Borgelt B-100 User Manual
Software Revision 1.12

Foreword

Thank you for purchasing the finest and most reliable sailplane instrumentation available. Our goal is to make your soaring more enjoyable and productive by minimizing cockpit time spent on calculation and planning. This means more time looking out of the cockpit, for faster and safer soaring.

It will take only a few minutes to learn to operate the B-100, but to become completely comfortable with its operation will take about 2 hours. Before installing the instrument in the sailplane, please take the time to go through this manual with the B-100 at home. This will help you quickly configure and install your new B-100, and also aid you in using the B-100 to best advantage in flight.

Happy Soaring from Dave Nadler, Mike Newman, and Mike and Carol Borgelt !

What is the B-100 ?

The B-100 represents the state of the art in variometer and computer functions for sailplanes. It contains extremely accurate solid state sensors for variometer, airspeed, altimeter, and G load. Optional compass and GPS (satellite navigation) sensors are also available. The B-100 provides complete variometer functions and shows your choice of variometer indications on as many as five external meters plus audio.

The B-100 provides a wide range of flight planning and analysis functions. A built-in turnpoint library eases task planning. Continuous estimation of time and altitude required to complete the task provides superb task progress tracking with little effort from the pilot. For P.O.S.T. type tasks, the pilot can ask the B-100 "what-if" type questions to determine the best task for the time remaining. A simple glideslope presentation, coupled with an accurate digital altimeter, provides final glide monitoring without arithmetic. The unique thermal heightband graph allows easy monitoring of lift conditions through the day and eases 'time-to-leave-this-thermal' decisions.

Warning

No instrument, B-100 or otherwise, can replace pilotage and judgment. The B-100 provides base-line calculations, but the pilot is the one responsible for flight safety. This instrument is not a replacement for your certificated primary flight instruments and may not be used as such.

Copyright Notice

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Getting Started

Before installing the B-100 in the sailplane, we recommend reading through this manual and familiarizing yourself with the B-100 in the comfort of your home. To make this convenient, the B-100 is supplied with a small AC adapter. This manual is broken into a tutorial, an overview of how to use the B-100 in flight, and a section on setting up the B-100. If you are already familiar with the B-100 operation you may want to skip the tutorial, but please review the material on setting up the instrument and using it in flight.

The B-100 is equipped with an internal battery so that all user entered information is saved when it is turned off. You can freely turn the B-100 off and on without loss of any information, and you can set all configuration options prior to installation in the sailplane.

Unpack the system unit (the big gold box), the display unit (the screen), the control unit (long thin box with 3 knobs and 2 pushbuttons), and the AC adapter (pre-wired to the external connection board). Leave the meter(s) and other paraphernalia packed until you are ready to install them in the sailplane.

On a table with some space, assemble the B-100. BEFORE PLUGGING IN THE AC ADAPTER, plug the display and control units into the system unit. All the connectors are differently sized so this is quite simple. Make sure to fasten the clips securing the cable for the display unit. Plug the connector from the external connection board into the system unit. Check to make sure all 3 cables are firmly inserted, and then plug in the AC adapter. Your B-100 should now be operating. Prop up the display so you can see it comfortably. You're now ready to start configuring your B-100.

Basic Controls and Tutorial

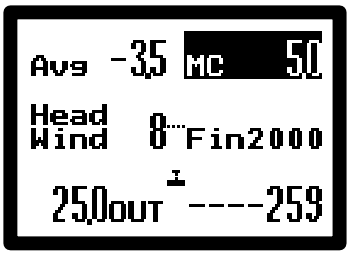
The B-100 is operated using the buttons and knobs on the control unit. In addition, the display unit contains the audio volume control (on the left) and the contrast adjustment (on the right). At this time, adjust the contrast knob for easiest viewing. The external speaker is not connected at this time, so the volume control will have no effect.

The control unit is designed to be operated with the left hand. You should install it in your glider so that the controls are easily reached with your left hand without stretching or changing your seating position. Some pilots prefer to rest the control unit on their leg, and a velcro strap has been provided for this purpose.

When using the B-100 on the ground, we suggest that you hold the control unit with your right hand with the pushbuttons pointed up and slightly away from you, preferably resting on your left leg. Operate the buttons and knobs with your left hand. Holding the control unit in this position will make it easier to use and simulate the manner in which you will use it in your glider.

We will begin this tutorial with the simple final glide calculator. This calculator may be used at any time in flight. Its wind, finish altitude, and distance are independent of the B-100 position tracking and course planning functions, though the MacCready, water, and other sailplane performance settings are shared (and discussed later). Use this to plan a final glide over an obstacle such as a mountain, or when you do not want to use the task planning and course following features of the B-100. Its operation is similar to other final glide calculators you may have used.

The *PAGE* knob is the rotary knob at the end of the control unit. Turning this knob changes the page of the B-100. Try slowly turning the knob, and you will see the pages change. Spinning the knob rapidly to the left (counter-clockwise, CCW) or right (clockwise, CW) will advance to the first or last page. Turn or spin the *PAGE* knob to the right until the display stops changing. This page is the simple final glide calculator.



The *CURSOR* knob is the middle knob on the control unit. Turn the knob to highlight different fields on the display. The highlight is referred to as the *CURSOR*. Try turning the cursor knob, and watch the cursor move around the page. Place the cursor on the MC field at this time (highlight the MC field as in the illustration above).

The *HELP* button is the square push-button at the end of the control unit. Holding the *HELP* button down will allow you to view an explanation or 'help message' for <u>any</u> field in the B-100. Try viewing *HELP* for the MC field at this time. In addition to the MacCready explanation, the units in use for the field (Knots, Meters per Second, Feet per Minute, etc) are displayed.

The *VALUE* knob is the knob closest to the push-buttons on the control unit. With the cursor on the MC field of the simple final glide page, turn the *VALUE* knob to adjust the MacCready setting. When you need to enter a large number, spin the *VALUE* knob briskly and the B-100 will advance quickly. The *VALUE* knob is used through-out the B-100 for entry, update, or selection of all values, whether they are numbers (such as the MC setting) or choices (such as a turnpoint, an option, etc).

The MacCready setting (MC) is displayed on many of the B-100 pages. Changing MC on any page sets MC for the entire B-100, so if you change MC and turn to a different page you will see the updated MC value.

Move the cursor to the FIN field and then hold down the HELP button. This is where you set the desired finish altitude (for the simple final glide calculator only). The finish altitude you enter should include the field elevation plus reserve (pattern) altitude; that is the MSL altitude you wish to have upon arrival at the destination. Try changing the finish altitude using the VALUE knob. Now move the cursor to the field in the lower right beginning with **---** or **+++** and hold down HELP. Here the B-100 displays the amount you are above or below the final glide (surplus or deficit), rather than the altitude which will be used in the glide. This relies on the B-100 altimeter, which you must set on one of the other pages (described in detail below).

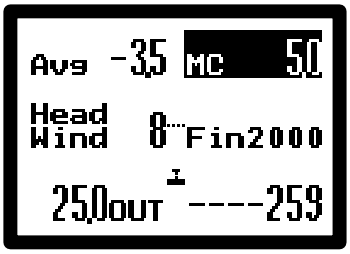
The surplus or deficit is a 'total energy glideslope'. It is continually corrected for the current airspeed, so as you perform pull-ups and pushovers the number does not change (in still air). The glideslope is computed for an arrival at the destination with the expected cruise airspeed for the selected MacCready, at the selected finish altitude, and with the selected bugs, water, and polar. (Setting the bugs, water and polar are done on another page and are discussed in detail below).

Move the cursor to the DISTANCE field and look at the HELP. Try entering a small distance here. Now move the cursor to the field displaying HEADWIND or TAILWIND and press HELP. To decrease a headwind or increase a tailwind you turn VALUE counter-clockwise. Try setting a headwind of 10, then a tailwind of 15. Watch the change in the altitude surplus or deficit as you change the wind speed.

Move the cursor to the other fields on the simple final glide page and view the HELP for these fields. Experiment with changing the distance out, finish altitude, and wind. In the center of the page is a glideslope indicator. When the small glider symbol is completely above the dotted line in the middle of the page you are above the glideslope for the conditions programmed. The glider symbol will sit at the bottom of the page until you are within 130 meters (420 feet) of final glide, at which point it will start to rise. Try reducing the distance out to 0.5 and reduce the finish altitude, and you will see the glideslope indicator operate.

The *ENTER* button is the pushbutton next to the value knob on the control unit. For most adjustments of the B-100, you will not need to use ENTER. ENTER is used only in cases where the B-100 asks you a question or in other specific cases discussed below.

Use the simple final glide calculator in flight as follows:



• Verify the B-100 altimeter setting (on the status page, described below).

• Set the desired finish altitude *Fin* to the altitude at which you wish to finish the final glide (field plus reserve).

• Dial in the distance *Out* and press *ENTER* with the cursor still on the distance. *ENTER* causes the B-100 to interpret the distance as an exact position fix, and restarts the final glide wind calculation from this point.

• Set the headwind or tailwind based on your estimate.

• As the sailplane progresses along the final glide, the B-100 will count down the simple calculator distance, based on the airspeed and the headwind or tailwind you have entered on this page. It will stop counting and assume that the sailplane is drifting with the wind when switched into CLIMB mode, and resume counting when switched back to CRUISE (switching between CLIMB and CRUISE is discussed in detail below).

• During the final glide, you can adjust the wind, and the B-100 will adjust the distance expected from the revised wind. To correct the position without affecting the wind, simply adjust the distance. Adjusting the simple final glide calculator distance will NOT cause recalculation of the wind.

• On reaching a known position, adjust the wind until the distance shown matches your (known) distance out. If you think the headwind or tailwind the B-100 has calculated seems incorrect, reset the distance, press ENTER with the cursor on the distance to give a position fix, and change the wind to your best estimate.

• The surplus or deficit is a 'total energy glideslope'. This means that in still air, pullups or pushovers will not affect the surplus or deficit. This is computed for completion of the final glide at the selected finish altitude, with the expected still air cruise airspeed for the selected MacCready setting, and with the selected bugs, water, and polar.

• For example, in still air, flying slower than speed-to-fly for the selected MacCready speed will result in a gradual decrease of the altitude deficit, plus a 'speed-up' indication from the speed-to-fly variometer and audio.

• Remember that while the headwind/tailwind and distance of the simple final glide calculator is independent of any task you have selected, the values for MC, water, bugs, and altimeter setting are shared with the rest of the B-100 and should be verified on the status page (described below). **Always check the B-100 altimeter setting before starting a final glide !**

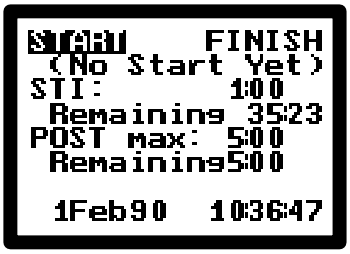
Using The B-100

In the tutorial section above, you learned to use the B-100 controls to interact with the B-100, and the how to use the simple final glide calculator. This section describes in detail how to use the remainder of the B-100 in flight, including:

- Pre-flight task planning,
- In-flight position tracking and possible task changes,
- In-flight position estimation of wind strength and direction, and
- In-flight and Post-flight statistics.

The B-100 has two modes of operation called *FLIGHT* and *SETUP*. In *FLIGHT* mode the B-100 does not display the numerous pages of setup information. You choose *SETUP* or *FLIGHT* mode with a selection on the *Vario Tuning* Page. Find this page using the PAGE knob, move the cursor to the field showing *SETUP* or *FLIGHT*, and press HELP. If the B-100 is in *SETUP* mode, change it to *FLIGHT* mode using the VALUE knob at this time.

Before Take-Off - Timers and STI Warning

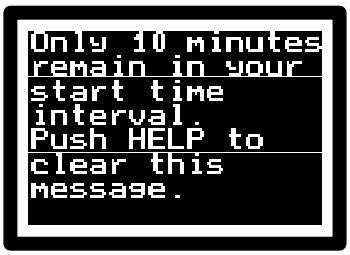


The B-100 provides two timers to assist with time management chores. These timers track the start time interval (STI), and time on task for time limited tasks (POST or similar). The *timer* page is the page with START and FINISH at the top, illustrated above. At this time turn to the timer page.

Place the cursor on START and press HELP. This field is referred to as the 'START button'. You must select this page, place the cursor on START, and press ENTER to inform the B-100 that you are starting a task or going through the start gate. This action is referred to as 'pressing the START button'. Pressing the START button resets the timers and fixes your position at the start gate. It also clears the statistics and resets any turnpoints crossed off on the task page, both discussed below.

On the timer page (with START and FINISH at the top), move the cursor down to STI and press HELP. Next, try entering a 1 hour and 40 minute STI using the VALUE knob. Press ENTER and watch the B-100 reset the countdown timer. If you modify the STI or POST time limits in flight and do not press ENTER, the remaining time in the interval will be updated accordingly (used for example, to add 15 minutes to your STI).

Before each flight, enter a start time interval. The B-100 will automatically start counting down your STI when you launch, and will provide a warning when you have only 10 minutes remaining in the interval. The timer will not count down on the ground, as the B-100 detects that you do not have airspeed.



If you are flying a time limited task such as POST you will also want to enter the task time limit on this page. Try entering a new POST time limit, then press the ENTER button.

The FINISH field at the top of the timer page is referred to as the FINISH button. This is used to inform the B-100 that you have finished the task. Pressing the FINISH button stops the timers and freezes the statistics for this flight. If you do not press FINISH at the end of the task, the B-100 will continue accumulating statistics until you land.

Also on the timer page is the clock with the current date and time; used by the barograph, statistics, and logbook features. You should set it at this time. The time can be set to a mark by dialing in a time and pressing ENTER on the mark. When you press ENTER the clock will be reset to the nearest minute (seconds will be set to zero). Try setting the time to a mark, as you would if given a time hack.

B-100 Task Planning and Tracking - Introduction

Programming the B-100 with a task will provide you with substantial assistance in task planning, time management, wind estimation, and final glide planning and course tracking. If you don't want to bother with task programming, the B-100 is still an extremely easy-to-use final glide computer (as described below in the section titled *If no task is entered*). When a task is entered, the B-100 will provide continually updated estimates of:

- Your position as you fly around the course,
- Distance and heading to the next turnpoint,
- Wind speed and direction,
- Glideslope (altitude surplus or deficit) for final glide, and
- Time remaining to complete the task.

With the GPS satellite navigation option, position plus distance and heading to the next turn will be extremely precise while the GPS receiver is navigating.

The glideslope (altitude above or below final glide) is continually updated through-out the task, and will even give the altitude required for final glides around turnpoints.

Programming a task is simple ! The B-100 has a library of turnpoints for each programmed soaring site. This library contains the latitude and longitude of each turnpoint, so when you dial in a task the B-100 can compute distances and headings. When flying at a site for which the factory has not provided turnpoints, you can enter your own site and turnpoint information. (Selecting a site and entering or changing site and turnpoint information is covered in detail in the setup section of this manual). For the purposes of learning to use the task page, just use whatever site is currently selected in your B-100. Only the turnpoints of the currently selected site are available for the task.

Entering A Task

The *task* page shows the list of turnpoints comprising the task you expect to fly. The task page is the 'leftmost' page in the B-100. Turn the PAGE knob left (counter-clockwise) until the display stops changing. If the title page is displayed, your B-100 is in SETUP mode, and the task page is the next page to the right (one click clockwise). When flying, you will soon get used to selecting the task page by spinning the page knob to the left before looking at the display.

The B-100 assumes that the task starts at the home airport for the selected site (or the remote start point, if a remote start has been selected for the current site; discussed in the section on site setup below). In any case, the starting point is never displayed on the task page. Move the cursor around the page and observe the order of the turnpoints. The list of turnpoints programmed for the task starts at the upper left, continues down the left side of the screen, and then continues on the top of the right side of the screen. The end point of the task is always displayed in the last turnpoint slot in the right column. Usually the end point remains set at the home airport, but you can set it to a remote finish point. The illustration above shows the task from Minden to Bishop to AirSailing and return to Minden.

Place the cursor in the upper left corner of the screen and try entering a turnpoint by turning the VALUE knob. You will see the distance remaining (lower right of the screen) change as you change the turnpoint. Try putting in an additional turnpoint by moving the cursor down to a blank entry and turning the VALUE knob. To delete a turnpoint from the task, just place the cursor on the turnpoint and spin the VALUE knob to the left (CCW). Blank turnpoint entries on the task screen are ignored, so you are free to place blank entries in the list wherever you wish.

Task Planning

In the lower right of the task page you will see the MacCready setting, estimated time to finish the task (ETF), remaining time, and remaining distance. Try dialing in a task, then change MC and watch the estimates change. Flip to the next page, change water or bugs, and flip back - you will see the estimates again revised.

For a speed task, program the task before the task start. Once airborne, adjust the MC setting based on your estimate of how the day looks. Use the estimated time to complete the task (ETF) to help pick the best time to start the task. The estimates include climb time and are based on the current altitude, so the time estimate will be a bit too long while on the ground and a bit short if several thousand feet above the start gate.

The time estimate is based on MacCready theory. This is a baseline only ! In typical conditions with scattered thermals, you should beat this time by a small margin given the correct MC setting (this due to pulling up in lift). In conditions with streeting you will beat this time by a larger amount.

For speed tasks, the task page is rarely used during the flight. For POST tasks you will add turnpoints and continually revise the task as you make decisions about where to fly. Use the estimated time to finish in comparison with the remaining time allowed to determine whether you have time to add additional turnpoints. The glideslope indicator for the task is presented on this page as well as other pages (this is the glider symbol in the center of the page).

The Status Page

The page to the right of the task page is the *status* page. This page includes all of the information about your estimated position and the final glide. On the left is the turnpoint to which the B-100 expects you are flying (*Bishop*), the distance to the turnpoint (*Out 135.6*), and the distance left or right of the courseline between the last turnpoint and the turnpoint displayed (*Right 0.0*). Also presented is the magnetic heading from the currently displayed position to the next turnpoint (*Head 130*). Try placing the cursor on the left or right field. Try changing back and forth from left of course to right of course, and watch the magnetic heading change. Also note that the direction you turn the VALUE knob is left (counter-clockwise or CCW) to move more left of course and right (CW) to move towards right of course.

The B-100 internal altimeter is presented on the status page (*Alt 9,529*). Adjust the altimeter by dialing in a sea-level pressure (in the *Q* field), or by changing the indicated altitude. This altimeter is used for computing the altitude required for both the task final glide and for the simple final glide calculator, so **it is very important to keep the B-100 altimeter set correctly**. Try adjusting the altimeter by changing Q, and next by changing the altitude. You will see that Q and altitude move together automatically.

The water loading and bug degradation are also on the status page. Look at the HELP text for these fields to ensure that the units (lbs, gallons, etc.) are what you expect. Wind direction and strength are also presented here; note that the convention for wind direction is 360 degrees for true North (rather than magnetic North; also explained in the HELP text in case you forget).

Final glide information presented on the status page includes the target finish altitude (field altitude plus reserve *Fin*), the surplus or deficit for the final glide, and a glideslope indicator. The final glide deficit is the additional altitude needed to complete the final glide from your current position; thus while circling in 10 fpm lift with a strong headwind the deficit will increase. The surplus or deficit is a 'total energy glideslope'; which is to say the additional altitude needed is corrected for airspeed and is unaffected by

pullups or pushovers. Final glide surplus or deficit is shown in the lower right corner of the status page (a 74,599 foot deficit is illustrated above).

In the center of the page is a glideslope indicator which graphically presents the altitude surplus or deficit. When the small glider symbol is completely above the dotted line in the middle of the page you are above the glideslope for the conditions programmed. The glider symbol will sit at the bottom of the page until you are within 130 meters (420 feet) of final glide, at which point it will start to rise.

Position Tracking During The Task. The B-100 attempts to track your position during the flight. While flying along each leg the distance to the next turnpoint (*Out*) will count down and the distance left or right of course will change. With the compass option installed, the B-100 knows your heading and tracks any deviations. With the GPS option installed and navigating, your position will be regularly updated from the GPS receiver. Without the compass or GPS options the B-100 assumes that you are flying on course, and you must input any large deviations to keep the computer aware of your position (see the next section for a discussion of how to update your position).

The B-100 system cannot prevent you from getting lost ! As a pilot you need to keep track of your position (even GPS can be foiled by a dead sailplane battery !). Any dead-reckoning (non-GPS) system will accumulate errors over time. You will need to periodically update the position in the B-100 to reflect your actual location and remove any accumulated errors. As described below, updating your position will also help keep an accurate picture of the wind. This will in turn allow the B-100 to track your position more accurately.

Wind Estimation Basics. The wind influences not only the altitude required for final glide, but the time to complete a task, the location of thermals and thermal streets, and many other aspects of a flight. Obtaining an accurate estimate of the wind strength and direction is very important !

The B-100 continually estimates the glider's position by integrating airspeed and heading, where heading is taken from the optional compass or estimated based on the leg you are flying. Periodically, you will tell the B-100 to recalculate the wind, which it performs by comparing your actual position and the estimated position. This wind estimation procedure is used in the basic B-100 as well as B-100's with GPS or compass options. If you don't have a GPS, you must tell the B-100 your actual position in order to recalculate the wind.

Before starting a task, you should always set an initial wind direction and strength based on your weather briefing. Set the wind on the status page; for example *Wind 270 at 5* is illustrated above.

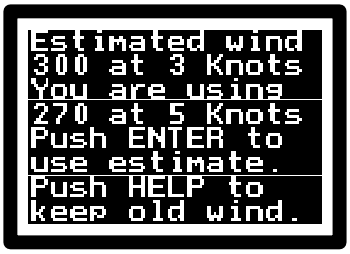
Flight Segments for Wind Estimation. In the simplest case, each time you round a turnpoint the B-100 recalculates the wind. If you make no large deviations and you dialed in a reasonable initial wind, this wind estimate will be remarkably accurate. B-100's without a compass best estimate the wind when this procedure is repeated on multiple task legs (or leg segments) with very different headings, and where the segments are long (such as a complete task legs, or periods over 20 minutes).

Position and Wind Calculations During The Task (no GPS). As you fly along a course leg, you can periodically update your position by adjusting the distance to the next turnpoint (*OUT*) and the distance left or right of course. When you update your position, the B-100 recalculates the wind direction and strength to match the revised position. Similarly, adjusting the wind will cause the B-100 to update your estimated position. These wind and position calculations are based on the distance and direction flown through the air since your last position fix, described below.

Position Fixes (no GPS). Telling the B-100 your exact position is referred to as giving a position fix. Each position fix restarts the B-100's wind calculation and eliminates any accumulated dead-reckoning errors. To give the B-100 a position fix, place the cursor on either the distance to the turnpoint *Out* or distance left or right of course and press ENTER. Normally, you adjust the position, the B-100 adjusts the wind, and you fix the position by pressing ENTER. If you wish to reset the position without the B-100 changing the wind, press ENTER with the cursor on distance out or left/right **before** adjusting the position. If you believe that you have a better estimate of the wind than the B-100 has calculated, correct the wind after the position fix.

Arriving at a Turnpoint. Upon arriving at a turnpoint, you should inform the B-100 and fix your position at the turnpoint. This is automatic if you have a turnpoint camera switch wired to the B-100 (described in detail below). If you do not have the camera switch installed, place the cursor on the turnpoint name (either on the task page or on the status page) and press ENTER.

Pressing ENTER with the cursor on the turnpoint name or using the automatic turnpoint camera switch fixes your position at the turnpoint. The B-100 will ask if you wish to use the newly estimated wind, or if the wind you had previously entered should be preserved. With the compass option you will usually want to allow the B-100 to calculate the wind. Without the compass, avoid using the newly estimated wind if you made any significant detours since the most recent position fix.



After you inform the B-100 that you have arrived at the turnpoint, it will start tracking the next leg of the task. The next turnpoint name will be displayed on the status page, along with the compass heading and distance to the next turnpoint. Re-photographing a turnpoint with the camera switch installed does not cause problems; the B-100 will reset your position to the current turnpoint rather than advancing to the next turnpoint.

Wind Calculation with GPS. A GPS-equipped B-100 calculates wind when you round a turnpoint (as illustrated above), or when you explicitly request calculation. To request a wind calculation, place the cursor on either the distance to the turnpoint *Out* or distance left or right of course and press ENTER. The B-100 will show you the currently selected and the newly calculated winds just as if you rounded a turnpoint (again, see the illustration above). This will also restart the wind calculation from the current location. Again, with the compass option you will usually want to allow the B-100 to

calculate the wind. Without the compass, discard the estimated wind if you made any significant detours on the segment just completed.

Stepping through a Task. To familiarize yourself with how all this works, try stepping through a task as follows. Put an example task in the B-100 (just place some turnpoints on the task page). Turn to the timer page and press the START button, which resets your position to the start point and resets any accumulated statistics. Turn back to the status page, and note the first leg information including the name of the next turnpoint, and distance and compass heading to this turnpoint. Put the cursor on the turnpoint name (still on the status page) and press ENTER, and the B-100 will reset your position to the first turnpoint and show you the leg information for the next leg.

If you continue pressing ENTER (with the cursor on the turnpoint name), the B-100 will step through the entire task. If you like to put headings and distances on your map, you will want to do this as a part of your regular task planning before each flight. Press the START button at any time to reset the B-100 back to the start of the task.

Now look at the task page. You will see the turnpoints crossed off (displayed with a line through the name) after they have been reached. Each time you tell the B-100 that you have arrived at a turnpoint, the remaining distance and ETF (estimated time to finish) shown on the task page are reduced. Try crossing off a turnpoint on the task page (place the cursor on the first turnpoint not crossed off and press ENTER), and watch the distance and ETF change. (In flight the remaining distance and ETF will be continually updated.)

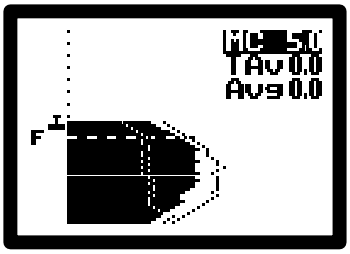
Correcting an Accidental Turnpoint Entry. If you accidentally step past the turnpoint you intended, turn to the task page and place the cursor on the last crossed off turnpoint. Press ENTER, and the B-100 will 'back up' to the previous turnpoint. You may need to reset your exact position and the wind if this occurs. At this time, try stepping part way through a task and then 'backing up' a turnpoint.

If No Task Is Entered...

For weekend flying about, you may decide not to use the task planning features. The B-100 can easily be used as a simple final glide calculator - just leave the task blank (no turnpoints on the task page, except the home airport in the last entry). With no task programmed, the B-100 will operate as follows:

> With the compass or GPS option installed: The B-100 will track your position and provide continually updated final glide information for the return to the home field. With GPS only, wind estimation can only be performed when flying towards the home airport.
>
> Without the compass option or GPS installed: The B-100 will not track position and will not provide wind estimates. Final glides can only be calculated using the simple final glide page.

Using the HeightBand Graph



The *heightband* graph is designed to help in recognizing trends in the lift band and relating the current thermal to those recently encountered. It helps make it clear when its time to leave a thermal and where the day's optimum height band lies.

The vertical axis represents altitude, and the horizontal axis represents rate of climb. The solid graph is 'painted' during each climb, showing the current thermal's profile. The two previous thermals are shown as dotted lines for comparison. The height and strength are automatically scaled to fit on the screen.

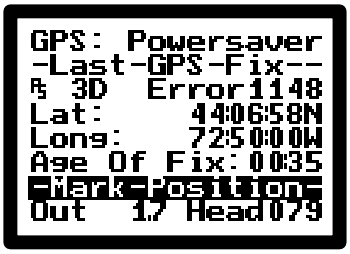
On the left is a small glider symbol that shows current altitude with respect to the thermal information presented. During cruise, the most recent thermal will remain on the display and the glider symbol will descend alongside the thermal information (showing your altitude with respect to the heightband being worked). At the beginning of the next climb, the solid graph from the last thermal will become one of the dotted lines and a new solid area will be started.

When you are close to final glide altitude or when the final glide altitude is close to the top of the heightband you have been flying, a final glide indication will appear as a horizontal line labeled **F**. If you change MC, you will see this line move up or down. When the glider symbol (your current height) is above the final glide line, you're above the final glideslope for the task you have entered based on your current estimated position, MC, bugs, water, wind, and altimeter setting. **Before starting your final glide, verify that the estimated position, MC, bugs, water, wind, and altimeter setting are correct (on the status page)**.

TAv - Total Average in Thermal. On the heightband page the B-100 displays the overall climb rate (total height gained divided by total time) for the current thermal. (Tav displays overall climb for the last thermal while you're cruising). This gives an excellent baseline for determining what your MC setting should be; unlike short term averagers.

Selectable Average. On the heightband page underneath Tav, the B-100 shows a selectable averager. This can show 20 second average or a number of other averages, and can show different averager types in CLIMB and CRUISE. Choosing what averager types you would like displayed here is described in the setup section below (see the *Variometers 2* setup page).

The GPS Page - Using the Optional GPS



The GPS page displays the current navigation information and status from the GPS receiver. At the top of this page is the power control for the GPS receiver, providing Fulltime, Powersaver, and Power Off options. At the bottom of the page is the mark position function.

The B-100 will pop up a warning message if the GPS receiver stops navigating for an extended period. However, while using the GPS, you will want to check this page periodically to verify that you are getting navigation solutions.

The GPS receiver module consumes quite a lot of power, actually more than the B-100. If you have a excess battery capacity this is not a problem, but if you are flying with just a single 6.5 amp-hour battery and expect to be aloft more than 5 hours you may run out of power. To accommodate the limited battery capacity of many sailplanes, the B-100 provides a Powersaver mode. In Powersaver mode the B-100 powers up the GPS receiver once every five minutes to update the position, then turns the receiver back off. Between fixes, the B-100 estimates your position. With a small battery you will usually want to fly in Powersaver mode, switching over to Fulltime on final glide or possibly to help locate a stealth turnpoint. For legs where you do not require the GPS you can turn the receiver power off completely.

GPS position is often very accurate, using 4 satellites to triangulate your position down to around 30 meters. Unfortunately, there are not always enough satellites visible with the appropriate geometry to accomplish this. The B-100 presents the accuracy of the displayed navigation solution as a distance error. For example, if the B-100 displays *Error: 300 meters*, the receiver is 95% confident that your actual position is within 300 meters of the position displayed. GPS usually computes a 3-dimensional (3D) solution of position; that is position plus altitude. Sometimes the receiver can only compute a 2-dimensional solution due to inadequate satellites or poor geometry. The B-100 displays *2D* or *3D* to indicate the receiver's navigation mode, but the B-100 altimeter is much more accurate than GPS and consequently the B-100 does not use GPS altitude.

GPS navigation is not always possible ! Navigation can be prevented by satellite outages, by large parts of the sky blocked by the mountain next to you, or by poor satellite geometry. The B-100 always displays the age of the last navigation solution (position) in the *age of fix* field. In Fulltime navigation mode, *age of fix* will normally oscillate between 0 and 1 seconds as the GPS receiver computes a position once per second. In Powersaver mode *age of fix* will count up to about 5 and a half minutes while the receiver is powered down and while waiting for the first solution each time it is powered on.

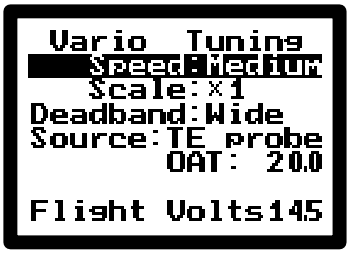
The GPS page has a navigation 'blinker' in the upper left corner. This blinker shows the following symbols:

- **P_S** The receiver is off to save power (Powersaver mode only),
- **?** Flashes while the receiver is trying to find your position,
- **N** Flashes while the receiver is navigating (once per second).

Placing the cursor on the **-Mark-Position-** button and pressing ENTER records your current position (this is referred to as marking your position). The distance and magnetic heading back to this position are continually displayed (underneath the button) until the next time you mark your position. Use this feature to record the location of a thermal when heading into a turnpoint, or to record the location of strongest lift when exploring a wave.

When the GPS power is turned off, the B-100 behaves as if there is no GPS option installed. As your position will no longer be periodically updated by the GPS, you will need to update your position manually if you make large detours.

The Vario Tuning Page - Adjusting Variometer Response



The variometer scale and speed are adjustable in flight on the *Vario Tuning* page. The scale choices will affect most meter indications and also the range of the audio. The normal **x1** scale provides full scale variometer indications at 1000 feet/minute (or 10 knots or 5 meters/second; selecting the desired units is described in the setup section below). The audio 'pegs' at 1.5 times the meter scale selected (thus in **x1** scale the audio doesn't stop changing until 1500 feet/minute).

The B-100 variometer response speed ranges from about .3 second response (extra fast) to about 4 seconds (extra slow). The variometer response speed you will like depends on the pneumatic installation in your plane, personal preference, and the conditions in which you fly. Many pilots prefer the faster vario for weak conditions only. If you have a gust filter installed in your TE line, your TE signal is already slowed and you may want to use a faster setting. The response speed you select affects both the meter indications and the audio.

The variometer source is normally the TE probe, but this can be forced to the regular statics. This is often used for motorgliders where the TE probe doesn't work well with the motor running, but it can be useful if you forget the TE probe. If regular static is selected as the source, variometers and audio will be uncompensated.

Also on the variometer tuning page you will find the outside air temperature, battery voltage, and the *SETUP* or *FLIGHT* mode control (*FLIGHT* mode suppresses display of all the setup pages).

The Simple Final Glide Calculator

The 'rightmost page' of the B-100 is a simple final glide calculator (turn the page knob clockwise until the page stops changing). This calculator is completely independent of the course planning and following features. Use this if you want to plan a final glide over an obstacle such as a mountain on course, or if you don't want to use any of the course planning and following features. Please see the section in the tutorial for a detailed description on using the simple final glide calculator.

Statistics

The B-100 provides comprehensive task statistics. During flight the average climb and speed for the task can be useful as a check on the MacCready setting. Task statistics are reset on START and frozen on FINISH.

Low Battery Shutdown

The B-100 is capable of operating down to a supply voltage of about 10.2 volts. When the voltage drops below this threshold, it turns itself off completely. This is necessary to protect the computer and all of the information you have entered ! When the B-100 shuts down, it displays a 'Powerfail' message on the screen, the meters stop moving, and the audio becomes silent.

Often, shutdown is provoked when you make a radio transmission with a low battery. If this occurs, complete your radio work, then turn the B-100 power off and back on again. The B-100 will resume operation from where it left off, and will continue to operate until the battery gets really weak or you again transmit.

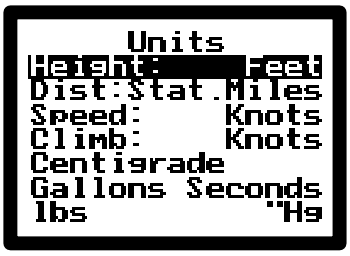
If your B-100 shuts down when you believe your battery to be adequately charged, please verify that the battery voltage is actually being delivered to the B-100. Compare the voltage displayed by the B-100 (on the Vario Tuning page) to the voltage measured at the battery with a high-quality voltmeter. If they are different by more than .2 volts, please see the section on sailplane wiring guidelines in the installation chapter below.

When a GPS-equipped B-100 observes the battery voltage below 11.2 volts, the B-100 will display a warning message recommending that you turn off the GPS. This is because the GPS draws more power than the remainder of the B-100 ! You can leave the GPS on, but unless you have a large capacity battery your remaining battery life is probably very short. A B-100 without GPS will also display a warning message when the battery voltage drops below 11 volts.

Configuring The B-100

Before using the B-100, you will want to set the configuration options which reflect your personal preferences in instrumentation. These include choice of units, variometer and audio presentations, and more. At this time, you should make your initial choices. These are easily modified at any time in the future, so you can come back to any items of which you are unsure. To configure the B-100 turn to the Vario Tuning page and select SETUP mode in the lower left.

The Units Page - Adjusting The B-100 Display Units



The B-100 provides a comprehensive set of presentation units. You may independently set the units you prefer for display of height, speed, climb, temperature, water ballast, weight, and pressure. You can also change whether you wish latitude and longitude displayed in degrees:minutes:seconds or degrees:minutes.tenths-of-minutes. At this time turn to the *Units* page and select the units you wish to use by moving the cursor to the measure of interest and changing VALUE.

The units selected affect only the format of information displayed by the B-100. If you wish to see a distance you have computed on the task page displayed in km and it is currently displayed in statute miles, just flip to the units page, change the display units for distance to km, and flip back to the task screen to view your distance in km.

Suppose you need to enter sailplane polar or airspeed calibration information provided in units other than those you normally use (and have selected for display):

(1) Change the selection on the units page to match the units in which the data you need to enter was provided,

(2) Enter the data in the units in which it was provided, and

(3) Change the units back to those you wish to use in normal operation. If you review the data you just entered, you will see it displayed in your familiar units.

Audio Selection

To configure the B-100 audio, turn to the *Audio Setup* page. If you move the cursor to the large field in the center of the screen and change VALUE, you will see the various different B-100 audio choices provided. We recommend the *B-100 Standard* audio style described below.

There are two general categories of audio you may select; switched and un-switched. The switched audio changes its behavior (sounds differently) depending on whether you are in *CRUISE* or *CLIMB* mode, whereas the un-switched audio does not change behavior. Switching between *CRUISE* and *CLIMB* may be accomplished with a pilot-operated switch on the stick, a mechanically operated switch on the flap or trim lever, or automatically switched by the B-100's G-sensor; and is discussed under *CRUISE/CLIMB SWITCHING options* below.

The *B-100 Standard* audio gives distinctly different sounds in cruise and climb (this is a 'switched' audio style). In *CLIMB* mode, the *B-100 Standard* audio sound is fairly conventional, and gives increasing pitch with increasing Total Energy. The tone is interrupted, with the duty cycle (percent of time turned on) higher when the TE is less than your current selected MacCready setting. The rate of interruption of the tone also increases with increasing TE. If your TE drops below zero, the tone interruption stops and eventually the audio goes silent in real sink. This is a very pleasant climb audio, and does not make annoying alert tones if you hit sink while trying to center a thermal.

In *CRUISE* mode, the *B-100 Standard* audio is quiet when you are flying at the correct speed to fly. When you hit lift or fly too fast, a gentle warble is produced with the tones increasing with increasing 'slow up' signal. If you hit sink or fly too slowly, a fast alert warble is produced, with increasing tones for increasing 'speed up' signal. These different sounds are quite easily understood in flight.

The *Warble both in Climb and Cruise* audio style is just like *B-100 Standard*, but uses a gentle two-tone warble in climb rather than an interrupted tone. Some pilots find this more relaxing and easier to hear, but most pilots prefer distinct sounds for *CRUISE* and *CLIMB* modes.

Additional switched options are *audio while circling only* or *audio while climbing only*. These provide the same sound as the *B-100 Standard* audio, but turn off the audio completely in cruise or climb respectively.

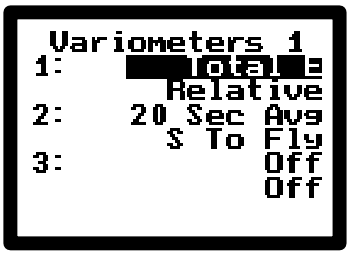
Un-switched audio choices produce climb tones when the TE vario is greater than zero, and produce speed-to-fly tones when TE is below zero. The different types of un-switched audio differ only in the alert (speed-up) signal provided. Each of these alert signals represents a trade-off between ease of distinguishing 'speed-up' versus 'slow-up' and how irritating the audio becomes at the edge of a thermal. The alert tones provided are:

Warble Alert: like the *B-100 Standard* audio alert tone in cruise,

Fast or Slow Chop Alert: the 'speed-up' alert is signalled by a fast interruption (chop) in the audio sound.

Many pilots strongly dislike the un-switched audio because it is common to hit sink alongside a thermal, and un-switched audios will give an alert signal each and every time this happens. Again, we recommend the *B-100 Standard* switched audio.

Additional options provided for the audio include a lift alert and automatic increase of audio volume with increasing airspeed. The lift alert will beep gently when you encounter lift worth considering in cruise. Set *Volume Coef* from 0 (no automatic increase in volume with airspeed) to 10 (maximum increase in volume with airspeed).



Configuring The B-100 Meter Displays

The B-100 can display indications on up to 5 separate analog display meters. These meters are just simple gauges, and the B-100 computer will use them to display whatever information you request. Each of these meters can be a round (270 degree) meter or a small vertical (edge) meter. The standard meter display unit provided with the B-100 actually includes <u>two separate meters</u>: a round (270 degree) meter and a small vertical edge meter.

Using the *Variometers 1* and *Variometers 2* pages, configure the B-100 to display the indication of your choice on each of the meters you attach. Each meter can show different indications for climb and cruise. The illustration above shows a typical configuration with meter 1 connected to a round meter displaying total energy in climb and relative in cruise, and meter 2 connected to the small vertical meter displaying 20 second average TE in climb and speed-to-fly in cruise (switching between climb and cruise is discussed separately below). If you position the cursor on one of the meter controls and change the value knob you will see the set of available display choices.

The B-100 provides a number of different kinds of variometer presentations, each with their own advantages and disadvantages. You can configure whatever best suits your preferences and needs, but please read the following section to be sure that you select the indications you really desire.

Total Energy. The total energy presentation reflects the input provided to the B-100 total energy pneumatic input, which should be plumbed to your total energy probe. TE is the recommended indication for use in thermaling. It is less useful in cruise; the indication will include both airmass motion and the normal sailplane sink rate, and it is difficult to use this combined information. Note that the TE indication is altitude corrected up to 20,000 feet, presenting true vertical speed in climb.

Netto. Netto is an abbreviation for net airmass movement. The B-100 will present the vertical motion of the air regardless of the speed of the sailplane, as long the sailplane is experiencing 1G. This is extremely useful in cruise, as you can see what the air you are flying through is really doing. It answers questions like "am I flying in a lift or sink street ?" or "am I flying in wave ?". Netto's disadvantage is that in many cases you are really interested in what climb rate you could achieve if you stopped to circle. Netto is not appropriate when circling in lift; this is really for use in cruise only.

Relative. Relative attempts to estimate the rate of climb you would achieve if you stopped to circle. This is computed as netto minus the projected sink rate of your sailplane at typical circling speed and bank angle. It is useful because it eases comparison between the climb rate, MacCready setting, and the air you are flying through. Disadvantages include inexact estimation of sailplane sink rate and difficulty in observing weak wave or lift or sink streets. Relative is not recommended for use in climb.

Speed-To-Fly. This indicates up (needle above center) when you are flying too fast, and down (needle below zero) if you are flying too slowly. The farther from the correct speed the larger the needle deflection. This is based on the MacCready speed-to-fly theory, using the selected polar modified by the specified weight, water on board, and bugs. Great when cruising, not appropriate when climbing. We recommend using the vertical (edge) meter in the dual meter display to show speed-to-fly.

Avg - 20 Second TE Averager. This is the most conventional averager presentation, similar to the averager in many instruments. The 20 second averager is quite useful to see how you are doing in a thermal on a short term. The B-100 restarts this averager each time you switch into climb mode.

Lav - 20 Minute (Long Term) Climb Average. Computed as the average of the last 20 minutes of CLIMB. This is useful for getting an idea of how the day is progressing. Some pilots prefer this measure as a base for setting the correct MC setting, we recommend using the Tav - Total Average in Thermal.

Nav - 20 Second Netto Averager. This averager is most useful as an airmass indication when cruising. It is especially useful in ridge flying when it can be difficult to see the ridge lift strength when flying downhill.

P - Performance Index. This is a long term computed index of how you are doing as compared to what would be expected from the sailplane polar. It is reset each time you leave a thermal and start cruising. This can be used to give an indication of what you can be expected on final glide; that is, if you've only been getting 80% all day don't try the final glide based on 100% ! This value is interpreted as illustrated by these examples:

100% You are achieving the expected performance.

90% You are achieving less than the expected performance, due to cruising in sink, dialing in more water than you are carrying, or dialing in less bugs than you are carrying.

115% You are flying in lift, or have been overly pessimistic in your estimate of bugs or water.

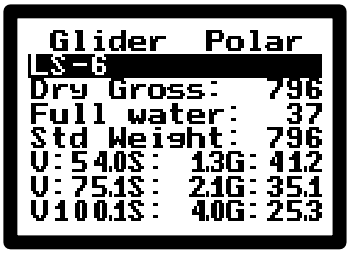
If you display the performance index on a meter, 100% will position the needle at 0, 0% will show -10, and 200% will show +10. When displayed on a meter, this value will be unaffected by the variometer scale selected.

Final Glide. Shows above or below final glide. Please note that this is the task final glide and not the simple final glide calculator. Displayed on a meter, 200 meters above glideslope will show +10 and -200 meters will show -10. When displayed on a meter, this value will be unaffected by the variometer scale selected.

Selectable Averager Display

An averager is presented on the status and thermal heightband pages. Often pilots prefer to see a 20 second averager, but you may choose which averager is to be displayed. On the *Variometers 2* setup screen, select which style of average you wish displayed in cruise and in climb modes.

Sailplane Polar



The B-100 includes a comprehensive set of sailplane performance polars. To select the polar for your glider, change to the Glider Polar page, position the cursor on the glider name, and change VALUE. When you select the polar for a ship, you will see three sink points and a 'standard weight'; that is the weight at which the polar was measured or computed. You will need to input the expected dry gross weight at which you expect to fly (pilot, parachute, equipment, but no water ballast), and the maximum amount of water that you will carry. The B-100 will correct the polar for the actual weight and water as you fly.

The wingloading of the glider has an enormous affect on the polar. In many cases, entering the proper dry weight and water on board has a larger affect on your B-100's ability to predict sailplane performance than the type of glider ! Please take the time to properly set the dry weight, and keep the water load reasonably accurate when you are flying. With correct polar and weight information, the B-100 will give extremely accurate netto and final glide information.

The B-100 provides three pilot programmable polars labeled CUSTOM1, CUSTOM2, and CUSTOM3. If you feel that the ship you are flying is not accurately represented by one of the factory polars or your ship is not one of the types provided, you can select a custom polar and input your own representative sink points. You should insure that the quadratic specified by these points accurately reflects your glider's performance.

Some of the more recent gliders have substantial differences in performance between full water and dry; due to the effect of wingloading on the Reynold's number and airfoil sensitivity to Reynold's number. We have attempted to provide polars which are representative of the way that these ships are flown. However, for these ships you may wish to adjust the polar in flight using the BUGS parameter. An example is the Ventus, which according to the DFVLR polars has noticeably better performance full than empty... you may want to add 1-2% bugs when dry if you are interested in this degree of accuracy.

Some gliders have speeds over which the polar falls off very rapidly (more rapidly than the quadratic we use). While we do not model these affects in the polar, in practice you will not be flying at these speeds unless you have made a bad error in wingloading or final glide !!

Using the Site and Turnpoint Library.

The B-100 contains a huge turnpoint library loaded at the factory. The USA version of the software contains all the major US contest sites, the BGA's official UK turnpoint list, New Zealand, and the Australian Gliding Federation turnpoint list. The European version of the software includes the UK plus national lists for Germany, the Alps, France, Italy, Spain, Scandinavia, and South Africa. Before use in flight, turnpoints must be grouped into sites, where a site is the place your flight originates. Only the turnpoints associated with the B-100's currently selected site are presented as possible turnpoints on the task page. You can extend or modify the B-100 turnpoint library as required for the sites at which you fly.

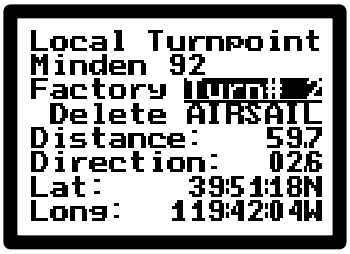
The USA version of the B-100 software includes a large number of contest sites (numbered 51-71 or more) with the turnpoints already selected. Outside of the USA, we have not provided factory sites. Instead, you must set up your own custom sites as described below. Then, you will add the turnpoints desired to your custom sites, by copying from the B-100 library or creating new turnpoints.

To change the B-100's current site, turn to the *Current Site* page, place the cursor on the *site #* field, and change the value. Sites numbered 1 through 49 are for sites you create (referred to as *Custom* sites), and the factory provided sites start at number 50. When changing the site number, you will notice a delay before the site name is displayed - be patient !!

Information that you add or change in the turnpoint library is essentially permanent. This information will be preserved when turning the B-100 off and on, and even during software updates. However, if you delete factory provided turnpoints, they can later be retrieved.

Site Information. With the exception of the start point and mean magnetic deviation, site information for factory provided sites cannot be modified. If you change the start location or deviation for a factory provided site, this change will not be preserved if you change to a different site and back.

When creating a custom site, you must spell out the name, and enter the latitude and longitude, the elevation, and the mean magnetic deviation for the task area. Like all value entry in the B-100, fill in or change the name by placing the cursor on the character you wish to change and changing VALUE. When entering new sites, be very careful to get the sign of longitude (East or West) correct. The site coordinates are used for the finish line and as the default start line (see remote starts, below). The fastest way to enter the site coordinates is to copy the coordinates from a nearby turnpoint in the library and then adjust them, described with the *Copy Turnpoint* page below. Always double-check the site coordinates against a map, as erroneous coordinates will cause great difficulty in using your B-100 !



Turnpoints. In addition to the thousands of factory provided turnpoints, the B-100 allows you to create, modify, or copy about 500 turnpoints. On the *Local Turnpoint* page (just after the *Current Site* page) you can view, modify, or add turnpoints for the currently selected site. To the left of the turnpoint number you will see a field showing either *factory* or *custom*, indicating whether this is a factory provided turnpoint or a turnpoint you have created, modified, or copied from another site. To view the different turnpoints already available for the current site, place the cursor on the turnpoint number field and change VALUE.

To add a new turnpoint, change the value of the turnpoint number field to the maximum it will accept, and fill in the turnpoint name using the VALUE knob. You can enter the turnpoint position either by latitude and longitude or by range and distance; the other will be automatically updated. Always double-check the coordinates by verifying range and bearing on a map !

The first turnpoint listed (*Turn# 1*) is always the site. You cannot change this 'site' turnpoint on the *Local Turnpoint* page; its name and coordinates are always copied from the current site page.

After the 'site' turnpoint, turnpoints appear with their names in sorted order, with numbers sorting before alphabetic characters. For some sites in the USA, tasks are regularly called by turnpoint number, and we have provided all turnpoints with leading numerics matching the numbers assigned the turnpoints. When creating your own custom sites, it is usually preferable to stick with alphabetic names. Only 7 characters are visible on the task and status pages, so make sure that you choose distinct and easily recognizable abbreviations for the turnpoint names. As you enter the turnpoint name, the turnpoint number will change, which is of no real importance but shows the order in which the turnpoints will be presented when you select a turnpoint on the task page.

If you change a factory turnpoint's coordinates, the original will be deleted and replaced with a turnpoint labeled as *Custom* rather than *Factory*. After you make a change to a factory turnpoint, the 'delete' button on the turnpoint will be replaced with a 'restore' button, which can be pressed to restore the turnpoint to the factory supplied coordinates. If you change the name of a factory supplied turnpoint, a new custom turnpoint will be created and the factory original will be deleted. Deleted factory turnpoints can be restored with the 'Reset' button on the 'B-100 Options' page (this will restore all factory turnpoints which were deleted and where there is no custom turnpoint with the same name, for all sites).

Remote Start Locations. Normally the B-100 assumes that the task start location is at the site coordinates. For sites where the start location is different from the site location, you can select a remote start location on the site page. If necessary create a new turnpoint with the coordinates of the remote start, and then select this turnpoint as the remote start point on the site page. A remote finish point is not selected on the site page, but by changing the last

turnpoint entry on the task page (by default this entry is set to the site).

The Copy Turnpoint Page. The B-100 built-in turnpoint library is available in its entirety thru the *Copy Turnpoint* page. The turnpoints are grouped by contest site (for example, Minden in the USA) or by region (for example, East Australia). This page is used to select turnpoints from the world library and add them to the current site. It can be used to quickly create a new site close to an existing site, avoiding the need to re-enter information about any shared turnpoints.

Select a turnpoint by placing the cursor as illustrated and changing VALUE. Copy the turnpoint to the current site by pressing ENTER. Note that only factory-supplied turnpoints (not custom turnpoints you entered) are available to be copied. Also note that each time you copy a turnpoint, you use up one of the 500 or so available custom turnpoint slots in the B-100.

Detailed Instructions for Setting Up a New Site:

(1) Create a custom B-100 site: Turn to the *Current Site* page and place the cursor on the site number (site#) field. Find an unused site numbered from 1-49, move the cursor to the beginning of the blank area below *Custom*, and dial in the site name. Also fill in the mean magnetic variation for the task area and field elevation.

(2) Set the site coordinates: If the site is already in the built-in European turnpoint database, the coordinates can be copied. Turn to the *Copy Turnpoint* page, dial to the site, move the cursor to 'Set Site Coord' and press ENTER. Always double-check the coordinates with a map !

(3) Alternatively, on the site page dial in the coordinates for the site. It is MUCH faster to set the site coordinates by copying the coordinates from a nearby turnpoint already in the turnpoint database, and then adjusting the coordinates. Make sure to set East or West longitude as appropriate !

(4) Copy turnpoints from the B-100 library to the new site: Turn back to the *Copy Turnpoint* page. Dial to each turnpoint you wish to include in the new site you are setting up, and press Enter while the cursor is on the turnpoint name. Always double-check the coordinates by verifying range and bearing on a map !

(5) Add any turnpoints not available in the B-100 library: Turn to the *Local Turnpoint* page, change the value of the turnpoint number field to the maximum it will accept, then fill in the turnpoint name using the VALUE knob. Next dial in either the turnpoint's coordinates, or its true heading and distance from the site. Always double-check the coordinates by verifying range and bearing on a map !

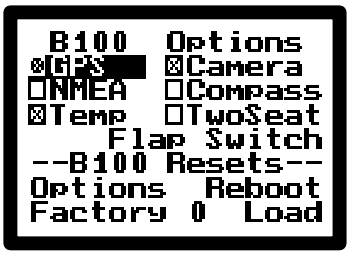
Airspeed Calibration. The B-100 airspeed calibration system is provided to get accurate airspeeds in spite of some very bad pitot-static systems. This is much more critical if you are using the compass option and want to get really good dead-reckoning, if you skip this you will find your wind estimates and dead-reckoning less accurate. This is not really required if no compass is installed, though if your pitot-static is bad enough it could cause noticeable netto errors.

To calibrate the airspeed system, get the calibration page from your glider's handbook or the latest flight test measurements. Turn to the units page and change the units to match those in the error plot you've located, and fill in the values on the airspeed calibration page.

Compass Calibration Page. This page will only be visible if you have the optional B-100 compass installed and you set the 'compass installed' option to 'yes'. The calibration procedure consists of pointing the sailplane to each of the headings displayed on this page, raising the tail of the sailplane to flight attitude in typical cruise, closing and latching the canopy, making sure all the avionics are turned on, and pressing ENTER. You should use a hand-held compass of good quality to verify the sailplane heading if you do not have a compass rose to use. This is also a good time to verify the operation of your mechanical compass.

The B-100 compass MUST be calibrated (if you have this option). Do not rely on the sailplane compass during calibration. Don't skip raising the tail to cruise attitude, as the amount of interference caused by metal in the cockpit area is dependent on pitch. A poorly calibrated compass will likely get lousy position following and/or lousy wind estimation.

B-100 Options Page. You will need to answer some general questions about what options you have installed or desire on this page. Also on this page are a number of system reset buttons, discussed below in the maintenance section.



GPS Installed. Set this option if have installed the optional GPS receiver. Selecting this option enables display of the GPS page.

Camera Switch Installed. Informs the B-100 whether you have wired the turnpoint camera switch; as we recommend. If you do not have this switch installed, when you near each turnpoint the B-100 will periodically ask whether you have reached the turnpoint. This question is suppressed if you have the camera switch wired to the computer.

Temperature Probe Installed. Inform the B-100 whether you have installed the temperature probe and are getting realistic outside air temperature readings. If you are not getting good outside temperatures (because the probe is installed in a warm place), you will want to inform the computer not to use the OAT temperature. In this case the B-100 will assume temperatures according to a standard atmosphere sea level temperature and lapse rate, resulting in less accurate true airspeeds and dead-reckoning information.

Compass Installed. The B-100 will not allow you to set this if you do not have an operational B-100 compass in place. Set this option if you install the optional compass.

TwoSeat. Set this option if you have installed the B-100 in a two-seat glider and have installed the optional second seat slave B-100 computer. This option must be selected on the main computer before the slave computer will operate !

NMEA. Set this option if you have installed both the GPS option and the optional NMEA-183 output cable. This output cable produces a stream of position data for use by other devices in the aircraft; for example the E.W. Barograph with the optional GPS input.

CRUISE-CLIMB Switching. The B-100 will behave differently depending on whether it is in CRUISE or CLIMB mode. If you have the compass option, CRUISE or CLIMB affects only the vario operation. If you do not have the compass option, this will also control whether distance is accumulated based on your airspeed and the wind programmed (in CRUISE) or whether the sailplane is assumed to be drifting with the wind (in CLIMB).

Switching the B-100 between CRUISE and CLIMB may be accomplished with an external switch (on the stick, flaps, or trim lever), or automatically based on the B-100's G-sensor (and optional compass). Just select your preference. You can override the external switch by changing the CRUISE-CLIMB value displayed on the status page; which is useful if you fly the instrument without installing a switch.

Installing The B-100 in The Sailplane

The performance of your B-100 is very dependent on a good quality installation job. Please have this system installed by a qualified mechanic and ensure that the guidelines in this section are carefully followed. With proper installation, the B-100 will give years of trouble-free service.

Before making any part of the installation permanent and before cutting any holes in the sailplane, do a trial fit of all components. Watch for interference problems with the instrument panel cover, the connectors that plug in to the B-100 system unit, the meters, between the display unit and your wheelbrake handle, etc.

Sailplane Wiring Guidelines. We strongly recommend that all wiring in a sailplane use shielded cables. Use of unshielded cable will greatly increase the likelihood of interference between the radio and the variometer systems. Wiring should always have the shield connected to ground AT ONE END ONLY. Wiring which should be shielded includes (especially) wiring for the radio microphone, push-to-talk, radio speaker, flap or stick CRUISE/CLIMB switch, B-100 speaker, wiring for a remote camera control, and barograph feature EVENT switch wiring. Example high-quality shielded 2-conductor cable includes Dearborn Type 1022401 or Belden Type 9501. Do NOT run any wiring for the B-100 around or immediately adjacent to the radio or antenna lead.

This is a good time to check the glider's antenna connection to the radio. The crimp-on BNC connectors are frequently installed improperly at the factory, which can cause poor radio reception and interference problems with other instruments.

The battery should be fused as close to the battery terminals as possible. This is a fuse of last resort, and should be a slow-blow type easily in excess of the requirements of your instrumentation. Several in-flight fires in sailplanes have resulted where a fuse was installed in the instrument panel only, and a short occurred between the battery and the panel (usually under the seat). Separate power wiring from the battery to the radio and to other instruments is recommended.

A secondary battery with independent wiring to a selector switch on the panel is highly recommended, due to the tendency of batteries to fail during the most important flight of each season. Panasonic, Dry-Fit, or Powersonic 6.5 Amp hour (or higher) 12 volt gel cells are recommended (14 volt batteries provide no advantage for the B-100). The Minus terminal of each battery should always be connected to the sailplane ground and should never be switched. Never connect the Plus terminals of more than one battery to each other.

Power wiring should use 18 gauge or larger wire. Avoid use of inexpensive automotive switches, connectors, and fuseholders. These are prone to contact corrosion leading to problems in operation of the sailplane instruments. The battery voltage indicated by the B-100 should be no more than .2 volts less than the voltage measured at the battery terminals (with a high quality voltmeter). If the difference is more than .2 volts, check the

voltage drop across each segment of the electrical wiring until the high resistance components are located (usually oxidized connections, switches, or fuses), and repair.

System Unit Installation. The B-100 system unit is the 221 mm x 105 mm x 69 mm gold finished box with mounting flanges which contains the system processor, power supplies, and sensors. The B-100 system unit is designed to be mounted horizontally, with the flanges facing down. The mounting orientation can be either fore and aft or across the cockpit. In Schempp-Hirth gliders without tilt-up panels the easiest installation is accomplished by installing a shelf between the canopy rails. If you need to install the system unit with the flanges up or vertically and wish to use the G-sensor, please notify your dealer as the G-sensor will need to be installed within the system unit accordingly. Ensure that the installation provides adequate clearance for the connectors which protrude from the end of the B-100 system unit.

Display Unit Installation. The display unit mounts on the front of a standard 80 mm (3 $^1/_8$ inch) instrument hole. The mounting screws are inserted from the back of the instrument panel.

Control Unit Installation. The control unit is designed to be operated with the left hand, and should be installed where it is easily reached. In some sailplanes a simple bracket to the sailplane's side can be fitted. Some pilots will prefer to use the velcro strap included, which allows easy removal in the event of a bailout emergency yet prevents damage to the canopy or pilot in turbulence. If the velcro strap is used, an additional plate with velcro for holding the control unit while entering and exiting the sailplane should be installed.

The control unit cable can be made to exit either end of the control unit (beneath either the help button or the page knob). If installation or operation would be easier with the cable exiting the opposite end of the control unit, your dealer or the factory can re-route the cable.

External Connection Block Installation. The B-100 comes with a wiring terminal block with screw terminals for all wiring connections. Place this for ease of access and ease of wiring.

Power Wiring. If you wish, you can install a switch between your sailplane master power and the B-100. If you do so, be sure to place the switch in the +12 battery wire (PLUS, and NOT in the minus or ground wire). To minimize the possibility of radio interference, separate power lines forward from the battery to the radio is recommended, though many installations will work fine without this precaution.

Speaker Installation. The B-100 speaker can be installed in the panel or (preferably) closer to the pilot's ears. Care must be taken to minimize blockage of the sound coming out of the speaker. As one of the speaker leads is connected to the +12 volt supply, the speaker leads absolutely must be protected from shorts or contact with metal or carbon fibre components in the sailplane.

Temperature Probe Installation. The temperature probe installation is very

important to getting correct true airspeed and climb information from the B-100. DO NOT install the probe at the airvent outlet in the cockpit ! We have measured a 50 degree Fahrenheit difference between the airvent outlet and the outside air temperature when the airvent was only partially opened. Recommended installation procedure for gliders with a nose vent is to drill a hole from the outside (from in front of the sailplane) into the vent duct, then snake the probe in from the front with a large dollop of RTV to seal the airvent and secure the probe. Make sure that the temperature probe installation will not interfere with any nose hook, pitot tube, or pneumatic runs in the nose of the sailplane.

Sailplane Pneumatic System Guidelines. Sailplane pneumatic systems and variometers often perform poorly for a number of common reasons. Follow these simple guidelines to avoid trouble:

- Avoid use of old and stiff tubing. It often causes leaks at connections.
- Avoid use of extremely soft tubing such as surgical or latex types, as any motion or change in cockpit pressure will stretch the tubing and cause erroneous instrument indications.
- Do not leave long lengths of tubing unsupported. Any motion or G-load will cause the tubing to move, which will change its internal volume and cause erroneous instrument indications. Long pneumatic runs are best installed with hard nylon pressure tubing such as Imperial Eastman Polyflow 44-P-1/4.
- Avoid soft-sided gust filters. The gust filter capacity must be extremely rigid, or any change in G-load or cockpit pressure (such as from changing airspeed) will change its internal volume and cause erroneous instrument indications. If in doubt, turn on your instruments and test by pressing **gently** on the capacity. If there is any variometer motion throw the gust filter in the trash immediately.

Avoiding Variometer Crosstalk. The most common mistake in variometer installations is to connect more than one variometer with a t-fitting at the instrument panel. This can cause crosstalk between variometers resulting in wild needle swings during pull-ups and other trouble. This type of installation is only permissible when all of the variometers are of the pressure transducer type. Flow sensor type variometers cause significant flows in the pneumatic system, which must be isolated from other instruments to prevent serious problems (flow sensor variometers are the types that use a flask or an internal capacity). To minimize crosstalk, minimize resistance between the instrument and the TE probe and maximize resistance between instruments. Ideally the installation would have separate lines from the TE probe forward. In practice:

- BEST: Place the T-fitting in the TE line under the pilots seat and run separate TE lines forward for each variometer. This usually prevents crosstalk.
- USUALLY OK: Use a T-fitting in the TE line at the panel, followed by a restrictor or gust-filter for EACH instrument.
- NEVER place a gust-filter in the TE line followed by a T-fitting to more than one instrument.

B-100 Pneumatic Connections. The B-100 requires pneumatic connections to TE, pitot, and static. A good quality TE probe is required and can be purchased from Borgelt Instruments. We recommend that you use the same pitot and static as are used for the airspeed indicator. Tailboom statics are NOT recommended for the B-100. Where you have a choice of nose or tail pitot/static, the nose sources are recommended. Tail pitot and static often have significant errors and time delays, each of which can cause problems.

Use of the pneumatic donuts included is recommended (slide over tubing, attach tubing to instrument, then role the donuts over the barbed fittings). Any leaks in the pneumatic system will cause serious problems with the operation of this and other instruments. We recommend a complete system leak check after any change in your instrumentation. Leaks in the airspeed system can be dangerous, make SURE this doesn't occur.

Camera Switch. The B-100 provides an input for letting it know when you have actuated your turnpoint camera. It is intended to be used with a DPDT momentary switch where one switch actuates the cameras and the other lets the B-100 know that you fired them. NOTE: The DPDT switch is just like two separate momentary switches in one package... NEVER wire either of the B-100 camera inputs to either of the leads from the cameras !!

Barograph Event Switch Wiring. Like the camera switch, the event switch for the barograph requires a simple switch closure. The event switch provides a supplemental trace on the barograph printout, and can be used to indicate 'motor out' for motorgliders.

Compass Installation. The optional compass (blind heading sensor) must be installed as far away from sources of interference as practical. Unfortunately the rudder pedals and supports, canopy support and latching structures, instrument pedestal supports, existing compass, and some avionics are interference sources. Install the compass as high as practical in the cockpit, just under or on top of the instrument cowling but not immediately adjacent to your aircraft compass. Make sure that it is aligned with the sailplane fuselage, level with the wings, and level with the sailplane in normal cruise attitude.

GPS Installation. The optional GPS receiver requires installing the receiver module and the antenna. The receiver module can be installed anywhere in the instrument panel, as long as the antenna cable reaches the antenna installation. Do NOT lengthen the antenna lead ! GPS receivers are very sensitive to antenna lead wiring type and length. If a longer lead is absolutely required, please contact the factory. The GPS antenna is best installed in the glare shield over the instruments. The GPS signal is line of sight, so do not install the antenna where its view of the sky is blocked by a compass or an airvent (you may need to relocate, and consequently recalibrate, the sailplane compass). If the glare shield is fixed to the canopy and jettisons with the canopy, the GPS antenna installation must be arranged such that the antenna will fall out the bottom of the glare shield during emergency canopy jettison.

Safety Check Before Flight.

We have provided a safety and installation checklist in **Appendix E**. Please ensure that this checklist is completed prior to flight !

Maintenance

There are no user serviceable components inside the B-100 system unit, and you should not open it ! If you open the system unit, you will void your warranty. The B-100 is constructed with CMOS circuitry that must be handled with special anti-static grounding equipment.

Reset Options. On the 'B-100 Options' page you will find two reset buttons. The 'Options' button resets all of the user selectable options to the factory defaults. This includes virtually everything you can set in the B-100, such as variometer and audio presentation choices, airspeed and compass calibration, etc. The 'Options' reset should only be used when installing the B-100 in a new sailplane ! The 'Reboot' button resets the computer and restores any factory turnpoints you may have deleted, but it does not reset any of your option settings.

Software Updates. The B-100 software can be updated without removing the unit from the sailplane. This is can be performed by you or your dealer, and requires a personal computer with a special cable and software. When a new version of the software is installed, all of the option settings and turnpoint library information are preserved. Please see Appendix H for information about performing a B-100 software update.

Fuse. The fuse provided in the external connection board is a 500 ma (1/2 amp) fast-acting fuse (not a slow-blow fuse !) with a voltage rating of 25 volts or higher. This is a metric 5 mm x 20 mm fuse. Suitable parts include the Littelfuse series 216 or 217. **NOTE:** GPS-equipped B-100's require a larger 1 amp fast-acting fuse. Please use quality fuses and not cheap fuses from Radio Shack; we have seen fuses that caused a 2 volt drop in supply voltage !

Emergency Restart Button. In case of software disaster, an emergency restart button is provided on the B-100 system unit. The B-100 can be completely reset by holding this button in for about 10 seconds during power-on. This functions like the 'Reboot' button, and will normally not cause the loss of any option or turnpoint information. This button is recessed behind the small hole in the end of the system unit and requires a paper-clip to operate. Please do not use this reset feature except under directions from the factory or your dealer.

Cleaning the Screen. The B-100 screen is easily scratched. Please use a soft moist cotton towel to clean it. Mild soap is OK, but solvents such as acetone or strong detergents will damage the screen. Damage to the screen from improper cleaning is not covered by your warranty.

Internal Battery. The internal battery in the B-100 has a lifetime of at least 5 years. After 5 years, the unit should be returned to a dealer for battery replacement (if this battery is replaced without specialized equipment, all option settings and user turnpoint entries will be lost).

Common Questions and Answers

How Does The B-100 Track Position Without a Compass ? The B-100 makes an educated guess as to what direction you will fly when cruising. This guess takes into account the estimated wind, current MacCready setting, glider polar including water and bugs, your true airspeed, and whether you are above or below final glide. (When you are above final glide no time will be spent circling, so your crab angle is less). When you are flying MacCready speeds with uniform conditions and no large deviations are required, this can be remarkably accurate.

This estimation algorithm works best when a reasonably accurate wind estimate is used as a starting point. For best results, always enter your expected mean wind each day prior to flight.

How Do I Update Position Without Affecting Wind ? Put the cursor on distance out or distance left or right of course and press ENTER as if giving a position fix, then update the B-100 to match your known position. The B-100 will not try to adjust the wind when the position is changed shortly after a position fix.

How Accurate are the B-100 Distance Calculations ? The accuracy of distance computations in the B-100 are related to the distance from the selected site. The B-100 uses a planar projection from the site, so the distance from the site to any point will be very accurate but the distances between remote turnpoints will be less accurate. The B-100 will overstate distances between remote turnpoints. For a 1000 km straight out flight with multiple waypoints the accuracy will typically be better than 2%. For a 1000 km triangle the accuracy will typically be better than 1%. For typical racing tasks the accuracy will be typically better than .5%. Distances at latitudes over 65 degrees will be noticeably less accurate. For record flights, best to check the distances with the latest FAI published formula (which has changed over the past few years).

Why Are There No Numbers on The Heightband Graph ? Actually, there isn't room on the screen ! The heightband graph is designed to give a picture of what the day's lift is like. Does the thermal strength tend to fall off rapidly ? Are the thermals consistently weaker at lower altitudes ? Is this thermal weaker than the last two ? You can see where you are in the heightband by the glider symbol on the left. In flight you will find that you are really most concerned with the shape and trend in the heightband, rather than the absolute numbers.

Where are the Barograph and Logbook Features ? The barograph and logbook features are not yet available.

Appendix A - Planning Final Glides

Planning and executing a final glide entails much more than just using the B-100. A final glide computer provides an accurate projection of the amount of altitude you will lose under laboratory conditions. The altitude required for a real final glide will vary considerably from this amount, so the computer must be used as a baseline only. Please keep in mind the safety requirements for a final glide when reading the analyses below !

The computer assumes that the final glide will be performed in still air (as does MacCready theory). In reality a final glide is rarely performed in still air. The computer relies on the pilot to provide correct inputs, and with incorrect inputs will usually give an incorrect projection. In the real world the information the pilot provides to the computer may not be completely accurate. Common sources of error are:

- Incorrect wind estimate,
- Incorrect estimate of water on board,
- Incorrect altimeter setting due to a weather change since takeoff,
- The sailplane may not perform according to the projected polar, and
- Incorrect estimate of the effect of bugs or rain on the polar.

The speeds now achieved in competition consistently exceed that which is forecast by MacCready theory, even after removing the energy differential between start and finish. Higher speeds can be reached because, while MacCready theory assumes climbing while circling and cruising in still air, we often take advantage of lift while cruising. In addition to the time not spent circling, the sailplane climbs much better while flying straight than turning (due to a much lower sink rate).

Bill Bartell won the Giltner Trophy for the fastest flight of the 1991 USA 15-meter nationals, flying 285 miles at 102 mph. His B-100 showed that only 16% of the time was spent circling with an average climb rate while circling of 8 knots. This day had only about 50% streeting, but with the performance of modern sailplanes this was enough to eliminate a lot of time wasted flying in circles. We both started the final glide well below glideslope on this day, as discussed below.

Just as the overall task speed can beat MacCready, so can the final glide. If the final glide is to be performed before the end of the day's lift, significant time savings can be realized by starting the final glide 'below glideslope' rather than climbing up to the projected final glide altitude prior to starting.

Take the example of a MacCready 5 knot day with 35 gallons of water in an LS-6B, with a target arrival altitude of 0 (no bugs, no wind). Starting a final glide 50 miles out, the simplest option would be to climb to 9615 feet and final glide in at 110 knots. Cruising at 110 knots uses about 200 feet per mile and 400 feet per minute. For every minute it is possible to climb straight ahead at 55 knots, the total altitude that must be climbed is reduced by 200 feet. If it is possible to climb straight ahead averaging 3 knots up for 2 minutes flying 55 knots, the time difference for starting the final glide 1000 feet 'below glideslope' would be:

- 2 minutes time saved in the last 5 knot thermal by leaving 1000 feet lower.
- 1 minute extra time on glide (2 minutes spent flying at 55 knots and climbing at 3 knots, rather than 1 minute flying at 110 knots sinking at 400 fpm).
- Net time savings: One Minute.

The savings wouldn't really be quite one minute, perhaps more like 45 seconds. If the final glide was started at 9615 the pilot would pull up slightly in the same 3 knot lift, resulting in increasing the MacCready setting and finally making it back at a slightly higher speed than the original still air prediction.

This is a fairly conservative example. The time savings will be greater in the presence of a headwind, and on a MacCready 5 day it should be possible to average better than 3 knots in pullups performed straight-ahead through the thermal cores. In addition it should be possible to climb straight ahead at a good climb rate for more than 2 minutes (or 2 miles) out of 50.

There are many cases in which it is unwise to start 'below glideslope'. First and foremost is safety... If there aren't adequate landing opportunities in the area to be crossed during final glide, pick a reasonable safety margin and stick to it. Other reasons why this may be impractical include:

- The heightband graph shows that the lift is significantly better at higher altitudes,
- At altitudes way below cloudbase it is very difficult to use the clouds as guides to locate the best lift; in this case it is more practical to stay high and finish the final glide at a much higher MacCready setting,
- The day is decaying quickly,
- The lift has been inconsistent and hard to predict,
- A large tailwind makes the savings less noticeable,
- Large areas of sink have been encountered or are likely, or
- There are no clouds and no gliders in front to mark the areas of lift.

Consider the situation where the LS-6B is 50 miles out, clean and dry, the day is dying, and the last foreseeable thermal tops out with a thermal average of 3 knots at an altitude good for a MacCready 0 final glide home. Changing the MacCready setting on the B-100 will show a surplus altitude of ++++++0 feet for MC 0, and ---2250 feet for MC 3. The question is, how can you not lose that 2250 feet during final glide (rather than can I climb that much) ? During MC 3 cruise the glider is flying at 99 mph, while sinking 170 feet per mile or 280 fpm. You can make it home at MC 3 if you can cover 13 out of the 50 miles at an average sink rate of 0. There are two extremes in how to fly this:

- Conservative: Set MacCready 0, bump each bit of lift, and gradually work up the MacCready setting each time you gain a bit more energy. Slower, but less risky.
- Aggressive: Set MacCready 3. On each bit of lift encountered, slow up as much as possible (rather than just slowing to the MC 3 speed-to-

fly). If all goes well, you will bounce up to the glideslope for MC 3.

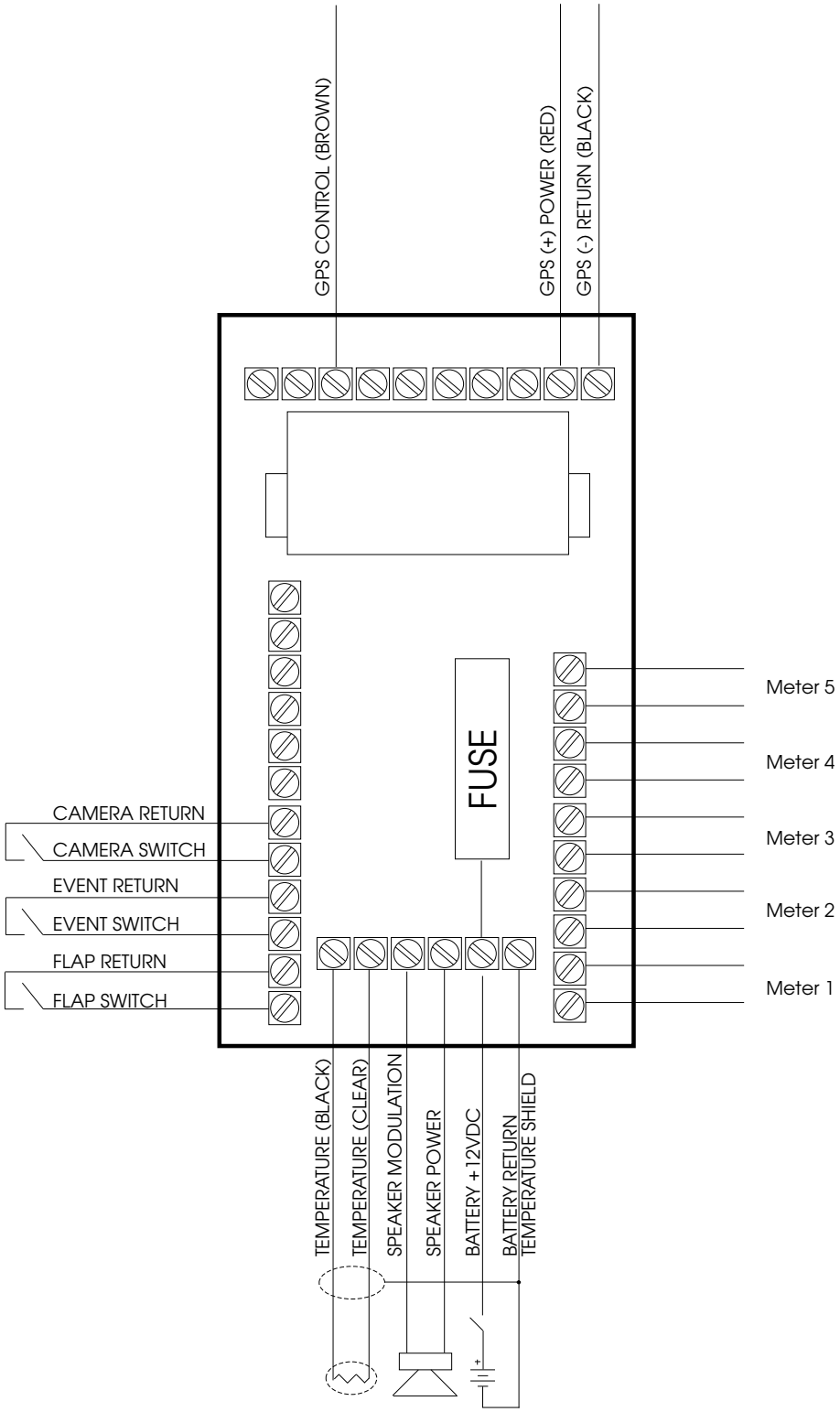
Lift that is too weak for thermaling can stretch the glide a huge distance. A decaying cloudstreet is perfect for the aggressive approach. The conservative approach will be slower because considerable time will be spent cruising at MC 0 (62 mph) rather than MC 3 (99 mph) prior to bumping up the MacCready setting. The aggressive approach may result in landing short. The correct approach is whichever wins on a given day ! In any case, minor deviations to stay in rising air are almost always worth the extra distance.

Planning of the final glide should start well before the last thermal. In the half hour preceding the expected start of final glide, watch carefully for signs of the day quitting or other weather changes that could mean trouble. Try to assess whether it will make sense to start 'below the glideslope' and if so by how much. The general steps in planning a final glide can be summarized as follows:

- Verify that the B-100 'FIN' target arrival altitude includes an adequate safety margin for the site.
- Verify that both the B-100 and standard altimeter are set correctly. In the 1981 Sugarbush contest a fleet of gliders landed short due to a barometric change during a race. Best to verify the altimeter setting by radio (ATIS or a local airport tower).
- Verify that the B-100 wind estimate looks reasonable. If you have been giving the B-100 periodic position fixes it should be quite accurate. Make sure to adjust the wind setting to account for the layer the final glide will pass through; including effects such as valleys in which the wind may increase with decreasing altitude, or a forecast low-level wind shift or increase.
- Verify that the B-100 water and bug settings are reasonable.
- Evaluate the MC setting with respect to the final glide. If there will be absolutely no more lift, fly the glideslope that gets you home. If you believe that there will be significant reduced sink or even lift during the final glide, consider whether you want to start 'below glideslope' for the MacCready speed you plan. If you expect sink, put some extra altitude in the bank (start 'above glideslope').
- Double-check all of the above before leaving that last thermal ! Its depressing to land short.

During the final glide, the B-100's total energy final glideslope indication makes it easy to monitor the process of 'working up to glideslope'.

Appendix B - B-100 External Connection Block Wiring Diagram



Appendix C - Acknowledgements

The principal designer of the B-100 is Dave Nadler (better known as Yankee Oscar, currently an LS-6B). Dave is a past winner of the U.S.A. Region One contest and first winner of the David J. Shapiro memorial trophy (fastest pilot in New England). He received his B.S. in Electrical Engineering from M.I.T. in 1978. Dave is the proprietor of the consulting firm Nadler & Associates, which has been creating software and hardware products for a variety of high technology customers for the past seven years. Dave came up with the overall design and functionality, user interface, and packaging of the B-100. He built the prototype hardware, designed the processor, wrote the operating system and low level software, developed the operating algorithms, designed the user screens and software architecture, wrote the manual, and did most of the early usability and flight testing.

Mike Newman (better known as Yankee Golf, currently a Ventus B/T) is a past winner of the U.S.A. Region One contest. Mike wrote most of the application level software for the B-100 and contributed mightily to the voluminous detail design that goes into a system like this. Mike received his Masters Degree in Computer Science from M.I.T. in 1976. He now works on CAD systems for large computer design at Digital Equipment Corporation.

Mike and Carol Borgelt manufacture the Borgelt line of variometer systems in Australia. Mike has been soaring since 1966, was the Australian National Champion in the 15m class in 1981, and currently flies a Ventus Ca with a TOP power-plant. Mike graduated from the University of Western Australia in 1970 with a B.Sc in Physics and holds a postgraduate degree in Meteorology. He has worked as a meteorologist and as a researcher in the Atmospheric Science Department of an Australian University. The sailplane instrument manufacturing business began in 1975. Borgelt Instruments was formed by Mike and Carol in 1978 and there are now many B-20 and B-100 systems in use world wide. Mike designed the transducer system in the B-100 building on the proven accuracy and reliability of the transducers in the Borgelt B-20 variometer system. He also designed the B-100 power systems, the circuit board layouts (except the processor), and the detail mechanicals.

Flight testing of the instrumentation and software included flying it in three U.S. nationals and four U.S. regionals prior to starting production. Testing of production systems has included one U.S. nationals, several U.S. regionals, several sports class contests, and extensive non-contest flying in the U.S. and in Australia.

Bill Bartell and Tom Knauff performed considerable flight testing of the production hardware and provided superb feedback for final adjustments.

Our Thanks to the 100 or so soaring pilots who have helped us with their suggestions, and acted as guinea pigs for our usability testing prior to series production.

Thanks also to the Nadler & Associates employees and customers, who have been extremely patient with Dave when he's off fooling with gliders and instruments.

Appendix D - Customer Suggestion Form

This instrument was designed for you. We value your input on any feature of this instrument or its documentation that you feel could be improved upon. Anything else we can do to help you in soaring, let us know !! If you have comments, please photocopy this page, fill it in and mail it to your dealer, Nadler & Associates, or Borgelt Instruments.

For Our Information:

Your Name: _____

Phone No (with country code): _____

FAX Number (with country code): _____

Your Borgelt Dealer: _____

B-100 Serial Number: _____

B-100 Software Version Number: _____

Your Comments and Suggestions:

Thanks for your Input !!

Appendix E - Installation Checklist

Safety Check Before Flight.

• Pneumatic system checked for leaks, including pitot, static, and TE.

• All controls, canopy hinges, and mechanisms checked for no interference with the B-100 system, wiring, or pneumatic runs. There must be absolutely no possibility of interference of any instrument components and the pilot or sailplane flight controls.

• Sailplane primary Airspeed and Altimeter are functioning correctly.

• The GPS antenna installation cannot interfere with canopy jettison.

• Battery voltage indicated by B-100 is no more than .2 volts less than the voltage measured at the battery terminals (with a high quality voltmeter). If the difference is more than .2 volts, check the voltage drop across each segment of the electrical wiring until the high resistance components are located, and repair.

B-100 Configuration Completed.

• Audio style selected (we recommend B-100 standard).

• Vario meter display choices entered. If there is any confusion about which meter is #1 etc; try changing the selection and see which meter moves (note that depending on whether the B-100 is in CRUISE or CLIMB, only one set of selections will cause the meters to move).

• Selectable averagers chosen (we recommend 20 second averager in cruise and climb).

• Units selected per pilot preference.

• Glider polar selected, and both water capacity and empty (dry) gross weight for this particular sailplane and pilot entered.

• B-100 options page completed (make sure that the indications for temperature sensor and camera switch are set correctly, and that the cruise/climb switching is set to reflect the pilot's preference).

• For compass equipped B-100, compass and airspeed calibration completed.

Appendix F - Pilot Checklists

Before Each Takeoff...

- B-100 Altimeter Set.
- Estimated Wind Entered.
- FIN (field plus reserve finish altitude) setting verified.
- Task Entered.
- STI (and POST interval) Entered.
- Press the START button to clear yesterday's statistics.
- Battery voltage verified (on the *Vario Tuning* page).

Before Each Contest

- Select (or enter) the correct site.
- Verify that the site information is correct, especially the mean deviation for the site (otherwise the displayed compass headings will be incorrect).
- If a remote start point is in use, enter the remote start point as a 'turnpoint' and set the remote start location to this turnpoint on the contest site page.
- Compare the B-100 list of turnpoints for the site to your handout. Enter any missing turnpoints and delete any turnpoints no longer in use. Most importantly, double-check both the coordinates and distance and bearing of all turnpoints against your handout and the map. It is extremely common to find errors in the coordinates provided by contest organizers, and this could cause you great annoyance in flight !
- Set the normal desired FIN altitude to field elevation plus the reserve appropriate for the site.

Appendix G - Warranty

If, under normal operating use, any part of the B-100 hardware proves defective in material and/or workmanship within the warranty period of twelve months from date of purchase, such defective parts and/or workmanship will be repaired by Borgelt Instruments or their agent. Freight charges are to be borne by the owner. This warranty is not transferable.

This warranty does not cover the liquid crystal display or damage caused by misuse, neglect, accident, reversal of power polarity, or repair attempts by unauthorized personnel. This warranty will be voided if any part of the instrument is disassembled except under specific authorization from the manufacturer.

Appendix H - Specifications

B-100 Basic System Weights:

System Unit	1.12 kg	2.51 lbs
LCD display	300 gr	11 oz
Control Unit	200 gr	7 oz
Meter display	280 gr	10 oz
XCB	130 gr	5 oz

GPS Option Weight and Size Specifications:

Receiver	350 gr	13 oz	41 x 71 x 108 mm
Antenna	100 gm	4 oz	75 x 75 x 8 mm

B-100 Power Consumption at 12 volts DC supply:

Component	Minimum	Typical	Maximum	Depending on..
B-100	145 ma	170 ma	200 ma	Audio Volume
GPS option	10 ma	70 ma	175 ma	Powersaver vs. Fulltime
TwoSeat Option	80 ma	80 ma	80 ma	

Note that the GPS receiver always draws 175 ma when it is operating, and the minimum and typical numbers represent average power usage when Powersaver mode is used exclusively or during most of a flight.

Appendix I - B-100 Software Update Procedure

Nadler & Associates and Borgelt Instruments periodically make new features available in the Borgelt B-100 through release of new revisions of the B-100 software. The B-100 is easily updated to a new software revision using an IBM-compatible personal computer and a B-100 update interface cable. When the B-100 software is updated, all pilot-selected options and turnpoints are preserved without change. Sometimes after updating the software the currently selected site may be changed; if this occurs please just re-select the site you require. Updating the B-100 software requires about 10 minutes.

This is normally a very quick procedure. However, as Murphy is always lurking nearby, DO NOT attempt to update your B-100 the night before that big contest. Please allow enough time so that if anything goes wrong, you can send your B-100 system unit back to a dealer for an update, and have it returned to you without great inconvenience (at least a week before that big contest !).

To Update Your B-100 Software, You Will Need:

- An IBM-compatible PC (personal computer) with a 9-pin serial port, which can be placed with a few feet of the B-100. 25-pin serial ports may be used with a 9-pin adapter. A notebook or laptop computer which can be placed in the cockpit is best.
- A B-100 update cable, available from your B-100 dealer. This is specially wired for the B-100; please do ***NOT*** attempt to use any cable or adapter except one provided by a Borgelt dealer.
- A B-100 software update diskette.
- A well charged battery (or an AC adapter) to power the B-100 during the update process.

To Update Your B-100 Software, Follow These Steps:

(1) Turn on the B-100. Check the battery voltage and verify that it is fully charged (12 volts or better is recommended). Turn the B-100 off again.

(2) Connect the B-100 load cable serial port adapter to the serial port on the IBM-compatible PC. If your PC has more than one serial port, use either COM1 or COM2.

(3) Place the PC near the B-100 where it is safe and stable, best in the sailplane's seat. Turn on the PC, and after it has started insert the B-100 update software diskette into the PC. Select the diskette drive containing the B-100 update diskette as the current DOS disk drive, usually by typing **A:** followed by pressing the Enter key.

(4) On the PC, start the B-100 load program by typing **BL** and pressing the Enter key (Note: European customers should type **BL EUROPE.HEX** followed by Enter). You should see some messages from the B-100 load program on the PC screen ending with 'attempting to connect to the B-100'. **If you do not see the 'attempting to connect' message:**

- The update program has not started correctly ! You will not be able to update your B-100.
- Please record any messages on the computer screen and send them to your Borgelt dealer along with the make and model of PC you used. We need this to assist you in determining why our update program does not work properly with your PC.

(5) If you have the B-100 two-seat or GPS options, carefully unplug the modular telephone-style connector from the B-100 system unit (the big gold box). If you have neither option this connector will have nothing plugged into it.

(6) Plug the B-100 update cable into the B-100 system unit. The telephone-style modular connector plugs into the jack in the corner of the B-100 system unit.

(7) Turn on the B-100. Select the ***Setup mode***, enabling display of all of the B-100 setup pages. Turn to the page labeled ***B-100 Options*** and place the cursor on the field in the lower part of the screen labeled ***Load***. Push the Enter button, and when the B-100 inquires *Are you sure you want to reload the B-100 ?*, press the Enter button a second time.

(8) Sometimes the B-100 audio will turn on at this point. This is not a problem, just ignore it ! Look at the PC screen. You should see messages indicating that the connection to the B-100 is established and the flash ROM is being erased. **If you do not see the 'connection is established' message:**

- The connection between the B-100 and the PC is not correctly hooked up. Turn off the B-100, recheck the connection to the PC, the adapter, and the B-100. Restart from step 7 above.
- If the PC cannot communicate with the B-100, you will have to obtain another PC or cable, or return the B-100 to a dealer for your software update.

(8) The PC starts by erasing the B-100 memory, which takes around a minute. Next, it loads the new software, which takes around 6-9 minutes. As the PC loads the B-100 software, it will display a bar-graph indicating what percentage of the software has been reloaded. After the software is loaded, a few checks are performed and the B-100 is restarted. After about 7-10 minutes, you should see the B-100 restart, displaying the copyright page for the new software version.

(9) Sometimes (rarely !) a problem occurs during the software load of the B-100. In this case, you will see error messages on the PC screen. **If the B-100 does not restart when the PC finishes running the software update program:**

- Turn the B-100 off for at least 5 seconds, then turn it on again. If the B-100 starts with the copyright page for the new software version, the B-100 software has been successfully updated.
- If the B-100 screen shows garbage, the software failed to load properly. Please write down any error messages that appeared on the PC screen and save them for your B-100 dealer. Then restart the B-100 load program on the PC as described in step (4) above. The B-100 load program should immediately reconnect to the B-100.

If for any reason the B-100 cannot be properly reloaded after 2 tries:

The B-100 load program communicates with the B-100 program at very high speed. Some PC's are not capable of reliable operation at these speeds. For this reason, an option is provided to perform the software update in 'slow' mode. Please try one last time, except when you start the B-100 load program on the PC type:

BL -slow
(or **BL -slow EUROPE.HEX** for European customers).

If for any reason the B-100 cannot be properly reloaded after 3 tries:

- Please return the B-100 system unit (the big gold box) to your dealer. You may leave the wiring connection board and all wiring in place in your sailplane; we only need the system unit !
- Please send us a transcription of any error messages you received on the PC screen and the make and model of PC you used.
- We will update your software and return your B-100 as quickly as possible.

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