Version 2

Sky Limit™

Altitude Limiter for R/C Planes

The *Sky Limit* is a tiny circuit board that installs in your R/C aircraft and monitors your altitude and flight time. When your plane reaches a specified altitude or time limit the *Sky Limit* will turn off the motor (or reduce the engine to idle).

The *Sky Limit* Programmer is used to change the *Sky Limit* settings. The Programmer features an LCD display and push-button controls. It plugs into the *Sky Limit* while your plane is on the ground and allows you to specify limits, select features, and view the peak altitude of your flight.

This instruction sheet covers the instillation and operation of the *Sky Limit*. A separate instruction sheet (packaged with the Programmer) provides details on using the Programmer. Read both before using the *Sky Limit* in your plane.

R/C Connector Polarity

R/C servos use a standard 3-pin connection scheme. Although the wire color may vary from brand to brand, the function of each wire/pin is the same. The *Sky Limit* has color-coded "bumpers" to aid in connector alignment.

Name	Symbol	Wire Color	Bumper
negative or ground	–	Brown or Black	Black
positive	+	Red	
signal pulse	⎍	Orange, Yellow, White, or Blue	Yellow

INSTALLATION

Complete your radio installation before installing the *Sky Limit*. Check the transmitter reversing, end points, failsafe, and trim adjustments for the throttle channel. Insure that the servo or speed control responds as expected to movements of the throttle stick. Now you can remove power and install the *Sky Limit*.

The *Sky Limit* has three connectors: a three-pin connector on the circuit board, a BLACK connector, and a BLUE connector.

1. Find the throttle channel on your receiver (often this is channel 1 or 3).
2. Unplug your throttle servo or speed control from this receiver channel.
3. Plug the connector you just removed into the 3-pin connector on the *Sky Limit* circuit board. **Position the black or brown wire toward the black bumper for proper polarity.**
4. Plug the BLACK *Sky Limit* connector into the receiver throttle channel. Make sure the polarity is correct.

You might have the red wire removed from your speed control connector (to disable the BEC). This is not a problem. Plug that connector, as is, into the *Sky Limit* circuit board. Do not remove a wire from the *Sky Limit*'s BLACK connector.

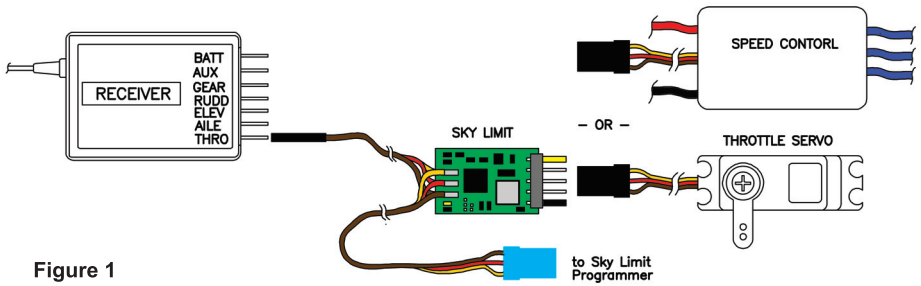

Figure 1

2. The restart operation is instantaneous when your plane descends below the altitude limit. You do not need to move the stick to any particular restart point. In short, the elevator will lock in your selected position whenever your plane is above the altitude limit and be under normal transmitter control whenever your plane is below the limit.

Note: **Never install the Sky Limit on the elevator channel unless you have it programmed for Elevator Mode.** You should be familiar with the *Sky Limit* and the flight characteristics of your plane before attempting to use Elevator Mode.

Depending on your choice of elevator position, your plane could enter an unusual flight attitude when the altitude limit is reached. Keep flying and adjust other controls (like the throttle) as needed. Normal elevator operation will return as soon as your plane descends below the limit.

HAVE FUN!

Thank you for purchasing the *Sky Limit*. Please feel free to contact us if you have any questions or comments. — Enjoy!

Winged Shadow Systems
Innovative Electronics for Model Aviation

Sky Limit™
Altitude Limiter for R/C Planes

SPECIFICATIONS

Input Voltage/Current:
3.4V - 10.0V / 8.0 mA max.

Size (circuit board):
0.95 x 0.60 in. (24.1 x 15.2 mm)

Weight (with wires & connectors):
0.17 oz. (4.8 grams)

Altitude Limit Range:
50 to 9999 ft (15 to 3050 m)
Above Ground Level (AGL)

Time Limit Range:
5 to 9999 seconds

WARRANTY

We want you to be happy with your purchase. If you are not satisfied with any product purchased directly from us, return it within 30 days for a full refund of your purchase price. We also provide a one-year replacement warranty on any device that stops working properly - regardless of cause (even crash damage).

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Sky Limit™
Altitude Limiter for R/C Planes

- Cuts the throttle at your specified altitude
- Works with Electric, Glow, and Gas models
- Timer for ALES and F5J-style electric sailplane competition
- Bonus features: Peak Altitude Capture & Elevator Mode

The BLUE connector is used to connect the *Sky Limit* Programmer. During flight, this BLUE connector is left unplugged. Place it in an accessible location.

Installation Tip: For a permanent installation, you can use a charging port (like the MPI 2590 or Ernst LXE965) and a JR-type servo extension for easy programmer access from the outside of your plane.

Location

Place the *Sky Limit* circuit board anywhere inside your fuselage or radio compartment. You can mount it with a small patch of Velcro® or double-sided foam tape. You can also simply wedge it into place with a piece of soft foam – just so it doesn't bounce around.

The *Sky Limit* measures tiny changes in atmospheric air pressure to calculate altitude. On most models, the inside of the fuselage is an excellent mounting location. The fuselage volume acts as a buffer against localized high or low pressure. If you must mount it on an exterior surface, choose a position with low air flow (like the fuselage side aft of the wing). Air passing over a surface creates a low pressure region (after all, airplanes fly by creating a low-pressure region above the wing), so mounting the *Sky Limit* on top of the wing would result in altitude measurement errors.

OPERATION

When new, the *Sky Limit* has both the altitude limit and timer turned off. In this configuration your throttle should respond normally – just as if the *Sky Limit* was not installed.

For electric motors, make sure the motor turns off when the transmitter stick is down in the idle position. For glow and gas engines, adjust your servo throw and linkages for a nice, reliable idle with the stick at idle and the trim up or neutral. If your R/C system has a fail-safe feature, be sure the throttle is shut down if signal is lost.

You are now ready to plug in the Programmer and choose your settings. See the Programmer instruction sheet for details.

"Throttle to Idle"

During setup you will be prompted with the message "*Throttle to Idle*". This is when the *Sky Limit* learns the throttle setting to use when a limit is reached. **Be sure the throttle stick is down before proceeding.**

What to Expect

When your plane reaches your altitude limit the throttle will shut down. To restart, you must:

1. Descend below your limit altitude, **and**
2. Move the throttle stick down to idle.

You can then advance the throttle stick and your motor/engine will respond normally. The requirement to move the stick down to "re-arm" the throttle prevents the motor/engine from ever starting up unexpectedly. This keeps you in control of restarts and prevents potentially dangerous surprise acceleration.

Keep in mind that momentum may carry your plane well above the limit altitude. If you immediately try a restart, the throttle may not respond. Don't be alarmed – this just means that the plane is still above the limit altitude. Allow the plane to descend farther; then move the stick to idle and try the throttle again.

Keeping it Simple

The *Sky Limit* has a number of optional features that add to its flexibility. While some pilots may find the features useful, others may find them confusing. To keep it simple, you can just set your altitude limit and fly.

The default feature settings are:

Timer=OFF, Restart=ON, Anti-Zoom=OFF

Time Limit

The timer is used primarily for motor glider contests where the motor is shut off at a specific time or altitude – whichever occurs first. The timer starts when your throttle is advanced above idle. While you are still on the ground, moving the throttle stick back to idle will instantly reset the timer. This way you can start your engine or test your motor without affecting your flight time. Remember to move the stick to idle to reset the timer right before you take off.

The timer can timeout on the ground if you keep the stick above idle for longer than your time setting. Move the stick back to idle to reset the time. Once you take off and reach an altitude of 35ft (11m) or more, the timer can no longer be reset. It will shut down your motor when the time limit is reached. The timer is disabled if the altitude limit is reached first.

Restart-After-Limit

With the Restart feature ON, you can restart your motor or engine after reaching an altitude or time limit. Simply allow the plane to descend below the altitude limit then move the throttle stick to idle. Your throttle control will then behave normally (until you reach your altitude limit again).

You can choose to turn the Restart feature OFF. In this case the *Sky Limit* will inhibit motor restarts after the motor is shut off in flight regardless of the reason: time limit, altitude limit, or if the pilot turns off the throttle. This is useful for contests where restarting your motor is not allowed.

The *Sky Limit* also features a Safety Restart feature. This option is available if you have turned normal restarts off. It will enable restarting at low altitudes – below 50 feet (15 meters). This allows you to power up to avoid a bad landing or to taxi after landing.

Anti-Zoom

Although the engine/motor will shut down when your plane reaches your altitude limit, the plane will continue to gain altitude due to its momentum. It will overshoot (or zoom past) your limit. For very fast climbing planes the zoom can be significant – 100 feet or more. The Anti-Zoom feature reduces overshoot by using the plane's vertical speed to calculate the momentum and trigger the shutdown sooner.

The *Sky Limit* also has a "Z-Factor" adjustment to allow you to fine tune the anti-zoom response. With the Z-Factor equal to zero, the anti-zoom function calculates how far the plane will overshoot if slowed only by gravity. This depends on the rate of climb and is the same for any plane. However, there are also factors that are unique to each plane, like throttle response time, propeller momentum, and aerodynamics. To compensate for these you can enter a Z-Factor value to further reduce the overshoot of your plane. You can enter a value between 0.0 and 9.9. Larger numbers have a greater effect and will result in a lower peak altitude.

You can use the Peak Altitude display and a few quick test flights to find the best Z-Factor for your plane. Start with a value of 5.0.

1. Make a flight high enough to reach your altitude limit.
2. Land; then check the Peak Altitude value.
3. If the peak is larger than your limit, increase the Z-Factor value. If the peak is less than your limit, decrease the Z-Factor value.
4. Repeat steps 1-3 as needed. It usually takes just a few quick flights to find the best value for a particular plane.

Your Settings are Saved

All your settings are saved within the *Sky Limit* airborne unit (not the Programmer). You do **not** need to plug the Programmer in after each flight – unless you want to change settings or view the peak or launch altitude.

OTHER USES

The *Sky Limit* can be used on receiver channels other than the throttle. You might want to activate a servo at a preset altitude or time to turn on a light, play a sound, or deploy a streamer. For this, you would attach the unit to an auxiliary channel and servo instead of the throttle. When prompted with the "Throttle to Idle" message just move the transmitter switch or knob to the position you want when the limit is reached.

Elevator Mode

Some modelers may want to experiment with using the elevator instead of the throttle to limit altitude. The Sky Limit has a special Elevator Mode for this application.

Consider the Elevator Mode experimental. It must be used with extreme care and is recommended only for experienced pilots.

In this mode, you install the *Sky Limit* between your receiver and the elevator servo. Refer to the Programmer instruction sheet (last page) for information on entering the Elevator Mode. When this mode is selected an '⇳' symbol will appear in the lower-right of the Settings screen. Operation is similar to the throttle mode, with the following exceptions:

1. The "Throttle to Idle" message is replaced with "Set Elev Trim". When you see this message you set the elevator trim on your transmitter. This will be the position the elevator servo goes to when the altitude limit is triggered. In most cases, use a small amount of down trim. Think about what your plane will do in various situations when the elevator goes to this position in flight.

(continued on back page)

Features for Electric Sailplane Competition

The *Sky Limit* has features that make it useful for many types of electric glider contests:

- Altitude-Limited Electric Soaring (ALES) events limit the motor run to a specific altitude and time. All planes start soaring at the same height (similar to a conventional winch-launch contest) so high-powered planes don't have an advantage.
- F5J is an international FAI competition class for electric-powered thermal duration gliders. While F5J has a time limit, it does not limit the altitude. Instead, points are deducted based on the altitude when the motor is shut off. [FAI competitors: please read the note at the bottom of this page.]
- The *Sky Limit* is also great for casual and club contests. It can turn popular "All Up, Last Down" events (where the plane with the biggest battery used to win) into a real test of thermaling skill.

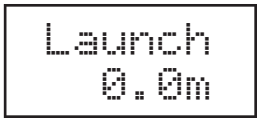
Here are details on a few features added specifically for glider competition. Some require an updated version of the *Sky Limit* airborne unit. If you have an earlier version please contact us regarding updating your unit.

Launch Altitude / Starting Height (ver 1.2+)

"Launch Altitude" (also called "Starting Height") is the maximum altitude between takeoff and 10 seconds after the motor is shut off. This is designed to capture the altitude of the powered climb plus any overshoot (zoom) after shutoff. It is captured by the *Sky Limit* and displayed on the Programmer after landing. This feature is primarily for F5J-style competition.

Restart Indicator (Tattletale) (ver 1.4+)

If you restart the motor in flight, the Launch Altitude will display zero. Although, most contests do not allow the motor to be restarted , you may want to enable restarts (all the time or only below 50ft/15m) to save your plane in an emergency. This feature will allow you to prove that your motor was, or was not, restarted.



Clearing Altitude Values (ver 1.2+)

The *Sky Limit* automatically resets the Peak Altitude and Launch Altitude values whenever the power is cycled or the programmer is plugged in. However, it retains the last flight data for display (so you can read it as often as you like, even after turning the power off and on). When your next flight reaches 35ft (11m) it overwrites the old data with new data. This way, you never need to remember to reset or zero the values. However, contest officials may want to see that the Launch value is zero before takeoff – so we have added a manual clearing feature. When either altitude value is on the display, hold the MOV button for 3 seconds until the value clears to zero.

ALES -- The *Sky Limit* is approved for League of Silent Flight LSF/AMA Altitude-Limited Electric Soaring contests in the United States.

F5J -- The CAIM/FAI F5J Working Group recently created a detailed specification for F5J altimeter/timer devices. Once formally adopted, only devices meeting this specification will be allowed in official FAI competitions. An important requirement in the specification is that devices have no configurable settings or adjustments. This means that the device cannot have any other capabilities or features. The *Sky Limit* is designed to be useful in a wide variety of applications and has many features and adjustments. Therefore, while the *Sky Limit* can be used in casual F5J-type contests and practice, it will not be approved for future FAI-listed events.