FLIGHT COMPUTERS

A Review of the LNAV and SN10

Luke Dodd

Variometer-Flight computers are becoming increasingly powerful and versatile instruments. They offer the soaring enthusiast a wealth of information to assist with in-flight decisions and planning. As I have flown with both the Cambridge LNAV and Ilec SN10, I thought a review article from a users perspective maybe of some interest to fellow soaring enthusiasts. As I have no commercial interest in either product I feel I can make a worthwhile comparison of the two.

The Cambridge LNAV and Ilec SN10 are both flow sensing variometers. After placing a request on the rec.aviation.soaring newsgroup for a ‘pros and cons’ discussion of variometer principles, I sparked quite a lively debate from the experts on whether flow sensing variometers or pressure transducer based variometers are preferable. A flow sensing variometer relies on differential cooling when air flows over a pair of heated thermistors. Rate of climb indication is derived from this differential cooling. Pressure transducer variometers rely on the reduction in air pressure with height, in effect an ultra sensitive altimeter.

After esoteric design principles of analogue to digital converters were thrown about I must admit to being none the wiser. Most experts considered pressure transducer based instruments theoretically superior, whether this equates to a significant real world advantage is unclear. One consistent point raised on the newsgroup was that variometers need altitude compensation to be accurate.

I will now discuss the functions of the respective flight computers as this is where a significant difference exists. Please don’t assume that because I have glossed over the variometer function that its not important, it is, as we all know one of our most important instruments. However it is difficult to stand up and categorically state that any particular variometer system is clearly the best for the soaring enthusiast.

The first flight computer I owned was a Cambridge MNAV which I purchased off a fellow Club member. It was a well built instrument and simple to use. When Ian McPhee, the local Cambridge agent, offered a very attractive trade-in I decided to upgrade to the LNAV. The LNAV arrived with flask, leads and an analogue readout, your choice of 57 or 80mm display. The various leads plug into telephone-type sockets at the rear of the unit. The LNAV has pneumatic connectors for pitot, TE probe, static and capacity. The build quality of the unit was reasonable.

The LNAV fits into an 80-mm panel cut-out with an LCD screen measuring 47X37mm. The display is not graphically capable, essential data is displayed primarily in digit form. In addition to the On-Off volume control, five pushbuttons operate the unit. Pressing the left or right arrow key changes screens, while a value on the screen is altered with the up or down key. The longer a button is held down, the faster the value is changed. In rough conditions you get a few interruptions as your finger slips off the small pushbuttons. The optional remote control unit is worth considering.

The LNAV offers a main flying screen, which displays a number of important variables. The pilot can set one of three home screens depending on what information he wants shown. The ‘GO’ button is a useful feature which instantly returns the LNAV to the Home screen from anywhere in the menu.

Probably the two main features of the display are a ‘speed to fly’ bar graph, and a glide slope indicator. This visual display of ‘speed to fly’ is backed up by the audio output. I never found the visual ‘speed to fly’ display useful in flight, preferring to look outside and listen for the audio queues. The glide slope indicator (which is total energy dependent) consists of a line with a dot in the centre, this depicts the glider, and another line with a gap in the middle, which represents the final glide altitude. The height of the glider above or below this line is proportional to your height above or below the glideslope. It is quite a neat arrangement, which works well in the air. A glance at the LNAV’s display shows whether you are on glide slope. This is preferable to looking at a ‘height required’ figure and comparing this with the altimeter

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reading. I found final glides accurate and reliable, which quickly gave me confidence in the instrument and allowed one to set 500' finishes comfortably.

The main screen also displays your current altitude using the LNAV's built in altimeter. I found this readout useful during low saves in weak lift. My mechanical altimeter is a little sticky and won't show any height increase until you've gained about 100'. The top left portion of the screen can be configured to display either netto average, achieved glide angle, track error in degrees, average climb over the whole thermal or the McCready setting. If you have a GPS connected, the bottom portion of the screen provides a read-out of the wind component. Finally, the distance from goal and a 30-second climb average complete the data displayed. The second flying screen, selected by pressing the right arrow replaces the wind component reading with the McCready setting and headwind estimate.

To the right of the main screen are the thermal statistic screens. The screen labelled 'Thermal' shows the achieved average climb rate, the normal 'averager' reading and the total height gained in the thermal. The next screen labelled 'Total', shows the achieved climbrate again, the percentage time spent circling and the total altitude gained since the start of the flight or since a reset was performed. The third screen, labelled 'Reset', resets the thermal statistics. It is surprising this information is split between three screens requiring a key press to view each one. I guess the size of the LCD limits the amount of information which can be displayed at any one time. These statistics require GPS positional data and hence are only available when a GPS is connected to the LNAV. The LNAV provides no other task statistics to the pilot, which is in sharp contrast to the SN10.

The LNAV also offers a Temperature/Altitude screen for manually entering the OAT and the altitude corresponding to this figure. This is required when the optional temperature probe is not installed. Of course you need an OAT gauge or a thermometer to hang out the window. I was surprised that a temperature probe was not supplied as standard with the LNAV, particularly considering the importance of temperature data for altitude compensation of the variometer. Screens are also available for the usual data such as ballast, 'bugs', altitude, and battery voltage.

The LNAV has the ability to accept GPS data from any NMEA 0183 compliant GPS device. I used the NMEA ouptut from my datalogger to drive the LNAV. Selecting a turnpoint on the datalogger's navigation page displayed the distance-to-go on the LNAV. The wind calculation function also worked as advertised. However, one must note the LNAV is optimised for Cambridge's GPS NAV. With non-Cambridge GPS devices your goal altitude must be manually entered, that is aerodrome elevation plus your finish height, and final glide calculation around turnpoints is not available.

The LNAV was delivered with software version 5.6 and I found a small bug in the system. The Netto average display did not read correctly. An e-mail to Cambridge in the U.S. confirmed the 'bug' and the latest software (version 5.7), was delivered in a week. The operating system is stored in a ROM chip. It was a simple matter to open the case and replace the chip. Quite impressive aftersales service.

With a GPS connected the LNAV calculates three wind values, an instantaneous headwind/tailwind, an averaged HW/TW and a vectored wind. It is beyond this article to describe each one fully. I found it difficult to keep track of these three values and the significance of each in flight. The LNAV can be used perfectly well without a GPS unit connected to it. In this case the distance counts down via dead reckoning using airspeed data from the glider's pitot.

The LNAV has the facility to accept an on-board 'G' meter. With the 'G' meter fitted you have the option of climb cruise switching automatically determined by 'G' forces as you thermal. Without the 'G' meter option climb-cruise switching can be based on a manual switch or GPS derived via heading changes as you start thermalling.

As with all flight computers the LNAV requires calibration before it can provide accurate data to the pilot. Airspeeds, ASI zero point, altimeter, TE compensation, can be adjusted by the pilot. I had the most difficulty with the wind calibration procedure. This requires you circle the glider in smooth air (constant air speed) and note the difference between the maximum headwind and tailwind values displayed. The

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difference is the offset that must be entered into the LNAV. During a circle the maximum headwind value equals the maximum tailwind value. Any difference is due to errors in the glider pitot-static system. I found determining and entering this value whilst keeping a lookout and flying the glider tricky. I never really achieved an accurate calibration. The calibration procedure must be performed before convection starts or very late in the day. Smooth air is essential as any thermal related gusts distort the wind value and accurate calibration is not possible.

The Cambridge LNAV also has undercarriage and spoiler alarms built in, you only have to wire up switches to the respective pushrods and connect these to the instrument.

Overall I found the LNAV a straightforward unit to use. Its Vario response was good and I liked its final glide display. However the LNAV has no task entry, task summary or flight planning capabilities and is best described as a final glide computer and speed-to-fly variometer. The LNAV can be expanded with the addition of the PalmNav, which uses a palmtop PC to provide a moving map display and task planning capabilities. The PalmNav also requires a Cambridge GPS NAV, the combination of LNAV, GPS NAV and PalmNAV requiring a considerable investment. As mentioned Cambridge after sales service is good and regular updates, improvements and fixes to the operating system are sent free to owners.

Pilots perspective of the LNAV

The SN10 is a significant step up in versatility and power compared to the LNAV and can lay just claim to being a true flight computer. It provides you with task planning and editing capabilities, a moving map display, graphical thermal height band depiction, comprehensive in-flight statistics and a flight recorder. All this in a compact, self-contained package which, fits into an 80mm panel cut out! The unit also connects to a computer via the supplied cable for updating the operating system and turnpoint database and downloading data from the flight recorder. There is not need to replace chips inside the unit to effect operating system updates. I was also impressed with the quality of construction of the instrument.

Owners of the B100 will quickly identify with the SN10. David Nadler designed the software and a lot of the hardware in both instruments and they share many features. However, the SN10 is a significant improvement on the B100.

Installation of the SN10 in the glider requires a little care. The plastic knobs of all switches have to be removed, and the bottom two switches actually fit through the instrument attachment holes. This approach has allowed the screen to be as large as possible, the dot matrix display measuring 63X45mm.The SN10 requires no capacity flask and uses standard computer DB connectors at the rear. The unit is supplied with integral ‘G’ meter, temperature transducer and a 57mm analogue readout.

The SN10 provides the pilot a lot of information and initially it looks a complicated unit to use. However after six flights I felt I had mastered the instrument. It proved to be simple to operate but also extremely powerful. If you do get stuck whilst operating the SN10 just push the help button for guidance. Also the information afforded the pilot is very useful for in-flight planning and tactical decision making.

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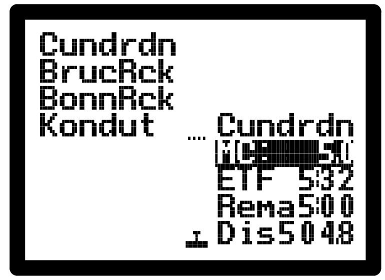
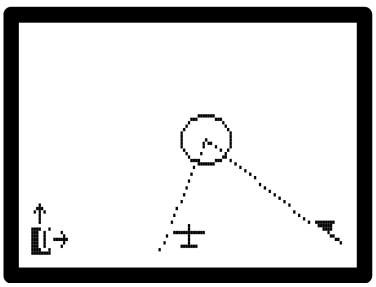
The SN10 is operated by three knobs, one selects the page, one moves a cursor on that page and the third alters the value highlighted by the cursor. Data is entered into the SN10 by turning the 'Value' knob, the speed of entry is increased the faster you spin the knob. The switches have detents, which provides tactile feedback. With a little practice one can change screens without looking at the display. This is particularly so if you purchase the optional remote control unit. Operation of the SN10 becomes intuitive. It's a very clever arrangement.

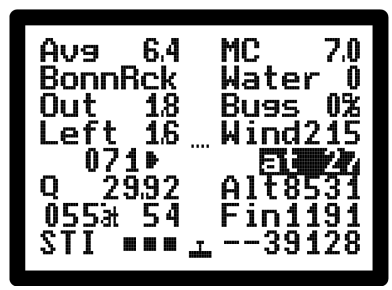
Your task is entered on the task-planning page. Once all turnpoints have been selected the task distance is displayed on the screen. Enter the McCready setting and the SN10 provides an Estimated Time to Finish, ETF. The final variable displayed is the time remaining to complete the task. This page supports in-flight task editing, the SN10 will recalculate distance and ETF when a task is modified. In effect providing a 'what if' calculator function. This ETF is also updated when the McCready setting is altered.

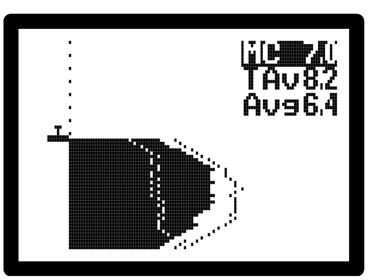




The moving map screen depicts the glider on task and you can quickly note any track deviation. In addition airspace data can be displayed. However, turnpoints in the database are not shown in the background. You can orientate the map to show north up or track up and a zoom function is available.

The next screen displayed is the Status page. This shows the average climbrate, the turnpoint, distance from, track deviation and bearing to the turnpoint, QNH, bearing, groundspeed and the start time interval. The McCready setting, water on board, 'bugs', wind, altitude, your finish height and the altitude deficit to reach goal are shown on the right side of the screen. Some pilots find the information cluttered and difficult to read, judge for yourself from the illustrations enclosed. Once the layout is learnt, information can be extracted in a timely fashion. I use this screen most often in-flight. This page also depicts the glider with respect to the final glide altitude. I like the way the SN10 displays important information on a small number of screens. It makes for less page switching and head down time. In addition you can alter a setting on any page it is displayed. For example, the McCready setting can be changed in any one of four screens.





The thermal height band page graphically displays thermal strength against height for the current thermal and the previous two thermals. The thermal and 20 second climbrate average are displayed in the top right corner below the McCready setting. When the climb rate drops below the thermal average its time to leave! When final glide altitude is approached, a horizontal line appears across the page and your position relative to this height is depicted by a glider symbol. On a recent 300km task I was thermalling 20km from the last turnpoint when the final glide symbol showed on the thermal page. I stayed with the thermal as a result, achieved final glide, flew around the turnpoint and home. Such final glide calculations around turnpoints are no trouble for the SN10.

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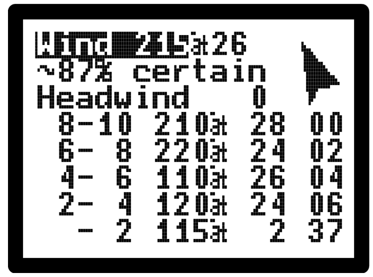

The wind page displays the wind speed, direction, and awards a 'Certainty' rating to the value calculated. Highlighting the wind value with the cursor and pressing 'enter' copies this wind value to the Status Page for final glide calculations. An arrowhead in the top right depicts the wind direction relative to the glider's heading in real time. This is particularly helpful in visualising thermal streets or the wind on a ridge. Wind data is also displayed according to various height bands, this aids detection of windshear. On one flight with a 20kt wind blowing, the SN10 indicated windshear at 6000'. During the second climb of the task I lost the thermal at this height. Recalling the direction of the shear displayed by the SN10 I quickly re-located the lift. I took the thermal to 11000' with an overall climbrate of 8kts.

The Flight Summary page shows your distance to go, distance flown, elapsed time, percentage spent climbing, total time in-flight, cross country speed and average climbrate since starting the task. After a quick review of your progress you can modify the task if required in the Task-Planning page. This is great for POST and I also found it useful on a recent 500km flight. I started the task at 1230 and had doubts about completing the flight. Halfway around the SN10 predicted I would finish at 6.05. I pushed on and completed the task at 6.15 having used the last thermal 50km from home.

The Alternates page provides a list of landable fields within reach from your present position. A useful feature if the day is dying or weather forces a diversion and landing. Other screens available include a 'Timers' page for start time intervals and POST times, the Flight Recorder page and a Simple Final Glide page.

Variometer tuning can be quickly altered in flight, with a choice of two response times depending upon thermal conditions, 'Filtered' gives a 1-second response and 'Extra slow' 3 seconds. The SN10 also has a significant lift alarm, which sounds if you are in the cruise mode dead-band and fly through a good thermal.

The SN10 has two modes of operation, Flight and Setup. In 'Setup' mode the SN10 is customised to your requirements, additional screens are available which are not seen when in 'Flight' mode. The glider's polar is entered along with weight, ballast capacity and calibrated airspeed data from the glider's manual. The pilot selects which average read-outs to display and the audio tone pattern. You have a choice of 10 audio patterns. Some options are copies of that offered by other manufacturers. There is a volume coefficient setting, 0-10, which automatically increases the volume of the audio as your air speed increases, pretty neat!

The SN10 will work with any GPS unit transmitting the NMEA 0183 protocol. I connected my datalogger without incident and the SN10 functioned exactly as the manual stated. It also works well without a GPS and counts down distance to the turnpoint by dead reckoning.
The built in flight recorder is approved for competitions, however it is <u>not</u> IGC approved, and I believe there is no plan to seek IGC approval in the future. Flight logs are downloaded from the SN10 in IGC format ready for analysis. When the SN10's flight recorder is engaged the unit alerts you to arrival at the turnpoint and automatically cycles to the next turnpoint of the task. The competitive pilot will also find the SN10 a useful backup to a dedicated flight recorder with the addition of a simple handheld GPS.

I have very high praise for the SN10. I believe it to be an excellent product providing the cross-country and competitive pilot a powerful tool to maximise his performance and enjoyment of the sport. Its price is similar to that of the LNAV, which represents excellent value. Particularly when you consider the SN10's features put it on par with the LNAV-PalmNav-GPSNav combination from Cambridge. The SN10 is definitely the more versatile and powerful unit by a significant margin.

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Pilots perspective of the SN10

With regards to pricing, exchange rates play an important part in the purchase price. The Cambridge unit is manufactured in the USA, while the Ilec product is produced in Germany. The Australian dollar has faired well against the German Mark most of this year and rather poorly against the Greenback. Also with the GST looming you will need to consult with the dealers for exact prices, Bruce Taylor/Ian McPhee (Cambridge) and Dion Weston (Ilec).

I have not mentioned the Borgelt instrument's B50 and B57, vario and flight computer package in this article. I have no personnel experience with this combination. However the no nonsense 2X8 LCD display of the B57 provides most of data the cross-country pilot needs. Some pilots prefer this simple form of data presentation finding it less distracting. Certainly if one is looking to update to a modern vario/flight computer system one needs to consider Borgelt products. The price of the combination is comparable to the LNAV and it provides task statistics that the LNAV doesn't. I do use a B40 as a backup vario, the B40 accepts a 9Volt battery which mounts on the rear of the instrument and will provide audio vario and averager capabilities in the event of battery failure. It is a very well made unit. With Borgelt products you have the manufacturer based in Australia.

Finally, the pilot must be careful not to get absorbed in all the information afforded to him by today's modern flight computers. Approaching turnpoints, during low scraps and even enroute it can be tempting to stare at the display and not look-out. Despite flying with an SN10, which does provide the pilot with many display options, I find I look at the instruments less and less these days. Preferring to look outside, listen to the vario and feel what the glider is doing. However it's nice to have detailed information available at your fingertips when the need arises and in this respect the SN10 is hard to beat.