trol over the model and Co-Pilot has more control. Conversely, a higher Stick Priority setting means the gain is turned down more the farther the stick is moved from neutral. This gives you more control over the aircraft.

Here are some guidelines that will give more control to you and less to Co-Pilot:

- If you are not getting any oscillation, then leave Gains where they are.
- Increase the Stick Priority. Experienced fliers tend to use higher figures like 150%.
- If possible, assign a slider or knob to the Co-Pilot ON/OFF channel so you can vary sensitivity in the air. If this isn't possible, you can accomplish the same thing by reducing the Gains when you land using the IRNet Programmer.
- You can eliminate Co-Pilot interaction when Co-Pilot is switched OFF by reducing the Auto Trim function to zero. But when you do this, the model will probably no longer be trimmed when Co-Pilot is ON. Use the Set Angles menus to trim the aircraft when Co-Pilot is ON. (To set Auto Trim to zero, you don't have to re-do the entire setup, just go to Preferences.)

Q: Are the LED's on the IR Router supposed to light up?

A: No.

Q: Why is one of the LEDs on the IR router shorter then the other three?

A: This is normal. There are three LEDs for transmitting. These are the tall "blue" domes. There is one IR receiver which is mounted internally on the PCB and sees through the 4th hole in the top of the Router case.

Q: Can the IRNet Programmer be used with different Co-Pilot II installations?

A: Yes, you only need one Programmer if you have multiple systems. FMA now offers Sensors, Computers, and Routers for purchase separately.

Q: How do I turn off the IRNet Programmer?

A: You don't. It turns off by itself.

Co-Pilot™ II

Advanced Infrared Flight Stabilization System

Reference Manual

Instructions for installing, setting up and using Co-Pilot™ II

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REVOLECTRIX™

FMA Direct

Introduction

Co-Pilot™ II features

- Works with all types of radio systems, including all spread spectrum radios. The Co-Pilot II Computer Module installs between your existing receiver and servos.
- Supports analog servos and high-resolution digital servos.
- As with all previous Co-Pilot models, the system offers accuracy to 1 degree of the horizon by sensing the temperature variation between the earth and the sky. Just center the control sticks and Co-Pilot II will right your model from any attitude.
- The optional Vertical Sensor Module forces the system to roll out of inverted to prevent the aircraft from striking the ground if recovery is required at low altitude. When installed, the Vertical Sensor Module also automatically performs continual calibration.
- Stabilizes up to 4 channels for compatibility with virtually any aircraft configuration, including CCPM helicopters, dual or differential ailerons and flapperons.
- Works in most weather conditions, with the exception of heavy rain and severe overcast. Temperature differential will be displayed on the IRNet Programmer during preflight checks.
- Provides flight stabilization with a “natural flight” feel. Co-Pilot II includes stick priority to provide a natural flying “feel” when using flight stabilization. With stick priority, Co-Pilot II automatically reduces flight stabilization sensitivity when you move the stick farther away from center. This results in a natural flying experience without sacrificing recovery time.
- On/Off remote control can be set up on any auxiliary transmitter switch, slider or knob.
- Flight Modes allow for setting up different stabilization characteristics on any type of auxiliary transmitter switch or knob. You can switch between basic stabilization and aerobatic modes with the flip of a switch. 3D modes include stabilization during vertical hover, knife edge, and inverted flight. Learn new aerobatic maneuvers with safety and confidence.
- Co-Pilot II uses SMT components and tiny infrared thermopiles that reduce the profile of sensor modules by about 50% over previous Co-Pilot models.
- Digital conversion takes place within the sensor modules, virtually eliminating the potential for analog noise in any installation. Communication between the sensor modules and the Co-Pilot Computer Module is sent over standard, 3-wire servo connectors.

Note: Co-Pilot II 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.

IRNet wireless user interface

Co-Pilot II includes a wireless user interface for simplified system setup and monitoring. This is a new technology developed by FMA called IRNet. IRNet consists of a wireless infrared 4-button programmer containing a 2-line, 16 character LCD, and a wireless network router. The router is mounted on the aircraft and is capable of supporting multiple IRNet compatible devices. Each device on the “network” communicates with the IRNet programmer using a unique address, much like the network of computers in your office, but on a smaller scale.

Connected IRNet peripherals are represented as separate devices in the programmer, each supporting its own unique menu system. Setting up an IRNet device is as simple as scanning for the device’s welcome screen and answering a series of questions, much like using a television remote.

Monitoring system information in real time is as easy as scrolling through the available data screens. IRNet enables you to perform preflight checks on every critical piece of electronics in your aircraft—without having to remove a wing or even plug in a wire. IRNet range is dependent on weather conditions but ranges from 30 to 200 feet, line of sight.

Co-Pilot II is the first IRNet peripheral to be made available by FMA/Revolectrix, but IRNet applications will extend far beyond the Co-Pilot II. This means that by purchasing Co-Pilot II, you are already set up to use any future IRNet peripherals that become available. Items under consideration include GPS integration, on-board wattmeter, tachometer, temperature sensor, digital servo matchbox, tools for selecting appropriate electric propulsion components and others.

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Set Angles, Stick Priority, Gyro output control on SVO4, etc., it’s a convenient place to set up Flight Modes.

Flight Modes are flexible, and it’s up to you how you want to use them. If no Flight Mode control is set up, then Co-Pilot will always be ON and set up for Level Flight Mode. If you have a Flight Mode control, then one setting must be OFF.

Many people use the Flight Mode control as a panic button. When you lose control, flip the switch to ON. Co-Pilot will stabilize your aircraft from any attitude to level flight immediately. Some people keep Co-Pilot on all the time. (Flying with Co-Pilot is very natural, so it should not be a problem to do aerobatic flying when Co-Pilot is always ON. The key is adjusting Gains and Stick Priority to suit your flying style.)

3D Flight Modes are more involved than the others, which is why they are harder to access. Let’s walk through a typical scenario. Suppose you have a 2-way switch programmed for OFF and Inverted Flight. You can take off with Co-Pilot in the OFF position or you can take off with it in the ON position. Co-Pilot will not arm inverted mode until the aircraft is in the correct attitude AND THEN the Flight Mode switch is moved from OFF to Inverted. If you take off with Co-Pilot ON in this scenario, Co-Pilot will operate in Level Flight mode. When you’re ready to go inverted, switch Co-Pilot to OFF. Invert the aircraft, then switch Co-Pilot ON. As long as the measured angles satisfy the computer that the aircraft is properly inverted, when the Flight Mode switch is moved to the Inverted position, Co-Pilot will hold inverted flight with little effort from you.

It may take some trial and error to set the Angles properly. This is because when the aircraft is inverted, it may require different trim settings than when it is flying right-side up. This is why you can Set Angles individually for each of the various Flight Modes from within Preferences. If invert the aircraft, then flip the Flight Mode switch to Inverted and the aircraft wants to fall out of inverted (due to trim issues), you need to land, use the IRNet Programmer to adjust the angles for inverted, and try again. Once the angles are adjusted properly for a specific installation, they will remain fairly well adjusted over time.

What happens when the aircraft is not properly trimmed during inverted, or perhaps it is adjusted properly, but you want to go back to Level Flight while flying? When the aircraft falls out of inverted, or if you roll it out of inverted, then Co-Pilot will do one of two things. It can be set up to turn itself OFF, or it can be set up to switch from Inverted to Level Flight. You set this option within Preferences. Since the vertical sensor is required for 3D Flight Mode setup, the aircraft will always roll out of Inverted during recovery to Level Flight if Co-Pilot is initially programmed to recover to Level Flight. We recommend you recover to Level Flight Mode when practicing Inverted, and this is the default setting. This is the safest action because if you fall out (or terminate) Inverted, the only thing you need to remember is to move the Flight Mode switch to OFF. Co-Pilot will do the rest to bring the aircraft to a safe attitude.

Q: What is the difference between Auto Trim and Set Angles, and what is a good strategy for trimming the model with Co-Pilot installed?

A: Auto Trim is expressed in degrees. The default value is 6 degrees. If you are using Auto Trim, trim the model with Co-Pilot switched OFF. Then turn Co-Pilot ON and re-trim the model again for level flight. When you turn Co-Pilot OFF again, trim should not change. If it does, increase the Auto Trim value. If it still does not hold same trim with Co-Pilot ON versus OFF, then you will need to either alter the angle of the main sensor (tilt it slightly), or use Set Angles to trim Co-Pilot.

Auto Trim maintains Co-Pilot slightly ON even when it is switched OFF, so it’s recommended for beginners. In contrast, advanced pilots may not like the fact that Co-Pilot has any control over the aircraft when it is switched OFF. If you want Co-Pilot to have no control over the aircraft when switched OFF, then set Auto Trim to zero.

You will need to trim Co-Pilot for level flight when it is ON independently of when it is OFF. Some people tilt the main sensor to achieve level flight in this case. Some people use the Set Angles menus. Both methods achieve the same result—one does it mechanically, the other does it electronically.

Auto Trim and Set Angles do similar things. They can be used independently or together. They both provide a way to adjust the model’s trim. The difference is that Auto Trim affects level flight even with Co-Pilot OFF. Set Angles only applies when Co-Pilot is ON.

The IR sensors see in “cones” 120 degrees across. If other installed components block a portion of a cone, it may affect the model’s trim. It’s usually not possible for the IR sensors to have a 100% clear view, so compensating with a higher Auto Trim value, or adjusting Set Angles is appropriate. If the sensor view is blocked by a component that could emit heat in varying amounts—like a muffler, or a black fin that heats from the sun, or a digital servo that heats up as you fly—then it will be more difficult to achieve proper trim because the trim could change continuously.

Q: I’m using Co-Pilot II and I want to SLOWLY take more control and reduce Co-Pilot’s help. Do I slowly reduce Gain and increase Stick Priority? (Or do I increase Gain and reduce Stick Priority?)

A: If the transmitter channel you are using to turn Co-Pilot ON and OFF can be assigned to a slider or knob, you vary Co-Pilot’s sensitivity from the transmitter. This is not the same thing as reducing the Gains. Gains control the gain of the amplifiers in the IR sensors. Higher sensitivity means that servo travel is increased during stabilization. Reducing Gains or reducing sensitivity will cause longer recovery time during stabilization.

Stick Priority works differently from Gains and sensitivity. Stick Priority lowers the gain of the system as you move the stick farther from neutral. A lower setting means the gain is turned down less; therefore you feel like you have less con-

Frequently asked questions

Q: What servos do I connect to the Co-Pilot II Computer SVO outputs for flight stabilization?

A: You need to connect the pitch (elevator) and roll (aileron) servos for flight stabilization. For 3D Flight Modes, you will also need to connect yaw (rudder). For CCPM helicopters, you will also connect the collective servo. Details:

For aircraft:
- Aileron (1 or 2 servos)
- Elevator (1 or 2 servos)
- Rudder (1 servo for 3D Flight Modes; must have available input)

"Old time" aircraft
- Rudder
- Elevator

For non-CCPM helicopter:
- Cyclic roll (aileron)
- Cyclic pitch (elevator)

For CCPM helicopter
- Cyclic roll (aileron)
- Cyclic pitch (elevator)
- Collective

Q: Do the channels on my receiver match up to the inputs on the Co-Pilot Computer?

A: No. The servo inputs on the Co-Pilot Computer are totally independent from the channels on your receiver. Just make sure you connect the servos listed above. The order that the servos plug into the Computer does not matter. The Computer learns the control settings during setup.

However, the input connector numbers must match the output connector numbers for each receiver channel. For example, if you plug RCV1 into the receiver's elevator channel, plug the elevator servo into SVO1. Never connect the throttle through the Co-Pilot Computer.

Q: What is the proper direction to connect servo leads to the Co-Pilot Computer?

A: Connect all servos, the Co-Pilot sensors and IRNet Router with the black (ground) lead toward the Computer's label.

Q: Do I have to connect my gyro gain control to the Co-Pilot Computer?

A: Normally, no. The gyro gain control (one-wire servo lead normally connected to transmitter channel 5) only needs to be connected to the Co-Pilot Computer when you want to free up a channel. See "If helicopter channels are limited," earlier in this manual, for details.

Q: Does it matter which way the Vertical Sensor is mounted?

A: Yes! The Vertical Sensor must be mounted with the arrow pointing toward the sky when the aircraft is in level flight.

Q: How do Flight Modes work, and how do I set up and use the 3D Flight Modes?

A: How you set up the system depends on what kind of switches or AUX knobs or sliders you have.

2-way switches, sliders and knobs can handle:
- OFF
- Flight Mode 1

3-way switches can handle:
- OFF
- Flight Mode 1
- Flight Mode 2

A standard setup for a 2-position control might be:
- OFF
- Level Flight

If you want to set up 3D Flight Modes on a 2-position switch, then it might work like this:
- OFF
- Inverted Flight

For an airplane, the system supports these 3D Flight Modes:
- Inverted Flight
- Vertical Hover
- Knife Edge, Right Wing Down
- Knife Edge, Left Wing Down

For a heli, there is only one 3D Flight Mode: Inverted.

All 3D Flight Modes require the Vertical Sensor to be installed.

To prevent you from accidentally stumbling into the 3D Flight Mode setup, the system requires you to enter a password (read "3D Flight Modes" in this manual to discover the 3D password). Once you know the password, enter it at the appropriate time in Quick Setup, and 3D Flight Modes are available to you. (If you answer NO to the 3D password question, then you only see OFF and Level Flight Mode as the program options.)

Once you enter the password the first time during Quick Setup, you will always be able to access to 3D Flight Modes during Flight Mode Setup (for switch assignments) from within the Preferences menu. For convenience, the Flight Mode Setup menus are available in two places. The first time you set them up on your Flight Mode control, you will do it during Quick Setup. From that point forward, you no longer need to use Quick Setup again unless you need to change aircraft, radio, sensor installation, etc. Quick Setup walks you through Sensor Setup first, followed by Flight Mode Setup. You may want to change Flight Mode Setup regularly, so you can also access it from Preferences, as well, instead of having to go through the entire Quick Setup process again.

Why would you want to change Flight Mode Setup regularly? Suppose you want to start off with just OFF and Level Flight. Later, you might want to set up OFF and Inverted. Or if you have a 3-way switch, you might want to set up OFF, Level Flight and Inverted on the same switch. Since Preferences is where you frequently go to adjust things like Gain settings,

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 or motor 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 many areas of the country, you cannot legally operate radio controlled models except at approved fields. Check with local authorities first.
- When using an FM or PCM transmitter, 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 FM or PCM radio control transmitter within 3 miles of another 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

Flight stabilization safety precautions

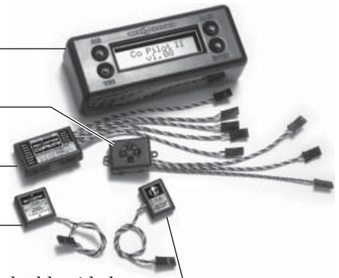
- Co-Pilot™ II is designed for flight stabilization only. It cannot navigate the aircraft or prevent a stall. You must control the aircraft's flight path.
- Co-Pilot II is for recreational use only. Do not install Co-Pilot II in aerial photographic aircraft where there is a possibility of flying over people.
- You must mount the Main Sensor Module and optional Vertical Sensor Module securely. If a Sensor Module comes loose during a flight, the aircraft will crash. Carefully follow the mounting guidelines in this manual.
- Keep fuel off the Sensor Modules. Fuel on the infrared sensors can affect Co-Pilot II operation for as long as 10 minutes.
- Besides your regular preflight check, also perform the Co-Pilot II preflight check before each flight. Details are in "Preparing to fly," later in this manual.
- If you are not using the optional Vertical Sensor Module, perform a manual infrared calibration at the beginning of each flying session, and repeat the calibration if there are major weather changes. Details are in "Preparing to fly," later in this manual.

Co-Pilot™ II specifications

Operating voltage	+3.5 to +9 volts DC
Operating current	<10 milliamps (servos may draw more current from rapid movement and stabilization)
Weight	Computer: 0.61oz (19gm) Main Sensor Module: 0.23oz (7gm) Vertical Sensor Module: 0.16oz (5gm) IRNet Router: 0.26oz (8gm)
Sensor field of view	60° radius cone from window centerline
Leveling response time	1/60th second
Drift from level	<2°
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 and selection of Flight Modes
Aircraft types	Works with all aircraft configurations, including dual aileron servos, quad flaps, elevons, V-tail, VTOL complex transmitter mixes, digital servos and CCPM

Installing Co-Pilot II

Parts list



- ☐ IRNet Programmer (Part no. IRNHP)
- ☐ IRNet Router (Part no. IRNRTR)
- ☐ Co-Pilot™ II Computer (Part no. CPII-CM)
- ☐ Main Sensor Module (Part no. CPII-MS)
- ☐ 3 heli boom mounts with double-sided adhesive (Part no. CPIISENMOUNT)
- ☐ 5 1"x1" double-sided adhesive strips (Part no. CPIITAPE)
- ☐ 6 6" nylon cable ties (Part no. NWT0.1x6)

Optional components

- ☐ Vertical Sensor Module (Part no. CPII-ZS)
- ☐ USB Interface Module (Part no. FUIM2 or FUIM3)

Other items you may need

- 3 AAA batteries (to power IRNet Programmer)
- Servo extension cables
  - Longer cables enable the Co-Pilot II Sensor Modules to be positioned properly on aircraft having large wingspans (see sensor mounting instructions for details).
  - Shorter cables reduce weight on smaller aircraft.
- Advanced Servo Buffer (Part no. 605SB). Recommended for aircraft with long servo extensions and/or gasoline engines. Works with analog and digital servos. See page 7 for more information.

Installing batteries in the Programmer

1. Remove four screws securing the back of the Programmer.
2. Insert three AAA batteries.
3. Replace the back of the Programmer and secure with four screws.

Before you start

Flight stabilization works with—and requires—a completely installed and correctly operating aircraft radio control system: transmitter, battery pack and servos. (An airplane with elevons may also need an on-board mixer, if mixing isn't provided in the transmitter.)

You should install and set up your entire radio system before you connect Co-Pilot II to it. Be absolutely certain the radio system operates correctly and moves the control surfaces in the proper directions. Once the radio system is working correctly, then install and configure the Co-Pilot II system. Finally, read and understand the safety precautions on page 3.

Tip: None of the Co-Pilot II components are particularly susceptible to vibration. In many cases, the components can be mounted using double-sided adhesive tape.

Mounting the Main Sensor Module

General information

The Main Sensor Module can be mounted anywhere on the aircraft, as long as the following requirements are met:

- Must be horizontal when the aircraft is in level flight.
- Must be oriented so that two opposite infrared sensors are parallel with the longitudinal axis of the aircraft (i.e., directly fore and aft), or at 45° to the longitudinal axis.
- All infrared sensors must have a clear view of the horizon. If the Main Sensor Module is mounted directly behind a canopy, for example, rotate it so the IR sensors are positioned 45° to the longitudinal axis.
- Must not be installed under a canopy or inside a cockpit (the infrared sensors cannot sense temperature differences through a canopy or plastic windows).
- Should be at least 6 inches from other components (including the Vertical Sensor Module, IRNet Router, digital servos, vertical stabilizer, horizontal stabilizer and landing gear) and at least 12 inches from engine and muffler.
- On fuel-powered aircraft, should be located where exhaust will not accumulate on the infrared sensors during flights.
- Must be mounted absolutely securely so it cannot move or come loose during flight. If the Main Sensor Module comes loose during flight, the aircraft may crash unless you immediately determine the problem and turn off Co-Pilot. The bottom side of the Main Sensor Module has attachment points that can be used, for example, to secure it with cable ties (however, the mounting surface must be solid to prevent the Sensor Module's plastic case from warping.

Additional mounting guidelines:

- The Main Sensor Module can be installed with the label up (toward the sky) or down (toward the ground).
- Sensor orientation does not matter, as long as the Module is parallel to or 45° to the aircraft's longitudinal axis. Choose the orientation that has the most effective cable routing. The "Quick Setup" programming procedure will ask you about the Sensor's orientation.
- Use double-sided adhesive strips (included) or hook-and-loop fasteners (not included) to secure the Sensor to wing or fuselage. Use the special heli mounts (included) to secure the Sensor to a helicopter boom (boom mounting details below).
- If needed, use a standard servo extension to connect the Main Sensor Module to the Computer.

3D Flight Modes

CAUTION: Co-Pilot™ II's 3D Flight Modes are for experienced pilots only.

Note: Co-Pilot II only supports aerobatic attitudes if the Vertical Sensor Module is installed and connected to the Co-Pilot II Computer. If the Vertical Sensor Module is not in the system, Co-Pilot II only supports Level Flight.

As explained in the "Remote on/off" section, you can use a dedicated channel to turn Co-Pilot II on and off during flights. Advanced pilots may want to extend this capability to activate 3D Flight Modes during flights. When a 3D Flight Mode is switched on, Co-Pilot II maintains the aircraft in an attitude other than level flight (e.g., inverted)—if it can.

Accessing advanced setup

To access advanced setup, enter "9" when prompted in the "Enter 3D Setup Password" screen in the "Quick Setup" procedure. Once you successfully enter the password, you can assign 3D attitudes to Flight Modes 1 and/or 2.

Note: "Quick Setup" requires that you erase the previous setup, so you must enter the password each time you go do the "Quick Setup" procedure if you want to access advanced setup options.

Tip: Once you enter the 3D password, you can assign 3D attitudes to Flight Modes via either "Quick Setup" or "Preferences" (as described in "Assigning 3D attitudes to Flight Modes," below). However, if you go back through "Quick Setup" and choose not to activate 3D modes, then you will not be able to assign 3D attitudes in either "Quick Setup" or "Preferences."

Assigning Flight Modes to the remote

- If your transmitter has a 3-way switch you can set up Co-Pilot II for three conditions: Off, Flight Mode 1 and Flight Mode 2.
- If your transmitter has a slider, knob or 2-way switch, you can set up Co-Pilot II for two conditions: Off and Flight Mode 1.

When setting up the transmitter's remote in the "Quick Setup" or "Preferences" screens, you can assign the Off and Flight Mode positions according to your personal preference. Here are two ways to assign Flight Modes to a 3-way switch:

Up:	Flight Mode 2	Up:	Flight Mode 2
Center:	Flight Mode 1	Center:	Co-Pilot **Off**
Down:	Co-Pilot **Off**	Down:	Flight Mode 1

Tip: Check Flight Mode assignments in the third "Preflight" screen by moving the transmitter remote.

Assigning 3D attitudes to Flight Modes

For an airplane, one of the following attitudes can be assigned to each Flight Mode:
- Level Flight.
- Inverted Flight.
- Knife Edge Flight (left wing down).
- Knife Edge Flight (right wing down).
- Vertical Hover.

For a helicopter, one of the following attitudes can be assigned to each flight mode:
- Level Flight.
- Inverted Flight.

Assign 3D attitudes to Flight Modes in the "Quick Setup" or "Preferences" screens.

Using Flight Modes

1. Using the transmitter's remote, set Co-Pilot to Off or Level Flight.

   Note: You can only invoke a 3D Flight Mode from Off or Level Flight.

2. Maneuver the aircraft into the desired 3D attitude. (If Co-Pilot is set to Level Flight, stick priority enables you to override flight stabilization.)
3. Using the transmitter's remote, select the Flight Mode corresponding to that 3D attitude.

   Note: The aircraft must be near the desired 3D attitude, as detected by Co-Pilot, before Co-Pilot will activate the Flight Mode.

4. Co-Pilot will attempt to maintain the aircraft in the 3D attitude.

   If Co-Pilot II cannot maintain the aircraft in the 3D attitude, it will take the action you specified in the "Disarm Flight Modes to..." screen in "Preferences":
   - Revert to Level Flight stabilization, or
   - Turn off flight stabilization.

5. When you are finished flying in the 3D attitude, you can:
   - Switch Co-Pilot to Off, then maneuver to level flight or another 3D attitude, or
   - Switch Co-Pilot to Level Flight; Co-Pilot will return the aircraft to level flight.

Example: Suppose you set up your transmitter's remote 3-way switch as follows:

Up:	Flight Mode 2, Inverted Flight
Center:	Flight Mode 1, Level Flight
Down:	Co-Pilot **Off**

Here's how you would use Co-Pilot for inverted flight:

1. Move the remote to Center (Level Flight). Co-Pilot keeps the airplane in level flight.
2. Roll or loop into inverted flight (taking advantage of Stick Priority to override Level Flight Mode).
3. Move the transmitter's remote to Up (Flight Mode 2, Inverted). Since Co-Pilot recognizes that the airplane is inverted (using input from the Vertical Sensor Module), it activates Inverted Flight.
4. Co-Pilot keeps the airplane inverted.
5. Move the transmitter's remote to Center (Level Flight). Co-Pilot rolls the airplane back into level flight.

VTOL aircraft

You can assign either Level Flight or VTOL to a VTOL aircraft's Flight Modes. VTOL is considered a "normal" attitude, and does not require that you enter that attitude before activating it—you can freely switch between Level Flight and VTOL at any time.

- Temperature differences of less than 10°F (5.5°C) 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 Co-Pilot II measures a temperature difference of 10°F (5.5°C) or less? It automatically turns itself off. Your aircraft simply responds to your commands as though Co-Pilot II weren't in the system.

What happens if you calibrate over land and fly over water? If you fly near a small lake, the Main Sensor Module 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 II measures a moderate to high temperature difference (20°F/11°C or higher) over land. It is safer to fly over large lakes when the temperature difference is 30°F (16.5°C) or higher over land.

About the Vertical Sensor Module

The optional Vertical Sensor Module has three functions:

- It lets the Co-Pilot II Computer know when the aircraft is inverted. When the aircraft is flying in Level Flight Mode, and the Vertical Sensor Module detects that the aircraft is inverted, Co-Pilot II will roll the aircraft back into level flight. (If the Vertical Sensor Module is not used, and the aircraft is inverted, Co-Pilot II will put the aircraft into a downward half-loop to return it to level flight. If the aircraft is too close to the ground, it will crash.)
- It performs continuous, automatic weather calibration. On the ground, you will see weather calibration in the "Sky to Ground T[emperature]. Diff[erential]. step in the Co-Pilot "Preflight" checks (or in the "DO FIELD CALIB." screens if the Vertical Sensor Module is not installed). If the temperature difference is 7°F. or less, infrared flight stabilization is not effective and Co-Pilot II turns itself off. Co-Pilot II will also turn itself off if the temperature difference falls below this threshold during a flight. Although this would be a rare occurrence (most RC flyers wouldn't be flying in such bad weather), it is better to revert to full pilot control than to allow flight stabilization under such poor conditions.
- It enables 3D Flight Modes (inverted, knife edge and vertical hover). While level flight is possible by monitoring the infrared environment in two axes (as provided by the Main Sensor Module), flight stabilization during aerobatic maneuvers requires infrared sensing in three axes (Main Sensor Module plus Vertical Sensor Module).

Gain

Gain determines how far Co-Pilot II moves the servos for a given deviation from level flight. When gain is set high, the servos move a lot. When gain is set low, the servos move a little.

Typical initial gain settings are:
- Pitch: 70%.
- Roll: 50%.

You may need to experiment with gain settings to determine what works best for your aircraft and flying style.

Note: If you notice the aircraft is oscillating, gain is set too high. Land the aircraft and reduce the gain.

Stick Priority

Stick Priority provides a natural flying "feel" by reducing flight stabilization when you move a stick away from center. Stick Priority enables you to take advantage of flight stabilization during moderate maneuvers with the sticks near center, while seamlessly enabling you to perform aerobatics such as snap rolls requiring extreme stick movement. When Stick Priority (set in the IRNet Programmer's "Preferences" screens) is 0%, it is off. Higher values reduce gain more as the sticks move from center.

Auto Trim

If you were flying without Co-Pilot II, you would trim the aircraft from your transmitter. Auto Trim enables you to trim the Main Sensor Module (rather than the aircraft) from your transmitter. The advantage of Auto Trim is that Co-Pilot maintains trim settings even when flight stabilization is switched off.

Auto Trim can be set to any value between 0° (disabled) and 9°. For example, if Auto Trim is set to 6°, when Co-Pilot II is off it will apply trimming as long as the aircraft is within 6° of horizontal. Follow these guidelines for Auto Trim:

- Best for beginners: Auto Trim should be set to a high value. Take off with Co-Pilot II on, and trim in the air with Co-Pilot II on. With Auto Trim enabled, the aircraft stays in trim when Co-Pilot II is turned off in the air.
- Best for experts: Auto Trim should be disabled. Take off with Co-Pilot II off, and trim in the air with Co-Pilot II off (since Auto Trim is disabled, it has no effect on trim). After turning on Co-Pilot II for emergency recovery, don't trim, or you will have to retrim when Co-Pilot II is off.

Set Auto Trim in the "Quick Setup" or "Preferences" procedures, in the "Flight Mode Setup" section.

More about trimming

Expert pilots may also want to adjust trims when Co-Pilot II is on using the "Set Flight Angles" section in the "Preferences" screens. Results will be similar to using Auto Trim—the aircraft will be trimmed whether flight stabilization is on or off—but when flight stabilization is off, Co-Pilot II will not affect flight controls. Also, in the "Set Flight Angles" screens, angles can be set independently for various Flight Modes (level flight versus 3D).

Remote on/off

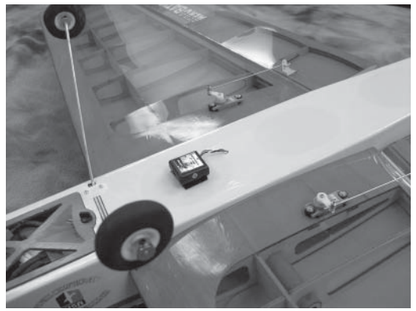
If your transmitter has a free channel controlled by a switch, knob or slider, that channel can be used to turn Co-Pilot II on and off during flights.

If your transmitter doesn't have a channel available for remote on/off control, Co-Pilot II will always be on (unless automatic or manual infrared calibration measures poor weather conditions, in which case Co-Pilot II will be off).

Note: Advanced pilots may also use the remote on/off channel to activate 3D Flight Modes. See the "3D Flight Modes" section.

Mounting on an airplane

Typical mounting locations for the Main Sensor Module include on the top or bottom of the fuselage, on top of the wing of a high-wing airplane, or on the bottom of the wing of a low-wing airplane.



Main sensor module mounted on bottom of fuselage

The photo above shows the Main Sensor Module mounted on the bottom of the fuselage of an electric airplane. This would not be a good location on a fuel-powered airplane, as it would expose the Sensor to exhaust.

Mounting on a helicopter

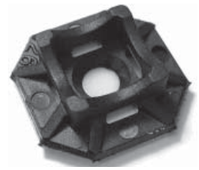
The best location for the Main Sensor Module is on top of the horizontal fin, rotated 45°. In this location and orientation, the IR sensors have the clearest view of the horizon. Sensors 2 and 3 should face forward so the cable routes forward along the boom. Secure the Main Sensor using double-sided tape (multiple layers may be needed to clear screw heads on top of the fin).

Main Sensor Module mounted on horizontal fin

Alternatively, you can mount the Main Sensor on the tail boom, rotated 45°, using this procedure:

1. Cut the corners from the included plastic mount as shown in the photo below (diagonal cutters can do this quickly).
2. Place double-sided tape on the boom, then place the plastic mount on the tape and secure it to the boom using a cable tie (the double-sided tape keeps the plastic mount from rotating).
3. Secure the Main Sensor Module to the plastic mount using double-sided tape.

Tip: For additional security, feed cable ties through the slots in the bottom of the Sensor's case and around the boom.



Plastic mount (trimmed)

Main Sensor mounted on boom

Mounting the Vertical Sensor Module

The Vertical Sensor Module can be mounted anywhere on the aircraft, as long as the following requirements are met:

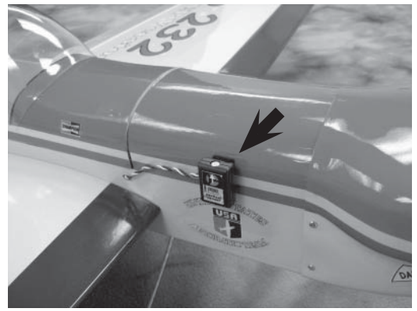
- Must be vertical when the aircraft is in level flight.

  IMPORTANT: The arrow on the Vertical Sensor Module must point to the sky when the aircraft is in level flight. Failure to follow this precaution may result in unexpected results and a crash.
- Must be at least 6 inches from the Main Sensor Module so that the Main Sensor Module's IR sensors are not obstructed.
- On fuel-powered aircraft, should be at least 12 inches from the engine and muffler, in a location where exhaust will not accumulate on the IR sensors during flights.

If needed, use a standard servo extension to connect the Vertical Sensor Module to the Computer.

Mounting on an airplane

The Vertical Sensor Module is typically mounted on the side of the fuselage.

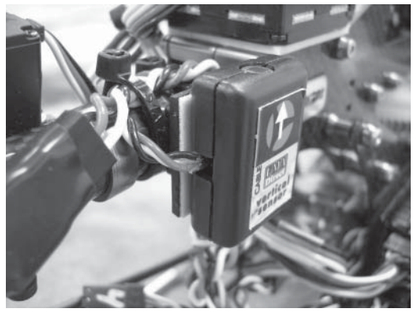


Vertical Sensor Module mounted on fuselage side

The photo above shows the Vertical Sensor Module mounted on the right side of the fuselage, in front of the wing, on an electric airplane. This would not be a good location on a fuel-powered airplane, as it would expose the Sensor to exhaust.

Mounting on a helicopter

The Vertical Sensor Module is typically mounted on the boom, close to the body. Use an installation procedure similar to boom mounting for the Main Sensor Module. Alternatively, the Vertical Sensor Module can be attached to the helicopter frame or cockpit using the included double-sided adhesive strips.



Vertical Sensor Module mounted on helicopter boom

Mounting the IRNet Router

The IRNet Router can be mounted anywhere on the aircraft, as long as it does not obstruct the Sensors and it has unobstructed, line-of-sight communication with the IRNet Programmer during setup and preflight checks.

If necessary, standard servo extensions can be used to connect the IRNet Router to the Computer.

> **Tip:** The IRNet Router is only required during system setup and preflight checks. If mounting or weight is a problem, it can be disconnected and left on the ground during flights. You will need to reconnect it to change settings or perform preflight checks.

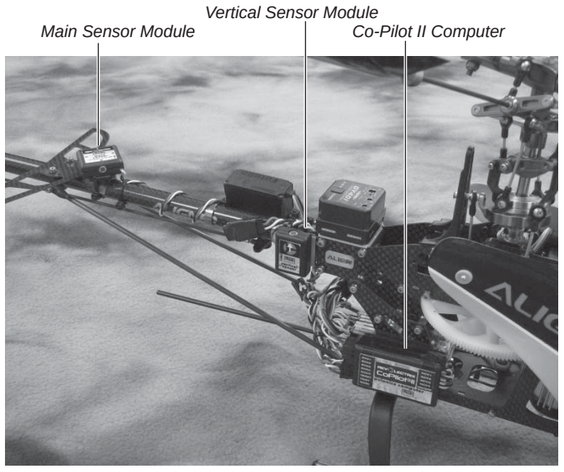
Mounting the Co-Pilot™ II Computer

Mount the Computer in a manner similar to your receiver.

Full helicopter installation

The photo below shows how Co-Pilot components might be mounted on a helicopter. Your installation may be different from this.

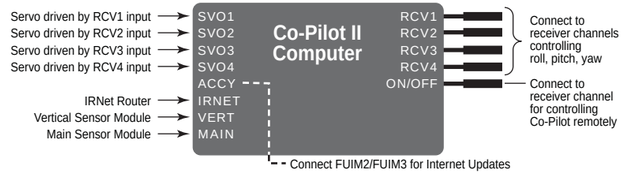
Notice that in this installation, the Main Sensor Module is rotated 45° and mounted in the middle of the boom using the plastic mounting block. This is not the ideal location, as the IR sensors are partially blocked by the horizontal fin. The Vertical Sensor Module is mounted so that it has a clear view of the sky and ground.



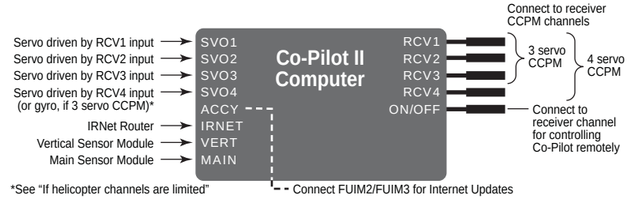
Typical helicopter installation (the IRNet Router is mounted on the frame on the left side of the helicopter, and is not visible in this photo)

Connecting the components

In an airplane



In a helicopter



*See "If helicopter channels are limited"

> **Tip:** The first four FAQs on page 22 provide more information about connecting servos, receiver and other components to the Co-Pilot II Computer.

> **Note:** Orient the connectors with the black or brown wires toward the computer's label.

Operating details

About flight stabilization

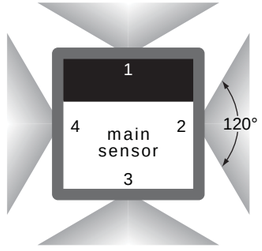
Co-Pilot™ II "looks" at the horizon with infrared heat sensors (this same technology is used in thermal imaging cameras). The Earth is warm (even when covered with snow) below the horizon, while the sky is cold above the horizon. Co-Pilot II "sees" this temperature difference. When Co-Pilot II senses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

Flying with Co-Pilot II is easy. When you center the control sticks, Co-Pilot II automatically returns the aircraft to level flight. Co-Pilot II works over a wide range of weather conditions. Continuous monitoring by the optional Vertical Sensor Module (or a simple manual calibration) adjusts Co-Pilot II to the local environment.

Co-Pilot II 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 II is useful for flying—and landing—under windy conditions. Because it responds much faster than you can, Co-Pilot II 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 II from the ground. Turn it on when it's needed, and turn it off when it isn't needed.

Co-Pilot II 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. The Main Sensor Module (illustrated below) contains four infrared sensors oriented at 90° intervals, with opposite sensors working as a pair. When one pair of sensors sees a change in an aircraft's orientation relative to the earth's infrared horizon, Co-Pilot II 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. Co-Pilot II 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 Co-Pilot II provides a more stable and precise reference than light or other phenomena. This gives Co-Pilot II much more precision than visible light stabilization systems. For example, Co-Pilot II 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 II 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 II's Vertical Sensor Module performs continuous calibration (not available in other flight stabilizers) that fine-tunes performance for near-perfect stabilization under all conditions.

Understanding infrared calibration

Co-Pilot II's Main Sensor Module 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 Main Sensor Module detects an average infrared temperature sufficient for Co-Pilot II to carry out flight stabilization under nearly all conditions.

If the optional Vertical Sensor Module is installed, Co-Pilot II uses information from it to continuously monitor the temperature difference between sky and ground.

If the Vertical Sensor Module is not installed, you must perform a manual infrared calibration (the "DO FIELD CALIB." option appears in the IRNet Programmer's Main Menu when the Vertical Sensor Module is not detected). Manual calibration measures 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 II's ability to stabilize the aircraft. If these occur, you may need to perform another manual calibration.

You should **not** manually 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.

In its Preflight check, Co-Pilot II tells you about the infrared temperature difference it measures. In several years of testing flight stabilization technology, we've made some important observations:

- Co-Pilot II rarely measures a difference greater than 60°F (33°C).
- Co-Pilot II even more rarely measures a difference of less than 10°F (5.5°C).

Flying a helicopter

CAUTION: Co-Pilot II 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, cut the throttle immediately. Never fly near houses, cars, trees or other objects which could interfere with operation and cause damage.

- Flying with Co-Pilot II when the wind is calm will "feel" different—it will seem like a breeze is moving the helicopter around. Co-Pilot II 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 II is doing most of the work. Flying on windy days takes little effort.
- The hardest part of flying a helicopter is getting it trimmed. It may help 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 II.
- Helicopters are very sensitive to small out-of-trim conditions. You may need to adjust Co-Pilot II's trims to match your flying site (for example, to compensate for high terrain or trees on one side). A little effort here will pay off with added precision.
- 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 gain.
- *To take off:*

  1. Check trims.
  2. Increase throttle.

  Co-Pilot II 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!). Co-Pilot II 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.
- Co-Pilot II 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 II, 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 II sees an uneven horizon and tries to compensate.
  - Your helicopter will hover best with Co-Pilot II 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 II on and off in the air should not change the hover. If it does, compensate by adjusting Co-Pilot's trim settings.
- Install a heading hold gyro to control yaw, in addition to Co-Pilot II. 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.

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!). Co-Pilot II 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.

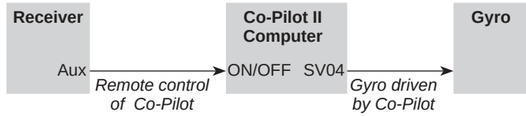
If helicopter channels are limited

As initially configured, many CCPM helicopter radio systems don't have a free channel for turning Co-Pilot II on/off and selecting Flight Modes. If your helicopter *doesn't* use four channels for flight stabilization (most helis use three servos for CCPM) *and* doesn't have enough channels for both gyro control and Co-Pilot on/off, there is a solution...

Once adjusted, a variable rate gyro doesn't need to be changed very often. If Co-Pilot II determines that only three channels are being used for CCPM, it can free up the receiver's gyro channel for on/off/Flight Mode use.

The simplified diagram below shows how the receiver would initially be set up to drive the gyro from an auxiliary channel. This arrangement enables you to adjust the gyro from the transmitter, and optimize its sensitivity before Co-Pilot II is connected into the system.

The next diagram shows how the Co-Pilot II Computer fits into the system. The auxiliary channel is used to control Co-Pilot through the Computer's ON/OFF input, while the Computer drives the gyro through its SV04 output. If you turn Co-Pilot II off, it continues to drive the gyro.



When you first program Co-Pilot II, you'll need to enter the gyro sensitivity setting (as a percentage) from your transmitter in the "Gyro Output Ch4" screen in the "Preferences" procedure. If you need to readjust the gyro later, just return to the "Preferences" screens.

Updating the Co-Pilot II Computer firmware

Note: Internet Explorer must be the default browser during this procedure.

1. Download the Co-Pilot II updater from *www.fmadirect.com/downloads.htm*

   The updater should install automatically.
2. Launch the updater: **Start > Programs > FMA Direct > Co-Pilot II Update**.
3. Follow the on-screen instructions.

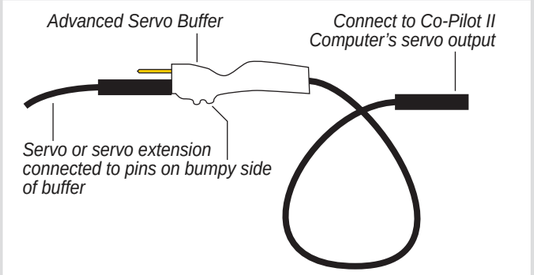
Special installation considerations

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 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 servo pigtail on the Co-Pilot II Computer.



FMA limited 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 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.

This warranty does not apply to:

- Consequential or incidental losses resulting from the use of this product.
- Damage resulting from accident, 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) 668-4280 for more information about service and warranty repairs.

Programming Co-Pilot II

About the IRNet Programmer

The IRNet Programmer is your "window" on the Co-Pilot™ II system. It enables you to interact with the Computer to configure the system and assure that it is working correctly.

Programming covers a wide range of settings, organized in four areas accessed via the Main Menu:

- Preflight
- Preferences
- Quick Setup
- Do Field Calibration (available only if the Vertical Sensor Module is not detected)

The "Overview" diagram on the next page shows the general structure of the programming screens. Flowcharts on the following pages will help you navigate the Programmer's screens. Notes in the flowcharts provide additional information about many of the screens.

Use the buttons on the Programmer to select options, adjust settings and move from screen to screen. In general, this is what each button does:

- **INC** ("increase") selects the next Main Menu option or increases a value within a screen.
- **DEC** ("decrease") selects the previous Main Menu option or decreases a value within a screen.
- **ENTER** moves to the next screen in a menu. If the current screen displayed a value you set, that value will be stored. If the current screen asks you to choose the next activity (using the **INC** and **DEC** buttons), pressing **ENTER** will display the screen for that activity.
- **BACK** moves to the previous screen. If the current screen displayed a value you set, that value will be stored.

Additionally:

- Press and hold the **BACK** button to move up one level in the menu structure.
- Simultaneously press **DEC** and **ENTER** to scan for IRNet devices (see next section).
- Simultaneously press **INC** and **BACK** to access the contrast adjustment screen. Press **INC** or **DEC** change contrast, then simultaneously press **INC** and **BACK** to exit.

Using the Programmer

1. Turn on the IRNet Programmer by pressing **ENTER**. The screen will show:

   ```
   IRNet Display
   Vx.x FMA Inc.
   ```

2. Turn on the Co-Pilot II Computer (by turning on the aircraft receiver).
3. In general, hold the IRNet programmer so its infrared transceiver can "see" the infrared transceiver on the IRNet Router, but be aware of the following:
   - The infrared transceivers are very powerful. Indoors, the signals will bounce off of floors, walls and ceilings.
   - Outdoors, especially in direct sunlight, range will be shortenened and the Programmer will be more "directional"—it will need to be aimed more directly at the Router to get the best reception.
   - To prevent swamping, don't aim the Programmer directly at the Router when the two are within 1-2 feet of one another.
4. As shown in the "Link Up" flowchart:
   a. Simultaneously press the **DEC** and **ENTER** buttons. The screen may briefly show:

      ```
      Searching...
      for a Device
      ```

   b. When the Programmer identifies the IRNet Router, the screen will show:

      ```
      IRNet Router
          Vx.x
      ```

   c. Simultaneously press the **DEC** and **ENTER** buttons. The screen may briefly show:

      ```
      Searching...
      for a Device
      ```

      Note: If other IRNet devices are connected to the Router, you may see screens identifying them. Simultaneously press **DEC** and **ENTER** until you see the Co-Pilot II screen (step d, below).

   d. When the Programmer identifies Co-Pilot II, the screen will show:

      ```
       Co-Pilot II
          Vx.xx
      ```

   e. Press the **ENTER** button to connect to the Co-Pilot II Computer. The screen will show the Main Menu:

      ```
      CHOOSE TASK?
        >[task]
      ```

      (You'll find the Main Menu in the "Link Up" flowchart.)
5. Press **INC** or **DEC** to select a programming task—"Preflight," "Preferences" or "Quick Setup" (or "Do Field Calib." if the Vertical Sensor Module is not detected)—then press **ENTER** to view screens for that task. Use the corresponding flowchart to help you navigate the screens.
6. If this is the first time accessing the Computer, navigate to "Quick Setup" and follow the on-screen instructions to configure Co-Pilot II.

The general approach to programming

- Use the "Quick Setup" screens to initially set up Co-Pilot II to work with the aircraft on which it is installed. Return to the "Quick Setup" screens if the sensor installation, radio system, servos or flight surfaces change. Also use "Quick Setup to configure Flight Modes the first time.
- Use the "Preferences" screens to configure how Co-Pilot II operates. Also use "Preferences" to change Flight Modes without having to navigate all the screens in "Quick Setup."
- Use the "Preflight" screens to check Co-Pilot II, the receiver battery voltage, sky-to-ground temperature differential and other functions before each flight.
- If the Vertical Sensor Module is not installed, use the "Do Field Calib." screens to perform a manual infrared calibration at the beginning of each flying session, or whenever the weather changes significantly. See "Preparing to fly," later in this manual, for details.

Flying with Co-Pilot II

General flying information

Note: This section discusses unique aspects of flying with Co-Pilot™ II. 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 II makes it easier to learn to fly, but it cannot teach you how to fly—only an experienced flyer can do that.
- Co-Pilot II 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.
- Flying with Co-Pilot II is different from normal flying. When Co-Pilot II 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 by adjusting stick priority and/or reducing gain settings.
- Initial flight tests, adjustments and trimming should be done by an experienced pilot.
- If you can control Co-Pilot II with your transmitter, you can have the best of both worlds: turn Co-Pilot II on when you need it, turn it off when you don't. Or use Co-Pilot II 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 gain is set too high. Land the aircraft and use the IRNet Programmer to reduce gain.
- Increase gain on windy days. The aircraft will fly more smoothly.
- Don't attempt intentional aerobatic flight until you gain experience. If the Vertical Sensor Module is not installed, Co-Pilot II reacts to inverted flight by applying 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, turn off flight stabilization or take advantage of Co-Pilot II's aerobatic Flight Modes (described later in this manual).
- If Auto Trim is off, and if you notice a small difference in trim when turning Co-Pilot II on and off, re-trim with Co-Pilot II off. Adjust flight angles in the "Preferences" screens to achieve proper trim with Co-Pilot on and off.
- 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. Take this into account when trimming and flying.
- 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 II makes landing much easier by keeping the plane level during the approach. However, stalls are still possible at low speeds.

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 the 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!). Co-Pilot II 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.
- *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.

Preparing to fly

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

- **Co-Pilot™ II preflight check** — before each flight, as part of your regular preflight check.
- **Infrared field calibration** (*only if the Vertical Sensor Module is not installed*) — before your first flight of the day, and any time there is a significant change in the weather.

Co-Pilot II preflight check

1. Turn on the radio receiver and transmitter, and turn on the IRNet Programmer.
2. Link up the Programmer with the IRNet Router (see "Using the Programmer" for details).
3. Navigate to the Co-Pilot II Main Menu.
4. In the Main Menu, select "Preflight," then press **ENTER**.
5. Check the information in each screen, until you return to the Main Menu (see the "Preflight" flowchart for details).

Infrared field calibration

Note: Infrared field calibration is only required if the Vertical Sensor Module is **not** installed.

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 that will be under the aircraft when it is flying. 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 7°F or less is rare. If a reading of 7°F or less is obtained, Co-Pilot II will turn itself off and you will not be able to use flight stabilization.
- Helicopters require extra precision to hover. For that reason, you should only use flight stabilization on a helicopter when the calibration reading is 20°F (11°C) or greater.

Performing the infrared field calibration

Note: Again, infrared field calibration is only required if the Vertical Sensor Module is **not** installed.

1. In the IRNet Programmer, navigate to the Main Menu.
2. In the Main Menu, select "Do Field Calib.," then press **ENTER**.
3. Position the aircraft with the nose pointed down (i.e., fuselage is vertical) or with one wing down (i.e., wings are vertical). Make sure the Main Sensor Module is not "seeing" any parts of your body during calibration. *While the aircraft is in this position,* press **ENTER** on the Programmer (and remember to keep the Programmer pointed toward the IRNet Router).

   Tip: It may be easier if two people perform step 3. One person can hold the aircraft nose down or wing down at arms length, while the other person operates the Programmer.

4. The Programmer will display the results: Good, Okay, Bad or OFF.

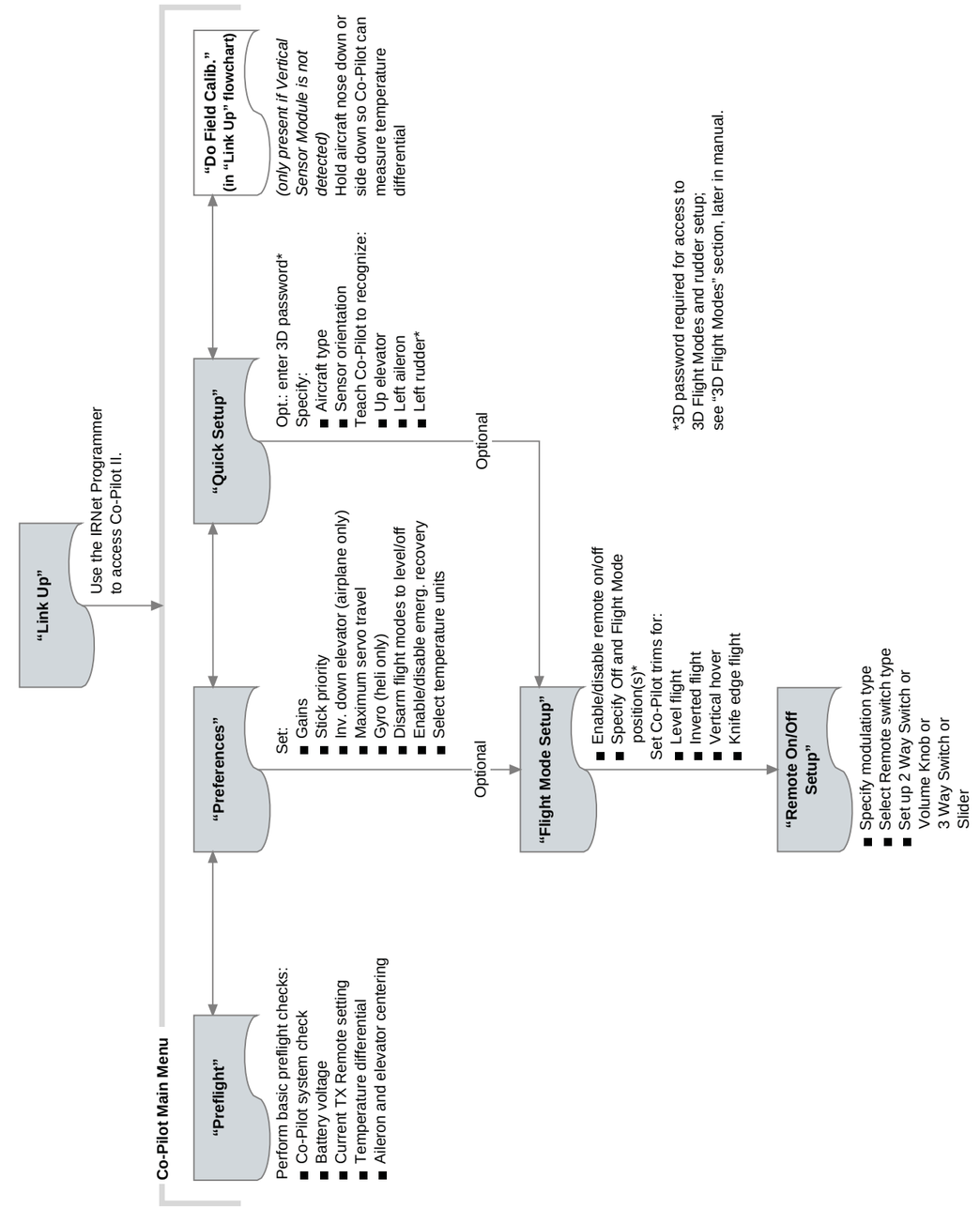
   Note: If the Programmer displays OFF, weather conditions do not permit use of Co-Pilot II. Flight stabilization has been disabled and cannot be used at this time.

5. Press **ENTER** to return to the Main Menu.

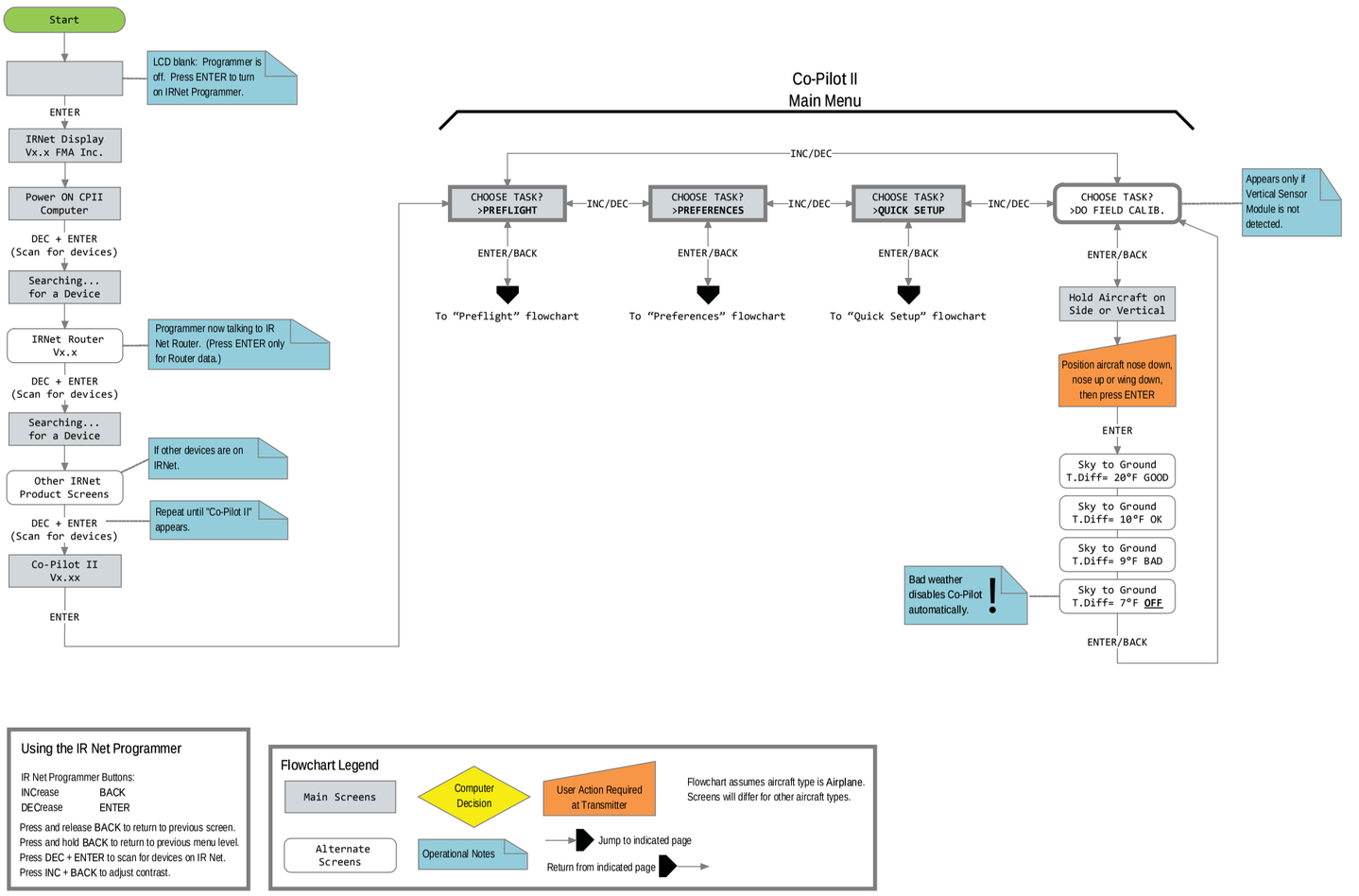
Overview

Showing organization of flowcharts that describe Co-Pilot II IRNet Programmer screens

Tip: The entire flowchart on one page can be downloaded from *www.fmadirect.com/support_docs/item_1275.pdf*.



Link Up



Using the IR Net Programmer

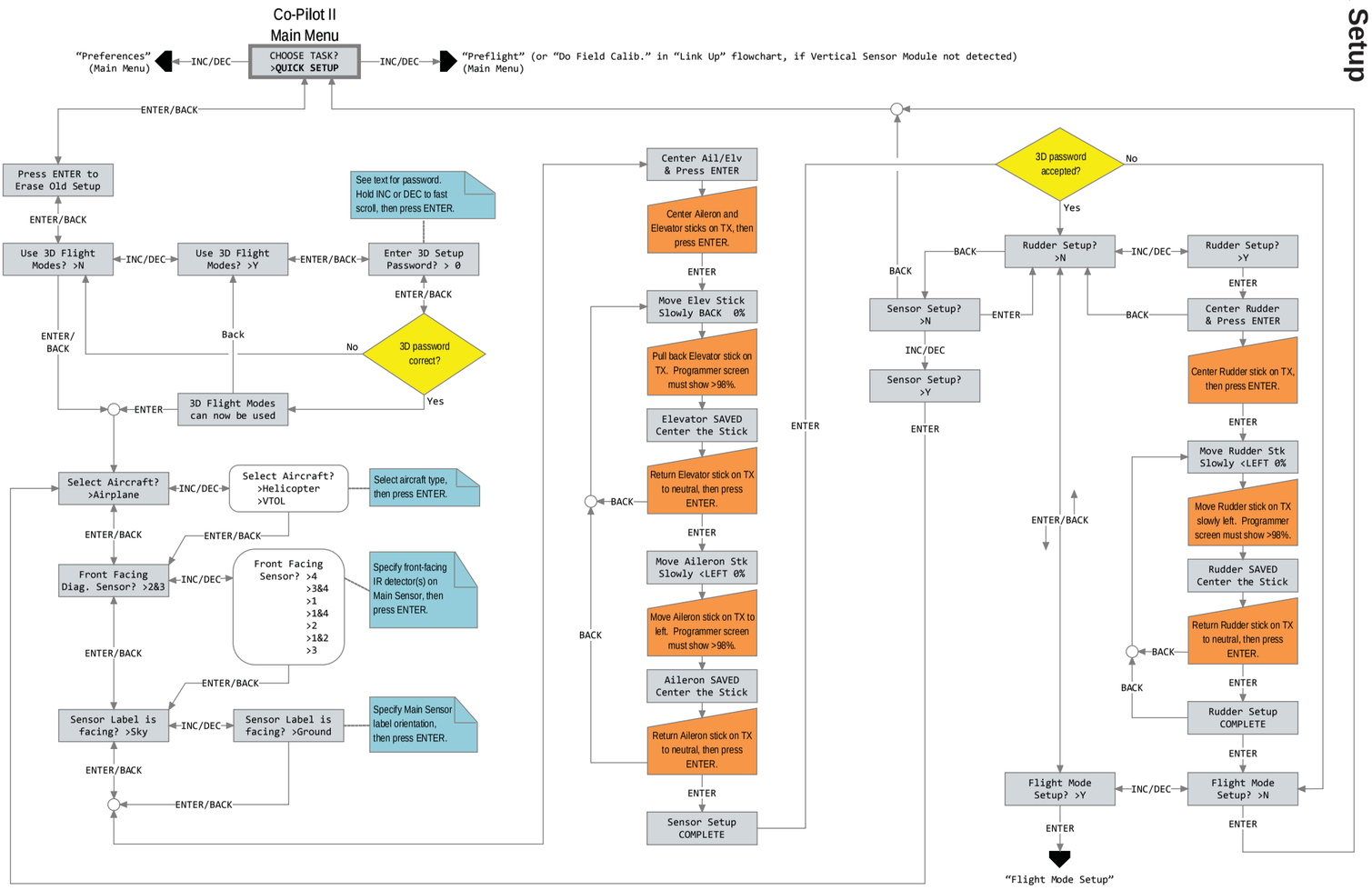
IR Net Programmer Buttons:

INCrease	BACK
DECrease	ENTER

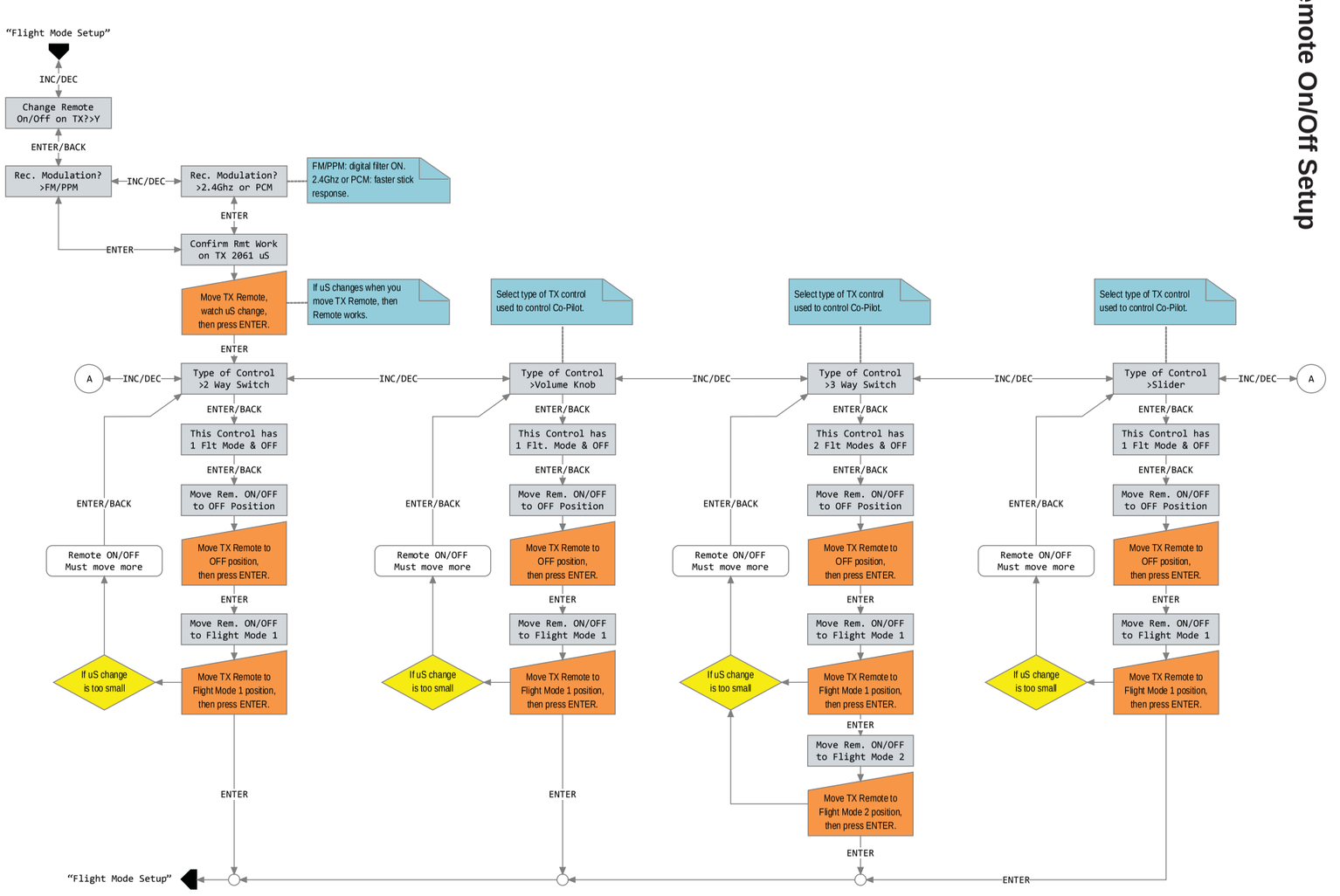
Press and release BACK to return to previous screen.
Press and hold BACK to return to previous menu level.
Press DEC + ENTER to scan for devices on IR Net.
Press INC + BACK to adjust contrast.

Flowchart Legend

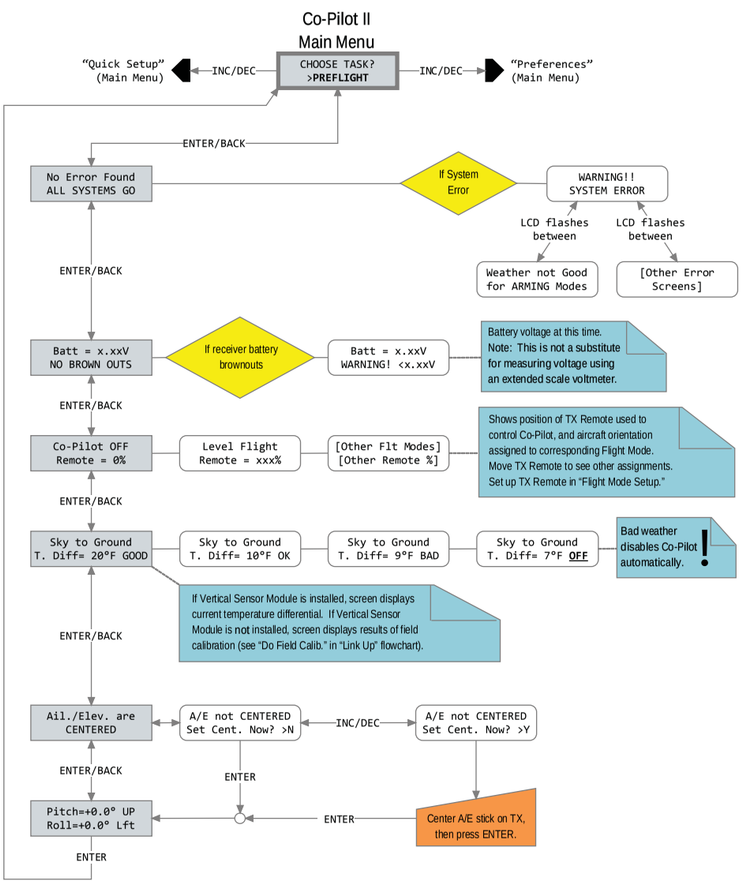
Quick Setup



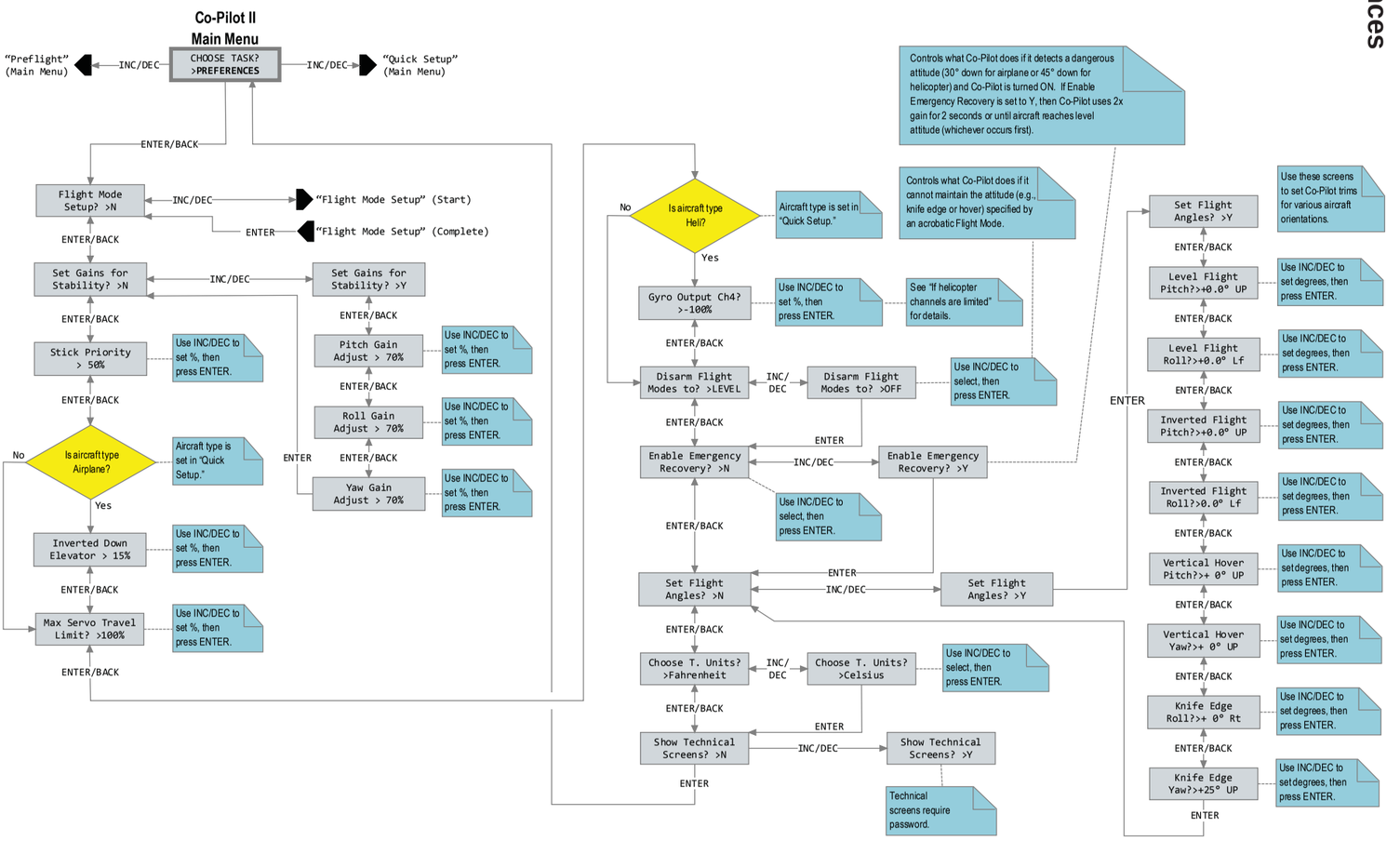
Remote On/Off Setup



Preflight



Preferences



Flight Mode Setup