate over asphalt or concrete.
- If the aircraft will be flying over patchy snow, calibrate over the snow.
- A calibration reading of 1 is rare. Do not fly using flight stabilization when a reading of 1 is obtained over the coolest terrain present. **Instructions for disabling flight stabilization are provided on page 21.**
- Helicopters require extra precision to hover. For that reason, you should only use flight stabilization on a helicopter when the calibration reading is 3 or greater.

About infrared field calibration

The infrared field calibration enables FS8 Co-Pilot™ to measure the environment in which it will be flying. The calibration has two parts:

1. **FS8 Co-Pilot™ determines the infrared temperature difference between sky and ground.**

   When this step is complete, FS8 Co-Pilot™ tells you the infrared temperature difference by cycling the servos. FS8 Co-Pilot™ works well with moderate to high temperature differences, but is less effective with a very small temperature difference. By counting the servo cycles, you can decide whether conditions are favorable for flying with FS8 Co-Pilot™.

   This step also enables FS8 Co-Pilot™ to determine when full pitch correction is needed. For example, when the aircraft is heading directly for the ground, Co-Pilot™ will apply maximum pitch correction.

2. **FS8 Co-Pilot™ determines how the infrared horizon appears when the aircraft is level.** This enables it to compensate for minor Pitch/Roll Sensor tilt (for example, caused by dihedral when the Sensor is mounted on a wing). FS8 Co-Pilot™ sets its own trims for level flight.

Infrared field calibration procedure

CAUTION: If you are near a flying field, observe frequency control rules and comply with local procedures before turning on your transmitter. If your transmitter is on—*even for a few seconds*—it will interfere with a radio system already operating on the same frequency.

1. Measure the temperature difference between earth and sky.

   a. Take the model to a spot (grass is best) representative of the area where you will be flying. The aircraft should be at least 100 feet (30 meters) from anything that radiates heat (heat from buildings or parking lots can affect calibration).

   b. Turn on the transmitter, then turn on FS8 Co-Pilot™. Do not press the CAL Button yet.

   c. If you *are* using the Vertical Sensor, set the plane level on the ground, then *go to step 1.d*.
   or
   If you *are not* using the Vertical Sensor: point one of the Pitch/Roll Sensor windows straight down at the ground (and the opposite window straight up at the sky), as shown in the next column.

continued

Fixed wing aircraft

Helicopter

d. Press and hold the CAL Button for 2 seconds. The servos cycle once to indicate infrared calibration has begun (a cycle is one complete back and forth servo motion).

e. Release the CAL Button, then count servo cycles. Here's what the count indicates:

- **3 to 10 cycles:** FS8 Co-Pilot™ will provide stabilization.
- **2 cycles:** FS8 Co-Pilot™ will provide some stabilization, but will be more sensitive to terrain hot spots.
- **1 cycle:** *Do not fly using FS8 Co-Pilot™:* turn it off using any of the following methods:
  - Turn off FS8 Co-Pilot™ using the knob or slider on your transmitter (if you assigned remote on/off to a channel during flight stabilization setup); turn off Auto Trim, and/or
  - Disconnect the Pitch/Roll Sensor from FS8 Co-Pilot™, and/or
  - Rotate both Throw potentiometers fully counterclockwise.

2. Set level orientation.

After step 1, the servos will cycle slowly. During this period:

a. Place the model level on the ground as shown in the next column. It's important to make the aircraft absolutely level, so take your time. If the model has conventional (taildragger) gear, support the tail with an object so the airplane is in a level attitude.

continued

Airplane with tricycle gear level on grass

Prop tail of taildragger so fuselage is level

Helicopter level on grass. A bubble level (arrow) will enable you to position the helicopter accurately

b. After the model is level, walk at least 10 feet (3 meters) away, then move any stick. The servos will cycle once, indicating that level orientation is set.

Go to "Preflight check." ➡

FS8 Co-Pilot™ preflight check

IMPORTANT:

- Perform the preflight check outside, and after the infrared calibration is complete.
- Add this routine to your other preflight checks.

1. Check for interference:

   a. With your transmitter off, turn on FS8 Co-Pilot™.

   b. Watch the LED:
   - LED on for 2 seconds, then off (and stays off) = no interference. Go to step 2.
   - Continuous blinks = interference is present. Find and eliminate the interference before continuing.

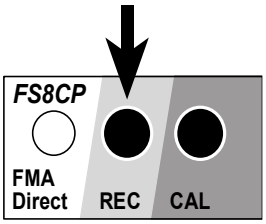
   Tip: Leave FS8 Co-Pilot™ on continuously (with your transmitter off) to check for intermittent interference.

2. Turn on your transmitter. Receiver LED will blink.

3. Check receiver battery voltage:

   a. While moving all transmitter sticks (to load radio system), press REC Button 1 time.

   b. Count LED blinks:
   - Each long blink = 1 volt.
   - Each short blink = 0.1 volt. (Example: 4 long blinks + 9 short blinks = 4.9 volts.)



4. Check radio system range:

   Range checking FS8 Co-Pilot™ is easier than other receivers. A failsafe condition will occur at the limit of the range. FS8 Co-Pilot's LED shows whether a failsafe occurred during the range check. Just check the LED after you return to the model.

   Note: The usual way of finding the range limit by looking for servo glitches does not work with FS8 Co-Pilot™. Since FS8 Co-Pilot™ reconstructs noisy or missed frames, servo glitches are much less noticeable.

   a. Collapse transmitter antenna.
   b. Walk 50 paces (about 150 feet or 45m) away from model.
   c. KEEP TRANSMITTER ON and return to model.
   d. Watch the LED:
   - Continuously on: no failsafes. Go to step 5.
   - Blinking: failsafes occurred. Find and correct the range problem before continuing.

   If you have range problems, see "Range checking" on page 22.

5. Check pitch compensation:

   a. Turn flight stabilization on (if it can be controlled from the transmitter) or set the Pitch Throw pot to maximum. **Set dual or tri rates to high.**

   Note: In step 5b, if you can't conveniently move the aircraft, place your hand or a hot object in front of the forward-facing one or two windows on the Pitch/Roll Sensor.

continued

   b. Point the model's nose straight down, and assure the aircraft responds like this:
   - Conventional airplane: elevator moves up.
   - Flying wing: both elevons move up.
   - Helicopter: swashplate tilts back, and does not tilt left or right.

   Note: Disconnected or broken sensor cables will disable flight stabilization. If flight stabilization does not appear to be working, make certain the sensor cables are plugged in at both ends. If a cable is not broken, flight stabilization will return when it is properly connected between the sensor and FS8 Co-Pilot™.

   c. Turn flight stabilization off (if it can be controlled from the transmitter) or set the Pitch Throw pot to minimum. This should significantly reduce the aircraft's pitch throw (elevator, elevons or swashplate).

   d. Turn flight stabilization on or set the Pitch Throw pot to the desired level.

6. Check roll compensation:

   a. Turn flight stabilization on (if it can be controlled from the transmitter) or set the Roll Throw pot to maximum. **Set dual or tri rates to high.**

   Note: In step 6b, if you can't conveniently move the aircraft, place your hand or a hot object to the right of the right-facing one or two windows on the Pitch/Roll Sensor.

   b. Hold the aircraft's body level, roll it to the right, and assure the aircraft responds like this:
   - Conventional airplane: left aileron moves up, and right aileron moves down.
   - Flying wing: left elevon moves up, and right elevon moves down.
   - Helicopter (boom parallel to ground): swashplate tilts left, and does not tilt forward or back.

   c. Turn flight stabilization off (if it can be controlled from the transmitter) or reduce Roll Throw pot to minimum. This should significantly reduce the aircraft's roll throw (ailerons, elevons or swashplate).

   d. Turn flight stabilization on or set the Roll Throw pot to the desired level.

7. Check pitch and roll neutral positions:

   a. Place the aircraft level on the ground.

   b. With flight stabilization on, the pitch and roll surfaces should be centered (or helicopter swashplate level).

8. Check that dual or tri rates are set to high.

   High rates are required to override flight stabilization.

9. Make sure Pitch/Roll Sensor and Vertical Sensor windows are clean.

   If necessary, clean windows with alcohol and cotton-tipped applicator.

10. Check failsafe operation: Turn off the transmitter. Servos with failsafe presets should move to those positions. **Turn on the transmitter!** (The receiver will count this as one failsafe).

continued

11. Test all transmitter controls—including flight stabilization remote on/off—for normal operation.

12. If you are flying with a buddy box: Switch on the buddy box for at least 2 seconds *before each flight*. (FS8 Co-Pilot™ requires 1 second to detect the buddy box. After that, the transition is instantaneous. However, you must allow FS8 Co-Pilot™ to identify the buddy box *before each flight, on the ground, before taking off*.)

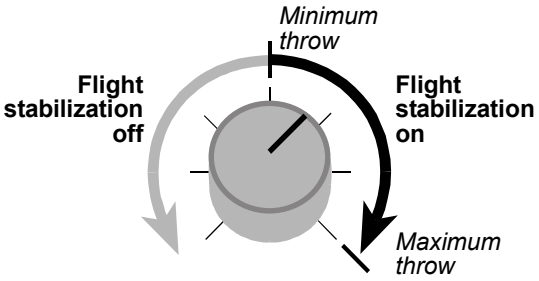
Working with FS8 Co-Pilot™

- **Sensor check.** When you turn on FS8 Co-Pilot™, it checks to make sure the sensors are connected. If a sensor cable is disconnected or broken, flight stabilization is automatically disabled. If flight stabilization doesn't seem to be working, check the cables.

  Tip: FS8 Co-Pilot™ Viewer Software displays a cable failure indicator when a cable operates intermittently. To clear the cable failure indicator in the Viewer, cycle power to FS8 Co-Pilot™.

- **Controlling flight stabilization** depends on how you set up your transmitter and FS8 Co-Pilot™ for remote on/off:

  - If you assigned remote on/off to a proportional channel, it works as shown below. Besides remote on/off, you can set throw based on flight conditions.



    For example, you can adjust throw to match a student's skills while the model is airborne. As the student gains confidence, decrease throw to provide less stabilization.

  - If you assigned remote on/off to a switched channel, you can turn flight stabilization on and off during flights. When flight stabilization is on, throw is set by the two manual Throw potentiometers on FS8 Co-Pilot™. To adjust throw, you must land the aircraft and manually change the Throw pots.

    With on/off control, an instructor can take off and trim without flight stabilization, then turn it on when giving control to a student. Or, you might use flight stabilization for most flying, turn it off for aerobatics or inverted flight, then turn it back on again for landing.

  - If flight stabilization is not assigned to a channel, it is always on during a flight. Throw is set by the two manual Throw pots on FS8 Co-Pilot™. To adjust throw, you must land the aircraft and manually change the Throw pots.

continued

- **Inverted flight.** How flight stabilization responds to inverted flight depends on whether you are using the optional Vertical Sensor:

  - *With* the Vertical Sensor, the aircraft will *roll* from inverted back to its normal attitude (because flight stabilization elevator response is reduced when the aircraft is inverted).
  - *Without* the Vertical Sensor, the aircraft may *loop* from inverted back to its normal attitude—**if it is high enough! CAUTION: If the aircraft is too low it will crash!**
  - To intentionally fly inverted (including in loops, half loops and other maneuvers where the aircraft is inverted) or in knife edge orientation: Turn off flight stabilization.

- **Overwhelming interference or loss of signal**—every pilot's worst nightmare—is where FS8 Co-Pilot™ may save your plane. When FS8 Co-Pilot™ is set up with servo failsafe positions and flight stabilization is on (or is activated by a failsafe setting), the plane moves into a stable, predictable flight path in the event of interference or signal loss.

  - Reasons FS8 Co-Pilot™ enters Failsafe Mode:
    - You accidentally turned off your transmitter.
    - Your transmitter batteries are depleted.
    - Someone else turned on a transmitter on your channel.
    - There is radio interference from some unknown source.
  - How you'll know FS8 Co-Pilot™ is operating in Failsafe Mode: the aircraft won't respond to your commands.
  - What you should do:
    1. **IMMEDIATELY WARN OTHER PILOTS AND SPECTATORS.**
    2. Make sure your transmitter on/off switch is on.
    3. Hold the antenna vertical and high to increase signal strength.
    4. Check your transmitter's battery status.
    5. Ask other pilots if anyone turned on a transmitter on your channel. If someone did, tell them to turn off their transmitter immediately.
    6. Attempt to regain control of the aircraft.
    7. If you are unable to regain control of the aircraft, keep it in sight and continue warning everyone in the area.
  - If you can't fix the problem, the aircraft should circle and descend slowly to the ground (but that's better than the plane drilling itself into the ground or flying out of sight).

Tips for trimming

- It's best if the aircraft's trim doesn't change when you remotely switch Co-Pilot™ on or off. Trim shift can occur if the model is not level when you set level orientation (step 2 in the "Infrared calibration" procedure on page 16). If you notice trim shift, calibrate again. If that doesn't eliminate trim shift, try slightly tilting the aircraft's position during calibration to compensate.
- If the aircraft is flying in a narrow valley, then high terrain or tall trees on one side will affect the average infrared radiation on that side. To the extent possible, calibrate with the model oriented diagonally to the valley and slightly tilt the aircraft's axes to compensate.
- Helicopters are very sensitive to small out-of-trim conditions. You may need to adjust Co-Pilot's trims (see tips above) to match your flying site. A little effort here will pay off with added precision.

Flying with FS8 Co-Pilot™

General flying information

> **Note:** This section discusses unique aspects of flying with FS8 Co-Pilot™. It is not a substitute for flight instruction from an experienced pilot.

- If you are a beginner, obtain help from an experienced modeler. FS8 Co-Pilot™ makes it easier to learn to fly, but it cannot teach you how to fly—only an experienced flyer can do that.
- FS8 Co-Pilot™ cannot correct for reversed controls, binding linkages, a balky engine or any other problems. Make certain your entire radio system is properly installed and working correctly before flying. Be sure your aircraft is airworthy. If the airplane hasn't been flown before, have a qualified pilot check it out—on the ground and in the air.
- Always perform an infrared calibration at the field before each flying session. Recalibrate after significant changes in the weather, or if you go to another field.
- Flying with FS8 Co-Pilot™ is different from normal flying. When FS8 Co-Pilot™ is on, it is always attempting to keep the aircraft level. You'll need to provide more stick motion to override this tendency. This is great for beginners, but experienced pilots will want to tailor performance.
- Initial flight tests and throw adjustments should be made by an experienced pilot.
- If you can control FS8 Co-Pilot™ with your transmitter, you can have the best of both worlds: turn FS8 Co-Pilot™ on when you need it, turn it off when you don't. Or use FS8 Co-Pilot™ as a "panic button" to quickly recover the aircraft from an unusual attitude.
- If you notice the aircraft shaking or oscillating while it is airborne, Co-Pilot's throw is set too high. Take action as follows:
  - If you have proportional control of FS8 Co-Pilot™ (versus on/off control), reduce throw using the knob on your transmitter. If necessary, turn the knob to the full off position and land the aircraft.
  - If you have on/off control of FS8 Co-Pilot™, switch FS8 Co-Pilot™ off and land.
  - If you don't have remote control of FS8 Co-Pilot™, land the aircraft.

    After landing, decrease throw by 1/8th turn. Continue flight testing and reducing throw until the aircraft flies smoothly.
- Increase throw on windy days. The aircraft will fly more smoothly.
- Don't attempt intentional inverted or knife edge flight until you gain experience. Without the Vertical Sensor, FS8 Co-Pilot™ reacts to inverted flight by applying full roll and full up elevator, which can put the plane into a descending loop until it is upright. Unless the plane is very high, it may crash. For aerobatic maneuvers, set Throw to the intermediate or expert level, or turn off flight stabilization.

continued

- If you notice a small difference in trim when turning FS8 Co-Pilot™ on and off, re-trim with FS8 Co-Pilot™ off. If you still have trim differences between FS8 Co-Pilot™ on and off, compensate by raising or lowering the nose a little in the leveling step of the infrared calibration.
- It's always a good idea to find out how your airplane handles at low speed (do this at high altitude). This will help you get a feel for how the plane will behave during landing. FS8 Co-Pilot™ makes landing much easier by keeping the plane level during the approach.

Flying a conventional airplane

- *To take off with tricycle landing gear:*
  1. Increase throttle to begin roll-out.
  2. Keep the plane moving straight with rudder.
  3. Pull back on the stick (up elevator) to lift off.
- *To take off with taildragger landing gear (see explanation below):*
  1. Apply full up elevator when taxiing and at the beginning of takeoff.
  2. Increase throttle to begin roll-out.
  3. Keep the plane moving straight with rudder.
  4. As the plane gains speed, ease off the elevator, but keep enough for lift off.

> **Why tail-draggers handle differently with flight stabilization**
>
> Recall that flight stabilization attempts to keep an aircraft level. While a tail-dragger's tail wheel is on the ground, the airplane isn't level. Flight stabilization tries to level the plane by feeding in down elevator. If you don't counteract this by holding full up elevator during ground maneuvers, the tail may come up when it shouldn't—causing loss of ground control.

- *To make a turn:*
  1. Hold aileron in the direction of the turn.
  2. Apply a little up elevator to maintain altitude.
  3. Center the stick (but don't let go of the stick!) to return to level flight.
- *To fly straight and level:* Center the stick (but don't let go of the stick!). You may need to adjust elevator trim to maintain level flight. Pitch angle changes with speed, so adjust elevator trim when you vary the throttle.
- *To recover from errors such as dives and unintended rolls:* Center the aileron/elevator stick (but don't let go of the stick!). FS8 Co-Pilot™ takes over and levels the plane.
- If the engine dies, apply a little down elevator to maintain airspeed. This is especially important for sport planes.

continued

- *To land:*

  1. Reduce speed and line up for the approach.
  2. Push gently up on the stick (for down elevator) to reduce altitude.
  3. Over the runway, throttle down to idle.
  4. Gently pull back on the stick (up elevator) to raise the nose and slow the plane.
  5. Steer the plane with rudder as it touches down.
  6. For a taildragger, apply full up elevator after touchdown to keep the tail wheel on the ground.

Flying an electric flying wing

- *To take off:*

  1. Set full up elevator trim.
  2. Launch according to instructions for your plane.
  3. When the plane is airborne, re-center elevator trim.

- *To make a turn:*

  1. Hold aileron in the direction of the turn.
  2. Apply a little up elevator to maintain altitude.
  3. Center the stick (but don't let go of the stick!) to return to level flight.

- *To fly straight and level:* Center the stick (but don't let go of the stick!). You may need to adjust elevator trim to maintain level flight. Pitch angle changes with speed, so adjust elevator trim when you vary the throttle.
- *To recover from errors such as dives and unintended rolls:* Center the stick (but don't let go of the stick!). FS8 Co-Pilot™ takes over and levels the plane.
- Electric planes tend to stall easily. Trim enough down elevator to maintain air speed.
- If the motor stops during flight, apply down elevator to maintain airspeed and prevent a stall. Flying wings tend to snap roll when stalled, so it's important to keep the plane moving above stall speed.
- *To land:* Reduce throttle and remove up elevator trim. Apply down elevator and keep up airspeed (to help prevent stalling) The plane will gently glide in.

How to disable flight stabilization

1. Deactivate Auto Trim (see "Set Auto Trim" on page 15).
2. Disconnect the sensors from the receiver.
   or
   Turn the receiver's Pitch and Throw pots fully counter-clockwise.
3. On your transmitter, turn off flight stabilization.

Flying a helicopter

CAUTION: FS8 Co-Pilot™ may give you a false sense of security. Do not fly close to yourself or other people. Any mechanical malfunction could result in loss of control. If the helicopter flies toward you or another person, stop the engine immediately. Never fly near houses, cars, trees or other objects which could interfere with operation and cause damage.

- Flying with FS8 Co-Pilot™ when the wind is calm will "feel" different—it will seem like a breeze is moving the helicopter around. FS8 Co-Pilot™ senses variations in the horizon and tilts the helicopter a few degrees, but the helicopter won't roll and crash. When you can keep the helicopter in one place, you'll realize that FS8 Co-Pilot™ is doing most of the work. Flying on windy days takes little effort.
- The hardest part of flying a helicopter is getting it trimmed. After calibration is complete, remember to add in a little right roll trim for clockwise blade rotation. Once the helicopter is properly trimmed, it is very easy to hover with FS8 Co-Pilot™.
- If you fly over asphalt (a parking lot, for example), heat from the asphalt may cause the helicopter to oscillate. Flying higher will stop the oscillation. However, the best solution is to install the Vertical Sensor, or reduce Co-Pilot's throw (see "If you notice the aircraft shaking or oscillating..." under "General flying information").
- *To take off:*

  1. Check trims.
  2. Increase throttle.

     FS8 Co-Pilot™ will keep the helicopter level.

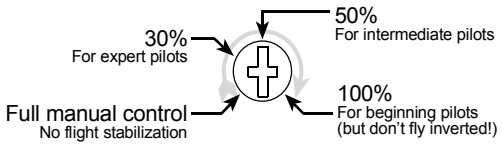
- *To hover:* Center the stick (but don't let go of the stick!).
- *To recover from unusual attitudes:* Center the stick (but don't let go of the stick!). FS8 Co-Pilot™ will return the helicopter to level.
- *To fly forward:* Apply forward cyclic. When you center the stick, the helicopter will stop and hover.
- Terrain angle will affect the ability to perfectly hover. If you are flying in a valley or at a sloping field, try calibrating with the helicopter diagonal to the ridge.
- FS8 Co-Pilot™ makes it extremely easy to fly a helicopter. Since the helicopter is flying close to the ground, variations in terrain (and the resulting infrared signature) will cause small variations in trim. As you become familiar with the "feel" of flying with FS8 Co-Pilot™, you'll be able to compensate for these changes almost automatically. Here are some examples:

  - Your helicopter will hover best over a flat, level field. Even a slight grade will cause the helicopter to "slide" down to a lower elevation, almost like there is wind blowing from the hill. This happens because FS8 Co-Pilot™ sees an uneven horizon and tries to compensate.
  - Your helicopter will hover best with FS8 Co-Pilot™ when the horizon is very clear. Cars, buildings, houses, mountains, cement and water, for example, can change hover trim by a few degrees.

continued

- Switching FS8 Co-Pilot™ on and off in the air should not change the hover. If it does, compensate by angling the helicopter in the same direction of trim during the leveling step of the infrared calibration.

- Install a heading hold gyro to control yaw, in addition to FS8 Co-Pilot™. The helicopter will then be stabilized in all three axes. That makes controlling the helicopter even easier: you only need to navigate the helicopter around the field. With this setup, beginners can be flying very quickly.
- For 3D flying, set Throw to the expert level. This will remove the trimming when FS8 Co-Pilot™ is off. Both the pitch and roll throw pots should be set the same for similar amounts of stabilization.



Range checking

The brief procedure used elsewhere in this manual is okay for quick range checking. If you suspect range problems, follow these steps to check your radio system:

1. Place the receiver on a non-metallic surface (a cardboard box, for example) to elevate it about 2 feet (60cm) off the ground.
2. Fully extend the receiver antenna and position it vertically above the receiver (tape the antenna to a wooden dowel, for example).
3. Connect one servo to receiver channel 1.
4. Fully collapse the transmitter antenna.
5. Turn on the transmitter.
6. Connect a battery pack directly to the receiver. Do not use a switch harness for this test, since a switch harness may reduce range.
7. Walk away from the receiver about 200 feet (60m) while moving the transmitter stick for channel 1.
8. KEEPING THE TRANSMITTER ON, return to the receiver and watch the LED:
   - If the LED is still continuously off: there were no failures during the range test.
   - If the LED is blinking, the range is less than 200 feet (60m).
9. Disconnect the receiver from the battery.
10. Turn off the transmitter.

Note: Over time, all RC transmitters are susceptible to detuning, frequency drift and power reduction. If you suspect your radio system's performance has degraded, carry out the rigorous range check (above) with the receiver out of the aircraft. If, under these conditions, the radio system experiences failures, there may be a problem with the transmitter, the receiver or another part of the radio system. If you suspect the transmitter is out of tune, FMA can tune it for you. With proof of purchase for an FMA receiver, FMA will tune your transmitter (any brand) at no charge. The only cost is for shipping.

Troubleshooting

Symptom	Possible solution
FS8 Co-Pilot™ doesn't seem to apply flight stabilization in Normal Flight Mode.	■ Operate FS8 Co-Pilot™ outside. ■ Turn flight stabilization on. Make sure remote on/off channel isn't reversed at transmitter. ■ Make sure Roll/Pitch Sensor is connected to FS8 Co-Pilot™. If Vertical Sensor is installed, make sure it is connected. ■ Make sure receiver battery voltage is above 3.5V. ■ Increase Pitch and Roll Throw. ■ Repeat Flight Stabilization Setup. (If FS8 Co-Pilot™ senses certain problems during Flight Stabilization Setup, it disables flight stablization in Normal Flight Mode.)
Aircraft trim changes when flight stabilization is turned on or off.	■ Trim with Throws fully off. ■ Turn on Auto Trim. ■ See "Tips for trimming" on page 19.
Aircraft shakes or oscillates in the air.	■ Reduce Throw. ■ Repeat infrared calibration every day you fly. ■ Assure airplane is vertical (or helicopter is rolled to horizontal) during step 1 of infrared calibration. ■ Repeat infrared calibration over grass, if possible.
Aircraft takes a long time to level.	■ Increase Throws.
Flight stabilization doesn't move the aircraft to level.	■ Clean Sensor windows with alcohol and cotton-tipped applicator. ■ Mount Pitch/Roll Sensor where it "sees" equal amounts of wing and fuselage on both sides. ■ Mount Pitch/Roll Sensor away from muffler and engine (which are hot). ■ Repeat infrared calibration every day you fly. ■ Perform infrared calibration at least 100 feet from trees or buildings. ■ Fly when the temperature difference is 3 or greater.
Flight stabilization works in warm weather, but not in cold.	■ FS8 Co-Pilot™ is more sensitive to rubber exhaust extensions in cold weather. Helicopters are especially susceptible to this problem, as the Pitch/Roll Sensor may have to be located near the muffler. The Helicopter will tilt away from the muffler. Remove the exhaust extension, or wrap it in aluminum tape.
Servos don't move.	■ Black or brown wire in servo cables should be toward component side of FS8 Co-Pilot™.
LED turns off and does not function.	■ FS8 Co-Pilot™ detected very low battery voltage. Check for shorted servos, bad switch and bad battery wires. Check battery charge state.
When in Flight Stabilization Setup Mode, there is no roll compensation.	■ Flight Stabilization Setup Mode has three parts: Pitch Setup, Roll Setup and Remote On/Off Setup. To cycle through them, press the CAL Button.
Sensor windows are dirty.	■ Clean Sensor windows with alcohol and cotton-tipped applicator.
Elevator servo sometimes twitches when operating FS8 Co-Pilot™ indoors in Normal Flight Mode.	■ The Vertical Sensor is seeing the warm ceiling, and is degrading the pitch feedback. You are seeing the digital effect of the Vertical Sensor. Put your hand or a hot object under the vertical sensor to stop the twitching.
Flight Stabilization setup goes properly, but Flight Stabilization does not work correctly in Normal Flight Mode. Symptoms include: ■ Pitch control surfaces move in the correct direction, but roll control surfaces move in the wrong direction (or vice versa). ■ Remote on/off channel does not turn Flight Stabilization on and off. Instead, it changes the direction that pitch and roll surfaces move to stabilize.	The Vertical Sensor may be installed upside down, or is sensing heat above the aircraft. ■ Inspect the Vertical Sensor to be sure it is installed with the arrow pointing up when the aircraft is in its normal orientation. ■ Put your hand or a hot object below the Vertical Sensor when verifying Flight Stabilization operation.

Frequently asked questions

General information

Q: Will FS8 Co-Pilot™ prevent my airplane from crashing?

A: No. FS8 Co-Pilot™ can only move your airplane's control surfaces and throttle to preset positions when it doesn't receive a clean signal from your transmitter. This may keep your airplane flying long enough for you to find and correct the problem.

Q: Can I use FS8 Co-Pilot™ with all types of airplanes?

A: Yes. FS8 Co-Pilot™ works with all aircraft configurations, including dual aileron servos, quad flaps, elevons, V-tail, digital servos and CCPM. It learns all pitch and roll mixes for all types of airplanes and helicopters. Its flight stabilization will level any aircraft.

> **Note:** If you are using a channel for on/off control of Co-Pilot™, set the failsafe for that channel so Co-Pilot™ is on during a failsafe. Even if you don't normally use flight stabilization, it will activate when the receiver enters Failsafe Mode.

Setting up

Q: I can't take my computer to the flying field. How do I set up FS8 Co-Pilot™ without the Co-Pilot™ Viewer Software?

A: You can set all FS8 Co-Pilot™ functions without the Co-Pilot™ Viewer Software. You interact with the receiver through its buttons and LED, and you set failsafe positions using your transmitter sticks. Details are provided in this manual.

Q: What are good failsafe preset servo positions for an airplane?

A: The best failsafe preset servo positions will depend on your particular aircraft and how it behaves in the air. A reasonable starting point for flight-stable airplanes is:

- Ailerons: neutral.
- Elevator: neutral or slight up.
- Rudder: moderate right turn.
- Throttle: 1/4 to 1/3.
- Flight stabilization: on.

You'll need to test these settings and adjust them as needed. Your goal is to have the plane circle and gently descend, without stalling, during a failsafe condition.

Q: My airplane has flaps and/or retractable landing gear. What about failsafe presets for those?

A: Since flaps can slow the airplane, deploying them (with some rudder failsafe preset) may help keep the airplane close to the field. It's probably a good idea to drop the landing gear, although for some airplanes a belly landing may be less costly than bent landing gear.

Q: How do I test failsafe operation?

A: First, do a check on the ground:

1. Turn on your transmitter, then turn on FS8 Co-Pilot™.
2. Move the transmitter sticks to make sure the aircraft controls respond correctly to your commands.
3. Turn off the transmitter and watch the airplane's control surfaces and throttle:
   - For channels with failsafe presets, the servos should move to their preset positions.
   - For channels without failsafe presets, the servos should remain where they were (last frame hold) when you turned off the transmitter.

If the radio system works properly, try forcing a failsafe condition in the air:

1. Take off and gain altitude until the airplane is at least three mistakes high.
2. Put the plane into straight and level flight at 3/4 to full throttle.
3. Turn off the transmitter for 2 to 3 seconds, THEN TURN IT BACK ON.
   - While the transmitter is off, watch how the plane responds.
   - Be prepared to correct the plane's attitude as soon as you turn the transmitter back on.

If necessary, land the airplane, change the presets, and test again on the ground and in the air. Be sure to avoid settings that would stall the airplane.

Q: Do I have to set up FS8 Co-Pilot™ before each flight?

A: No, the receiver stores setup information even when power is off. However, it's a good idea to test failsafe operation on the ground (by turning off the transmitter) and flight stabilization as part of your usual preflight checks.

Flying

Q: What can cause FS8 Co-Pilot™ to enter Failsafe Mode?

A: There are several possibilities:

- You accidentally turned off your transmitter.
- Your transmitter batteries are depleted.
- Someone else turned on a transmitter on your channel.
- There is electrical interference from the aircraft's gasoline engine ignition system. Gasoline-powered aircraft need buffers or opto-isolators on FS8 Co-Pilot™ servo outputs. See "Special installation considerations" on page 10 for one approach.
- There is radio frequency interference from some unknown source.

Q: When my airplane is flying, how do I know FS8 Co-Pilot™ is in Failsafe Mode?

A: Move the transmitter sticks. If the airplane doesn't respond, the receiver is in Failsafe Mode.

Q: What should I do if FS8 Co-Pilot™ goes into Failsafe Mode?

A: 1. **IMMEDIATELY WARN OTHER PILOTS AND SPECTATORS.**

2. Make sure your transmitter on/off switch is on.
3. Hold the antenna vertical and high to increase signal strength.
4. Check your transmitter's battery status.
5. Ask other pilots if anyone turned on a transmitter on your channel. If someone did, tell them to turn off their transmitter immediately.
6. Attempt to regain control of the aircraft.
7. If you are unable to regain control of the aircraft, keep it in sight and continue warning everyone in the area.

Q: What happens if FS8 Co-Pilot™ goes into Failsafe Mode and I can't find/fix the problem.

A: Ideally, your preset failsafe servo positions and flight stabilization will put the airplane into a stable attitude that will allow it to circle and descend slowly to the ground. Because you can't control the plane, expect a hard landing. That, however, is much better than the plane drilling itself into the ground, or flying out of sight.

Q: My FS8 Co-Pilot™ usually records a dozen or two bad frames during flights. Is that bad?

A: No. In fact, it indicates your radio system is performing very well. Occasional glitches are common. It takes at least 50 consecutive bad frames to cause a failsafe condition. Bad frames are an indirect measure of signal quality and receiver performance.

Q: What happens if the receiver battery dies during a flight?

A: Sorry, FS8 Co-Pilot™ can't help with that problem. To avoid that situation, check the receiver battery with an extended scale voltmeter before every flight.

Q: I accidentally turned off FS8 Co-Pilot™ before I "read" the bad frame count by pressing the button three times. Can I get that information later?

A: No. The bad frame and failsafe counts are lost when you turn off the receiver (unless the Flight Recorder is installed). With the Flight Recorder, you can "ride" in the aircraft during the entire flight.

Condensed instructions

Set up failsafe operation

To do this...	Do this...
Enter Receiver Setup Mode	1. Turn on transmitter. 2. With FS Co-Pilot™ off, press and hold REC Button. 3. Turn on FS Co-Pilot™. 4. Release REC Button. Receiver LED "twinkles" in Receiver Setup Mode. Servos set for Last Frame Mode move slowly back and forth, servos set for Failsafe Mode move to failsafe positions.
Set failsafe position for one channel	*While in Receiver Setup Mode:* 1. On transmitter, move stick/control for that channel to desired failsafe position (watch control surface or throttle). 2. LED blinks the selected channel(s). 3. Press REC Button 1 time to save failsafe position. 4. Return transmitter stick/control to neutral (or to idle for throttle) before LED turns on. If mixing is programmed in your transmitter for the stick or control, then this procedure sets failsafe positions for all channels in that mix.
Set failsafe positions for multiple channels	*While in Setup Mode:* 1. On transmitter, move sticks/controls to desired failsafe positions. 2. LED blinks the selected channel(s). 3. Press REC Button 1 time. 4. Return transmitter sticks/controls to neutral (or to idle for throttle) before LED turns on.
Erase failsafe position for one channel	*While in Setup Mode:* 1. On transmitter, move stick/control for channel you want to erase. 2. Return stick/control to neutral (or idle for throttle). 3. **Do not press button.** 4. When LED turns on, the channel operates in Last Frame Hold Mode. 5. LED blinks channel number just erased.
Erase all failsafe positions for all channels	*While in Setup Mode:* Press and hold REC button for 10 seconds (until channel 2 shakes once). *All channels now operate in Last Good Frame Hold Mode.*
Determine a channel's mode	*While in Setup Mode:* Watch servos, control surfaces and throttle: ■ Servos set for Last Good Frame Hold Mode move slowly back and forth. ■ Servos set for Failsafe Mode move to their preset failsafe positions (and don't move back and forth).
Leave Receiver Setup Mode	1. Turn off FS8 Co-Pilot™. 2. Turn off transmitter.

Set up flight stabilization

Do this...
1. Disconnect cable from Vertical ("Z") Sensor (if sensor is installed).
2. Turn on transmitter.
3. Press and hold CAL Button, turn on FS8 Co-Pilot™, then release button. ■ Channel 2 servo shakes three times. ■ LED twinkles. ■ LED blinks 1 time = Setup Mode 1.
4. Assign pitch channel: a. Place heat in front of forward facing window(s) on Pitch/Roll Sensor. b. Slowly move elevator (pitch) stick up and back.
5. Assign roll channel: a. Press CAL Button 1 time. LED blinks 2 times = Setup Mode 2. b. Place heat in front of right-facing window(s) on Pitch/Roll Sensor. c. Slowly move aileron (roll) stick left.
6. Assign remote on/off channel: a. Press CAL Button 1 time. LED blinks 3 times = Setup Mode 3. b. Slowly move knob, slider or switch you want for remote on/off control.
7. Verify flight stabilization. a. Turn off FS8 Co-Pilot™. b. Turn on FS8 Co-Pilot™ without holding any buttons (Normal Flight Mode). c. Assure remote on/off is on and set to maximum throw. d. Place heat in front of forward-facing window(s) on Pitch/Roll Sensor. Correct response: ■ Conventional airplane: elevator moves up. ■ Flying wing: both elevons move up. ■ Helicopter: swashplate tilts back, and does not tilt left or right. e. Place heat in front of right-facing window(s) on Pitch/Roll Sensor. Correct response: ■ Conventional airplane: left elevator moves up, right elevator moves down. ■ Flying wing: left elevon moves up, right elevon moves down. ■ Helicopter: swashplate tilts left, and does not tilt forward or back. f. If Vertical ("Z") Sensor is installed, place heat above Vertical Sensor to simulate inverted flight. Pitch stabilization should be reduced. Roll stabilization is not affected.
8. Turn off FS8 Co-Pilot™.
9. Reconnect cable to Vertical ("Z") Sensor (if sensor is installed).

Button summary

REC Button in Receiver Setup Mode

Do this...	And this happens...
Press and hold REC Button, turn on FS8 Co-Pilot™	FS8 Co-Pilot™ enters Receiver Setup Mode (LED “twinkles”). Do not turn off transmitter during Receiver Setup Mode.
Move transmitter stick(s) to servo failsafe position for channel(s), press REC Button, return transmitter stick(s) to neutral (or low for throttle)	FS8 Co-Pilot™ sets servo to failsafe position(s) for channel(s). For mixed channels, this sets failsafe positions for all channels in mix.
Press and hold REC Button for 10 seconds	FS8 Co-Pilot™ sets all channels to Last Good Frame Hold (this removes Failsafe Mode servo presets from all channels).

CAL Button in Flight Stabilization Setup Mode

Do this...	And this happens...
Press and hold CAL Button, turn on FS8 Co-Pilot™	FS8 Co-Pilot™ enters Flight Stabilization Setup Mode (LED “twinkles”). Do not turn off transmitter during Flight Stabilization Setup Mode.
Press CAL Button	Move to next Setup Mode, in this order: 1. Setup Mode 1 (pitch). 2. Setup Mode 2 (roll). 3. Setup Mode 3 (remote on/off).
Press and hold CAL Button for 10 seconds	FS8 Co-Pilot™ sets all flight stabilization channels to neutral (factory defaults).

REC Button in Normal Flight Mode

Do this...	And this happens...
Don’t press button	LED blinks number of failsafes (up to 9) since receiver was turned on. No blinks = perfect signal.
Press button 1 time	LED blinks battery voltage (each long blink = 1 volt, each short blink = 0.1 volt).
Press button 3 times	LED blinks number of bad frames (up to 99) since receiver was turned on (each long blink = 10 bad frames, each short blink = 1 bad frame). (Less than 30 bad frames indicates very clean signal during typical flight.)
Press button 5 times	Change between 1X and 2X LED flash rate (1X = 1 flash per second, 2X = 2 flashes per second).
Press button 6 times	Turn Auto Trim on/off.

Field checklist

Besides your regular preflight checks, for FS8 Co-Pilot™...

Infrared field calibration

1. Measure temperature difference over typical terrain:
   - With Vertical Sensor: set aircraft level on ground.
   - Without Vertical Sensor: point one Pitch/Roll Sensor window straight down at the ground.

   Press CAL Button for 2 seconds (servos cycle once). Release CAL Button, then count servo cycles. 3 to 10 cycles is good, don't use flight stabilization if only 1 cycle.
2. Set level orientation: place model level on ground, walk 10 feet away, move any transmitter stick.

Repeat when weather changes.

FS8 Co-Pilot™ preflight check

1. Check for interference: with transmitter off, turn on FS8 Co-Pilot™. LED on, then off (and stays off) = no interference.
2. Turn on transmitter. Receiver LED will blink.
3. Check receiver battery voltage: move transmitter sticks, press REC Button 1 time, count blinks.
4. Check radio system range: collapse transmitter antenna, walk 150 feet away from model, return to model. Receiver LED continuously on = no failsafes.*
5. Check pitch compensation: with flight stabilization on, point aircraft nose down; surfaces should respond this way:
   - Conventional airplane: elevator moves up.
   - Flying wing: both elevons move up.
   - Helicopter: swashplate tilts back, and does not tilt left or right.
6. Check roll compensation: with flight stabilization on, roll aircraft to right; surfaces should respond this way:
   - Conventional airplane: left aileron moves up, right aileron moves down.
   - Flying wing: left elevon moves up, right elevon moves down.
   - Helicopter (boom parallel to ground): swashplate tilts left, and does not tilt forward or back.
7. Check pitch and roll neutral positions: place aircraft level on ground; pitch and roll surfaces should be centered (or helicopter swashplate level) when flight stabilization is on.
8. Set dual or tri rates to high.
9. Assure all sensor windows are clean.
10. Check failsafe operation: turn off transmitter; servos with failsafe settings should move to those positions.
11. Test all transmitter controls, including stabilization on/off.
12. If using a buddy box, activate it for 2 seconds *before each flight*.

Normal Flight Mode

To do this...	Do this...
Check for interference	1. Turn on FS Co-Pilot™ (leave transmitter off). 2. LED is on for 2 seconds to confirm power. After that: ■ LED off = no interference. ■ Continuous blinks = interference is present.
Enter Normal Flight Mode	1. Turn on transmitter. 2. Turn on FS Co-Pilot™.
Check receiver input voltage	*While in Normal Flight Mode:* 1. While moving all transmitter sticks (to load radio system), press REC Button 1 time. 2. Count LED blinks: ■ Each long blink = 1 volt. ■ Each short blink = 0.1 volt. (Example: 4 long blinks + 9 short blinks = 4.9 volts.)
Check radio system range*	*While in Normal Flight Mode:* 1. Collapse transmitter antenna. 2. Walk 50 paces (about 150 feet or 45m) away from model. 3. KEEP TRANSMITTER ON and return to model. 4. Watch FS Co-Pilot™ LED: ■ Continuously on: no failsafes. ■ Blinking: failsafes occurred.
Check failsafe count after flight or range check	1. Keep transmitter on, keep receiver on! 2. LED continuously on = perfect signal. or Count LED blinks: each blink = 1 failsafe (maximum report is 9 failsafes).
Check bad frame count after flight or range check	1. Keep transmitter on, keep receiver on! 2. Press REC Button 3 times. 3. Count LED blinks: ■ Each long blink = 10 bad frames. ■ Each short blink = 1 bad frame. (Example: 2 long blinks + 4 short blinks = 24 bad frames; maximum report is 99 bad frames)
Change between 1X and 2X LED flash rate	(1X = 1 flash per second, 2X = 2 flashes per second.) Press REC Button 5 times.
Turn Auto Trim on/off	Press REC Button 6 times.
Clear failsafe count and bad frame count	Turn off receiver. Failsafe *positions* are retained.

*This is a quick range check. If you suspect problems, use the advanced range check procedure on page 22.