



WARNING! ATTENTION! PELIGROSO! BEWARE! ACHTUNG! DANGER! etc!

THE TANGENT FLIGHT COMPUTER WILL TELL YOU TO FLY AT DANGEROUS SPEEDS WHICH COULD LEAD TO INJURY AND DEATH!!! The TFC doesn't know anything about your glider's stall speed, its Vne (speeds never to exceed) or its maximum rough air airspeed. The **TFC will tell you to operate beyond these speeds. The TFC may also tell you to decelerate in a dangerous manner. You are responsible to know the limits of your glider and stay within them.** If you are not 100% absolutely certain that you can fly safely with a TFC, then please send it back immediately.

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RETURN POLICY:

We want you to be completely satisfied with the Tangent Flight Computer. If, however you find that it is not to your liking you may return the TFC within 30 days. There is a 10% restocking fee and the unit must be in as-new, resaleable condition. Arai Design will have the sole discretion on determining if the unit is returned in as-new resaleable condition. Prior to returning the unit you must contact Arai Design and request a return authorization. At that time we will ask you to describe the problems you are having and of course we will try to help you. If you still feel you don't like the TFC we will take it back under the conditions described above.

THE TANGENT FLIGHT COMPUTER

Version 2.10

The operation of the Tangent Flight Computer (TFC) is simple once you understand the structure of the interface. The interface consists of the **Display**, the **Keypad**, and the **Audio**. The following gives a description of the Display and Keypad, followed by a quick tutorial. Lastly, the Audio is discussed.

The DISPLAY:

The TFC Display consists of **pages of fields**.

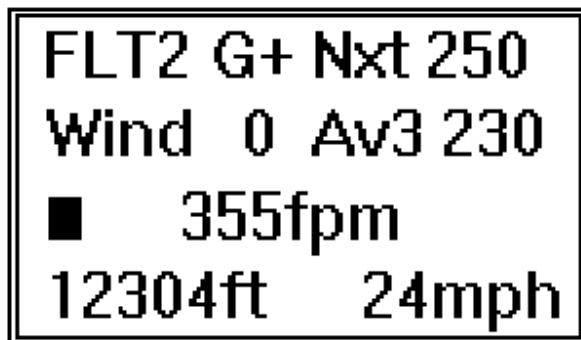
A PAGE is made up of **fields** of related information. The pages are organized like a slide carousel, so that if you keep flipping through pages in one direction you will come back to the beginning again. There are two types of pages: The first is a **dense page**, which may consist of more than one field per line, but the whole page is always visible in the display. The second type is a **list page**, which has only one field per line, but may have many more items on the page than can be displayed at once.

A FIELD, is each item of information on the display. The **active field** is the one which has the **cursor** blinking to its left. Fields may be of four types:

1. **Information only**. No user changes are possible.
2. **User input**. Values may be quickly changed.
3. **Secure user input**. For changing values to fields that contain information that one would not want to change accidentally, such as your altitude while flying.
4. **Title field**. Which is used for changing pages using the + or the - keys. The **title field** is the field in the upper left hand corner of the display.

More on the difference between the types later.

A sample page is shown below:



FLT2 is the **Title Field**.

The field showing **355fpm** is the **active field**.

The black box is the **cursor**.

THE KEYPAD:

The Keypad has six keys: The two **arrow keys** (<== & ==>), the **increment (+) key**, the **decrement (-) key**, the **?! key**, and the **S2F key**.

The **Arrow Keys** move the cursor on the display, one which points up and to the left (<==) and the other which points down and to the right (==>). The up arrow moves the cursor up or to the left, the down arrow moves the cursor down or to the right.

The **+/- KEYS**, which are used for increasing (+) or decreasing (-) a field value.

The **?! KEY** which has two functions. The first is for **HELP**. Holding the **?!** for about 1/2 second will give you information about the current active field. Not all fields have specific help, so a general description of the keys is given. This Help feature is really only intended for on-the-ground use if you forget how to do basic things.

The second **?!** function is to accept a change to a secure field, (the computer world equivalent of the "Enter" key.)

And last, but not least is the **S2F KEY**, which is the "thermalling arrow" icon. This key also has two functions. The main function is to toggle (switch) back and forth between speed-to-fly (gliding) mode and climb mode.

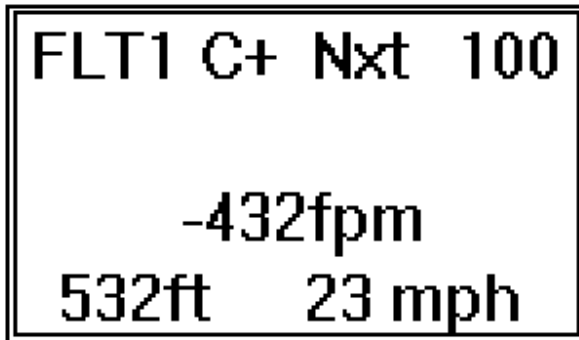
The second function of the **S2F key** is to exit from editing a secure field without accepting any changes made while editing (equivalent to an "escape" key.)

THE QUICK TUTORIAL:

This is the description of what you need to do to get around the TFC.

The thought behind the display of the TFC is to have a simple method for moving around a page, changing information, and moving to other pages.

Starting with moving around a page. The TFC powers up in the **FLT1** page, as shown below:



This is a **dense page**: the entire page is displayed at once.

The **arrow keys** (<== or ==>) are used to move the cursor to the next field, in either direction. The cursor is always at the left side of the field, sometimes on the first character of the field. The field with the cursor is the **active field**.

Click the ==> key to move the cursor to the **C+** field. This field is to remind the pilot whether the audio is in **C**limb mode or **G**lide (S2F) mode. + means to fly faster, - means to slow down.

Click the **S2F** key. You will see the **C** change to a **G**. You don't need to have the cursor on this field to switch back and forth. The **S2F key** works no matter where you are.

Click the ==> again. The **Nxt** field should now have the cursor on it. This is the "next expected climb" or "McCready speed ring" field. This is a **user input** field, which allows quick changes to its value.

Click the + key. You will see the value in the **Nxt** field change.

Click the ==> key again, moving the cursor to the **climb field**. This field shows the instantaneous rate of climb. While the climb field is active, you can use the +/- keys to turn the audio from off to low to high and back again. This is a special function: Audio level is also selectable on the Vario Setup page.

Now Click the ==> key until the cursor is on the altitude field (the field with altitude units attached to it, ft (feet) in the figure above).

The altitude field is a secure user input field. To adjust the altitude, the altitude field must be put in **edit mode** by holding the + or - key for about 1/2 second, at which point the cursor will change to an under_score. Now pressing + or - will change the character or digit marked by the cursor. Use the arrow keys to move to a different character or digit. When you have changed the field to what you want you have to choices. Pressing the ?! key will accept the change and restore the cursor. Pressing the **S2F** key will reject the changes you made and restore the field to it's original value. This protection prevents you from accidentally changing a field in the air, such as re-adjusting your altitude.

Click the **?!** key to accept your change .

Some fields allow rapid changing of information by holding the +/- key to accelerate the changes. This class of fields are designed to be quickly changed in flight, and includes fields like head/tail wind, next climb, ballast, etc.


Clicking the **==>** key again will bring the cursor to the airspeed field. This is an **information only** field and is not adjustable.

Click the **==>** key again and you will see the cursor go to the top left corner of the display. Remember that the **FLT1** page is a **dense page**. In a dense page the cursor "wraps" around the display. If you click the **<==** key you will see the cursor go back to the lower right corner of the display. Holding the **==>** or the **<==** keys will cause the cursor to jump to the lower right field or the title field, respectively.

With the cursor in the **title field** (the top left corner) you can use the + or - keys to move to other pages. Again, remember that the pages are organized like a slide carousel. Click the **+ key** several times. The pages change. Keep clicking the **+ key** until you come back to the **FLT1** page.

If you get lost, move to the title field and hold the + or - key for about 1/2 second. The display will jump to the first page and start flashing, at which point let go of the key.

With the cursor in the title field, click the **+ key** until you are on the **Vario Setup** page. This is a list page, which means that there is more information contained in this page than will fit in the display at one time. When you arrive at the **Vario Setup** page it will look like this:



```
Vario Setup
Audio Level  Lo
Auto Switch: On
Total Energy  On
```

Move down one field (using the **==>** key) to the **Audio Level** field.

Click the **- key** once to turn the audio off. Click the **+ key** once to turn the audio to low. Click again to turn the audio to high.

If you continue to move down the **Vario Setup** page you will eventually come to the **software revision** field. Below this point are five fields that contain the calibration coefficients of the vario. **DO NOT CHANGE THESE!!!** Doing so will cause altitude and airspeed to be inaccurate,

rendering the TFC **TOTALLY USELESS!** These are secure fields, so if you accidentally find yourself editing one, you can hit the **S2F** key to exit without changing the value.

To quickly move back to the title field hold the **<==** key for approximately 1/2 second and you will end up back at the top of the page. Holding the **==>** key for 1/2 second again will cause the cursor to move to the last field in the list page.

You now should have the idea of how to move around in the TFC. As you can see, there are lots of things in this page and other pages which the user can adjust. These are fully explained under the descriptions of each page.

THE AUDIO SYSTEM:

The Audio System has two modes:

The first mode is the normal **climb mode** that the vario comes up in when first turned on. This is similar to other varios in that it has an increasing interrupt, increasing pitch audio tone for lift and a steady, decreasing pitch tone for sink. What is different from most varios is that the audio is more sensitive at the lower climb rates, and tapers off as the climb rates increase. This gives you the most sensitivity for working weak lift.

The second mode is the **speed-to-fly mode**. This mode is used to tell the pilot to speed up or slow down according to the speed-to-fly theory. The "**speed up**" tone is the lower in pitch (like a vario in sink,) while the "**slow down**" tone is higher in pitch. Both tones have a variable interrupt rate, which gets further apart the further the glider is from the optimum speed. Two of the Flight pages have a field which inform the new user which mode the audio is in. This field is just to the right of the title field and consists of a "**C**" for climb mode or a "**G**" for glide or S2F mode. When the glider is at near the optimum speed, the audio goes quiet. The "**+**" indicates that you need to fly faster and the "**-**" indicates that you need to fly slower. The width of the "dead-band" around the optimum speed is selectable with the **S2F deadband**.

Controlling which mode the TFC is in is done by one of two methods, manually or using the unique **Auto Switch** feature in the TFC.

The manual method is used when the Auto Switch feature is turned off. Switching between the two modes is done by clicking the **S2F key**. When you do this you will hear the sound of the audio change and you will see the "**C**" change to a "**G**" or visa versa. The TFC will stay in its current mode until the **S2F key** is hit again.

With Auto Switch turned on, the TFC will automatically switch from Climb to Glide and back again. Switching from Glide to Climb is done by detecting that the glider is climbing for more than "**Climb Time**" seconds and then switching over. Switching from Climb to Glide mode is done similarly. The TFC looks for the glider to be sinking for more than "**Sink Time**" seconds before switching.

Manually changing modes is still possible with Auto Switching enabled. Clicking the **S2F key** will force the mode to toggle. Auto Switching will now be disabled for "**Hold Time**" seconds, keeping the TFC in its new mode. (Climb, Sink, & Hold Times are user settable: See the description of the

S2F Setup page.)

GETTING READY FOR YOUR FIRST FLIGHT

The TFC is shipped in a fully charged condition and should be ready to go. However charging is recommended. To charge, simply plug in either the DC wall charger or the cigarette lighter adapter and turn the unit on. Battery charging is now fully automatic.

ENABLING THE AUDIO. The first thing you will want to know how to do is to turn on the audio. This is done by moving to the rate of climb field (the field with the climb units, e.g. "210fpm") and then using the **+ key** to turn on the audio. There are two levels of audio; hit the **+ key** once and your in low, again and your in high. Use the **- key** to lower the volume or turn the audio off.

ADJUSTING THE ALTITUDE. The next thing you want to do is adjust the altitude. This is a secure field, so it requires that you hold the **+ or - key** to get into edit mode. Move the cursor to the digit that you want to adjust and change it. You will notice that when changing the more significant digits (more to the left) that the less significant digits may change. Because of this you will find it easiest to change the most significant digit first, then move the cursor to the right to change the others. Then hit the **?!** key to accept the change or the **S2F** key to cancel the changes.

Since the unit powers up in Climb mode, you could now go flying and use the unit as a regular vario, however you probably want to know more about the speed-to-fly functions. The most important is the **S2F** key. This toggles the vario back and forth between Climb and Glide modes. The **FLT1** and **FLT2** pages both have a speed-to-fly indicator field, which is used only as a reminder of which mode your in. "**C**" stands for Climb mode and "**G**" stands for glide mode. In Glide mode the indicator may show **G+** to indicate that you need to fly faster and **G-** to indicate that you need to slow down. This is so that if you forget what the tones are in Glide mode you can look over to the display for a reminder.

Now for some of the speed-to-fly stuff. The most important adjustment for most gliding is the next expected climb or MacCready setting, which is the field called **Nxt** on the TFC. This field is incrementable by 50fpm increments. Simply move the cursor to the **Nxt** field and change it to the desired setting. I recommend that you not get too carried away with this setting, as it will have you racing to the ground if you set it too high. I usually set the MacCready setting to 100-200fpm for weak days and 300 for moderately strong days, with 400-500 for the really booming days.

The other setting you may wish to use is the head/tail wind setting (**Wnd**). Tail winds are positive numbers and head winds are negative. The **FLT1** screen omits the **Wnd** and **Av** fields so that the display is simpler to read, but once accustomed to the display you will find **FLT2** page the most useful.

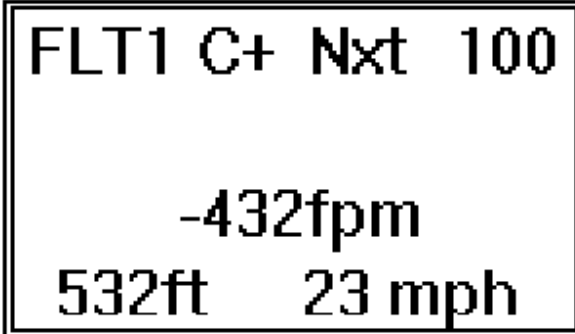
Mounting the speed probes: There are two speed probes, the straight one measures pitot pressure (also known as stagnation) pressure and the right angle brass one measures static pressure. Unclip them and mount them so that they are as far forward as possible, with the brass tube rotated away from the body of the vario. Make sure that the hoses are not kinked.

Clamp it on and go flying. You will find that the Glide mode audio takes a bit of adjusting to get used to. The rate of climb field reads the same in both Glide and Climb modes so you can see when you are going up. You can tell when you are in a thermal without looking at the vario because the audio will be telling you to slow down below min sink. That's when you look over and see if you want to switch to Climb mode and start circling. Of course if you use Auto Switching the transition from Glide to Climb is automatic.


DESCRIPTION OF FEATURES:

Now to describe what all the features do and how to set them. This is organized by page.

FLT1 and FLT2 : The Intro and Advanced Flying Pages



FLT1 C+ Next 100
-432fpm
532ft 23 mph



FLT2 G+ Next 250
Wind 0 Av3 230
■ 355fpm
12304ft 24mph

The only difference between these two pages is the absence of the Wind and Average fields in the FLT1 page. The purpose of having the screen with less information is to have a less cluttered display while getting accustomed to the TFC.

The fields are:

Title Field: FLT1 or FLT2

Speed-to-Fly Prompt: **C** or **G** to indicate **C**limbing or **G**liding. "+" means fly **faster**, "-" means to fly **slower**. This is a reminder while getting used to the audio sounds of the TFC. The +/- are useful for S2F information while the audio is in climb mode.

Next Climb (Nxt): This is the McCready speed ring setting. It is adjustable in 50fpm increments.

Wind Strength: This is the **Head** or **Tail** wind component. It is adjustable in 2mph increments. It is not available on FLT1.

Averager (Avx): This is the climb rate averager with 5 presettable time constants. The display will show Av1, Av2, Av3, Av4 & Av5 representing 10, 20, 30, 40 & 50 second time constants, respectively.

Rate of Climb: This is the instantaneous rate of climb. The audio level can be set while this field is active by pressing the + or - keys.

Altitude: Altitude is a secure field. You can adjust altitude by holding the + or - keys until the cursor changes from a blinking block to an under_score. Use the arrow keys to move from one digit to the next and the the + or - keys to change values. The ?! key will exit and save; the **S2F** key will escape, exiting without saving.

Velocity: Airspeed in miles-per-hour. This is not adjustable. Airspeed shows the "true airspeed", which is to say that it is compensated for air density, but not for position error.

The Final Glide Pages:

The Final Glide Calculator has 3 pages: FG1, FG2 and Goal Setup, in order of their appearance in the stack of pages. Before describing the fields in each of the pages you should understand the principles behind final glide.

In competitions much time can be wasted in climbing too high before going on your final glide to goal. You typically end up having to fly at dangerously high speeds in order to cross below the typical 1000ft limit and if you have greatly overestimated you may have to circle down over the goal to get low enough to be scored. Mean while the pilot who knows when to leave that last thermal will have finished 5 minutes ahead of you at 100ft over the finish line. Stunning photo finish versus Unidentified Flying Orbitron.

How do those guys do those final glides? In modern hang gliders with glide ratios around 12:1 it has become much harder to visually estimate how much altitude you need to make goal. This is particularly true in a tail wind where your actual glide over the ground can be much higher (20:1 in an 18mph tailwind!) This means that you will tend to have difficulty believing that you are high enough until you are too high. The way it is was done prior to the Tangent is to mark an 8:1 and 12:1 altitude on your map at several easily identifiable points. Then when coming in you could at least know approximately what sort of altitude would be required. The problem was you never really knew how the wind would affect your glide.

The speed to fly theory comes to the aid of us all. In it's normal use the S2F theory is a model that represents starting off at the top of a thermal, gliding to the next and climbing back up again.

Given your ability to guess the the climb of that thermal you could maximize speed, assuming you can afford to fly fast enough. What is unknown in the normal model is how far away the next thermal is and of course one's estimate of it's climb rate is only a guess.

In the final glide scenario the S2F model is reversed: The starting point is the climb in the last thermal followed by the glide. In addition it's easy to know how far away goal is, how high goal is, and since the thermal is being climbed in before the glide, it is obvious that its strength is known. Wind speed can also be measured. Thus with every thing known the exact altitude required can be calculated.

It should be noted that the altitude required is not just the bare minimum goal can be made with, but the altitude that will result in the fastest time to goal. The minimum altiitude would be the altitude that you could fly best glide (a zero speed ring setting) and just arrive at goal. However for any given climb rate in the last thermal there is an optimum additional altitude that should be gained. The time spent climbing the extra altitude is made up by flying faster on the glide to goal.

The Tangent's Final Glide Calculator makes all these calculations for you based upon your inputs for distance, wind, climb rate and goal altitude. It starts with the polar you have selected. It scales that polar for your wingloading, including any ballast, and then scales it for altitude. The Tangent uses the altitude half way between the goal altitude and the required altitude. This is because the polar can change significantly along a final glide (8000 feet of vertical on a final is not unusual.) An example of how thorough the Tangent is.

Not only does the Tangent let you know how much altitude you need for final glide, it lets you constantly check to see if you are above or below the glide path as you head in on final. This allows you to adjust your glide according to how well it is going. A good glide (lift on route) will have have you increasing your speed. If your glide is going badly the Tangent will let you know so that you can do something before it is too late.

Now for the explanation of the final glide pages in the Tangent.

FG1 Page: The main Final Glide page

FG1	G+	fCL	300
DG	8.2mi	Wind	0
5583req		355fpm	
12304ft		24mph	

In **FG1** the **S2F prompt (G+)**, **Climb**, **Wind**, **Altitude** and **Airspeed** are the same as on **FLT1** or **FLT2**. Most people find **FG1** the easiest to use.

fCL is the final climb field. This field shows two different pieces of information depending on the whether the Tangent is in Glide mode or Climb mode. Calculation of the Altitude Required is

based upon what is shown in this field. While climbing it shows the averager (same as on page FLT2.) While gliding it shows the Nxt field value (the speed ring setting.) Changes can be made to this field and will change the Nxt field in the FLT1 and FLT2 pages.

DG is the Distance to Goal. This will increment in .2 mi or km. Holding the + or - will cause it to change in 1 mi or km increments.

Wind is as before. This field must be very carefully estimated or entered conservatively. Errors on the wrong side here will put you on the ground.

XXXXXreq is the **Altitude Required** to make goal. When this field is lower than your **Altitude** then you can make goal. This assumes that your estimate of DG and Wind are accurate.

FG2 Page: Final Glide in terms of Glide Angles

FG2	G+	fCL	300
DG	8.2mi	Wind	0
	355fpm	LDr	10.6
	5108ft	LDg	12.0

In **FG2 LDr** (L/D required) and **LDg** (L/D to goal) are used instead of altitude. I put this field in for people who like the Trimble Vertical Nav screen, but thinking in terms of L/D is less intuitive than Altitude Required. Also note that this screen omits airspeed. What is most useful about this page is that you can study how the speed ring setting and wind setting affect the L/D of your glider.

LDr is the glide angle that you will get given the conditions you have entered for **Wind** and **fCL**. Note that the distance from goal doesn't have any affect on **LDr**.

LDg is the physical ratio of your distance from goal to your altitude above the **Goal Alt**. In the example shown above, $LDg = (8.2 \text{ mi} \times 5280) / (5108 - 1500) = 12.0$.

Goal Setup Page:

Goal Setup	
Goal LZ:	500ft
Margin:	1000ft
Goal Alt:	1500ft

Set this information up before you take off so that you don't need to deal with it in the air.

Goal LZ: is the altitude (msl) of the ground at goal.

Margin: is the desired goal crossing height. 1000' is recommended. See discussion below.

Goal Alt: is the sum of the above two fields and cannot be set directly. This is the altitude that is used to calculate the Altitude Required.

How to Use the Final Glide Calculator

This is not only a discussion on the use of the Final Glide Calculator, but also a discussion on general considerations concerning final glides.

There are several things you should do before you even launch. First is to set the Goal LZ and Margin fields in Goal Setup. We recommend that Margin be set to 1000 feet. This does three things: 1) It will get you to goal below the typical 1000 foot limit set in most contests. 2) If you are used to coming in too high, it will make you more comfortable when Tangent tells you to go on final much lower than you would normally. Lastly it builds in a healthy margin in the event that the conditions on your glide path are less than favorable.

The next thing you should do is go to the **FG1** page. Move down to the **DG** (distance to goal) field and increment it up until the Altitude Required field shows an altitude that you feel you will be able to reach. The reason for this exercise is so that you can get a feel for how close to goal you will need to be before you need to switch to the Final Glide Page.

In flight when you think you are getting close to your last thermal, switch to the **FG1** page. Enter in your distance from goal into the **DG** field. Enter in the wind in the **Wind** field. If you are climbing, the **fCL** field will show your average climb and the Altitude Required will be calculated based upon this climb rate.

When your altitude is higher than the Altitude Required you are high enough to go on final. When you go on glide the **fCL** field will display the speed ring setting (Nxt field). **fCL** needs to be adjusted so that Altitude Required is less than your actual altitude. Now you follow the Tangents S2F tones as you would in any gliding situation. If you have entered in the correct values for wind and distance and you glide in air that doesn't have any surprises you will arrive at goal at 1000 feet.

As you get to within a mile or two from goal you will be able to see that you need to trim 1000 feet off, which is easily done with little risk.

Some pilots ask why the Tangent doesn't automatically remember the climb rate in the last thermal for use while gliding. The reason for this is that you will want to update your final glide as you are gliding in. This may require that the speed ring setting be changed. If you are flying with a GPS you should check your progress every mile. This is most easily done by setting the **DG** field ahead and checking the Altitude Required as the GPS distance from goal unwinds to match the **DG** field. If you are above the Altitude Required you can increase the **Nxt (fCL)** setting. This will increase your average speed and lower your glide angle so that you arrive at the desired altitude in the least time. Conversely if you are below the Altitude Required you should lower the **Nxt** setting until the Altitude Required is less than your current altitude. If you lower **Nxt** to zero and the Altitude Required is greater than what you have, you may need to find lift. Your decision to look for lift depends on whether you think that you will eat up your entire Margin (1000 feet in this example.)

There are a couple of things that are very important when doing final glides. Most important is the **Wind** factor. Always err on the conservative side with wind. If you figure the wind to be a 8 mph head wind, enter in a 10 mph head wind. If you estimate an 8 mph tail wind, enter in a 6 mph tail wind. Over estimating the wind will have disasterous consequences. You can see the effect of winds on Altitude Required by playing with the final glide calculator on the ground.

Another important factor is lift and sink on your glide path. We lied when we said that "with every thing known the exact altitude required can be calculated." The one thing we assume in that statement is that the average lift and sink on the glide will be zero. There are many times when that is not the case. Encountering lift along the glide is always welcome. You can compensate for it by increasing your speed ring setting (Nxt/fCL). Sink on the other hand can eat up your margin. You must consider the conditions you will encounter on glide. Some of the things to consider are:

1. Mid-day glides. If you are getting to goal while the conditions are still strong you might encounter large areas of sink. Late glides typically encounter more neutral or even bouyant conditions. Of course a mid-day glide may also encounter a large patch of lift. Keep an eye out for clues.
2. Clouds. Will your glide be under clouds or under blue holes?
3. Lee side or windward side of ridges. Making a long glide in the lee of a ridge may be accompanied by stronger sink.
4. Wind gradient. If you are making a downwind glide and you measure a 15mph tail wind at altitude, a wind gradient will mean that you will have less tail wind as you get lower. In this case you may wish to lower your estimate of tail winds.

We recommend that you spend some time with the Final Glide Calculator on the ground so that you can familiarize yourself not only with the layout of the screen, but more importantly how the various factors affect your glide.



The Final Glide Calculator is not intended for use in situations where life or property could be lost or damaged. There are too many variables that can be mis-estimated. A safe pilot will always have an alternate place to land at all times during a flight, and final glide is no exception. You should not rely on the Final Glide Calculator for safety!



The Vario Setup Page:



This is how the **Vario Setup** page appears when you turn to it. It is a **list page**, which means that there is more information than will fit in the display at one time. Use the **==>** key to move the cursor and scroll the display.

Audio Level: This tells you the setting of the audio. Can be set to OFF, LO, or HI. The audio level can also be set when the Rate of Climb field is active.

Auto Switch: Enables Auto Switching of the audio between Climb or Glide modes. See the description of the S2F Setup page for more information.

Total Energy: Turns on/off Total Energy. Also see sections on TE damping and TE Factor in the description of the TE Setup page.

Climb damping: Adjusts the damping of the Climb Rate. Adjustable from 1 (fastest) to 5 (slowest). Setting to 1 will be extremely sensitive, but very jumpy. 2 is usable, but jumpier than most people will like. 4 and 5 are very quiet, but slow. 3 is the default setting and is the setting used when comparisons are made to other varios. A setting of 3 is recommended.

Alt damping: This setting should be left at 2.

TE damping: This is the damping factor applied to the Total Energy system. It is adjustable from 1 to 5. 3 is the default setting and is recommended.

Audio Thresholds (+Aud Thld, -Aud Thld): These are the settings where the climb mode audio will turn on. The audio is turned off between Climb rates less than +Aud Thld and greater than -Aud Thld.

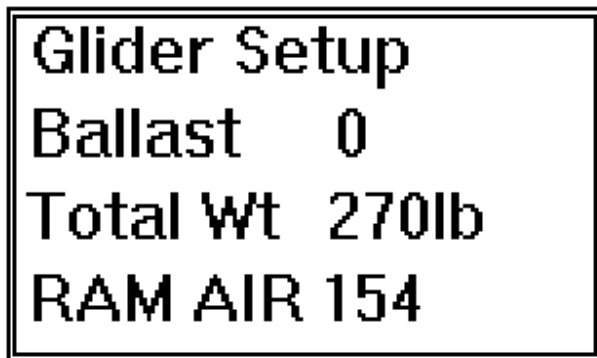
TE Factor: This is the total energy compensation factor, adjustable from .1 to 2. Values of less than one give less TE compensation, values greater than one give more compensation. If we were capable of measuring true compensated airspeed, this factor would stay at 1. You will find that the total energy will be over or under compensated. You adjust this number to your preference. A setting of .5 gives 1/2 the compensation, a setting of 2 gives double the compensation.

Avgr T: This affects the averager. Not recommended that this number be changed. If you insist, change the averager (Avx) time constant and see how this number changes.

SW REV #: This is the revision level of the software.

sc, of, av0, av1 & av2: These are calibration coefficients and should not be changed. **If you change these values the TFC may be rendered totally useless!**

The GLIDER SETUP Page:



The image shows a digital display with a double-line border. The text is as follows:

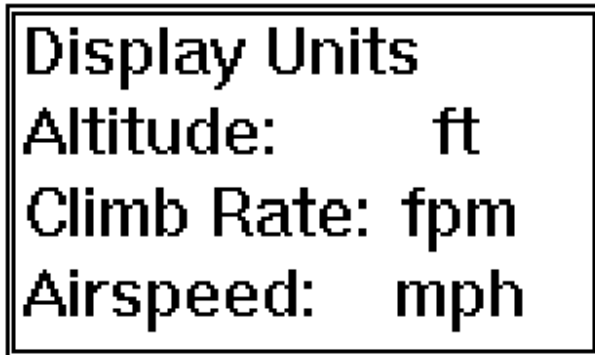
Glider Setup	
Ballast	0
Total Wt	270lb
RAM AIR	154

Ballast: The ballast weight in pounds. Changes to ballast are added to Total Wt and then the glider polar is recalculated based upon the new gross weight.

Total Wt: This is the weight of you, your harness, and your glider, without any ballast in pounds.

RAM AIR 154: This is the glider polar you have selected. To select or modify a polar hold + or - until you see the display change. See section on polars for more information.

The Display Units Page:



This page is for configuring the display units of the TFC to your preferred state. To change a unit move the cursor to the item you wish to change and hit '+' or '-' to change the unit. There are several different units for each field type.

Altitude: Choice of feet or meters

Climb Rate: Choice of feet/minute, meters/second or knots

Airspeed: Choice of miles/hour, kilometers/hour, meters/second or knots. The **Wind** (head or tail) field will be displayed in the same units as airspeed.

Weight: Choice of pounds or kilograms

Baro Press: (barometric pressure) Choice of torr (millimeters of mercury), inches of mercury, or millibar.

ASI Press: (pitot pressure) Choice of inches of water or millibar.

The RAW DATA Page:

RAW
749.4 torr
0.113"h2o
Prw 60205

This page has very little useful information for most users. The only meaningful fields are:

Barometric pressure: Displayed in torr, which is the same as mm of mercury.

Pitot pressure: Displayed in inches of water column.

The **SPEED TO FLY (S2F) SETUP** Page:

S2F Setup
Auto Switch: On
Sink Time 10
Climb Time 3

The S2F Setup page contains settings for various speed to fly parameters.

Auto Switch: Enables Auto Switching of the audio between Climb or Glide modes.

Sink Time: This is the amount of continuous time spent in sink that is required before Auto Switch will change the audio from Climb to Glide mode.

Climb Time: This is the amount of continuous time spent in lift that is required before the Auto Switch system will change the audio from Glide to Climb mode.

Hold Time: The amount of time that the TFC will remain in a new mode if the modes were switched with the **S2F** key.

Auto Avg: This is a time constant of the climb rate averager used by the Auto Switch system for making decisions about time spent in lift or sink. A smaller number increases the time constant. The default value is .150, just in case you change it. It is recommended that you do not adjust this number.

A Brief Discussion of the Auto Switch System

Auto Switching was created because pilots were nervous about gliding in glide mode which means without a vario. They were worried that they would fly through lift. The glide mode does tell you when you are in lift by telling you to slow down, but pilots still felt nervous.

The answer is the Auto Switch System.

The Auto Switch System works by detecting when you are in lift and automatically switching the vario to climb mode. There are three important time periods: Sink Time, Climb Time and Hold Time. Climb and Sink times are the amount of time spent climbing or sinking before the Auto Switch System will change the audio from Glide to Climb or Climb to Glide, respectively.

The Sink and Climb times are independently settable. Climb Time is typically set so that you can have the TFC quickly change from Glide to Climb so that you have Climb mode audio for detecting small patches of lift. Sink Time is typically set longer so that it won't switch back to Glide mode if you are working weak lift or you fall out the back of a thermal.

When you manually switch modes using the **S2F** key, the TFC will remain in its new mode for Hold Time seconds. This is useful if you are in very trash air or are circling in 50fpm sink. If you find that it reverts back to Auto Switch too quickly and you don't like having to keep hitting the S2F key, increase the Hold Time.

Deadband: In Glide mode, this is how far from the optimum speed you can be and have the audio remain quiet. This number is actually +/- which means that a setting of 2 keeps the audio quiet from 2mph too slow to 2mph too fast.

S2F tones (Too Fast, Too Slow): These are numbers that are proportional to the frequency of the tones that tell you that you are flying Too Fast or Too Slow. You may wish to change these tones according to your preference. The original settings of these tones are not the loudest possible and you may find that different set points are better suited to the combination of your TFC and your ears. To optimize, turn on the audio and switch to S2F mode. At rest the TFC will be telling you to fly faster. Use the **Too Slow** field to set it to where you like it. To set the **Too Fast** tone, gently blow into the pitot tube (straight tube) so that the TFC thinks you need to slow down. You will now hear the **Too Slow** tone and can adjust it to your liking. Alternately you can select the **Too Fast** tone by selecting a tone with the **Too Slow** tone and then copying that number into the **Too Fast** tone. Return to **Too Slow** to select that tone. You can even reverse them if you wish. The default tones are set up to be a lower frequency tone to indicate that you need to speed up, while a higher frequency tone indicates you need to slow down. If you don't like that scheme, you can reverse the tones so that higher frequency means speed up and a lower frequency

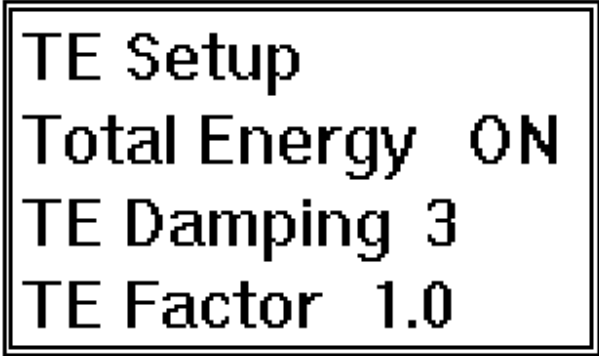
means to slow down.

S2F damp: This number can be reset so that the Speed to fly audio system is slowed down. If you find that in Glide mode the audio is jumping between slow down and speed up too quickly, you may wish to adjust this number. The recommended range for this number is .05 to .3, with the smaller number being more damped. The default value is .1.

Vel damp: This number controls the damping placed upon the airspeed. This number affects the Total Energy system and the displayed airspeed. The smaller the number, the more damped TE will be. It is recommended that you not change this, however if you insist the useful range for this number is .05 to .3, with the smaller number being more damped. The default value is .2.

S2F Rate, S2F Tmn: Affects the Glide mode audio. It is recommend that you not change these fields.

The **TOTAL ENERGY SETUP** Page:



```
TE Setup
Total Energy ON
TE Damping 3
TE Factor 1.0
```

Most of the fields on this page are also available in the Vario Setup page.

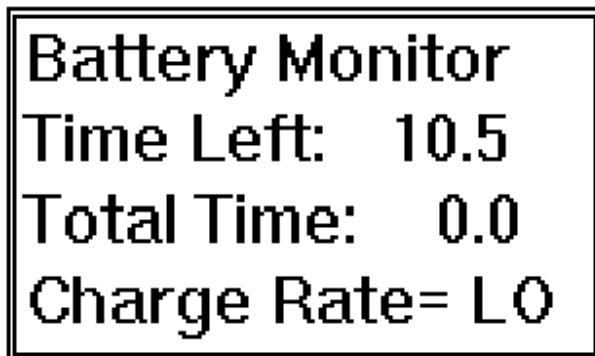
Total Energy: Turns on/off Total Energy. Also see sections on TE damping and TE Factor in the description of the TE Setup page.

TE damping: This is the damping factor applied to the Total Energy system. It is adjustable from 1 to 5. 3 is the default setting and is recommended.

TE Factor: This is the total energy compensation factor, adjustable from .1 to 2. Values of less than one give less TE compensation, values greater than one give more compensation. If we were capable of measuring true compensated airspeed, this factor would stay at 1. You will find that the total energy will be over or under compensated. You adjust this number to your preference. A setting of .5 gives 1/2 the compensation, a setting of 2 gives double the compensation.

TE climb, Climb, Airspeed: Just for curiosities sake, you can see how much compensation is being added by the TE system. The first of the fields is the rate of climb due to the TE compensation, without any climb due to elevation changes. The second field is the Rate of Climb field, and the third is the Airspeed.

The **BATTERY CHARGING** Page:



Battery Monitor
Time Left: 10.5
Total Time: 0.0
Charge Rate= LO

This page shows the state of the battery and the automatic battery charging. The TFC should be charged with its power on, as this the only way for it to monitor the charge state. A fully discharged battery will charge in about 5.5 hours. This is very useful if you find you are getting back late and plan to fly the next day. Of course you may charge the TFC in your car, just plug it into the cigarette lighter and turn it on.

Time Left: This is the amount of time that the TFC estimates that it has left on its battery. When fully charged this will read 10.5 hours, which is a conservative estimate of time remaining (most units will run 11 -12 hours on a charge.) Time Left will increase as you charge the TFC, stopping at 10.5 hours.

Total Time: This shows you the amount of time the TFC has been on since the last **full** charge. This number will reset to zero when the TFC is fully charged. If you forget to charge the TFC the night before and plug it into the cigarette lighter on the way up the hill, but don't get a full charge this number will not reset. This is so you can see that you are operating on partially recharged batteries.

Charge Rate= This shows the charge rate of the battery. When Time Left is less than 10.5 hours, the TFC will charge in the HI rate, which is the fast charge mode. After Time Left reaches 10.5 hours the TFC will switch the charge rate back to LO. The LO charge rate is suitable for long periods of time, but it is not recommended that you leave the TFC charging for more than a few days. Charge Rate will say **OFF** when no charger is connected.

Nicad VIts: This shows the voltage on the battery. The voltage of nicads is not a good indication of charge state, but it can be useful for diagnosis if you have a problem.

A NOTE ABOUT THE TANGENT FLIGHT COMPUTER & NICADS:

Contrary to popular belief nicad memory is not the problem people think it is. Memory is a property of nicads that if they are repetitively discharged only part way, they "remember" this and will cease to be able to provide full capacity down to lower levels of discharge. Memory can occur, but the key thing to remember is that it must be very repetitive, such as a satellite that orbits the earth in a charge/discharge cycle that is exactly repeated every day for years. You are very unlikely to produce this type of repetition in a variometer or 2m radio, thus memory is not an issue.

In an effort to prevent memory, people commonly discharge their batteries all the way, which leads to a much worse problem: reverse charged cells. Nicads in variometers and radios typically consist of multiple nicad cells (the TFC battery has eight cells.) Due to mismatches in capacity of the individual cells, one cell may discharge all the way to zero volts before the other cells. At this point this discharged cell starts to receive a reverse charge, which can permanently damage the cell. The likelihood of damage is also a function of the discharge current, so using a cordless drill until it ceases is much harder on the batteries than using a ham radio until it dies. Unfortunately, cordless drills are typically used all the way down, thereby seriously shortening the life of the batteries. In the case of the Tangent, it will automatically shut itself off before the cells are discharged all the way. In addition, the current drain of the Tangent is much less than that of a 2m radio while transmitting, so reverse charge damage is less likely to occur.

To summarize, don't worry about memory in nicads, and don't discharge them all the way. If you are uncertain as to how much charge is left, go ahead and charge them. This way you don't have to worry about your variometer dying in the middle of a great flight. Every so often you should discharge the Tangent all the way to see how many hours the nicads are capable of running.

COMPARING NICADS WITH ALKALINES

Some people don't like nicads, because they have lower capacity. While this is true, there are numerous reasons for switching every thing you own to nicads. First is long term cost. An "AA" nicad will cost about \$2/cell, whereas the same size alkaline will cost about \$0.50/cell. The capacity of the alkaline is about 3.3 times that of nicad (at 20C, 50 milliamps, discharged to 1.0V.) At first glance this implies that an nicad will cost 13 times an alkaline for the same amount of energy. Of course an alkaline is disposed of while a nicad can be recharged 500 to 1000 times if they are used properly. Taking reuse into account (using 500 for conservative measure,) one nicad will provide the same amount of product use as 150 alkalines! In terms of cost, for every dollar you spend on nicads, you would have to spend almost \$38 on alkalines. Clearly, in terms of impact on your local landfill and your purse, nicads make a lot of sense.

The other popular misconception about nicads and alkalines is temperature performance. Alkalines will retain about 80% of their room temperature (20 C) performance at 0 C and about 60% at -10 C. Nicads will retain 90% of their room temperature capacity at 0 C and about 80% at -10 C. Since variometers tend to spend time at altitudes where the temperatures are cool, the difference in capacity between nicads and alkalines begins to shrink.

Lastly, the application has much to do with battery life. Nicads have a relatively constant output voltage over the duration of use, while alkalines' output voltage steadily decreases with use. If the product's performance is a function of battery voltage, nicads will give much more consistent performance. Some products can still function (to some degree of usefulness) until the battery voltage is quite low, while others will cease to function if the battery voltage drops below a certain point, or "cutoff voltage". If this "cutoff voltage" is relatively high, the extra capacity of alkalines is

wasted because their "end of life" voltage is much lower than nicads.

As a comparison of alkalines vs nicads over temperature and at a high cutoff voltage, look at the following battery life table from a Nikon 801 motor drive camera owners manual. The 801 uses 4 AA cells.

Number of rolls of 36 exposure film

20 C -10 C

Alkaline 105 15

Nicads 75 22

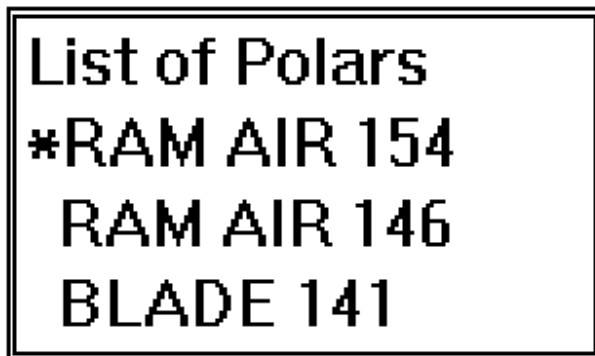
In this example, at 20 C the alkalines only have a 41% higher capacity than nicads, while at -10 C the alkalines only have 68% of the capacity of nicads.

The same comparison cannot be done for the Tangent since the cell size used is not available in alkaline. Since the Tangent doesn't have as high a cutoff voltage as the Nikon 801 the results would not be as dramatic.

SELECTING A POLAR OR ENTERING A CUSTOM POLAR FOR YOUR GLIDER

Selecting a Polar:

To select a polar, go to the [List of Polars](#) page.



Use the arrow keys to move the cursor to a desired polar. Click the + or - keys to select the new polar. To exit, move to the title field (List of Polars) and click the + or - keys to exit back to the Glider Setup page. You will see the newly selected glider name at the bottom.

Entering a custom Polar or scaling the stock polar to your glider:

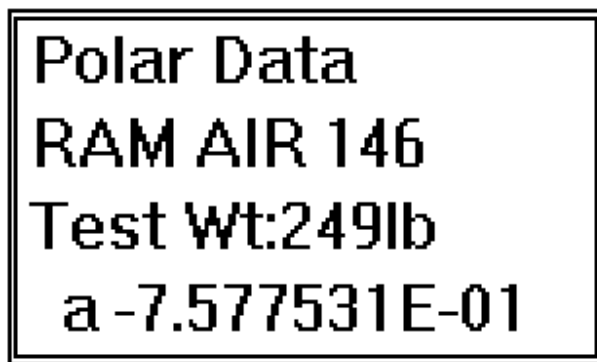
The TFC has memory allocated for 10 different glider polars. If you want to enter a new polar you must edit an existing one.

Use the same procedure as described above to get to the **List of Polars** page.

Move down to the polar you would like to edit.

Hold the **+** or the **-** key until the **Polar Data** page is displayed. If the polar you wish to edit is the one the cursor is pointing to when you enter the List of Polars page, you must move the cursor off of this field and then back again before holding the **+** or the **-** key will allow you to enter the Polar Data page.

The **Polar Data** page will look like this:



Glider Name (RAM AIR 146): You may change this name to any name you like. This is a secure input field so you must hold the **+** or the **-** key until the cursor changes to an under_score. Use the arrow keys to move to the character you wish to change, then use the **+** or the **-** key to change the character.

Test Wt: The weight of the glider and pilot when the polar measurements were made. This number is necessary because a polar may be measured at a different wing loading than you fly.

Scaling the Stock Polar to your glider.

As an example of editing the stock polar, we will scale the HP AT 158 polar to the RAM AIR 146. In order to scale the HP AT 158 polar to your glider you need to adjust the test weight so that the polar represents your gliders area. Scaling a polar makes the assumption that the glider in question would perform the same as the HP AT 158 if it were flying at the same wing loading.

Mathematically, the following relationship is maintained:

$$\text{New_Glider_Test_Weight} / \text{New_Glider_Sail_Area} = \text{HP_AT_Test_Wt} / \text{HP_AT_Sail Area}$$

Enter the following number in for the new test weight:

$$\text{New test weight} = \text{HP 158 Test Wt} * (\text{Your gliders area} / \text{HP AT 158 area})$$

For example:

RAM AIR 146 area = 146

HP AT 158 Test weight = 270

HP AT 158 area =158

New test weight = $270 \cdot (146/158) = 249$

Polar Coefficients a, b, c: These coefficients characterize the glider's sink rate vs. airspeed curve, the glide polar. These are secure input fields. The form of this equation is

$$W_s(V) := a \cdot V^2 + b \cdot V + c$$

Where

W_s = sink rate in feet/min. W_s is always negative.

V = airspeed in miles/hour. V is always positive.

To exit the Polar Data page, move up to the title field (Polar Data) and touch **+ or -** to exit to **List of Polars** and you will see the asterisk next to the name of the polar you just edited. Move up to the title field (List of Polars) and touch **+ or -** to exit back to the **Glider Setup** page. Now you should enter your the actual total weight at which you normally fly in the **Total wt** field.



WARNING! ATTENTION! PELIGROSO! BEWARE! ACHTUNG! DANGER! etc!

THE TANGENT FLIGHT COMPUTER WILL TELL YOU TO FLY AT DANGEROUS SPEEDS WHICH COULD LEAD TO INJURY AND DEATH!!! The TFC doesn't know anything about your glider's stall speed, its V_{ne} (speeds never to exceed) or its maximum rough air airspeed. The **TFC will tell you to operate beyond these speeds. The TFC may also tell you to decelerate in a dangerous manner. You are responsible to know the limits of your glider and stay within them.** If you are not 100% absolutely certain that you can fly safely with a TFC, then please send it back immediately.

WARNING! ATTENTION! PELIGROSO! BEWARE! ACHTUNG! DANGER! etc!



Tangent Flight Computer

Software Version 3.06

At long last! The GPS version of the Tangent Flight Computer is finally released. This version now offers the ability to connect up to your favorite GPS unit for automating final glides and measuring the head or tail wind components.

What's New in This Revision:

GPS Interface: Using the NMEA 0183 protocol, the Tangent can now listen for information about how far it is from the next way point and how fast it is moving over the ground. With the distance information the final glide is now automated. With the ground speed information, head and tail wind components can be measured for use in the Speed-to-Fly settings.

Final Glide Odometer: The hardest part of using the Final Glide calculator was constantly updating your distance to goal. With a GPS connected to the Tangent, this problem goes away, but even with out a GPS connected to the Tangent, the distance to goal will automatically update based upon your flying speed and whether or not you are climbing or gliding to goal. A handy feature if that battery gobbling GPS dies on final glide!

Toggling in and out of Auto Switch mode: It seems that every one loves the Auto Switch feature about 95% of the time, however there are times when working weak lift or searching for lift down low that having the Tangent switch back to Glide mode is not desirable. Many pilots have asked for a way to disable the Auto Switch while in the flight pages, and now there is a way to do so: Holding the **S2F key** until you hear 4 rapid beeps will toggle the Auto Switch from On to Off, or visa versa.

Temperature Measurement: The **FLT1** page now has the temperature displayed. This can be setup to display in Centigrade or Fahrenheit. (Some of the earliest Tangents do not have this capability and will display a fixed temperature. Upgrades are possible at a low cost.)

Improved Battery Life: The Tangent now lasts longer on a charge, up to 20 hours with out the GPS connected and over 12.5 hours with the GPS connected.

THE GPS CONNECTION:

Connecting the Tangent to a GPS is very simple. You will need a cable that interfaces to your GPS and the special connector that connects to the Tangent. Arai Design can supply cables for use with the Garmin handhelds and the Trimble Flightmate Pro, as well as just the connector for those who wish to make their own. Contact the factory for more information.

The Quick Setup:

There are two new screens associated with the GPS interface, **Comm Setup** and **GPS Info**. Scroll through the pages to **Comm Setup** and set **Mode: NMEA 2**. Now the Tangent is ready to receive data.

Setting up your GPS depends upon the make you have. I assume that you know how to operate your GPS:

For the Garmin 38/40/45/90 series, go to the Menu page, select Interface and then set the interface to NONE/NMEA and NMEA 0183 2.0.

For the Trimble Flightmate Pro, got to the Setup page, select Data Port mode, NMEA sentences? and set the repeat rate of RMB and RMC to 1, all other sentences to zero. While still in Data Port mode, go to the Output Baud rate? and select 4800. Lastly, make sure the data port is on.

Now your ready to go. To check that its working, go back to the **GPS Info** page. The field **Data/Rcvr:** shows the status of the communication with the GPS link with two letters. If your GPS has acquired enough satellites then **AA** should appear and the **Time:** field should show time updating every two or three seconds. If the connections and settings are correct, but the GPS hasn't finished acquiring then **VV** will appear. If the physical connection is bad or the settings are not correct then **nn** will appear. Some GPS units, such as the Garmin, will always broadcast the time, even though it is not acquiring. Other units, like the Trimble, won't broadcast the time unless the unit is fully acquired. Thus, a Garmin will show the time even though the **Data/Rcvr:** status shows **VV**.

New Features Related to the GPS Interface:

Before going in to a long description of each field, you should know what features have changed. Several of the fields in the flying pages will now display more than one item or to change the source of the displayed item.

The **Wind** field will now show two different pieces of information: The Speed-to-Fly wind setting as usual and the wind component as calculated from GPS data. To access the GPS data, simply move the cursor to the **Wind** field and hit the **?!** key. If the Tangent is connected to a fully acquired GPS, the field will now show **Wgps**, which is the head or tail wind component. If no GPS data is available, then the field will show **noGP**. If you wish to change the head or tail wind setting simply hit the **+ or -** keys and the display will change to **Tail** or **Head** depending on the setting.

The **DG** (distance to goal) field also has two modes. When the letters are capitalized (**DG**) the field is taking information from the GPS. If the field is in lower case (**dg**) the field is in automatic odometer mode. Toggling between these modes is done the same way as in the **Wind** field, by positioning the cursor on the field and hitting the **?!** key. Toggling is only necessary if you wish to disable the GPS input to **DG**, otherwise **dg** will automatically switch to **DG** when GPS data is

current.

In odometer mode, the value can be changed and then will update automatically based upon your setting in the **Wind** field and your airspeed. While you are climbing, the odometer counts down at the **Wind** field setting rate, i.e. if you have a 10 mph tail wind setting, the Tangent calculates how far you are drifting towards goal at 10 mph. When you are gliding, the Tangent adds your airspeed to the **Wind** setting. The Tangent assumes that when you are climbing you are drifting with the wind and when you are gliding that you are gliding straight towards goal. If the GPS becomes unavailable, the field automatically switches over to odometer mode.

Why Doesn't the Tangent Automatically Use the GPS Wind in the Speed-to-Fly?

The glib answer is "What?! You want us to wipe your nose too?" The real answer is that you don't want it to be automatic and there are two classes of reasons why: The first is related to the Speed-to-Fly theory. The second is related to the problems with using a GPS to measure the wind.

The Speed-to-Fly theory suggests that you don't always wish to use the actual wind in your S2F calculations. If you are flying for best L/D or towards a goal, then yes, the real wind is what you need in the S2F equations. When racing the situation is different. Close analysis of the math reveals that the wind should be set at the difference between the wind and how fast the lift source is moving. If, for example, the wind is blowing at 25mph, and the thermals are drifting exactly with the wind, the proper setting for the wind is zero. If the thermals were drifting at only 15 mph, the wind setting would be 10 mph. If you were flying towards ridge lift or wave, which are stationary, then the setting would be 25 mph. How is the Tangent supposed to know what kind of lift you are headed for?

Here is a real life example of why you don't want your flight computer selecting S2F values. You have been flying for speed in 600 fpm lift under good clouds, the speed ring set at an aggressive 400 and wind set to zero, because the thermals have been drifting with the wind. Now you must go across terrain that won't likely produce many thermals, in a 10 mph head wind, to a ridge that you must cross the lee side of, but you expect more 600 fpm lift when you get to the windward side. It's far enough away that if you were to use your current settings you would end up coming in low on the lee side. Instead you back the speed ring off to zero and set the wind to 10 mph (which is what **Wgps** indicates the wind to be,) the proper settings for maximum glide. Now you arrive high enough to clear the ridge and get straight into the strong lift, rather than groveling in the lee hoping to find something to stay in the air with. The theory would have suggested to leave the settings as you had them, but you would have wasted far more time and possibly even have landed if you had not cleared the ridge. Yes, you flew more slowly, but you saved time. This is a classic example of blindly following the S2F theory to your disadvantage, versus using the S2F theory wisely as a tool. How could any flight computer have made these decisions for you?

As for GPS and the wind, it ain't so simple as subtracting airspeed from ground speed. The problems arise from the way a GPS measures velocity and then reports it over the NMEA interface, both causing delays in the reporting of velocity. What this means is that during acceleration or deceleration the wind measurement won't be accurate. When you are flying at a constant speed, the calculated wind component is as accurate as the GPS ground speed and the Tangent airspeed. Imagine that you are flying straight downwind in a 10 mph breeze, your airspeed is a constant 25 mph, and therefore your ground speed is 35 mph. The Tangent **Wgps** will read 10, indicating the wind. Now let's say you accelerate your airspeed quickly to 35 mph. Ideally **Wgps** will remain at 10 mph. What will actually happen is that the airspeed measurement will quickly go to 35 mph, but the GPS ground speed will lag behind. The lag is enough so that when you reach 35 mph airspeed the ground speed will still be at 35 mph and **Wgps** will drop to zero (wind =

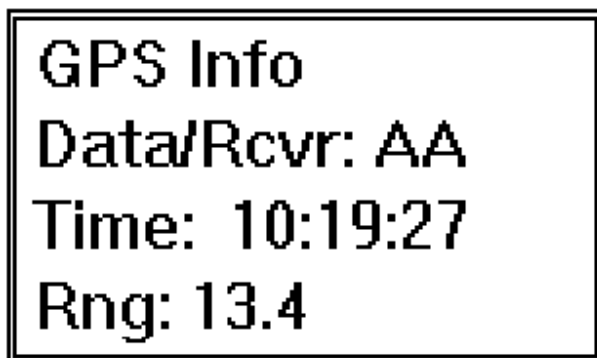
ground speed - airspeed). Slowly the GPS will catch up and **Wgps** will return to 10 mph. This problem could be solved if the Tangent filtered airspeed so that it matched the response of the GPS ground speed. The problem is that the GPS filter is dependent on velocity and satellite geometry, the manufacturers guard their techniques closely and won't reveal any details about their filters, and the filters differ from one manufacturer and the next. The last problem is how often and how current the information being sent to the Tangent is (you guessed it, each manufacturer does it differently.)

In summation, it is very difficult to provide wind estimates that can handle dynamic (acceleration or deceleration) situations. The Tangent does a reasonable job at steady state (flying a constant speed,) but you will see when you fly that **Wgps** can be made to vary all over the place. If these widely varying values for wind are blindly entered into the S2F equations, the results would vary wildly. If you have a friend with a vario that claims to use GPS for S2F, ask if it displays it's estimate of the wind. You will find that most of them don't. Makes you wonder why.

Wgps is intended to be used as a tool. Our philosophy is for you to enter the wind, allowing you to make the decisions that no flight computer could ever make.

DETAILED DESCRIPTION OF NEW PAGES:

The GPS Info Page:



This page is used to trouble shoot problems with your GPS interface connection. In addition it shows the raw data that is coming in from the GPS. **Most of this information is technical and can be ignored by most users.**

Data/Rcvr: There are two status flags associated with the GPS data that the Tangent uses. The Data status from the GPRMB sentence and the Receiver status from the GPRMC sentence. "A" means the data is OK, while a "V" indicates data is not valid. On the Tangent a third flag "n" shows when there none of the NMEA sentences the Tangent looks for were present. An intermittent "n" in either of the positions not necessarily a problem. If the "nn" appears for a continuous period then either the **Mode:** is not set to **NMEA 2** or there is a problem with the data cable.

Time: This is the time of the last GPS fix. This will not tick on one second intervals. The intervals are dependent on the the make of GPS. The Garmin will typically tick every 2 seconds. The

Trimble is 3 or 4 seconds.

Rng: This is the range in nautical miles to the next way point.

GPS V in: This is the units that ground speed is coming in at from the GPS. According to the NMEA specification this should be set for **kts** (knots). Some GPS receivers reportedly don't follow the spec accurately. This can be used to compensate for such receivers. If you suspect a problem you can connect your Tangent and GPS together and go for a drive at 60 mph. Set your GPS to show speed in knots. The number shown on your GPS and the **GndSpd** field (see the next field description) should match. (1 mph = 1.61 kph = .869 knots = .447 mps, or 60 mph = 96.6 kph = 52 knots = 26.8 mps.)

GndSpd This is the speed over the ground from the GPS. It should be in knots (see above.)

Wind This is the wind field from the flying pages. Hitting the **?!** key will cause it to show **Wgps**, the wind component as estimated from GPS data.

8mph This is the airspeed field.

ASlg Damp This is the filter coefficient used to help match the airspeed with the GPS delay. The smaller this number, the more damping that is applied to airspeed before comparison with the GPS ground speed. The above three fields can be used for adjusting this number so that it matches your GPS the best. The default value is .080.

The COMM Setup Page:

```
COMM Setup
Mode: NMEA 2
Baud Rate: 4800
Status: Idle
```

This page is used for configuring the Tangent to talk with your GPS.

Mode: This field has five settings, **OFF**, **NMEA**, **NMEA 2**, **FAI PRN** and **FLT REC**, indicating the various modes the communications can be set up in.

OFF If you are not using a GPS you should use this setting. This will give you the maximum battery life, typically 20 hours.

NMEA or NMEA 2 Use these settings for talking with GPS units. If your unit will work in **NMEA**, that is preferred. Otherwise use **NMEA 2**.

The other modes are not used.

Baud Rate: This is the baud rate that the communication port is set to. Your GPS must be set to match. This is not a user controllable setting.

Status: This field is not currently in use.

Changing the ROM:

Changing the ROM is a simple task, but it will seem intimidating if you have never done it before. Take the following precautions:

1. Static electricity will damage the ROM or the circuit board. Try to work on a conductive surface such as a metal work bench. If you don't have one then work at the kitchen sink where you can touch the faucet (ground) to discharge your self before you do each step.
2. DO NOT damage the circuit board or break the ROM leads. This is easily avoided if you are gentle. Think before you apply more force.
3. DO NOT insert the ROM chip backwards. The notch in the ROM chip should be near the edge of the PCB, which is the edge the LCD cable (P4) is located.
4. The end plate of the case is not symmetrical. You must be sure you place it in the correct orientation before screwing the case back together.
5. **Read these instructions completely before starting!! Then read each paragraph again before you commence that step.**

You will need a small phillips head and a small (1/8" wide) flat tip screwdrivers.

The procedure:

1. Place the TFC and the UNOPENED ROM package on the work surface. Discharge your self. Open the package with the new ROM in it and place the ROM in it's black conductive foam on the work surface.

2. Gently remove the four (4) screws on the back of the case. You will have to unclip the airspeed probes from the clips (don't unscrew the screws holding the clips.)

3. Turn the TFC over so that it is face up. Gently open the case like a book, lifting the right side. The plumbing and wiring will prevent it from opening up all the way.

4. Locate the ROM. The ROM is the 28 pin socketed DIP chip with the label on it. It is also marked "U10" on the PCB it self. There are two chips of the same size at the top center of the board. The ROM is the one on the left. Before touching the PCB, discharge yourself and then discharge the PCB by touching any of the leads of the power-on switch.

5. Remove the ROM by slipping the flat tip screwdriver between the ROM and its socket from end opposite the notched end and gently twisting (not prying) the screwdriver. **Make sure the tip of the screwdriver is between the ROM and the socket** and not between the socket and the PCB. Only lift it a millimeter or so. Now do the same thing at the notched end, only lifting a millimeter or so. Repeat until the legs of the ROM comes out. If one side of the ROM is coming out of the socket before the other side, carefully slide the screwdriver over to the side that is staying in the socket and twist so that the ROM is comes out of the socket more evenly. If one set of legs come completely out of the socket before the other, gently hold the side of the ROM with the free legs while using the flat tip screwdriver to lift the other side of the ROM until all the legs come out. Carefully place the ROM in the black foam next to the new ROM or on the other side of the foam.

6. Insert the new ROM in the socket by first aligning the notch in the top of the ROM chip with the top of the PCB (the top is the edge near the LCD cable. **Double check the orientation of the ROM. If you put it in backwards it will burn up when the power is turned on!** Next place the chip in the socket so that all of the left side leads line up with the holes in the left of the socket. Don't push the ROM in yet. Now align the right leads up by gently pushing the ROM to the left so that the left leads flex enough to allow the right leads to drop into the holes. Before pushing the ROM into its socket, make sure all the leads are lined up in the holes, then gently press straight down on the center of the ROM to seat the chip in it's socket.

7. Replace the end plate back in the case if it fell out, being very careful to make sure it's in correctly. The narrow bevelled corners go in the bottom half of the case.

8. Close the case back up, making sure that none of the tubes get kinked or wires get trapped in the case halves.

9. Turn the unit over and place the screws in thier holes. The proper way to reseal the threads is to turn the screwdriver backwards (counter clockwise) slowly while applying a very light (not much more than the weight of the screwdriver) force. You will feel a click as the screw aligns with its threads. Now reverse the direction, but don't apply much force until the screw has gone in two turns. Finish screwing the screws in, but DON'T OVER TIGHTEN.

***** **EIGHTEEN MONTH LIMITED WARRANTY** *****

The Tangent Flight Computer has a limited warranty for eighteen (18) months from the date of sale to remain free from operating defects We also provide free software upgrades as they

become necessary. This does not include upgrades from lower models to higher models.

This warranty is void if the equipment is altered, misused, mishandled or submerged in water. The warranty does not include transportation costs incurred because of the need for service.

Arai Design reserves the right to make changes in design and improve upon its products without any obligation to install these improvements in any of its products previously manufactured.