Thermal Soaring with the *Thermal Scout*™

This document provides tips for using the ***Thermal Scout Lift Finder for R/C Gliders****. A separate instruction sheet details installation and operation. Be sure to read those instructions before using the Thermal Scout in your plane.*

Thermals

Thermals start out simple enough. The sun heats the ground; the ground warms the air near the surface; and the warm air expands and rises. But that's not the whole picture. Cool air sinks displacing the warm air creating conductive circulation. The resulting instability, while necessary for thermal production, creates turbulent swirls and eddies. As the thermal rises it moves with any prevailing wind and pulls in surrounding air. If that air is warm enough, the thermal will build in size and strength with altitude. While we can think of a thermal as a simple rising column of air, in actuality it is much more complex. Complicating matters further is the fact that all this air movement is invisible. Lift or sink – it all looks the same.

Human Perception

Although thermals are invisible, we can see the movement of our plane. But this too can be misleading. Figure 1 is the pilot's view of an R/C glider flying toward the pilot. Initially the plane is at point A. A short time later the plane is at point B. As the plane moves from A to B it appears to be rising. Our pilot sees it higher in the sky and assumes it is in lift. However, this is not the case.

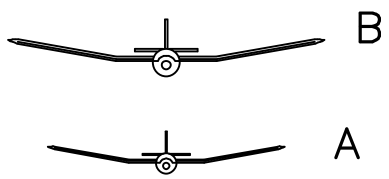

Figure 1 – The Pilot's View

In Figure 2 we see the same situation from a side view. The plane has actually lost altitude as it moved from point A to point B. The pilot sees it at a higher angle only because it is closer. In general, flying toward the pilot will make a plane appear to climb even when it is actually losing altitude. Conversely, flying away produces the illusion of a loss in altitude.

The *Thermal Scout*

The idea behind the *Thermal Scout* is to provide an unambiguous indication when an R/C glider is rising. When your plane encounters lift, the *Thermal Scout* will swing the rudder from side to side. Most gliders have strong yaw-roll coupling. This means that movement of the rudder causes rolling of the wing. So the rudder swing provides not just a tail wag, but wing rocking as well. The result is a distinctive movement that is visible from a great distance.

You can choose the amount of rudder movement in the *Thermal Scout* setup mode (refer to the instruction sheet for details). For less movement, use low rates or move the stick less in setup. You can also choose between smooth and stepped movement. Try a flight with each setting. The stepped movement produces a twitch that is especially clear for large slow models. For faster ships the smooth setting works fine.

For V-tail or flying wing gliders use one of the ruddervator or elevon servos instead of the rudder servo. Adjust the amount of travel to achieve a distinctive movement in flight. It might not be the same tail wagging and wing rocking as a conventional glider, but as long as it is a distinctive movement it will work.

The instruction sheet describes the technique of turning the control channel on and off when scouting for thermals and checking the boundaries of a thermal. Remember that the control channel should always be off during launch or powered flight.

Where and When

It's always best to fish where the fish are. The same is true of thermal soaring – fly where and when thermals are present.

• **Strong Sun –** Thermal soaring is fundamentally a solar-powered sport. Thermal activity peaks around mid-day and early afternoon when the sun is high and has had time to warm the ground.

• **Warm Ground –** Dark earth, buildings, parking lots, and plowed fields all absorb solar energy and warm the air. The mowed areas and dry weed patches that often surround our flying fields can be pretty good thermal sources too.

• **Cool Air –** It is a misconception that thermals exist only on hot days. Thermals are formed when the ground is warmer than the surrounding air. Spring and summer days after the passing of a cold front produce great thermals. Winter soaring can be fun too. When the air is well below freezing it doesn't take much surface warming to create good lift. Don't rule out hot days; just don't limit yourself to them. Remember that cool and warm are relative terms.

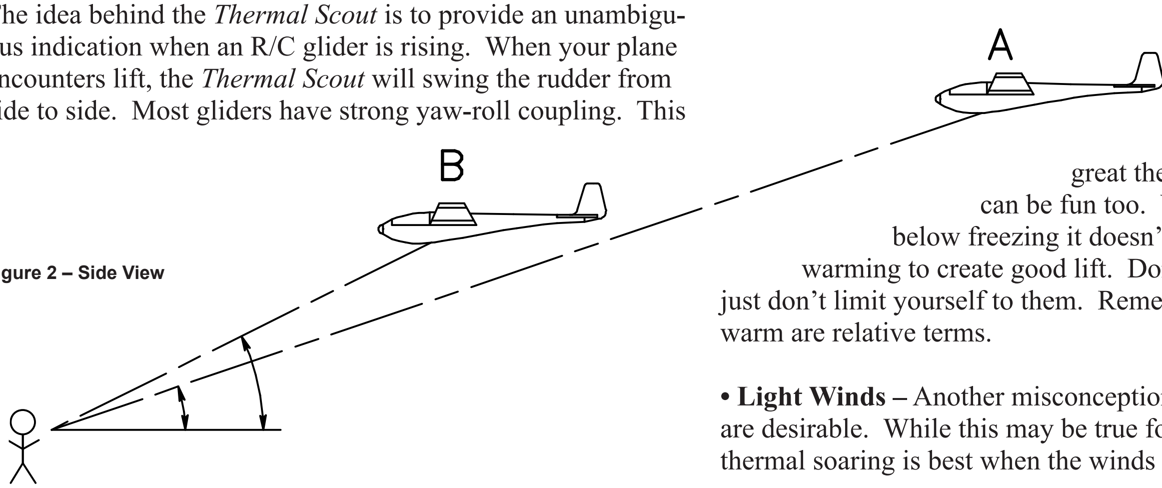

Figure 2 – Side View

• **Light Winds –** Another misconception is that strong winds are desirable. While this may be true for slope soaring, thermal soaring is best when the winds are light and variable.

Thermals move with the wind so it is difficult to stay in a thermal rising at one MPH while being blown downwind at 20 MPH.

• Cumulus Clouds – These fluffy, cotton-like clouds are usually a good sign. In fact, they indicate the top of thermals where the humidity in warm rising air condenses into water vapor in the cold air aloft.

• Launch High – Thermals coalesce and become better formed and larger with altitude. It is easier to find workable thermals at 400 feet or more above the ground. At 100 feet finding workable lift is much more challenging (this is part of the skill and fun of hand-launched gliders). At 2000 feet thermals are often strong enough for full-scale gliders weighing 1000 lbs and spanning 50 feet.

• Motor Off – If you fly a motor-glider, climb high then shut down the motor to search for lift. "Trolling" around the sky at low throttle will only create confusion.

• Watch Your Plane – Keep a close eye on how your plane behaves in flight. Flying by the edge of a thermal will often cause one wing to blip upward. Turn into that high wing. The *Thermal Scout* will soon confirm if you've found a workable thermal or just turbulence.

Flight Speeds

The *Thermal Scout* gives you the ability to clearly see when your plane is in lift. So, now you can optimize your flight speeds for better performance. Your glider's stall, minimum sink, and best L/D speeds all come into play. Stall speed is, of course, the speed where your wings stop creating enough lift to support the plane. Minimum sink speed is a speed, a little faster than stall speed, where your plane will lose the least amount of altitude over a given amount of time. Best L/D (Lift/Drag ratio) speed, a little faster still, is the speed where your plane loses the least altitude over a given horizontal distance.

For effective thermalling you want to fly at the best L/D speed while searching for thermals. This way you cover the most area with the least altitude loss. Once you find a thermal and begin circling, slow to the minimum sink speed. This gives you the greatest altitude gain.

In a full-scale glider these speeds are documented and can be compared to airspeed instrument readings. [For the full-scale Schweizer 1-26E stall, min. sink, and best L/D speeds are 28, 40, and 53 MPH respectively.] In a model we must live with estimates. Test fly your glider in calm air to get a feel for these speeds. Add up trim to find the point where the plane stalls. Now add enough down trim to achieve a glide speed where you can do gentle turns and circle without stalling. The controls may feel a little mushy and slow to respond, but the plane should not feel on the verge of stalling. This is your minimum sink speed. Now add a little more down trim until you achieve a glide where the control response is more positive and good maneuverability is obtained. Do not go so far as to cause a steep dive or tuck in. This is your best L/D speed. For most pilots this speed is just slightly faster than their typical glide speed.

The idea is to switch on the *Thermal Scout* and fly at this best L/D speed while scouting for thermals. This allows you to fly more quickly through areas of sink (downdrafts) and cover more area for a given launch. When the *Thermal Scout* indicates lift, switch it off, slow to minimum sink speed and circle in the thermal. Since most pilots tend to add a little back pressure on the stick when circling, slowing to minimum sink is a pretty natural instinct. This way you can leave the elevator trim at the best L/D speed and automatically slow while circling then resume a higher speed on straight flight.

Without the *Thermal Scout* many glider pilots tend to fly too slowly as they try to extend their flight time. This can result in lingering in sink and actually shortening the flight. With the *Thermal Scout* you know when you are in lift and when you are not. This allows you to speed it up a little and search more effectively.

Beware "Stick Thermals"!

Simply pulling back on the stick will make your plane rise. Of course, since your plane will slow and eventually stall, this altitude gain is short lived. This false lift is called a "stick thermal". You haven't found lift, you are just trading airspeed for altitude.

A major problem with audio variometers and older R/C lift finding products is false alarms. Minor movements of the elevator stick or turbulence produce the same indication as true lift. Responding to these false signals sends the pilot on a wild goose chase. We want to soar like eagles and hawks – not geese. The *Thermal Scout* uses an exclusive *Flight Filter*™ technology to analyze signals and increase sensitivity while reducing false alarms. Sustained lift must be found to trigger the output. Only extreme and prolonged stick thermals, or powered climbs, will produce false signals. If you fly smoothly while scouting for thermals, you can rest assured that each rudder wag is really indicating lift.

Happy Soaring! – Dave West, Winged Shadow Systems

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