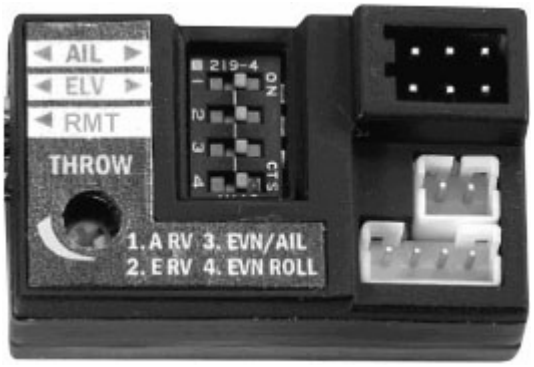
Co-Pilot™

Infrared Flight Stabilization System

User's Guide



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

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FMA Direct

Introduction

Thank you for purchasing the FMA Direct Co-Pilot™ infrared flight stabilization system.

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. Co-Pilot™ "sees" this temperature difference. When Co-Pilot™ senses changes in aircraft attitude relative to the infrared horizon, it sends corrective signals to keep the aircraft level.

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

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 Co-Pilot™ is useful for flying—and landing—under windy conditions. 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 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 Co-Pilot's sensitivity.

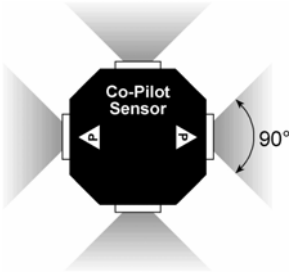
This manual provides complete instructions for setting up and using Co-Pilot™. The manual contains these sections:

- How Co-Pilot™ works
- Safety precautions
- Co-Pilot™ parts
- Other items you may need
- Before you start
- Options for controlling Co-Pilot™
- How to use this manual
- Installing Co-Pilot™
- Initial setup
- Co-Pilot™ troubleshooting
- At the field
- About the infrared field calibration
- Infrared field calibration
- Co-Pilot™ pre-flight check
- Flying with Co-Pilot™
- Co-Pilot™ mini-manual

Note: 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.

How Co-Pilot™ works

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. 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, 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), the sensors see 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. Co-Pilot™ incorporates a microcomputer to interpret input from the sensors and modify signals between the aircraft's receiver and 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 Co-Pilot™ provides a more stable and precise reference than light or other phenomena. This gives Co-Pilot™ much more precision than visible light stabilization systems. For example, 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 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, Co-Pilot™ incorporates a simple calibration procedure (not available in other flight stabilizers) that fine-tunes performance for near-perfect stabilization under all conditions.

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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 Co-Pilot™:

- 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.
- 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 Co-Pilot™ Sensor securely. Carefully follow the instructions in "Installing Co-Pilot™," which tells you to roughen the surface with sandpaper, then clean the surface with rubbing alcohol.
- Keep fuel off the Sensor. Fuel on the Sensor can affect 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 "Infrared calibration."
- Besides your regular pre-flight check, also check Co-Pilot™ operation before each flight. Details are in "Co-Pilot™ pre-flight check."
- Co-Pilot™ derives precision and flexibility from the calibration procedure on page 16 ("Infrared calibration"). Background information and technical reasoning are provided on page 15 ("About infrared calibration" and "More about infrared calibration"). Please read and observe the following guidelines for the best, safest operation with the greatest margin:
  - As nearly as possible, calibrate 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 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 Co-Pilot™ when a reading of 1 is obtained over the coolest terrain present. **To completely turn off Co-Pilot™, you must rotate the sensitivity control ("Throw") on the Computer fully counterclockwise.**
  - Helicopters require extra precision to hover. For that reason, you should only use Co-Pilot™ on a helicopter when the calibration reading is 3 or greater.

Co-Pilot™ parts

Co-Pilot™ includes these components:

- Co-Pilot™ Computer
- Co-Pilot™ Sensor
- 24" flat ribbon cable (other lengths are available; see below)
- Infrared Calibration Button
- 6 inches of Velcro®
- Instruction manual

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!

- Digital Servo Buffer (Part no. 605SB)

  Required when using Futaba RD129DP or similar PCM receiver.

Before you start

Co-Pilot™ works with, and requires, a completely installed and correctly operating aircraft radio control system: transmitter, receiver, 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 install Co-Pilot™, install and set up your entire radio system. Follow the instructions provided with the radio system and aircraft. Be absolutely certain the radio system operates correctly before you install Co-Pilot™.

Finally, read and understand the safety precautions on page 3.

Note: Co-Pilot™ is not designed to handle the high resolution of certain digital servos. In some applications, certain digital servos may jitter when connected to the Co-Pilot™

Co-Pilot™ specifications

Operating voltage	+3 to +9 volts DC
Operating current	<10 milliamps (servos may draw more current from rapid movement and stabilization)
Weight	1 oz.
Leveling response time	1/60th second
Drift from level	<2° (infrared calibration must be performed before each flying session)
Flying conditions	Day and night; all weather conditions (rain, fog, sleet and snow may degrade performance)
Humidity	Sensor is sealed; keep windows clean
Vibration	200G max.
Remote activation	On/off control or proportional sensitivity adjustment, depending on channel availability of radio system
Aircraft types	Aileron/elevator, elevons or helicopter with standard linkages (Multi Channel Co-Pilot supports flaperons, differential ailerons, 3x120 CCPM and 4x90 CCPM helicopters)

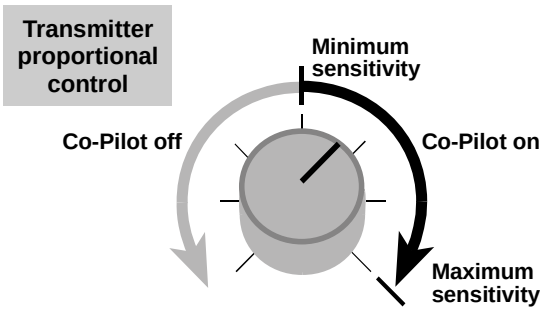
Options for controlling Co-Pilot™

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 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 Co-Pilot™ sensitivity while the model is airborne to match a student's skills. As the student gains confidence, for instance, set Co-Pilot™ to provide less stabilization.
  - Turn 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 Co-Pilot™," the transmitter knob works like this:



Note: When Co-Pilot™ is turned off remotely, it still trims the control surfaces.

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

  Examples of on/off control:
  - An instructor can take off and trim an airplane with 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.

continued

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

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

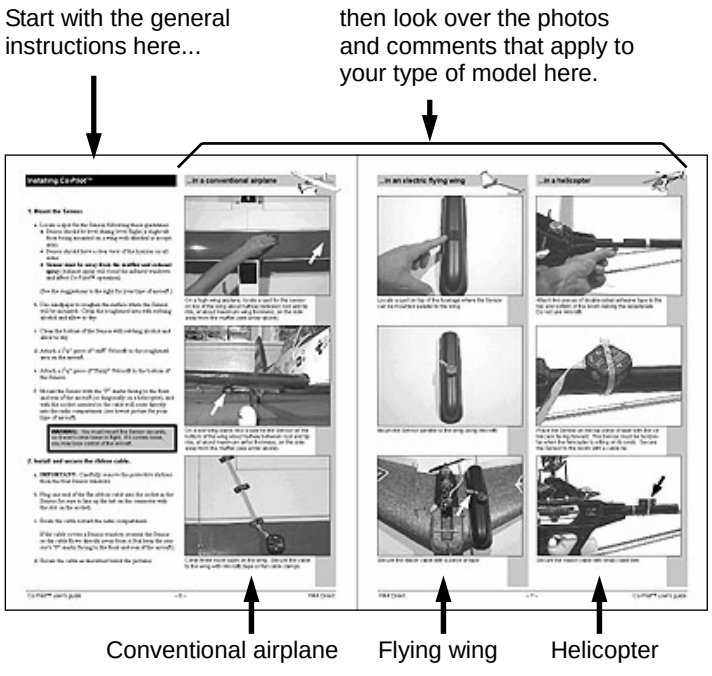
FMA Direct welcomes your suggestions about flying techniques, experiments and applications. Early feedback from Co-Pilot™ users shows great creativity. One pilot, for example, is using Co-Pilot™ to stabilize aircraft carrying still and video cameras.

How to use this manual

Co-Pilot™ can be used with virtually any radio controlled model aircraft. This manual describes Co-Pilot™ installation, set up, calibration, pre-flight checking and flying for three common types of radio controlled models:

- An engine-powered fixed-wing airplane.
- An electric-powered flying wing.
- A helicopter.

There are small differences in the way Co-Pilot™ works with each type of aircraft. The manual provides general instructions that apply to all three types, and offers specific instructions and photos for each type of model. A typical page from the manual is shown below.



Installing Co-Pilot™

1. Mount the Sensor.

> **IMPORTANT:** Carefully remove the protective stickers from the four Sensor windows.

a. Locate a spot for the Sensor, following these guidelines:
- Sensor should be level during level flight (a slight tilt from being mounted on a wing with dihedral is acceptable).
- Sensor should have a clear view of the horizon on all sides.
- **Sensor must be away from the muffler and exhaust spray** (exhaust spray will cloud the infrared windows and affect Co-Pilot™ operation).

(See the suggestions to the right for your type of aircraft.)

> **Note:** If your low or mid wing airplane has a cockpit canopy and the exhaust flows below the fuselage, see special mounting and setup instructions on page 23.

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

c. Clean the bottom of the Sensor with rubbing alcohol and allow to dry.

d. Attach a $1^1/_4$" piece of "stiff" Velcro® to the roughened area on the aircraft.

e. Attach a $1^1/_4$" piece of "fuzzy" Velcro® to the bottom of the Sensor.

f. Mount the Sensor with the "P" marks facing to the front and rear of the aircraft (or diagonally on a helicopter), and with the socket oriented so the cable will route directly into the radio compartment (see lowest picture for your type of aircraft).

> **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.

2. Install and secure the ribbon cable.

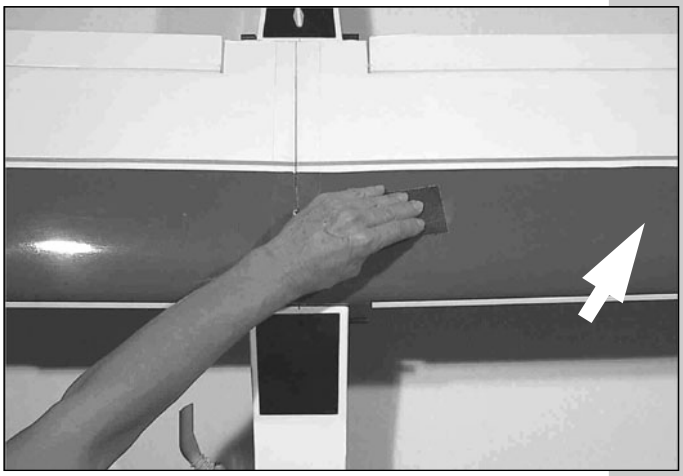
a. Plug one end of the flat ribbon cable into the socket in the Sensor (be sure to line up the tab on the connector with the slot on the socket).

b. Route the cable toward the radio compartment.

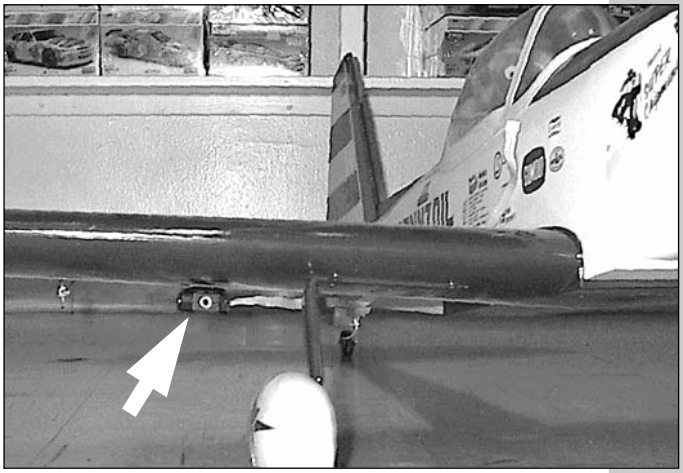
If the cable covers a Sensor window, reorient the Sensor so the cable flows directly away from it (but keep the sensor's "P" marks facing to the front and rear of the aircraft).

c. Secure the cable as described below the pictures.

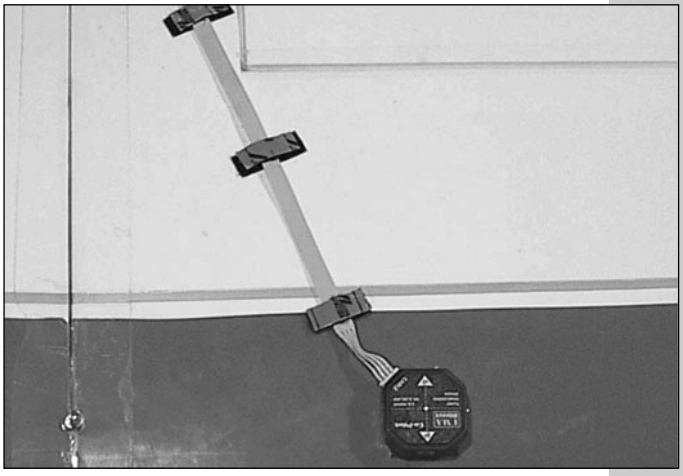
...in a conventional airplane



On a high-wing airplane, locate a spot for the sensor on top of the wing about halfway between root and tip ribs, at about maximum wing thickness, on the side away from the muffler (see arrow above).

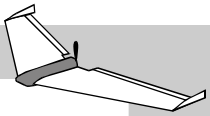


On a low-wing plane, find a spot for the Sensor on the bottom of the wing about halfway between root and tip ribs, at about maximum airfoil thickness, on the side away from the muffler (see arrow above).

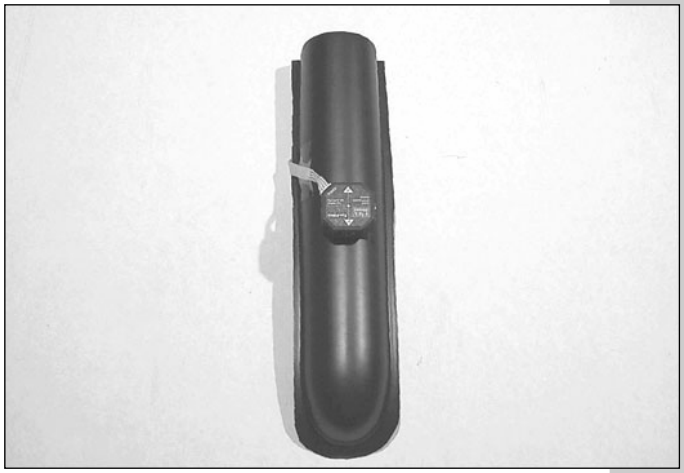


Clean three more spots on the wing. Secure the cable to the wing with Velcro®, tape or flat cable clamps.

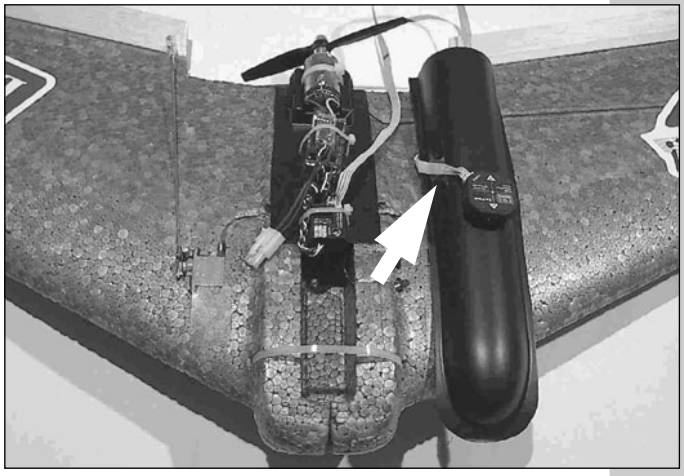
...in an electric flying wing



Locate a spot on top of the fuselage where the Sensor can be mounted parallel to the wing.



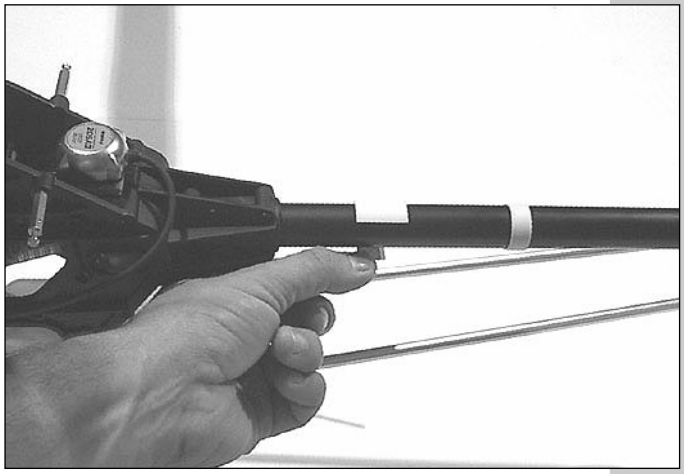
Mount the Sensor parallel to the wing using Velcro®.



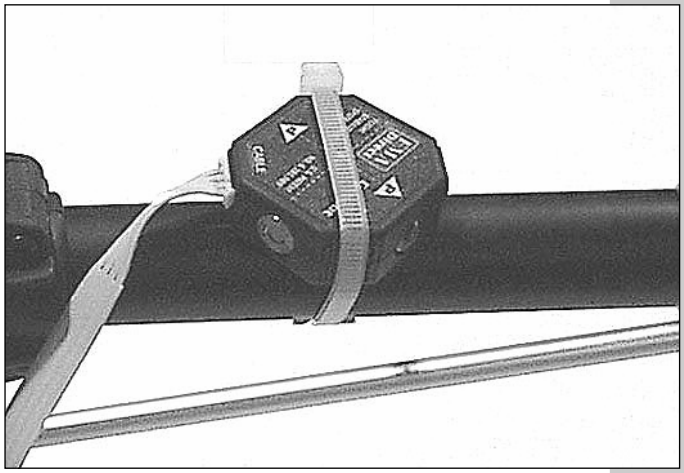
Secure the ribbon cable with a piece of tape.

Note: If you must mount the sensor diagonally on a flying wing, see special instructions on page 22.

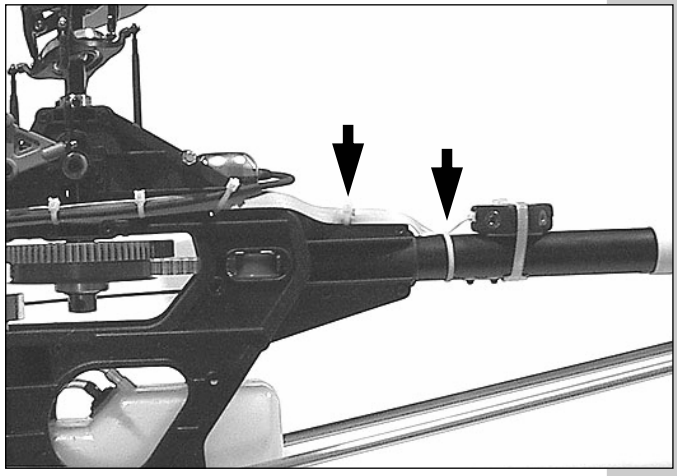
...in a helicopter



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

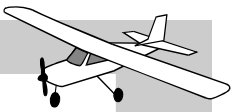


Place the Sensor on the top piece of tape with the cable jack facing forward. The Sensor must be horizontal when the helicopter is sitting on its skids. Secure the Sensor to the boom with a cable tie.



Secure the ribbon cable with small cable ties.

...in a conventional airplane

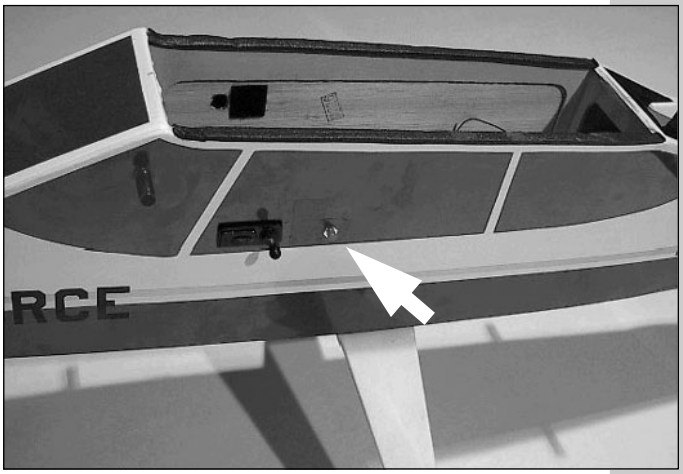


3. Mount the Infrared Calibration Button.

a. Select a mounting location for the Infrared Calibration Button (see suggestions for your type of aircraft).

b. Mount the Infrared Calibration Button securely in the aircraft.

IMPORTANT: Don't just dangle the infrared calibration switch outside the fuselage. Mount it securely where you won't accidentally bump it when you are preparing the aircraft for liftoff or hand launching. When pressed, this switch tells Co-Pilot™ to enter infrared calibration mode—and you don't want to do that when the aircraft is about to fly.



A good location for the button is near the receiver on/off switch. If you will be hand launching your aircraft, locate the button where you won't accidently bump it.

4. Make the Co-Pilot™ electrical connections.

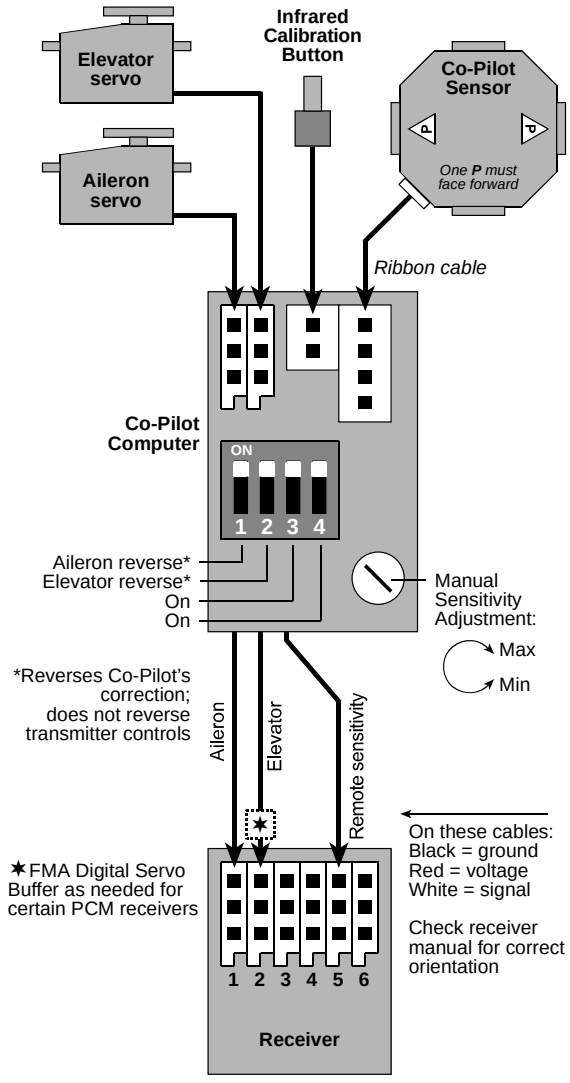
a. Disconnect the roll (aileron) and pitch (elevator) servos from the receiver.

b. Connect the cables as shown to the right for your type of installation.

If your receiver doesn't have an unused channel for the Co-Pilot™ remote control cable, leave it unconnected (but tuck it out of the way). See "Options for controlling Co-Pilot™" on page 5 for more information about this function.

c. Set switch 3 as shown at right for your kind of aircraft.

Note: If your system has a Futaba PCM receiver, you must install the FMA Digital Servo Buffer. See page 14 for details.

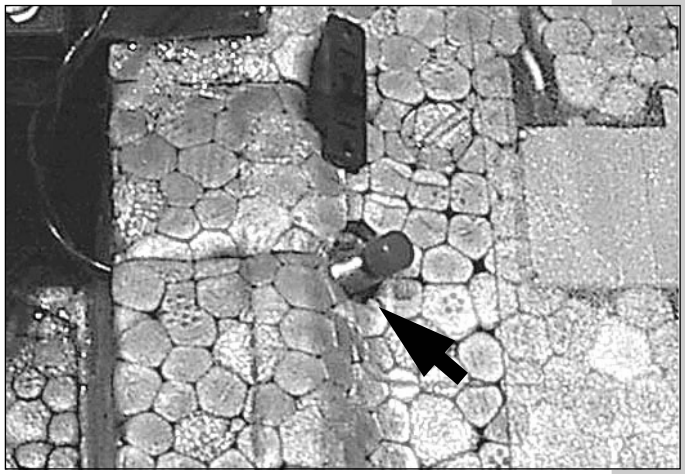


If you have an on-board elevon mixer...

After connecting the cables, you must assure the elevons move in the correct directions *without Co-Pilot*™.

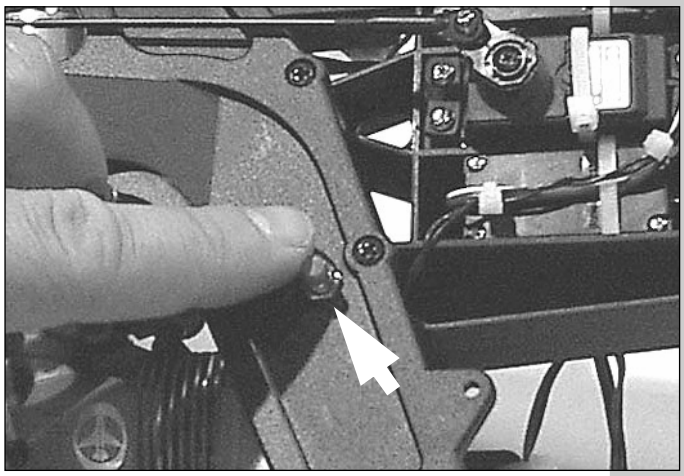
1. Turn the Co-Pilot™ sensitivity control (marked "Throw"), all the way off (counterclockwise).
2. Turn on the transmitter, then turn on the receiver.
3. Pull the transmitter stick back for up elevator. Both elevons should move up. If they don't, then:
   - If the elevons move in opposite directions, switch elevon 1 and elevon 2 cables at the receiver.
   - If both elevons move down, change the elevator reversing switch on the transmitter.
4. Move the transmitter stick right for a right roll. The right elevon should move up and the left elevon should move down. If they move opposite to this, change the aileron reversing switch on the transmitter.
5. Repeat the above checks to verify correct elevon operation.
6. Turn off the receiver, then turn off the transmitter.

...in an electric flying wing

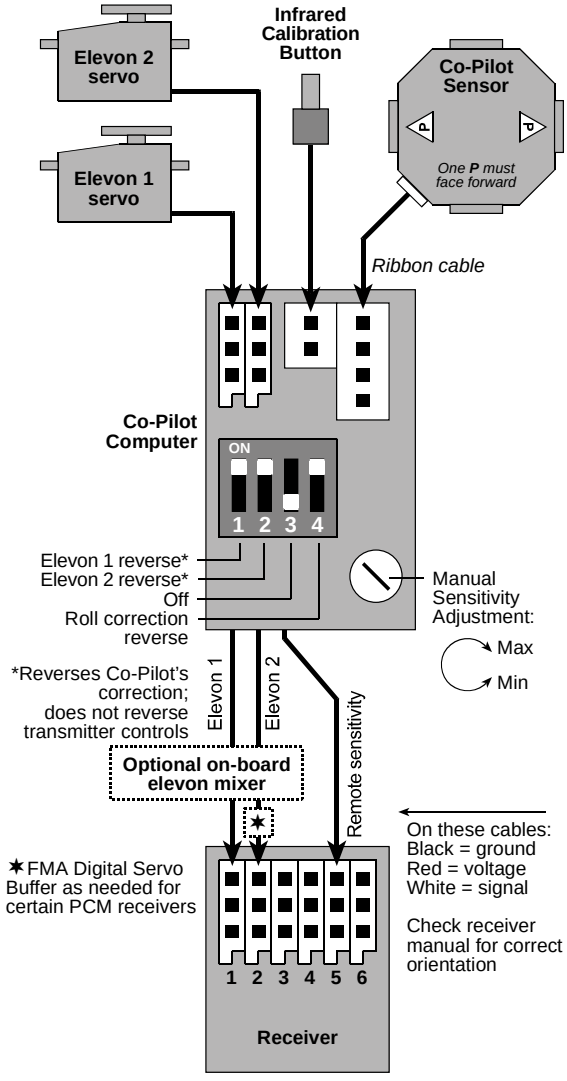


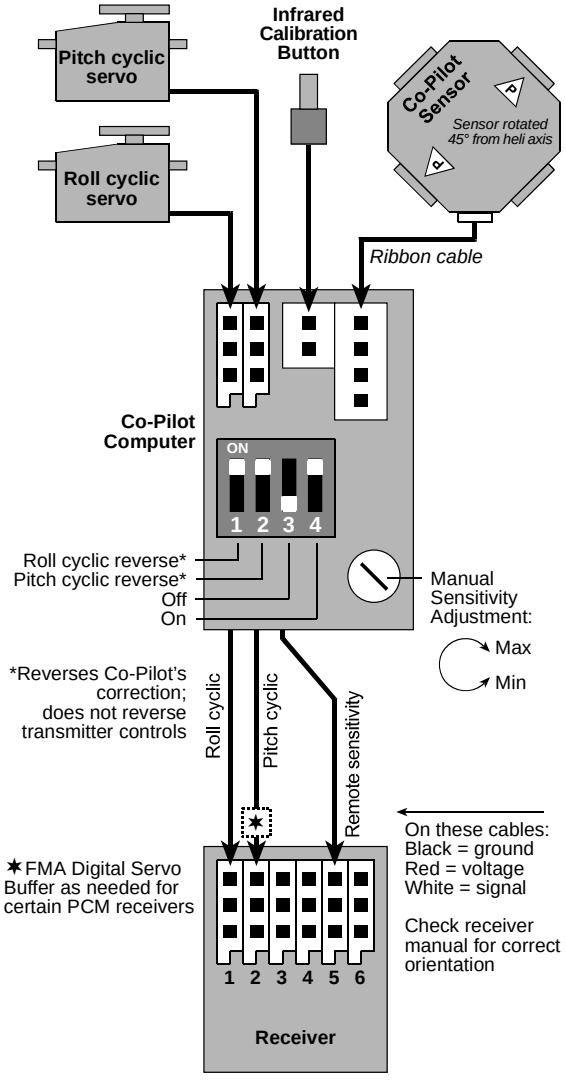
In this foam flying wing, a slot was cut in the fuselage side to hold the Infrared Calibration Button and its wire. If you will be hand launching your aircraft, locate the button where you won't accidently bump it.

...in a helicopter



Drill a hole in the frame, then mount the Infrared Calibration Button in the hole.





Initial setup

Setup assures that Co-Pilot™ switches are set properly.

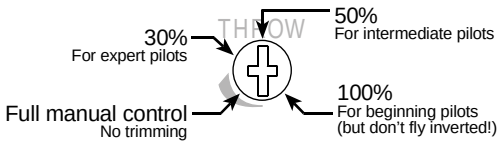
- Perform this setup procedure after installing Co-Pilot™, and after making any changes to the radio system. Do not fly the aircraft without this setup.
- Switches can only be set in Setup Mode (their settings are stored in memory). Changing the switches at any other time has no effect until you enter Setup Mode again.
- You can perform this setup indoors or outdoors.
- Servos will chatter slightly in Setup Mode.
- **Never fly while Co-Pilot™ is in Setup Mode.**

1. Set the manual sensitivity control.

a. Locate the Throw control on the Co-Pilot™ Computer.

b. Using a small screwdriver, rotate the control all the way clockwise.

This maximizes sensitivity, and Co-Pilot™ levels fast.



2. Power up in Setup Mode.

a. Turn on the transmitter.

b. Press and hold the Infrared Calibration Button.

c. With the Button still pressed, turn on the receiver.

The servos will cycle three times to indicate that Co-Pilot™ is in Setup Mode.

(Actually, when power is applied like this, Co-Pilot™ starts in Pitch Setup Mode, used in step 4 on the next page.)

3. Confirm remote control of Co-Pilot™.

Note: Skip this step if you don't have remote control over Co-Pilot™—that is, if the Co-Pilot™ remote control cable is *not* connected to the receiver.

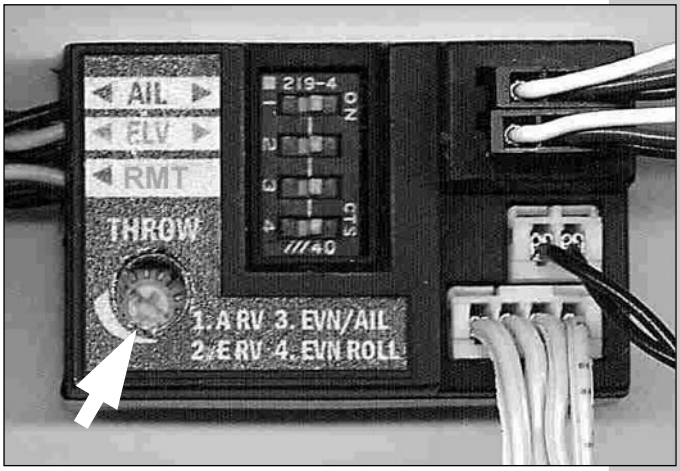
a. On the transmitter, actuate the channel controlling Co-Pilot™:
- If the channel is switched: flip the switch.
  or
- If the channel is proportional: rotate the knob.

The servos will tell you Co-Pilot's status:
- If the servos cycle once, Co-Pilot™ is on.
- If the servos cycle twice, Co-Pilot™ is off.

b. Set the transmitter's servo reversing control for this channel so that:
- Switch up = Co-Pilot™ on.
  or
- Knob fully clockwise = Co-Pilot™ on and at maximum sensitivity.

c. If Co-Pilot™ doesn't seem to respond, increase the transmitter rate to 120% for this channel.

...for a conventional airplane

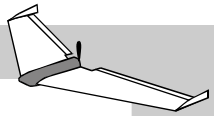


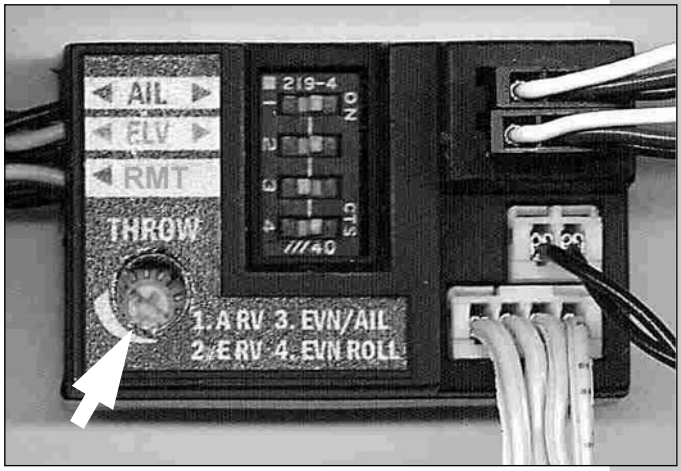
Rotate Throw control fully clockwise.


Press and hold the Infrared Calibration Button while you turn on the receiver.

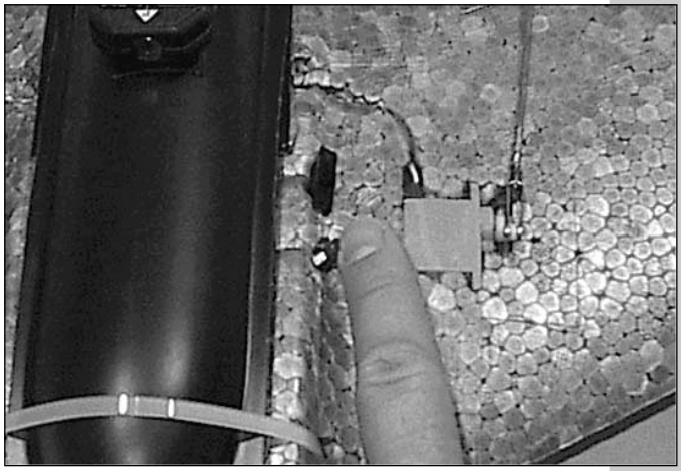

Operate the transmitter switch or knob controlling Co-Pilot™.

...for an electric flying wing

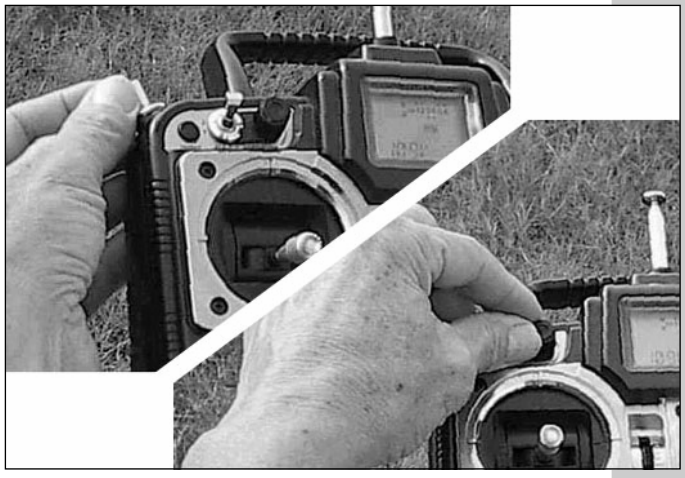




Rotate Throw control fully clockwise.

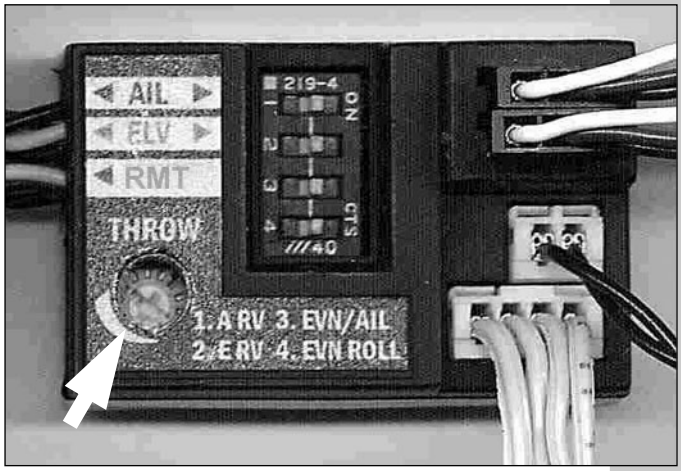


Press and hold the Infrared Calibration Button while you turn on the receiver.

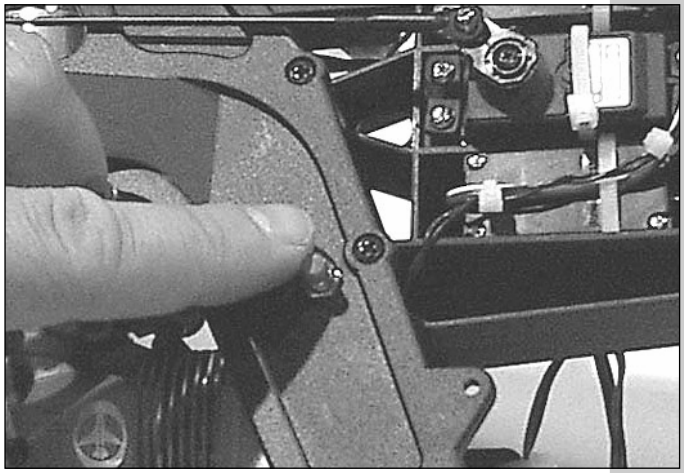


Operate the transmitter switch or knob controlling Co-Pilot™.

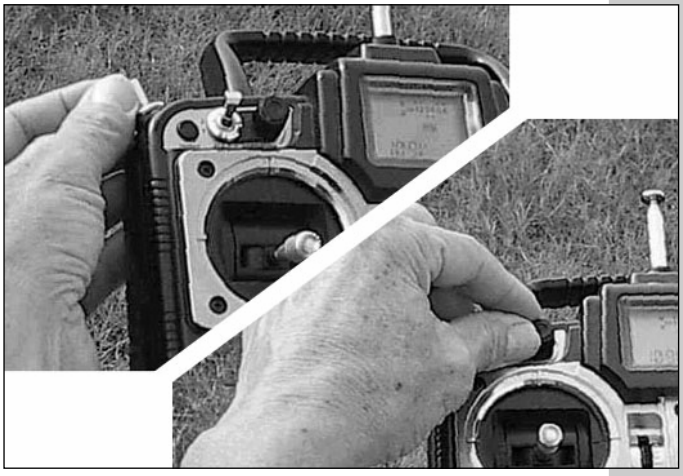
...for a helicopter



Rotate Throw control fully clockwise.



Press and hold the Infrared Calibration Button while you turn on the receiver.



Operate the transmitter switch or knob controlling Co-Pilot™.

4. Check Co-Pilot's pitch correction (P sensors are on).

a. Stand to the side of the aircraft, then place your hand in front of the P sensor window that faces forward (this simulates the aircraft pitching toward the Earth).

b. The aircraft's pitch control should move to a pitch up position (as described to the right for your type of aircraft). If the control moves in the wrong direction, follow the instructions to the right.

(Set up for a helicopter mixes roll and pitch. Since the Sensor is mounted diagonally, the swashplate must move diagonally.)

Note: If you see little or no movement as a result of placing your hand near the Sensor:
- Be sure protective covers are not on Sensor windows. If you still see little or no movement, then...
- Use a glass of hot water instead of your hand.
- Continue setup outdoors. If you still see little or no movement, then...
- In step 4, angle the aircraft's nose down while watching the aircraft's pitch control.
- In step 5, roll the aircraft while watching the aircraft's roll control.

5. Check Co-Pilot's roll correction (other sensors are on).

a. Complete step 4 before starting step 5.

b. Press the Infrared Calibration Button to change to Roll Setup Mode (see tip below).

c. Stand behind the aircraft, then place your hand in front of either side sensor window (this simulates the aircraft rolling a wing toward Earth, represented by your hand).

d. The aircraft's roll control should move to correct the roll (as described to the right for your type of aircraft).

If the control moves in the wrong direction, follow the instructions at right for your model type.

Tip: While in Setup Mode, you can press the Infrared Calibration Button as many times as needed to alternate between Pitch Setup and Roll Setup.

6. Set Auto Trim to on or off (see details at right)**.**

- For Auto Trim on, turn Throw fully clockwise.
- For Auto Trim off, turn Throw fully counterclockwise.

7. Turn off receiver to exit Setup Mode.

8. Set trims.

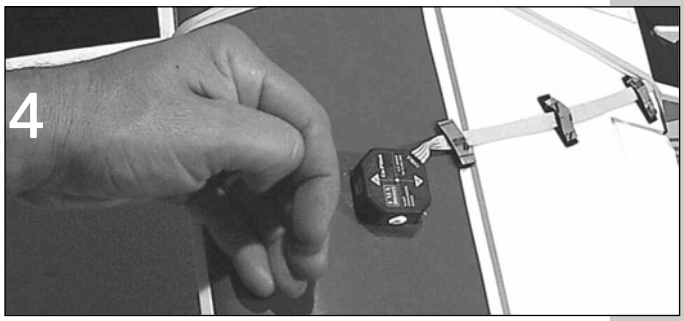
a. Turn the receiver back on.

b. Turn Co-Pilot's Throw control all the way off (counterclockwise) at the Computer.

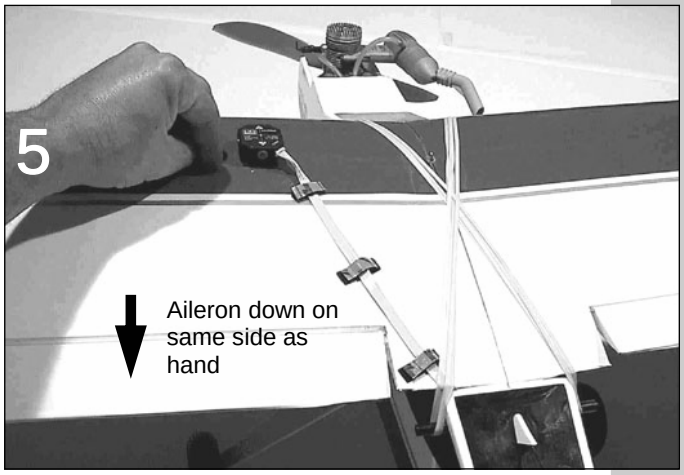
c. Set the aircraft's roll and pitch trims (it's best to do this without any influence from Co-Pilot™). As with any model aircraft, you must estimate the trim needed. Follow the instructions provided with your model.

d. After trimming, reset the Throw control.

...for a conventional airplane



Hand near forward Sensor window should make elevator move up. If elevator moves down, change switch 2 on Co-Pilot™ Computer.



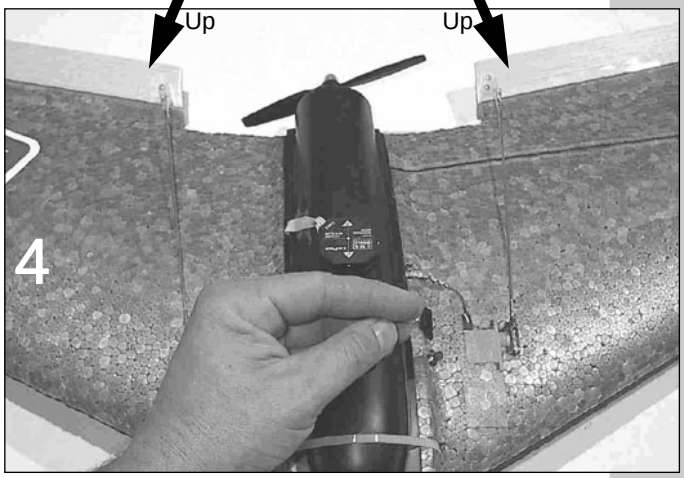
Hand near side Sensor window should make aileron on that side move down. If that aileron moves up, change switch 1 on Co-Pilot™ Computer.

Note: When performing these tests, if both elevator and ailerons move at the same time, make sure switch 3 (on the Co-Pilot™ Computer) is on.

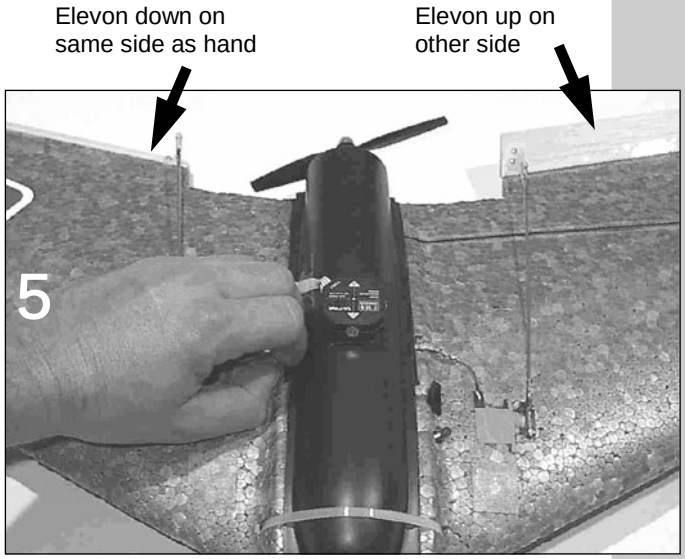
About Auto Trim

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

...for an electric flying wing



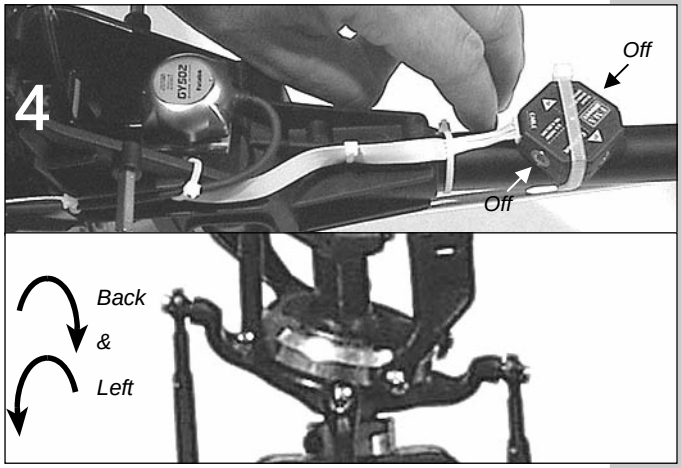
Hand near forward Sensor window should make both elevons move up. If both elevons don't move up, change switches 1 and/or 2 on the Co-Pilot™ Computer until they do.



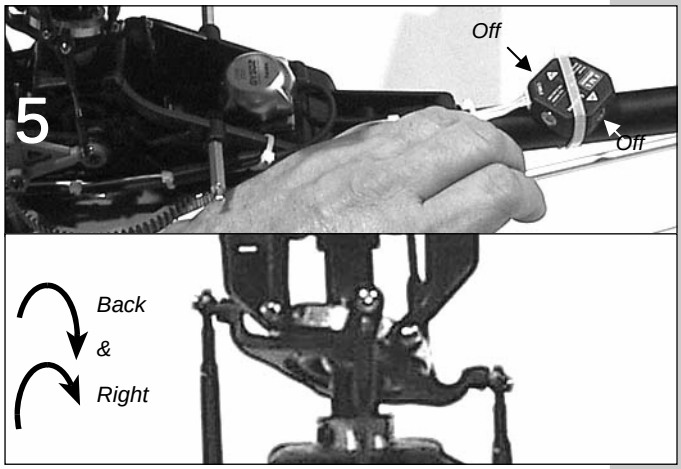
Hand near side Sensor window should make elevon on that side move down. If elevon moves up, change switch 4 on Co-Pilot™ Computer.

Note: When performing these tests, if both elevons don't move at the same time, make sure switch 3 on the Co-Pilot™ Computer is off.

...for a helicopter



Hand near right front Sensor "P" window should move swashplate left and back. If swashplate moves incorrectly, change switches 1 and/or 2 on the Co-Pilot™ Computer until it moves diagonally back.



After pressing Infrared Calibration Button, hand near left front Sensor window should move swashplate right and back (if the helicopter were flying, it would fly away from your hand). If swashplate moves incorrectly, change switch 4 on the Co-Pilot™ Computer (do not change switch 1 or 2 in this step).

Note: When performing these tests, if swashplate is not moving diagonally, make sure switch 3 on the Co-Pilot™ Computer is off. You must complete step 4 first with the "P" sensor pair. You can change between sensors by pressing the Infrared Calibration Button.

Co-Pilot™ troubleshooting

Symptom	Possible solution
Co-Pilot™ doesn't seem to apply corrections.	Operate Co-Pilot™ outside. Turn Co-Pilot™ on. Increase Throw.
Aircraft trim changes when Co-Pilot™ is turned on or off.	Assure Co-Pilot™ Sensor is parallel to line of flight. Trim with Co-Pilot™ Throw control fully off (counterclockwise). See "Tips for trimming," below.
Aircraft shakes or oscillates in the air.	Reduce sensitivity. Repeat infrared calibration. 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 Throw.
Co-Pilot™ doesn't move the aircraft to level.	Clean Sensor windows with alcohol and cotton-tipped applicator. Mount Sensor where it "sees" equal amounts of wing and fuselage on both sides. Mount Sensor away from muffler and engine (which are hot). Fly when the temperature difference number is 2 or greater. Perform infrared calibration at least 100 feet from trees or buildings.
Servos don't move.	Black or brown wire in servo cables should be toward outside of Co-Pilot™ computer.
When in Setup Mode, there is no roll compensation.	Setup Mode has two parts: Pitch Setup and Roll Setup. To change between them, press the Infrared Calibration button.
I changed the switches on the computer, but operation didn't change.	Enter Setup Mode, set the switches, then exit Setup Mode. The computer "reads" the switches only in Setup Mode.
Elevator or aileron is far from correct position.	Make sure the remote on/off cable is not plugged into the aileron or elevator channel by mistake.
Sensor windows are dirty.	Clean Sensor windows with alcohol and cotton-tipped applicator.

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.

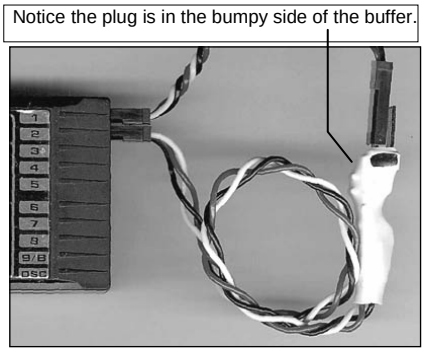
Using Co-Pilot™ with Futaba PCM receivers

(May be required for Futaba PCM receiver models if channel 1 and/or 2 servos do not operate smoothly.)

Install the FMA Digital Servo Buffer (Part no. 605SB) as shown in the picture below:

1. Plug the elevator/pitch cable from the Co-Pilot™ Computer into the jack on the Digital Servo Buffer.
2. Plug the Digital Servo Buffer cable into the elevator/pitch jack on the PCM receiver.

If Co-Pilot™ still moves the servos coarsely, make sure the cable from the Co-Pilot™ Computer is plugged into the correct header on the Digital Servo Buffer.



At the field

When using Co-Pilot™, you'll need to add two routines to your normal pre-flight checks *at the field*:

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

These procedures are described on the following pages.

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

About the infrared field calibration

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

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

   When this step is complete, Co-Pilot™ tells you the infrared temperature difference by cycling the servos. 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 Co-Pilot™.

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

More about infrared field calibration

Co-Pilot's 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 Co-Pilot™ to carry out flight stabilization under nearly all conditions.

During calibration, Co-Pilot's 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 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.

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 two years of testing Co-Pilot™, we've made some important observations:

- Co-Pilot™ rarely measures a difference of 10.
- 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 Co-Pilot™ under the worst possible conditions? When 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 Co-Pilot™ weren't in the system. We recommend that you deactivate Co-Pilot™ (turn the "Throw" control 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 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 Co-Pilot™ measures a moderate to high temperature difference (4 or higher) over land. 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 Co-Pilot™ was calibrated, 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 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.

CAUTION: Read safety precautions on page 3 before flying with Co-Pilot™.

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.

1. Set orientation for maximum pitch correction and measure temperature difference.

a. Turn on the transmitter, then turn on the receiver. Do not press the Infrared Calibration Button yet.

b. Hold the model over 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 (heat from buildings or parking lots can affect calibration). Stand where the Sensor can't "see" you.

c. Orient the aircraft as described to the right for your type of model.

d. Press the Infrared Calibration Button and release after at least 1 second while keeping the model's nose-down.

e. After a short delay (about 2 seconds), count the servo cycles (a cycle is one complete back and forth servo motion).

Here's what the measurement indicates:

- **3 to 10 cycles:** Co-Pilot™ will provide stabilization.
- **2 cycles:** Co-Pilot™ will provide some stabilization, but will be more sensitive to terrain hot spots.
- **1 cycle:** *Do not fly using Co-Pilot™:* turn it off by rotating the sensitivity control ("Throw" on the Computer) fully

2. Set level orientation.

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

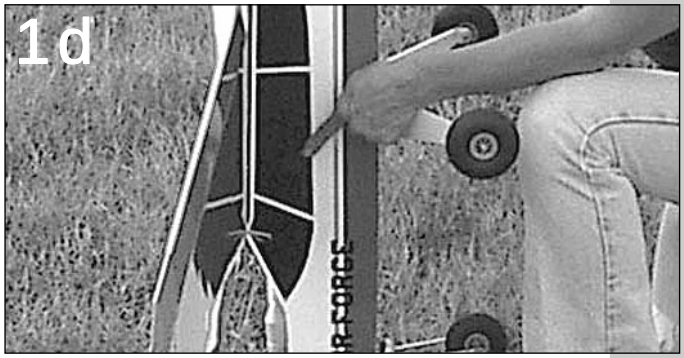
a. Place the model level on the ground. It's important to make the aircraft absolutely level, so take your time.

b. After the model is level, walk at least 10 feet (3 meters) away, then move the aileron (roll) control on your transmitter all the way to the right or left. The servos will cycle once, indicating that level orientation is set.

Note: The calibration is saved, even after power is turned off.

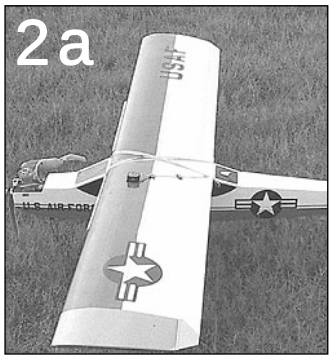
Calibration is complete.
You are now ready for the pre-flight check. ➔

...for a conventional airplane



Hold the airplane nose-down, then press the Infrared Calibration Button and release after at least 1 second.

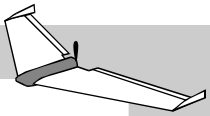
After a short delay, count the servo cycles.



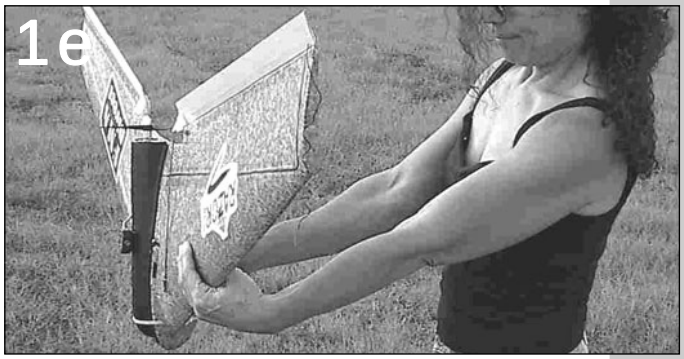
Place the airplane level on the grass. Prop up tail of tail dragger so fuselage is level.

Step back 10 feet and move the aileron stick. This records the horizon and ends the calibration.

...for an electric flying wing



Hold the flying wing nose-down, then press the Infrared Calibration Button and release after at least 1 second.

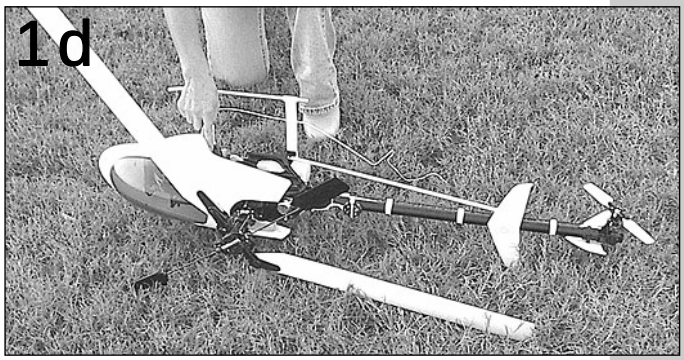


After a short delay, count the servo cycles.

Place the flying wing level on the grass, with the nose slightly up.

Step back 10 feet and move the aileron stick. This records the horizon and ends the calibration.

...for a helicopter



Roll the helicopter on its side. Keep the driveshaft parallel to the ground. Press the Infrared Calibration Button and release it after at least 1 second. Do not block the Sensor's view of the sky.

After a short delay, count the servo cycles. Use Co-Pilot™ only if calibration number is 3 or higher.

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

Step back 10 feet, move aileron (roll) stick. This records horizon and ends calibration. Add small amount of right roll trim to compensate for tail rotor thrust.

Co-Pilot™ pre-flight check

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

1. Check pitch compensation.

a. Turn on the transmitter, then turn on the receiver.

b. Turn Co-Pilot™ on or set sensitivity to maximum (if it can be controlled from the transmitter). **Set dual or tri rates to high.**

c. Point the model's nose straight down, and assure it reacts as described to the right for your type of aircraft.

d. Turn Co-Pilot™ off or reduce sensitivity to minimum (if it can be controlled from the transmitter). This should significantly reduce the aircraft's pitch throw (elevator, elevons or swashplate).

e. Turn Co-Pilot™ on or set sensitivity to maximum.

2. Check roll compensation.

a. Hold the aircraft's body level, and roll it to one side.

b. Assure the model reacts as described to the right for your type of aircraft.

c. Turn Co-Pilot™ off or reduce sensitivity to minimum (if it can be controlled from the transmitter). This should significantly reduce the aircraft's roll throw (ailerons, elevons or swashplate).

d. Turn Co-Pilot™ on or set sensitivity to maximum.

3. Check that dual or tri rates are set to high.
High rates are required to override Co-Pilot's corrections.

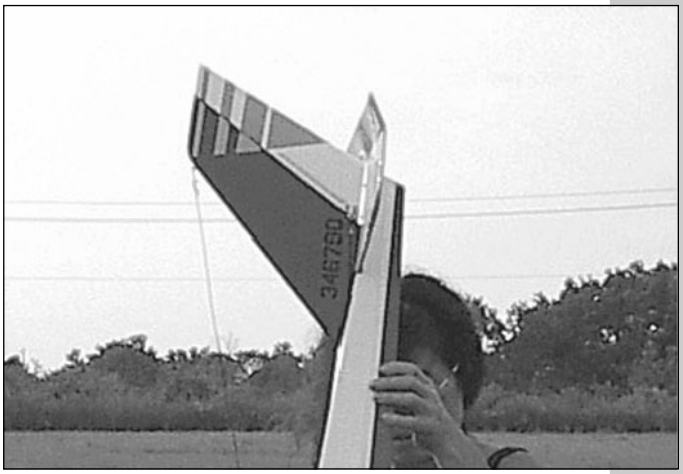
4. Make sure Sensor windows are clean.
If necessary, clean windows with alcohol and cotton-tipped applicator

5. Check roll and pitch control operation.
See description at right for your type of aircraft.

Tip: If the aircraft needs to be trimmed before flying and Auto Trim is on (see page 12, step 6):
1. Rotate the Throw control on the Computer fully counterclockwise (minimum sensitivity).
2. Set the trims.
3. Reset the Throw control to the desired level.

6. Carry out your other pre-flight checks...
for other controls and components.

...for a conventional airplane

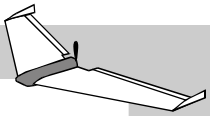


With the nose straight down, the elevator should move to its maximum up position. The ailerons should not move.

With the airplane rolled, the low wing should have down aileron and the high wing should have up aileron. The elevator should not move when the plane rolls.

When the plane is level, the control surfaces should be centered.

...for an electric flying wing



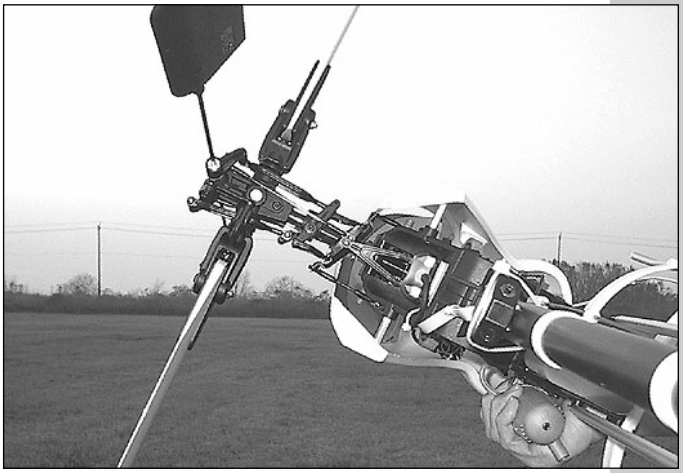
With the nose straight down, the elevons should both move to their maximum up position.

With the flying wing rolled, the low wing should have down elevon and the high wing should have up elevon.

When the plane is level, the control surfaces should be centered.

...for a helicopter

With the nose straight down, the swashplate should tilt all the way back. The swashplate should **not** move left or right.



With the helicopter rolled (and boom parallel to the ground), the swashplate should tilt in the opposite direction. The swashplate should **not** tilt forward or back.

When the helicopter is level, the swashplate should be level.

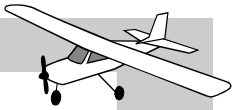
Flying with Co-Pilot™

Note: This section discusses unique aspects of flying with 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. Co-Pilot™ makes it easier to learn to fly, but it cannot teach you how to fly—only an experienced flyer can do that.
- 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 Co-Pilot™ is different from normal flying. When 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 sensitivity adjustments should be made by an experienced pilot.
- If you can control Co-Pilot™ with your transmitter, you can have the best of both worlds: turn Co-Pilot™ on when you need it, turn it off when you don't. Or use 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 sensitivity is set too high. Take action as follows:
  - If you have proportional control of Co-Pilot™ (versus on/off control), reduce sensitivity 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 Co-Pilot™, switch Co-Pilot™ off and land.
  - If you don't have remote control of Co-Pilot™, land the aircraft.

  After landing, decrease Throw on the Computer by 1/8th turn (counterclockwise). Continue flight testing and reducing sensitivity until the aircraft flies smoothly.
- Increase sensitivity on windy days. The aircraft will fly more smoothly.
- If you notice a small difference in trim when turning Co-Pilot™ on and off, re-trim with Co-Pilot™ off. If you still have trim differences between 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. Co-Pilot™ makes landing much easier by keeping the plane level during the approach.

Flying a conventional airplane



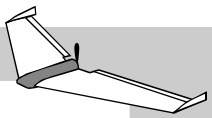
- *To take off with tricycle landing gear:*
  1. Increase throttle to begin roll-out.
  2. Keep the plane moving straight with rudder.
  3. Pull back on the stick (up elevator) to lift off.
- *To take off with tail-dragger landing gear (see explanation below):*
  1. Apply full up elevator when taxiing and at the beginning of take-off.
  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 Co-Pilot™

Recall that Co-Pilot™ attempts to keep an aircraft level. While a tail-dragger's tail wheel is on the ground, the airplane isn't level. Co-Pilot™ 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 to return to level flight.
- *To fly straight and level:* Center 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. Co-Pilot™ takes over and levels the plane.
- Apply a little down elevator if the engine dies.
- Don't attempt inverted flight with Co-Pilot™ until you gain experience. 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 there is plenty of altitude, the plane may have an untimely meeting with the ground. For inverted flight, set the "Throw" control to the intermediate or expert level (see page 10).
- *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 ailerons or rudder as it touches down.
  6. For a tail-dragger, 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 to return to level flight.

- *To fly straight and level:* Center 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. Co-Pilot™ takes over and levels the plane.

- Electric planes tend to stall easily. Trim enough down elevator to maintain air speed.

- Don't attempt inverted flight with Co-Pilot™ until you gain experience. Co-Pilot™ reacts to inverted flight by applying full up elevator, which puts the plane into a descending loop until it is upright. Unless there is plenty of altitude, the plane may have an untimely meeting with the ground. For inverted flight, set the Throw control to the intermediate or expert level (see page 10).

- 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 add up elevator trim. The plane will gently glide in.

Flying a helicopter

CAUTION: 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 Co-Pilot™ when the wind is calm will "feel" different—it will seem like a breeze is moving the helicopter around. 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 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 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 reduce Co-Pilot's sensitivity (see "If you notice the aircraft shaking or oscillating..." in the left column on page 20).

- *To take off:*
  1. Check trims.
  2. Increase throttle.

  Co-Pilot™ will keep the helicopter level.

- *To hover:* Center the stick.

- *To recover from unusual attitudes:* Center the stick. 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.

continued

- 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 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 Co-Pilot™ sees an uneven horizon and tries to compensate.
  - Your helicopter will hover best with 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.
  - Switching 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 Co-Pilot™. The helicopter will be stabilized in all three axes. Controlling the helicopter is then even easier: you only need to navigate the helicopter around the field. With this setup, beginners can be flying in one day.

- For 3D flying, set the Throw control to the expert level (see page 10). This will remove the trimming when Co-Pilot™ is off.

Special setup for flying wing

A slightly different setup procedure is required if you must mount the Sensor diagonally on a flying wing (so the Sensor windows have an unobstructed view of the horizon).

1. Enter Setup Mode:
   a. Turn on the transmitter.
   b. Press and hold the Infrared Calibration Button.
   c. With the Button still pressed, turn on the receiver. The servos will cycle three times to indicate that Co-Pilot™ is in Setup Mode.

2. Set Switch 3 to OFF.

3. Hold your hand in front of one forward-facing sensor window. The opposite elevon should move down, and the same-side elevon should not move.

   If the wrong elevon is moving:
   - Rotate the Sensor 90º, **or**
   - At the Co-Pilot™ Computer, exchange the two elevon connectors at the receiver, and exchange the two elevon servo connectors.

4. Hold your hand in front of one forward-facing sensor window. Change switch 1 or 2 until the opposite elevon moves down.

5. Press the Infrared Calibration Button once. Hold your hand in front of the other forward-facing window. Change switch 1 or 2 until the opposite elevon moves down.

FMA limited warranty

Warranty. FMA, Inc. warrants this product to be free of manufacturing defects for the term of one year from the date of purchase. Should any defects covered by this warranty occur, the product shall be repaired or replaced with a unit of equal performance by FMA, Inc. or an authorized FMA service station.

Limits and exclusions. This warranty may be enforced only by the original purchaser, who uses this product in its original condition as purchased, in strict accordance with the product's instructions. Units returned for warranty service to an FMA service center will be accepted for service when shipped postpaid, with a copy of the original sales receipt or warranty registration form, to the service station designated by FMA, Inc.

This warranty does not apply to:
- Consequential or incidental losses resulting from the use of this product.
- Damage resulting from accident, crashes, misuse, abuse, neglect, electrical surges, reversed polarity on connectors, lightning or other acts of God.
- Damage from failure to follow instructions supplied with the product.
- Damage occurring during shipment of the product either to the customer or from the customer for service (claims must be presented to the carrier).
- Damage resulting from repair, adjustment, or any alteration of the product by anyone other than an authorized FMA technician.
- Installation or removal charges, or damage caused by improper installation or removal.

Call (301) 829-5533 for more information about service and warranty repairs.

Special installation and setup for sensor mounting behing cockpit

Slightly different installation and setup procedures are required if your airplane...

- Has a low or mid wing, *and* exhaust flows under fuselage (the Sensor should be mounted on top of the fuselage to prevent exhaust from covering its windows); *and*
- Has a canopy (the Sensor must be mounted diagonally to prevent the canopy from obstructing the Sensor's view).

With this configuration, make the following changes:

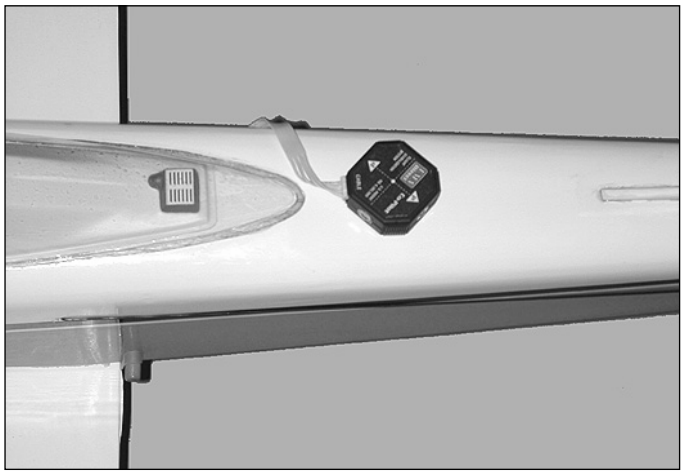
- **Installation**
  - Step 1.a. (page 6): best location for Sensor is on top of the fuselage, behind the canopy.
  - Step 1.f. (page 6): mount the Sensor diagonally behind the canopy, as shown at right.
  - Step 4.c. (page 8): set switches like this:

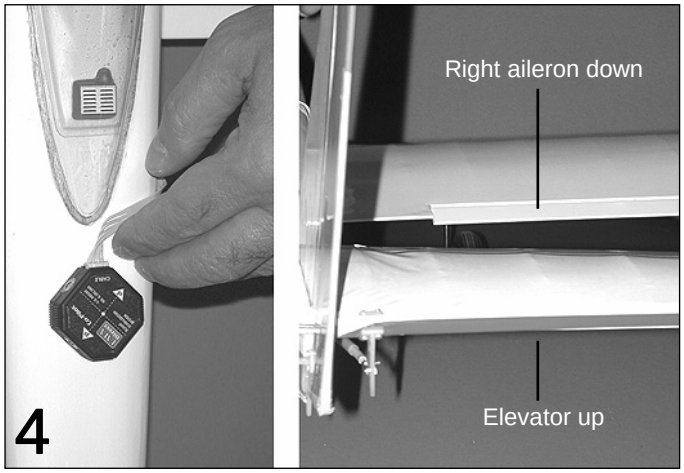
- **Setup**
  - Step 4 (page 12):
    a. Stand at the right front of the aircraft, then place your hand near the right front "P" window (this simulates the aircraft pitching down and rolling to the right).
    b. The right aileron should move down and the elevator should move up. If the surfaces move incorrectly, change switches 1 and/or 2 on the Co-Pilot™ Computer until the surfaces move as shown in the photo to the right.

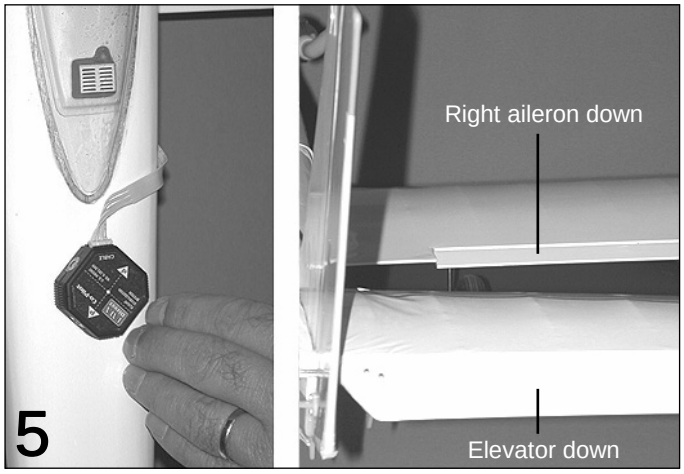
  - Step 5 (page 12):
    a. Press the Infrared Calibration Button to change to Roll Setup Mode.
    b. Stand at the right rear of the aircraft, then place your hand near the right rear Sensor window (this simulates the aircraft pitching up and rolling to the right).
    c. The right aileron should move down and the elevator should move down, as shown in the photo to the right. If the surfaces move incorrectly, change switch 4 on the Co-Pilot™ Computer (do not change switch 1 or 2 in this step).

    Note: When performing these tests, if both ailerons and elevator are not moving, make sure switch 3 on the Co-Pilot™ Computer is off. You must complete step 4 first with the "P" sensor pair. You can change between sensors by pressing the Infrared Calibration Button.

  - Step 8.d. (page 12): Set Throw to 50% (or to half of the setting you would otherwise use).







Co-Pilot™ mini-manual (for checking out Co-Pilot™ at the field)

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.
- Read safety precautions on page 3 before flying.

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

1. Set orientation for maximum pitch correction and measure temperature difference.

a. Turn on the transmitter, then turn on the receiver.

b. Hold the model over 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 (heat from buildings or parking lots can affect calibration). Stand where the Sensor can't "see" you.

c. Position an airplane or flying wing nose down, or position a helicopter on its side with its skids and driveshaft parallel to the ground.

d. Press the Infrared Calibration Button and release after 1 second while maintaining the model's orientation.

e. After a short delay (about 2 seconds), count the servo cycles (1 cycle = 1 complete back and forth servo motion).

How to interpret the measurement:

- **3 to 10 cycles:** Co-Pilot™ will provide stabilization under all conditions.
- **2 cycles:** Co-Pilot™ will provide some stabilization, but will be more sensitive to terrain hot spots.
- **1 cycle:** Do not fly using Co-Pilot™: turn it off by rotating the Throw on the Computer fully counterclockwise.

2. Set level orientation.

After step 1, the servos will cycle slowly.

a. Place the model level on the ground, then walk at least 10 feet (3 meters) away.

b. Move the aileron (roll) control on your transmitter. The servos will cycle once, indicating that level orientation is set.

Co-Pilot™ pre-flight check

1. Check pitch compensation.

a. Turn on the transmitter, then turn on the receiver.

b. Turn Co-Pilot™ on or set sensitivity to maximum (if it can be controlled from the transmitter). **Set dual or tri rates to high.**

c. Point the model's nose straight down, and assure Co-Pilot™ applies full pitch compensation (full up elevator, full up elevons or swashplate tilted all the way back).

d. Turn Co-Pilot™ off or reduce sensitivity to minimum (if it can be controlled from the transmitter). This should significantly reduce the aircraft's pitch throw (elevator, elevons or swashplate).

e. Turn Co-Pilot™ on or set sensitivity to maximum.

2. Check roll compensation.

a. Hold the aircraft's body level, and roll it to one side.

b. Assure Co-Pilot™ applies roll compensation (down aileron on low wing, down elevon on low wing or swashplate tilted away from low side.

c. Turn Co-Pilot™ off or reduce sensitivity to minimum (if it can be controlled from the transmitter). This should significantly reduce the aircraft's roll throw (ailerons, elevons or swashplate).

d. Turn Co-Pilot™ on or set sensitivity to maximum.

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

High rates are required to override Co-Pilot's corrections.

4. Make sure Sensor windows are clean.

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

5. Check roll and pitch control operation.

a. Move stick up and down, and assure aircraft controls move in correct directions.

b. Move stick right and left, and assure aircraft controls move in correct directions.

6. Carry out your other pre-flight checks...

for other controls and components.