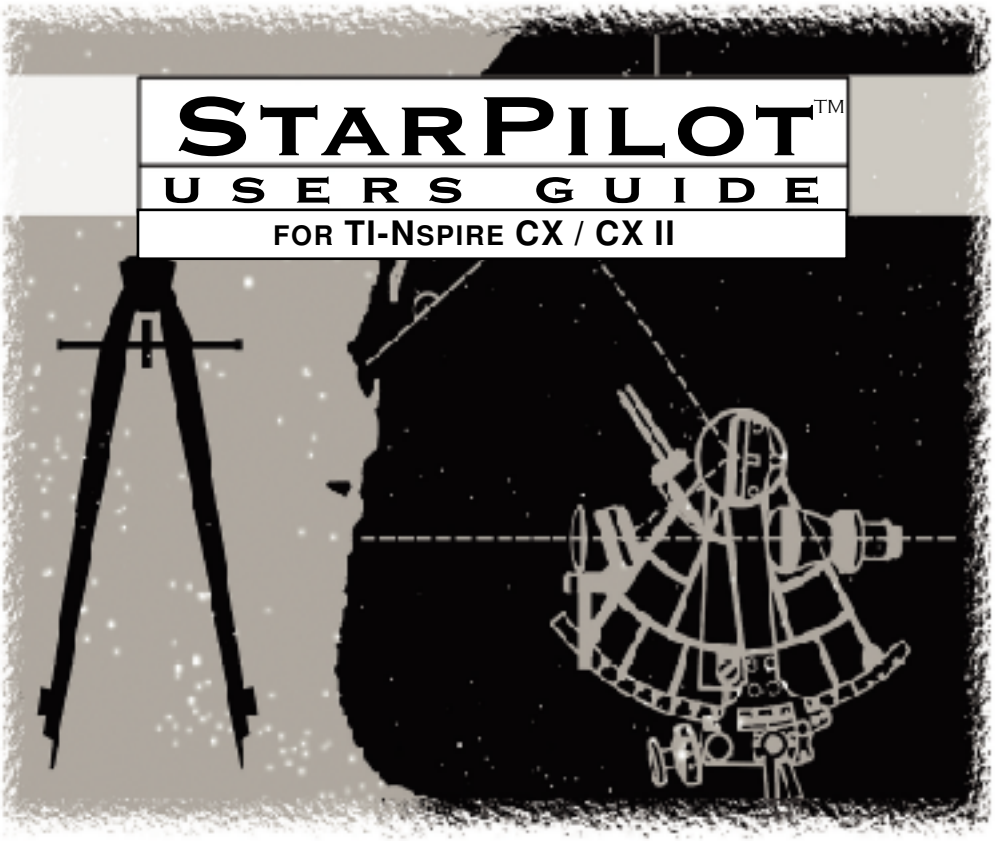


STARPILOT™

USERS GUIDE

FOR TI-NSPIRE CX / CX II

VERSION 4.2, NOVEMBER 2026

STARPILOT

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Quick Start

This User's Guide is for StarPilot for the TI-Nspire CX and CX II calculators. It follows the guide for StarPilot-89, which ran on the TI-89, TI-92 Plus and Voyage 200, and it closely resembles the help of StarPilot for PC. If you are familiar with StarPilot for PC or StarPilot-89 you will feel right at home: the menus, the prompts and the answers are the same. If you are new to the product line you will find the program intuitive and easy to use.

The quick start instructions are intended to get users familiar with celestial navigation and the Starpath approach to navigation off to a running start. If you are new to celestial navigation you may consider reading the guide starting at the Introduction, in the next section. Many examples and additional documentation for StarPilot can be found at our web site, starpilotllc.com, with detailed discussions of many celestial topics.

We at Starpath are proud to bring this product to you and feel confident you will find StarPilot an invaluable navigational tool.

Menu structure In this guide we show keys in square brackets with the key's label inside: [enter] is the enter key, at the right of the keypad; [esc] is the escape key at its top left. The screen below is the main menu, or index, of all StarPilot functions. This is the starting place for all operations.



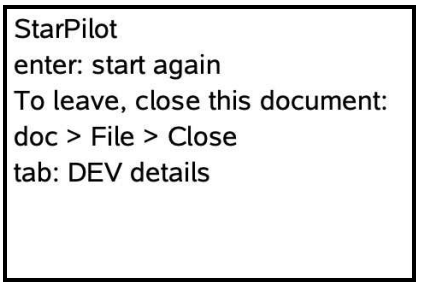
The main menu, ***StarPilot***

Note the cursor is on the 1. You can press [enter] to open the Settings menu, or you can press the [1] key. Likewise you can move down to the 3 with the arrow keys and press [enter], or without moving press [3], to open the Sight Reduction menu. The arrows are on the calculator's touchpad: press its edge at the top, bottom, left or right. Later in this guide we organize all functions according to the key sequence you follow starting on this screen.

Starting StarPilot StarPilot is a TI-Nspire document. To start it, open the document: press [home], choose My Documents, and open StarPilot (on the calculator the file is called StarPilot.tns, or the name it was given when it was copied in). The main menu appears after a second or two. StarPilot keeps working on its own groups of programs for a few seconds after the menu shows; if you choose a function before its part is ready you will see Loading... for a moment, and the keys you typed meanwhile are kept and carried out in order.

To quit Press [esc] at the main menu, or choose 7 Exit. StarPilot shows its resting screen: [enter] starts it again; to leave, close the document with

[doc] > File > Close. You can also just put the calculator away: it turns itself off after a few minutes, and when you turn it on again the document is where you left it.



The resting screen (this capture is from a development copy, whose screen adds a fifth line)

WARNING

When you close the StarPilot document the calculator may ask **Save changes?**. Answer **Yes** to keep the sights and settings you entered; **No** discards everything since the document was last saved. Press ctrl+S at any time to save. The chapter "Your Sights: Keeping Them and Moving Them" explains this in full.

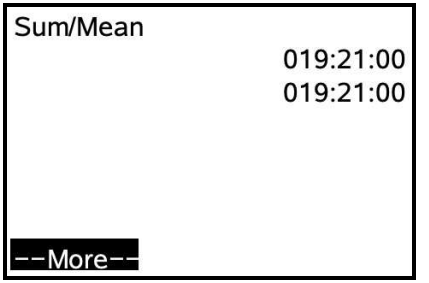
User defined values User defined values are entered in the Settings menu, item 1 on the main menu. There are 4 menus of settings, which we call [S1] to [S4]. To get to [S1] press the [1] key once from the main menu. To get to [S2], press [1] twice, and so on. Refer to the Table of Contents to see what is entered on each Settings menu.

[esc] is your friend [esc] at any prompt or menu gets you back to the menu that started the operation. So if you are in the middle of a Star sight reduction and you make a mistake entering data, you can press [esc], which gets you back to the Sight Reduction menu, and you can choose Star again to redo the sight. Data that you entered in the previous sequence is remembered: keep pressing [enter] until you reach the wrong value, change it, and off you go.

Pressing [esc] in a menu returns to the previous menu. This is the same as choosing 7 (Return). [esc] at the main menu shows the resting screen.

Enter angles Enter angles as degrees and minutes, d.m: 48.325 is $48^{o}32.5'$. North latitude and east longitude are positive; south latitude and west longitude are negative, entered with the [(-)] key at the bottom of the keypad (the subtraction key works too): $122^{o}14.2'$W is entered as -122.142. An angle like $12^{o}5.3'$ must be entered as 12.053: the leading 0 of the minutes is important.

Enter times Enter times as hours, minutes and seconds, h.ms: 12.3247 is 12h 32m 47s. On output they are displayed as 012:32:47. For example 19.2100 is 19h 21m 00s and is displayed as 019:21:00 (below: Add Times, 19.2100 plus 0).



Utilities, Piloting, Add Times/Angles: 19.2100 plus 0

StarPilot uses watch time (WT) for all events and bookkeeping. For celestial computations, GMT is obtained from GMT = WT + WE + ZD, where ZD is the zone description of the watch and WE is the watch error. If WE = 0 and ZD = 0, then WT = GMT, which is the same as UT or UTC. All times are 24 hour: 2 min and 5 sec past 2 PM is 14.0205. WE and ZD are entered in the Settings 3 menu, [S3][5]; WE is in seconds, ZD in whole hours, + for West, - for East.

SR mode SR mode VERIFY (on) means StarPilot asks for all the input for each sight. With SR mode OFF, StarPilot reads IC, HE, Limb and DR position from the settings and prompts only for WT and Hs, the sextant reading. (If the DR position is set to 0, however, it asks for it even in OFF mode.)

All fixes are running fixes, so course and speed must be entered if underway. You will be prompted for these when needed.

To change an input Use the left and right arrows to move in the number you are typing, [del] to remove the character before the cursor, and [clear] to remove the entry from the cursor on (or all of it, at its end). Until you press [enter] nothing is taken.

To interrupt StarPilot [esc] leaves any prompt and any page of results. If StarPilot is busy, your keys wait their turn and are carried out when it is ready. You cannot hurt the calculator or the StarPilot program by pressing keys: have no fear and click away.

Do not, however, delete the StarPilot document from the calculator, and do not replace it with another copy, unless your sights are safe elsewhere: the sights and settings live inside the document (see "Your Sights: Keeping Them and Moving Them").

--More-- --More-- is shown whenever there are several screens of output. When you see it, press [enter] to see the next screen. You are returned to the menu when all the data has been shown.

Settings locations The settings are referred to by menu and item. A date, for example, is stored in Settings menu 1, item 2, so we might say Date [S1][2].

Old routines, new guide The basic computations and mathematical routines of StarPilot have been tested for many years now, but each new edition of this User's Guide presents us with new opportunities for typos as we add new features to the program or improve its interface. If you run across typos, errors, or unclear sections, please drop us a note at helpdesk@starpath.com. We will address the issue immediately, and update the on-line version.

To update to a newer version of StarPilot Your sights and settings live in your StarPilot document, so a new version is a new document. Before you start using a new copy, move your sights to StarPilot on another platform (your computer or your phone), and bring them in again to the new copy if you want them there: see "Upgrading StarPilot" in the chapter "Your Sights: Keeping Them and Moving Them".

To use the calculator for math You can step out of StarPilot for a quick calculation and come back to it. The Scratchpad is the calculator's own quick calculator, outside the StarPilot document. With StarPilot on the screen, press the Scratchpad key (the calculator picture, just below [esc]): the Scratchpad opens. Work out what you need, for example 2+2 [enter]. Press [esc] to close it: StarPilot is on the screen again, exactly where you left it, with nothing lost or changed.

Tip on typos StarPilot takes all positive values without a sign and all negative values with the [(-)] key (or the subtraction key). A second minus, a second decimal point, or a letter shows INVALID INPUT. at the bottom of the screen: use the arrows and [del] to fix your mistake and off you go.

Abbreviations During the operation of StarPilot you will notice many abbreviations. They come from StarPilot's first homes, calculators with screens of 21 or 22 characters; the TI-Nspire keeps them, so that its screens read as the other StarPilots' do.

Quick Start Examples

Most of the examples in this section are quite advanced, but we start with a simple one intended for users new to StarPilot. Once you complete this sight you may want to read through the guide first and come back to the other quick start examples when you are more familiar with StarPilot.

Each topic in the guide is illustrated with a detailed, self-consistent example. If, for example, you want to know how to compute great circle routes, look in the table of contents for the Great Circle function and open the guide to that page. There you will find a description of the calculation along with screen captures of a detailed example.

Your First Sight Reduction

The following data is from the Sun Sight Reduction section ([3][1]) of the guide, discussed in more detail here for the benefit of first-time StarPilot users. Here is the data:

- GMT 15h 35m 42s, Date Sept 10, 1996
- DR Latitude $34^{o}55'$N, DR Longitude $35^{o}50'$W
- Hs $54^{o}58.8'$ for a lower limb Sun
- HE 10 feet, IC $2.5'$ (that is, $2.5'$ OFF the scale)

Step 1 Open your StarPilot document if it isn't already open. You should see the main menu:



The main menu

If you see the resting screen instead, press [enter].

Step 2 Use the down arrow to move the cursor to menu entry 3, Sight Reduction, and press [enter] (or just press [3]).

Step 3 You should now be in the **Sight Reduction** menu:



*The **Sight Reduction** menu*

Since the cursor is on the Sun entry, simply press [enter] to start your sight reduction.

Step 4 You should now see WT? on the screen with a cursor. WT stands for watch time, which equals UTC (GMT) when the zone description is 0. Since StarPilot starts with a zone description of 0, what you enter here is the GMT of the sight: 15.3542. Note the format: times are entered as hh.mmss, where hh is the hour, mm the minutes and ss the seconds. Use [del] to fix any errors, or [clear] to erase the whole entry and start over. Press [enter] after you type in the time.

Step 5 Continue entering the data, being careful to enter the minus signs needed for west longitude and the lower limb, with the [(-)] key: day 10, month 9, year 1996, Lat 34.550, Lon -35.500, IC 2.5, HE 10, limb -1, Hs 54.588.

Step 6 Pressing [enter] after Hs (54.588) gives the result:



The Sun sight's result

The first line tells you which body was sighted. The second line describes what the numbers below it mean. The # goes with the 1, which is the sight number; WT goes with 015:35:42, the watch time you entered; Hs is $054^{o}58.8'$, again a number you entered; Zn is the azimuth, 214.3^{o}T; and Int(nm) is the intercept in nautical miles, 9.6 toward.

Step 7 Your sight is now complete. Pressing [enter] again clears the screen and returns to the Sight Reduction menu.

Date Input for Sight Reductions and Fixes

Earlier versions of the program assumed that celestial fixes were made from data on the same date, since we assumed most users would choose the optional Zone Description and so effectively use local time for the sights. In practice this is still the most convenient means of sight reduction, since you can also store the Watch Error and so correct all sight times automatically at the input.

Some users, however, prefer to record and analyze all sights using only GMT. Then we must be careful about the date, since it could change or not change within a series of sights or during a long running fix, depending on our longitude. To accommodate this approach, StarPilot stores the date of each sight along with its other data, which means that unless the date is stored in the settings it is asked for at each sight reduction, and again when computing a fix from that set of sights. The example below illustrates it.

Example of Running Fix Using GMT and Date

Sight 1 22h 05m 10s on Apr 14, 2000 GMT, DR 40°58′N, 135°20′W, S = 8.0 kts, C = 225°T, lower limb Sun Hs = 55°31.2′, HE = 9 ft, IC = 1.5′ On.

Sight 2 01h 36m 02s on Apr 15, 2000 GMT, DR 40°38′N, 135°46′W, S = 8.0 kts, C = 225°T, lower limb Sun Hs = 22°36.2′, HE = 9 ft, IC = 1.5′ On.

Solution First Set Defaults with [S4][2], so that all start the same way: from the main menu press [1] four times, then [2]. This clears the date so that it is asked for each time, sets ZD = 0 so we are using GMT, and sets SR mode to VERIFY so that HE, IC and limb are asked for each time. Then go back to the main menu.

From the main menu press [3] for Sight Reduction, then [1] for Sun, and enter the data of sight 1:



Running fix using date: sight 1

This first sight gives an LOP of 4.1′ Away from 208.8°, based on an assumed position equal to the DR position we entered. The a-value is valid at the time and date we entered.

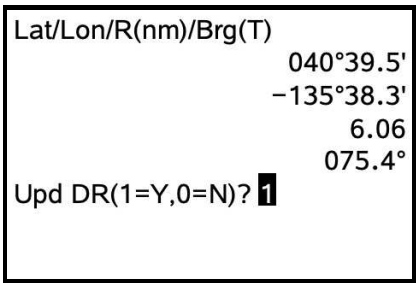
Now from the **Sight Reduction** menu select Sun again and enter the data of sight 2, which gives an LOP of 6.0′ Away from 263.2°. Again the result is based on the DR position and time we entered.



Running fix using date: sight 2

To get a fix from these, we must advance the first to the second with the course and speed. This is done from [6] on the **Sight Reduction** menu, or from the **Celestial Fix** menu, [4] on the main menu. From the **Celestial Fix** menu choose [2] Fix by Computation: this computes a running fix according to a US Naval Observatory formula.

StarPilot first asks the method, (1=USNO,2=VanAllen)?: press [enter] for 1, the USNO method (the Van Allen method is in the chapter on the Celestial Fix menu). Then it asks for a DR position. It does not matter which you use, but generally one would choose the DR position that corresponds to the fix time you will be asked for, since these two positions are compared at the end of the computation. A fix time rounded off to something near the time of the last LOP is reasonable (0136 GMT on 15 Apr 2000). The result:



The running fix

The running fix is at 40°39.5′N, 135°38.3′W. From the entered DR position you would get to this fix by traveling 6.06 miles in direction 075.4°T (rhumb line): that is how much the DR was off. StarPilot then offers to update the DR to the fix (Upd DR(1=Y,0=N)?): answer 1 to store the fix as your new DR.

How StarPilot Handles Dates

Several functions in StarPilot use the date as an input; sight reduction and celestial fix are two of them. If there is any value other than zero stored in any part of the date (day, month or year), StarPilot reads that value when executing a date-sensitive function rather than asking for it. For example, in the previous exercise, had we stored 2000 in the year and 4 in the month, it would have asked only for the day on each sight and fix. This is a very convenient option, but we must remember how it works to avoid errors.

Alternatively, you can leave day, month and year set to 0, and then StarPilot asks for them at every stage of every sight and fix. Practice with the various modes in various circumstances will lead you to the best choice for the job.

How StarPilot Handles DR Positions

As with the date, several functions in StarPilot use the DR position as an input, and it is equally important to keep in mind how StarPilot handles it if stored. If there are any values other than zero stored in DR Lat or DR Lon, then StarPilot reads them when executing a function that needs them rather than asking. This offers very convenient time-saving options, especially since the DR position can be updated by other functions, but we must keep in mind how it works to be sure we are doing what we think we are.

An illustration is below (redoing the same running fix as before), but remember you can turn off this automatic reading at any time by entering zeros into the DR position, or by Set Defaults, which does the same.

How StarPilot Handles Times

StarPilot performs all time functions using Watch Time (WT), which differs from GMT by a Watch Error and a Zone Description: GMT = WT + WE + ZD. These two offsets from GMT, or UT as it is

now called, are entered in [S3][5]. Set Defaults puts both equal to zero, so that WT = GMT. If you have a ZD other than zero set, then many of the time-dependent answers are labeled as being valid at, for example, GMT-8 for times in PST, ZD = +8. If you prefer GMT only, then Set Defaults and leave ZD and WE = 0.

How StarPilot Handles IC, HE, Limb

These data are used mainly in sight reductions. You have two options: store them in the settings and always use the stored values, or input them for each sight. For routine sights underway the former is clearly better, but for practice doing examples or problems from a textbook the latter is likely better. You choose with the SR mode (sight reduction mode), set in [S2][5]: VERIFY means enter them for every sight; OFF means read them from the settings, which of course means you must enter them there first. All of these shortcuts are illustrated in the next example.

Same Running Fix Using Local or Other Time Zone and Other Shortcuts

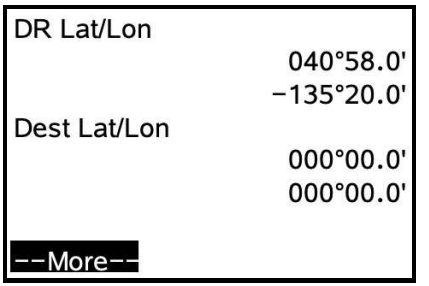
Suppose in the last example we kept all clocks set to ZD = +7, corresponding to PDT, as we sailed across. Now we work the same set of sights using this option, plus a couple of other shortcuts.

Sight 1 15h 05m 10s on Apr 14, 2000 (ZD = +7), DR 40°58′N, 135°20′W, S = 8.0 kts, C = 225°T, lower limb Sun Hs = 55°31.2′, HE = 9 ft, IC = 1.5′ On, WE = 0.

Sight 2 18h 36m 02s on Apr 14, 2000 (ZD = +7), lower limb Sun Hs = 22°36.2′, HE = 9 ft, IC = 1.5′ On, WE = 0. Note we have a watch error of 0, and we do not yet know the DR at the second sight, but course and speed are the same.

Solution Set Defaults ([S4][2]), then in [S3][5] enter ZD = 7 and WE = 0. Go to [S2][5] and set SR mode OFF, then in [S2][2], [3] and [4] set IC = -1.5, HE = 9.0 ft and limb = -1. Then set the date in [S1][2]: day 14, month 4, year 2000.

Then in [S1][3] set DR Lat 40.58 and DR Lon -135.20. Then go to [S4][5] and set DR mode Speed, which asks for the DR time 15.0510, Course 225 and Speed 8.0. Now check with View Settings, [S1][6], that all is set right:



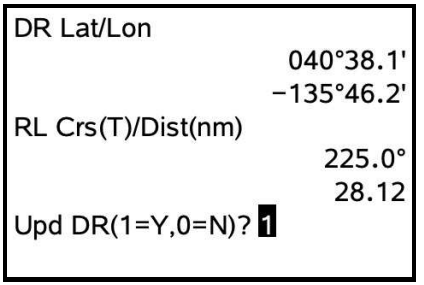
Settings for the running fix example

Then do the first Sun sight reduction by selecting [3][1] from the main menu: you are asked only for the time and Hs, and get the same LOP.



Sight 1, with SR mode OFF

Now go to the main menu and select [5] Update DR, enter the time of the second sight, 18.3602, answer 0 at Next day?(1=Y,0=N) and 1 at Upd DR(1=Y,0=N)?. The 1 stores the new DR for later use.



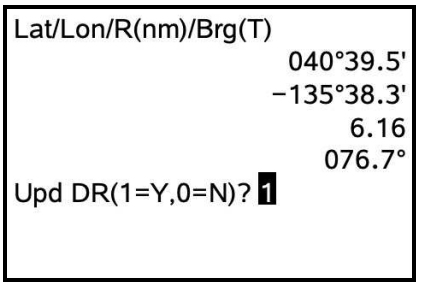
Update DR to the time of sight 2

Now we can do the second sight:



Sight 2

which is the same LOP we got before (very slightly different, since we have a slightly different DR). Now do Celestial Fix option [2], [enter] for the USNO method, and the answer is the same as before:



The running fix, local time

The logical next step is to accept the offer to update the DR and carry on with the navigation. The running fix is complete.

This illustration of using stored values is not much shorter in this particular example, but note we have only 2 sights here. Normally you would have (or should have) 4 or 5 Sun sights at each sight session, and then this method is very much quicker. Note, too, how the DR function is folded into the sight routine automatically, so that we do not have to re-enter that position. We could also have updated the DR with log readings (DR mode Log).

We could also have updated the DR after a series of course and speed changes, if these had been made between the two sets of sights; but then, when doing the fix itself, one should use the speed made good and course made good between sight sessions when course and speed are asked for.

Introduction

License Agreement

StarPilot is licensed to you, not sold, under Starpath Corporation's End-User License Agreement. The software and its almanac data are protected by copyright: you may keep one archival copy, but you may not rent or lease the software, modify or reverse engineer it, or defeat its license checks, and the almanac data delivered to your calculator works on that calculator alone and may not be extracted or given to anyone else. A license is for you, on devices you personally use. Starpath warrants for ninety days that the software will substantially perform as its documentation describes, and gives no other warranty; the software is intended for training and education, not as a means of navigation, and Starpath is not liable for damages arising from its use. If you do not accept the agreement, you may return the software unregistered and unused within seven days for a full refund. The full agreement is in Appendix 9, License Agreement.

Features

StarPilot for TI-Nspire runs on the TI-Nspire CX and CX II calculators. It computes altitude, azimuth and intercept for Sun, Moon, planet and star sights using an internal perpetual almanac, and provides a complete suite of navigational functions: sight planning, running fixes by computation and by plotting, the Sight Analyzer, DR, route and current sailings, piloting, and the celestial utilities.

Its almanac and its computations are those of StarPilot for PC: given the same sights, the two give the same answers. Its menus, prompts and screens are those of StarPilot-89, so the many navigators who learned StarPilot on the TI-89 will find their way at once.

The TI-Nspire CX has a 320 x 240 colour screen, of which StarPilot uses the handheld's full working area, a touchpad with arrow edges, and a rechargeable battery. StarPilot shows eight rows of large type on each screen, the sky and LOP plots in colour, and a popup with each body's data on the sky plot.

The calculator has a guidebook of its own, which covers its mathematical use and its other applications. For navigation you should not need any extra information from it: StarPilot uses only a few keys, all menu driven.

Installing StarPilot

StarPilot is one TI-Nspire document, made for your calculator. Each copy is personalized: it opens only on the calculator it was made for (it reads the calculator's ID). If StarPilot was installed by Starpath, it is already on the calculator, in My Documents. If you bought StarPilot for a calculator you already own, you register the calculator on the StarPilot registration page and download your copy there, as this section describes.

What you need To put StarPilot on your calculator you need:

- a computer running Windows or macOS;
- a supported web browser: Google Chrome 90 or later, or, on Windows, Microsoft Edge 90 or later;

- the USB cable that came with your calculator;
- for a TI-Nspire CX II, TI's free TI-Nspire CX II Connect, which runs in that browser at nspireconnect.ti.com.

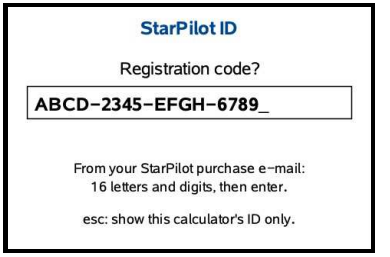
An original TI-Nspire CX uses TI's TI-Nspire Computer Link Software (free; it supports the TI-Nspire CX, not the CX II), or the TI-Nspire CX Student Software or CX Premium Teacher Software. TI-Nspire CX II Connect does not support the original CX.

The calculator has no web browser, so both of its documents, StarPilot ID and your StarPilot.tns, come to it from that computer: download them there. A phone is used only to scan the registration QR code (step 4), and is not required.

To send a document to the calculator: connect the calculator to the computer with its USB cable, open TI-Nspire CX II Connect at nspireconnect.ti.com in the browser, and send the file to the calculator. TI-Nspire CX II Connect puts it at the top of My Documents. On an original TI-Nspire CX, use TI's TI-Nspire Computer Link Software instead; on either calculator, the TI-Nspire CX Student Software or CX Premium Teacher Software also works, without the browser. Whichever you use, the transfers in this guide are the same.

Registering and downloading

1. Buy StarPilot. The e-mail that confirms the purchase gives your registration code: 16 letters and digits, in groups of 4.
2. On the computer, open the StarPilot registration page and download the free StarPilot ID document (StarPilotID.tns). It shows your calculator's ID.
3. Send StarPilotID.tns to the calculator, as described above, and open it. It asks Registration code?: type the code (capitals or not, with or without the hyphens) and press [enter].

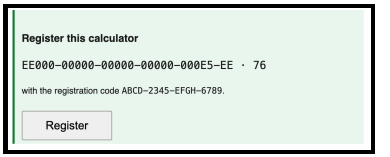


StarPilot ID: the registration code typed

4. StarPilot ID shows a QR code, with the code and your calculator's ID beside it. Scan the QR code with your phone: the registration page opens on the phone, with the code and the calculator's ID filled in.

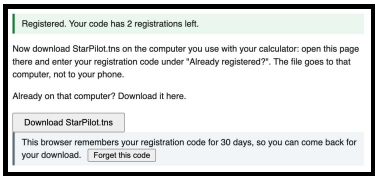


The QR code to the registration page, the code and the calculator's ID beside it



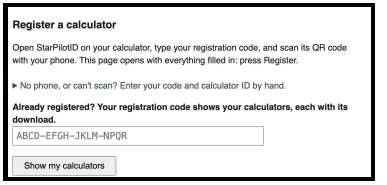
The registration page on the phone, opened by the QR code: the calculator's ID with its two check characters, and the code

5. Check the code and press Register. The page says Registered. and how many registrations your code has left, and sends you back to the computer for the download: StarPilot.tns is not downloaded to the phone. Registering the same calculator again does not use another registration, and gives you the same file. Without a phone, open the registration page on the computer, choose "No phone, or can't scan?", and type the code and the calculator's ID with its two check characters.

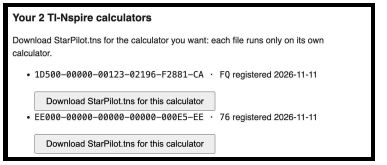


The page after Register: the registrations left, and the download on the computer

6. Back on the computer, open the registration page again. Under "Already registered?", type your registration code and press Show my calculators. The page lists the calculators registered with your code, each with its download: download StarPilot.tns for this one. It is made for that calculator and runs only on it. The browser on that computer remembers your code for 30 days, so when you come back the list is shown at once; "Forget this code" clears it.



The registration page on the computer: "Already registered?"



The calculators registered with your code (here two), each with its download

7. Send StarPilot.tns to the calculator, as described above.

8. Open StarPilot on the calculator. While it unlocks, its first screen shows StarPilot and, under it, its version and build, for example Version 4.2 build 225; then the main menu. Support Info, [S4][6], shows the same version and build: give them when you write to Starpath about StarPilot.

StarPilot ID never stores the code: close it without saving. [esc] at the code prompt shows the calculator's ID alone.

Opened on another calculator, the document says This StarPilot is registered to another calculator. Opened on a computer, which has no calculator ID, it shows only the sights it holds, so that you can copy them out (see the chapter "Your Sights: Keeping Them and Moving Them").

Data Representation

Periodically StarPilot prompts you for data such as the time of a sight, DR latitude or longitude, GHA, SHA and declination. The format used to enter these and other values depends on the type of data.

All time values are entered in hour-minute-second (h.ms) format: hh.mmss, where hh is the hour and .mmss the minutes and seconds. Two digits must be used for each of the minutes (mm) and seconds (ss). For example 15h 5m 42s is entered as 15.0542.

Times are displayed in the hh:mm:ss format: a time entered as 17.0822 is displayed as 017:08:22, and the various times computed by StarPilot are displayed in that format.

Compass bearings, courses and headings are entered in ddd.d format: three digits and a decimal (the decimal is optional). Leading zeros (090) are optional.

Sextant altitude (Hs), latitude, longitude, GHA, SHA and declination (Dec) are entered in ddd.mmm format, which we abbreviate as d.m. For example $34^{o}55.2'$ is entered as 34.552, $34^{o}5.1'$ as 34.051, and $35^{o}0.6'$ as 35.006.

Index Correction (IC) is entered in decimal minutes (mm.m): an index error of $3.3'$ on the scale is entered as -3.3. IC has a minus for on-the-scale errors and no sign for off-the-scale errors. Horizontal parallax (HP) and the additional planet correction, used in some specialized functions, are also entered as mm.m.

Results such as the computed altitude (Hc), azimuth (Zn) and times are displayed as $nnn^{o}nn.n'$, with a few exceptions such as the intercept, which is displayed in nautical miles (nm).

The following sign conventions apply when entering data. Positive values of Lat, Dec and Lon are North and East; negative values are South and West. A positive intercept is TOWARD the sighted body, a negative one AWAY.

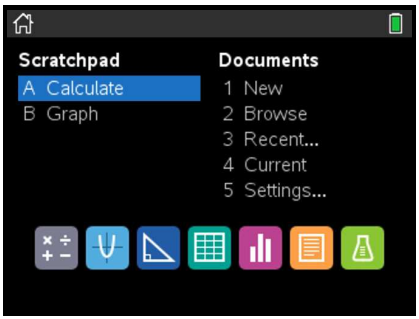
We do not use a sign for positive numbers: values are positive unless a minus is typed first, with the [(-)] key or the subtraction key. A minus anywhere but first is refused (INVALID INPUT.).

The year of an event should always be entered in full 4-digit format: 1998, not 98. Valid days are 1 through 31, and months 1 through 12.

Getting Around the Calculator

If the TI-Nspire is new to you, these few keys are all you need to reach StarPilot and come back to it.

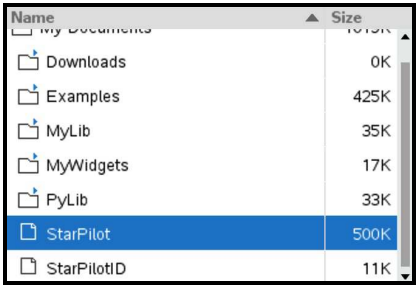
The [home] key, at the top right with a house on it, turns the calculator on. When the calculator is already on, [home] shows the Home screen; press it again to return to the document you were in.



The Home screen

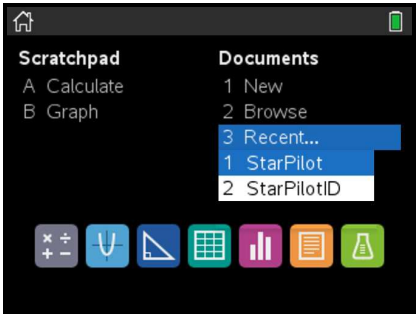
Browse, [home] [2], lists the documents on the calculator, in My Documents. Move to StarPilot

(or StarPilot ID) with the arrows or the touchpad and press [enter]: the document opens and runs.



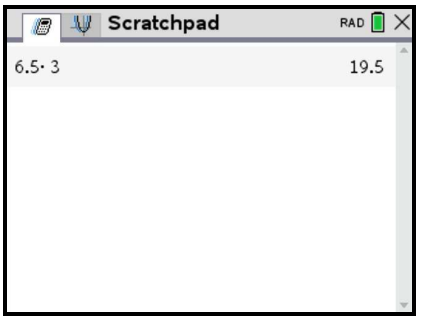
Browse: My Documents, with StarPilot and StarPilot ID

Recent, [home] [3], lists the five documents saved most recently. Once StarPilot has been saved on the calculator (ctrl+S), [home] [3] [1] is the quickest way back into it.



Recent: the documents saved last

The Scratchpad key, on the left between [esc] and [tab], opens the Scratchpad: the calculator's own calculator, for a quick sum outside StarPilot, such as 6.5 knots for 3 hours. The Scratchpad changes nothing in StarPilot or its sights. [esc] closes it.



The Scratchpad: a quick sum outside StarPilot

StarPilot Operation

StarPilot is a TI-Nspire document. Open it with Browse ([home] [2], StarPilot, [enter]) or Recent ([home] [3]), as in Getting Around the Calculator, and the main menu, **StarPilot**, appears:



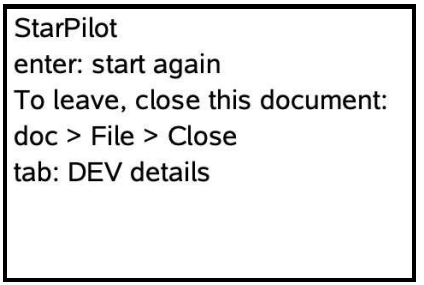
The main menu

All StarPilot functions are reached through menus. Each StarPilot menu has a title followed by numbered entries. To run the function you want, press its number, or move the cursor to it with the arrows and press [enter].

To leave StarPilot from the main menu, press [esc] or choose 7 Exit: the resting screen shows.

[enter] there starts StarPilot again. To close the document, use [doc] > File > Close. You can also just put the calculator away: it turns itself off after a few minutes and comes back where you were.

StarPilot keeps your settings and the sights you have completed in the document. A sight is stored only when its reduction is complete: leaving a sight reduction part-way discards that sight's entries, but not the sights already completed. The document keeps them from one session to the next once it is saved: press ctrl+S, or answer Yes to Save changes? when you close it. The resting screen reminds you when something is not saved yet.



The resting screen

The [esc] key returns from anywhere: at a prompt it leaves the function and returns to its menu; in a menu it returns to the previous menu; at the main menu it shows the resting screen. If you are in the middle of a Star sight reduction and make a mistake, [esc] takes you back to the Sight Reduction menu; choose Star again, and the data you entered before is offered again: press [enter] through it until you reach the wrong value, change it, and off you go.

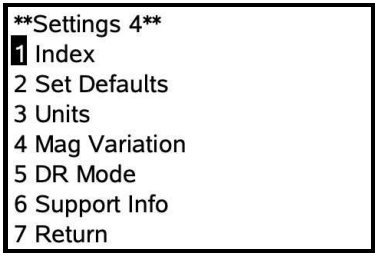
StarPilot prompts you for numbers such as the time of a sight. Type the number in its format (see Data Representation) and press [enter]. Until you press [enter] you can change it: [clear] erases the entry from the cursor on, the left and right arrows move the cursor, and [del] removes the character before the cursor. The value offered (the default, shown in reverse) is taken by [enter] as it is; the first digit you type replaces it.

Resetting Factory Defaults

At times you may want to reset StarPilot to a known state. Later in this guide we refer to this as [S4][2], the second entry of the fourth Settings menu.

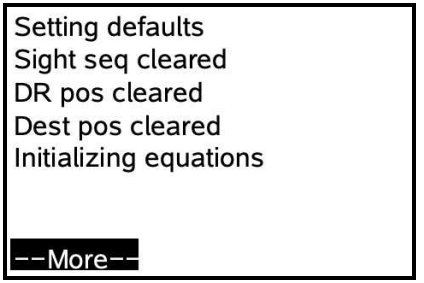
1. Open StarPilot.

2. Press [1] to get the **Settings 1** menu, then [1] again for **Settings 2**, again for **Settings 3**, and again for **Settings 4**:



*The **Settings 4** menu*

3. Press [2] (Set Defaults): StarPilot resets the settings to its defaults and shows:



Set Defaults

There are many optional settings in StarPilot, so you may want to use this at some point to get re-oriented. See [S4][2] for the list of the default settings. Set Defaults also clears the sights in the current sequence; it does not touch the Sight Archive.

Moving Around Quickly

StarPilot-89 had a custom menu on the TI-89's function keys. The TI-Nspire has no such keys, and StarPilot for TI-Nspire reaches every function from its menus; the numbers are the shortcut. From the main menu, [3][2] starts a star sight, [4][2] a fix by computation, [5] an update of the DR, and [1][6] shows the settings. On the star list, [tab] moves from item to item without the touchpad (see The Star Selector). The plots' keys are in Plot Controls, next.

Plot Controls

StarPilot draws three plots: the sky picture of the Sight Planner [2][2], the graph of the Sight Analyzer [2][3], and the LOP plot of Fix by Plotting [4][3]. They share their keys as far as they can: [+] zooms in and [-] zooms out, a fifth at each press, the arrows move an eighth of the screen, [0] shows the whole plot again, and [esc] leaves. Here [-] is the subtraction key; the sign key [(-)] has its own use on the sky picture. The touchpad's pointer works on all three: resting it on a body, a sight or a line shows its popup, and a click picks it.

The sky picture [2][2]

- [+] and [-]: zoom in and out, a fifth at each press, about the body under the pointer or the selected one (or the middle of the picture when there is none), up to 6 times.
- The arrows: move the picture an eighth of the screen.
- [0]: the whole sky again.
- [enter] or [tab]: the next suggested set of three bodies; [(-)] or shift+[tab]: the previous one. Both go round from the last set to the first.
- The pointer on a body: its popup; a click selects the body (ringed in green) and keeps its popup.
- [esc]: back to the Sight Planner menu.

The Sight Analyzer [2][3]

- [+] and [-]: zoom in and out, a fifth at each press, about the selected sight, from all the sights up to 16 times. Scale = at the top left is the graph's height in minutes of arc.
- The arrows: move the graph an eighth of the screen.

- [0]: all the sights again.
- [tab] and shift+[tab]: the next and previous sight on the screen, ringed in green, with its popup, going round from the last to the first.
- [enter], or a click: the line redrawn through the selected sight (or the point clicked), a grey line at its time, and the bottom row reads Hs' and WT there.
- [esc]: back to the Sight Analyzer menu.

The LOP plot [4][3]

- [+] and [-]: zoom in and out, a fifth at each press, about the cursor (the red cross), which stays on its spot of the chart, from the first plot in to a plot 0.1 nm high. Scale= shows how many times larger.
- The arrows: move the cursor; at the plot's edge, the next arrow moves the plot an eighth of the screen instead.
- A click: puts the cursor at that point, and nothing else.
- [0]: the first plot again.
- [tab] and shift+[tab]: the next and previous line, drawn green, with its popup.
- [enter]: the cursor's position, with its distance and bearing from the DR, and Upd DR(1=Y,0=N)?; then the plot again.
- [esc]: back to the Celestial Fix menu.

The --More-- Scroller

After a computation, or when presenting a sequence of data, StarPilot clears the screen, prints the data and shows --More-- at the bottom when there is more to see. The keys:

- [enter]: the next screen, or back to the menu after the last one.
- [esc]: back to the menu.
- [del]: in Review Sights, delete the sight shown.
- The left and right (or up and down) arrows: the previous or next page, where a list has several (Review Sights, View Settings, the star list).

Battery Life

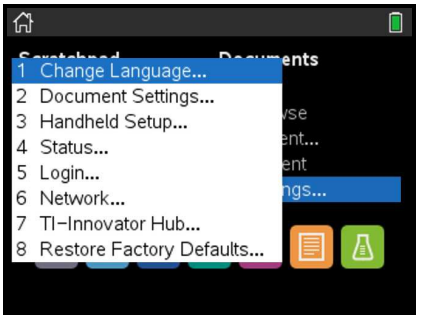
The TI-Nspire CX and CX II run on TI's rechargeable battery. TI rates a full charge of the CX II at up to one week, with about two hours' use a day; heavy use, such as running programs, shortens it. A full charge takes about six hours, from the USB cable on a computer or from a TI wall charger, and the calculator works normally while it charges. The battery's charge shows at the top right of the Home screen; Settings > Status, [home] [5] [4], gives it as a figure. The calculator warns when it is low.

To make a charge last longer:

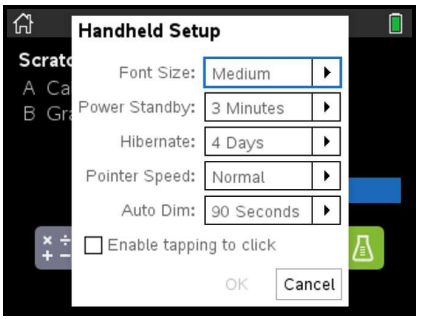
- Dim the screen (see Screen Brightness, next).
- Shorten Power Standby, the idle time after which the calculator turns itself off (3 minutes as it comes; 1, 3, 5, 10 or 30), and Auto

Dim, the idle time after which the screen dims. Both are in Settings > Handheld Setup, [home] [5] [3]: [tab] moves from field to field, the arrows choose a value, and OK keeps it.

- Turn the calculator off when you are done: [ctrl] [home].
- Before storing the calculator for months, charge the battery fully, and charge it again every three months.



Settings, [home] [5]



Handheld Setup, [home] [5] [3]: Power Standby and Auto Dim

A spare battery, the TI-Nspire Rechargeable Battery, can be bought from TI (the TI Online Store). You can change it yourself: a small screwdriver releases the panel on the back of the calculator. Use only a TI battery. A battery lasts about three years.

StarPilot and your saved sights are kept in the calculator's flash memory and are not lost when the battery runs flat. What is lost is what was not saved: the sights and changes since the last ctrl+S. Save before a long watch away from the calculator.

Screen Brightness

The TI-Nspire CX has a backlit colour screen. To make it brighter, hold [ctrl] and press [+]; to make it dimmer, hold [ctrl] and press [-]. In the cockpit at night use the dimmest setting you can read, to keep your night vision.

Your Sights: Keeping Them and Moving Them

StarPilot for TI-Nspire reduces your sights and finds your fixes on the calculator, and it keeps the sights you take so that you can review them, plot them and archive them. This chapter explains where those sights are kept, how to keep them safe, and how to move them between the calculator and the other StarPilot platforms.

The Calculator Is a Scratch Pad

Think of the sights on the calculator, and of its Sight Archive, as a scratch pad: the place you work underway, not the place you keep your record. Your sight record belongs in StarPilot on another platform: StarPilot on your computer or StarPilot on your phone. There each set of sights is a file that you can name, back up, print and come back to years later.

The calculator's storage is small and fragile by comparison. The Sight Archive has ten slots. The sights are kept only inside the StarPilot document, and only when that document is saved (see the warning below). A document replaced or deleted, or a calculator lost overboard, takes every sight in it along.

So make it a habit: **move your sights off the calculator after each passage**, into StarPilot on your computer or on your phone, and start the next passage with a clean scratch pad. "Taking Sights Out" below shows how. "Bringing Sights In" shows how to bring sets back from StarPilot on your computer when you want them on the calculator again.

WARNING

Answering **No** to the calculator's Save changes? question when you close the StarPilot document **discards every sight you entered since the document was last saved**, together with every change since then to the Sight Archive and to the settings.

To keep them, save the document with **ctrl+S** (hold down ctrl and press S) whenever you have entered sights you want to keep, or answer **Yes** when the calculator asks Save changes?.

The Storage screen, Settings 2 item 6 ([S2][6]), tells you whether anything is unsaved: it ends with Unsaved changes: Press ctrl+S to keep them. or with All changes saved.

Where Your Sights Are Kept

Your sights are kept inside the StarPilot document itself, the file StarPilot.tns on the calculator. They are not kept in separate files. (StarPilot-89 users will remember that the TI-89 version kept each archived set as a variable of its own, in a folder called SPSITE. The TI-Nspire version has no such folder.)

Three things follow from this:

- **They are kept only when the document is saved.** Until you press **ctrl+S**, or answer Yes to Save changes? on closing, new sights and changes exist only in the open document.
- **A copy of StarPilot.tns carries them.** Copy the document to your computer and

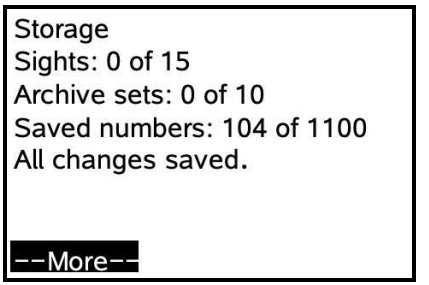
the copy holds every sight as of the last save. That is how StarPilot on your computer reads them (see "Taking Sights Out").

- **Replacing or deleting the document loses them.** Copying another StarPilot.tns over it, or deleting it, takes the sights inside it too. This matters most when you upgrade StarPilot: follow "Upgrading StarPilot" at the end of this chapter.

The document holds three kinds of sights:

- **The current sights**: the sequence you are working on, up to the Max Sight # set in Settings 3 ([S3][6]). These are the sights that Review Sights, Fix by Computation and Fix by Plotting work from.
- **The Sight Archive**: ten slots, numbered 0 to 9. Each slot holds one set of sights, together with the settings that were in force when the set was archived (date, DR, units and the rest), under a name of up to six letters and digits.
- **The sample sights**: eight read-only sets that come with the program, taken from the sample sight files of StarPilot on your computer. They are listed after slot 9, and they cannot be changed or deleted.

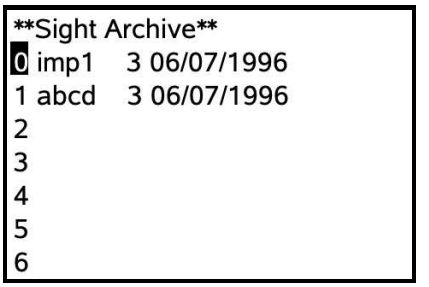
The Storage screen ([S2][6]) counts what the document holds: Sights: the current sights, of the Max Sight #; Archive sets: the slots in use, of 10; and Saved numbers: the size of everything StarPilot saves, of the most it can save safely. When an archived set brings the document near that limit StarPilot says Archive nearly full; when a set would take it past the limit, StarPilot refuses to archive it and says Archive too large to save safely: delete an archived set.



Storage screen, Settings 2 item 6

The Sight Archive at a glance

The Sight Archive is on the Celestial Fix menu: Celestial Fix [4], Sight Archive [4]. Its list shows the ten slots, slot 0 first, each with its digit, and then the sample sights. A slot in use shows its name, its number of sights and its date; a free slot is blank. Seven rows fit on the screen; the arrow keys move through the list.



Sight Archive list

- A digit key, 0 to 9, picks that slot directly, wherever it is in the list; **enter** picks the highlighted row.

- Picking a free slot starts **New**: StarPilot asks Filename? and saves the current sights and settings in that slot under the name you type (a letter first, then letters or digits, six at most).
- Picking a slot in use opens its list of actions: **View**, **Restore**, **New**, **Ren**, **Del**, **Del All** and **Done**, the words of StarPilot-89's toolbar.
- **del** deletes the highlighted slot, after asking About to Delete "name" (1=Y,0=N)?.
- **esc** returns to the Celestial Fix menu.



Sight Archive, a slot's actions

Restore replaces the current sights and settings with the set's own. StarPilot asks first: About to restore "name" (1=Y,0=N)?. If the current sights matter, archive them (New) before you restore another set.

The sample sights are listed with an asterisk before the name (*1982-LAN and so on) and their number of sights. They offer View and Restore only; anything else gets Sample sights are read-only. A sample's Restore takes the sample's sights and the settings they depend on, and raises the Max Sight # if the sample has more sights than it allows. The eight samples are the sample sight files of StarPilot on your computer (described as in its help, Sample Sights topic):

***1982-LAN** (14 sights) Sun sights through local apparent noon on 20 July 1982: a noon latitude by LAN.

***3-sunlines** (3) Three Sun lines on 5 March 1999, a running fix of the Sun, off the Pacific Northwest coast.

***4-2** (6) Six sights on 6 July 1993, the Sun and a planet, in the North Atlantic.

***QuickStart1** (2) Two Sun sights from 26 September 2001.

***QuickStart2** (2) Two Sun sights from 14 April 2000, worked as a running fix by computation.

***plottest** (3) The Sun and two stars on 4 April 2005, laid out to be plotted: three lines of position that cross.

***stars** (3) Three star sights on 6 July 1996 at 32N 15W: a three-star fix.

***sunrise** (0) No sights: a position of 47N 122W (Seattle) and the date 6 August 2001, for sunrise, sunset and twilight.

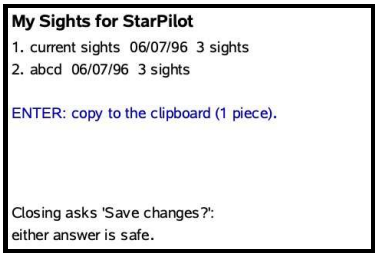
Bringing Sights In

StarPilot on your computer does both directions of the round trip: File > Export for TI-Nspire... writes your sights for the calculator, and File > Import from TI-Nspire... reads them back from the calculator's StarPilot document.

1. **In StarPilot on your computer, choose File > Export for TI-Nspire...** It writes the sights you choose as MySights.tns: one piece of at most 15 sights. It does not split a larger set; export more than 15 sights a few at a time.

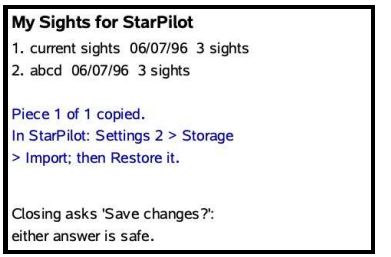
2. **Copy MySights.tns to the calculator** as you would copy any document: with TI-Nspire CX II Connect at nspireconnect.ti.com in a supported browser (Google Chrome 90 or later, or, on Windows, Microsoft Edge 90 or later), or with TI's TI-Nspire computer software if you have it (see "What you need" in the Introduction).

3. **Open MySights.tns on the calculator.** Its page, headed My Sights for StarPilot, lists each set with its name, its date and its number of sights.



MySights page, before copying

4. **Press enter.** MySights copies its sets to the calculator's clipboard, and the page says Piece 1 of 1 copied. and reminds you of the next steps.



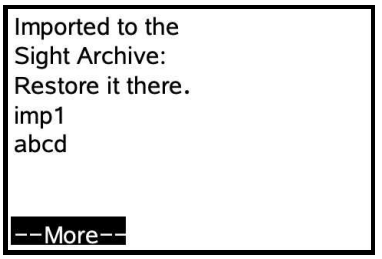
MySights page, Piece 1 of 1 copied

5. **Close MySights.tns** (doc > File > Close). Until a document like this one has been saved once, the calculator asks Save changes? when you close it; after that, only when something has changed. For MySights either answer is safe: it holds nothing you have changed, and the clipboard keeps the sights.

6. **Open StarPilot.tns and go to Storage**: Settings [1], More Settings [1], Storage [6], or [S2][6] in this guide's notation.

7. **Answer 1 to Import(1=Y,0=N)?** and press **enter**. (The default, 0, leaves the Storage screen without importing.) StarPilot reads every set on the clipboard, checks each one, and reduces every sight again with its own almanac, on the settings that came with the set. Then, for each set, it shows Set 1 of 2 with the set's name, date and number of sights, and asks Slot (0-9)?, offering the lowest free slot: press enter to take it, or type another. A slot in use shows what it holds and asks Overwrite(1=Y,0=N)?; the default, 0, asks for the slot again. esc skips that set. At the end StarPilot reports Imported to the Sight Archive: Restore it there. with the names it used. A name already taken by another slot gets a digit

added; a set without a name, such as a set of current sights, is called imp1, imp2 and so on.



Storage, Import done

8. **Restore the set you want to work with**: Celestial Fix [4], Sight Archive [4]; pick the set's slot, choose Restore, and answer 1 to About to restore "name" (1=Y,0=N)?. Import never touches the current sights; Restore replaces them, and the settings, with the set's.

9. **Press ctrl+S** to save the document. Until you do, the imported sets exist only in the open document.

The checks are all or nothing: when the clipboard's text is wrong, StarPilot says so and changes nothing, neither the Sight Archive nor the current sights:

- No StarPilot sights on the clipboard. Copy them in MySights first. The clipboard holds no sets: step 4 was skipped, or something else has been copied since.
- Clipboard sights damaged (check failed). Nothing imported. A set failed its check: its text was damaged on the way.
- Not StarPilot sights this version can read. Nothing imported. Foreign text: text that is not StarPilot's, or a newer format than this version reads, or a set of more than 15 sights, or a sight of a body for which only the Nautical Almanac gives the data.
- No sets imported. Every set was skipped (esc at Slot (0-9)?): nothing changed.

Taking Sights Out

To StarPilot for PC. StarPilot on your computer reads the sights straight from a copy of the StarPilot document, with File > Import from TI-Nspire...:

1. **Press ctrl+S in StarPilot**, so that the document holds the sights as they are now. StarPilot on your computer reads only what was saved.

2. **Copy StarPilot.tns to the computer** with TI-Nspire CX II Connect at nspireconnect.ti.com in a supported browser (Google Chrome 90 or later, or, on Windows, Microsoft Edge 90 or later), the way MySights.tns went to the calculator, or with TI's TI-Nspire computer software if you have it (see "What you need" in the Introduction).

3. **In StarPilot on your computer, choose File > Import from TI-Nspire... and open the copy.** StarPilot on your computer reads its sights: the current sights and each Sight Archive slot in use, each as a set of sights that you can keep as a sight file there.

Once the sights are safe in StarPilot on your computer, clear the scratch pad: New Seq (Del ALL)

[4][6] for the current sights, and Del or Del All in the Sight Archive for the archived sets. Then press **ctrl**+**S**.

To StarPilot Mobile. This is coming. StarPilot will show the sights as QR codes on the calculator's screen, and StarPilot on your phone will read them with the phone's camera: no cable and no computer. The current sights or any archived set can go this way. A set may take several codes; each code says which set it belongs to and where it falls in the set, and StarPilot on your phone checks that it has every code, undamaged, before it accepts the set.

Upgrading StarPilot

A new version of StarPilot comes as a new StarPilot.tns. The new document does not read the old one's sights: there is no migration inside the program. Your sights cross over by way of StarPilot on your computer, the same way they go out and come in. Do this **before** you delete or replace the old document:

1. **Save the old document.** Open the old StarPilot, press **ctrl**+**S**, and close it.
2. **Copy the OLD StarPilot.tns to the computer.** This copy is also your backup: keep it until the upgrade is finished.
3. **In StarPilot on your computer, read its sights (File > Import from TI-Nspire...) and write MySights.tns** with the sets you want to carry over (File > Export for TI-Nspire..., as in step 1 of "Bringing Sights In"). The current sights come across as a set like any other.
4. **Copy the NEW StarPilot.tns, and MySights.tns, to the calculator.**
5. **Import the sets** into the new StarPilot: steps 3 to 9 of "Bringing Sights In". Open the Sight Archive and check that every set is there; Restore the set you were working on; press **ctrl**+**S**.
6. **Only then delete the old document** from the calculator.

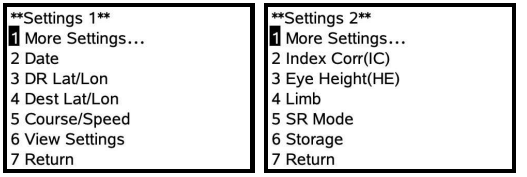
Each set brings along the settings its sights need: the DR, course and speed, magnetic variation, limb, temperature and pressure, Dip Short, units, zone description and watch error; each sight brings its own height of eye and index correction. Other settings, such as the Max Sight # and the Hc limits, are the new document's own. Check them with View Settings ([S1][6]) after the upgrade.

Functions by Key Strokes

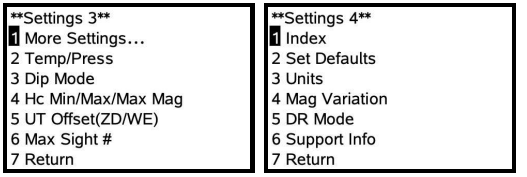
In the following, each function of the program is described in order of its keyboard access, starting from the main menu.

[1] Settings

StarPilot stores a number of user-defined options that make sight reduction and DR more convenient. Reach them with [1] on the main menu, which takes you to the first of 4 menus of settings, which we call S1 to S4.



*The **Settings 1** and **Settings 2** menus*



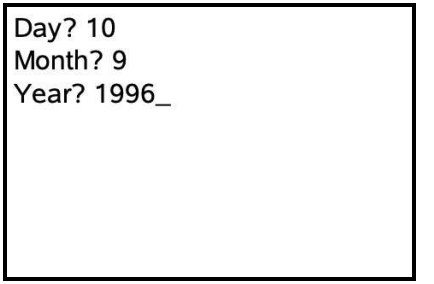
*The **Settings 3** and **Settings 4** menus*

[S1] Settings 1

The first entry in Settings 1 goes on to Settings 2 (More Settings), so we start each discussion with the second entry, which we call [S1][2], the Date, and so forth.

[S1][2] Date

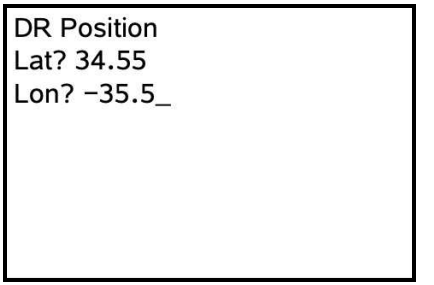
The date is used to identify celestial sight times as well as the current DR position, and for sight planning. Enter the date on the watch you use for the sight times: if using GMT, the GMT date; if local time, the local date.



Date: day, month and year

[S1][3] DR Lat/Lon

The stored date and DR position are taken as the current date and DR position in all calculations, and StarPilot stops asking for them. Set Defaults ([S4][2]), or setting the date or DR position to 0, makes StarPilot ask for them again.



DR Lat/Lon

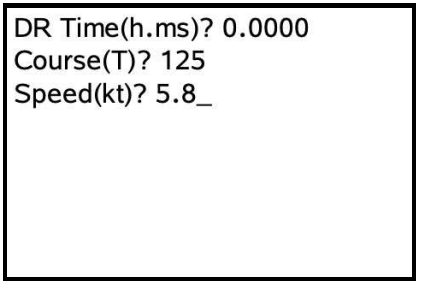
[S1][4] Dest Lat/Lon

This position is used for the route sailing computations. It can be very convenient to have it stored, to save entering it for every computation.

[S1][5] Course/Speed

Course/Speed sets the vessel's course and speed for the DR functions. It first asks for the DR mode (see [S4][5]), then for the course and speed in Speed mode (with the DR time first), or the course and the log reading in Log mode.

The course is asked with (T) or (M), true or magnetic, depending on whether a magnetic variation is set in [S4][4]. A variation of zero means true. You can change this back and forth as you see fit.

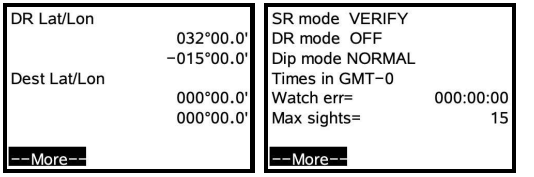


Course/Speed in Speed mode

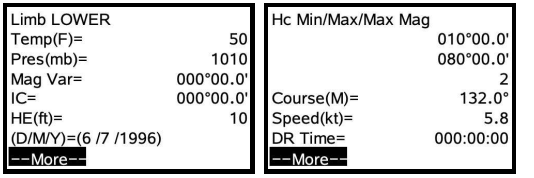
These values of course and speed are used for DR updates; but when it comes time to compute a running fix, you are asked for them for each fix, so that you are certain the right values go into it. You could be doing a routine DR with one set of values and want an effective CMG or SMG for sights with course changes during the sight sequence. (The Traverse function [6][3][3] is a convenient way to figure CMG over a series of course changes.)

[S1][6] View Settings

View Settings steps you through all the settings, followed by the sights stored. Press [enter] for the next page, and [esc] when you have seen what you need. Since the DR position is checked most often, it comes first.



View Settings, pages 1 and 2 (after Set Defaults)



Pages 3 and 4 (page 4 after the entries in this section: the course is shown magnetic, since a variation is set)

Pressing [del] while a sight is shown deletes it from the sequence. This can be a convenient way to remove bad sights as they are discovered; see [4][5].

[S2] Settings 2

[S2][2] Index Correction (IC)

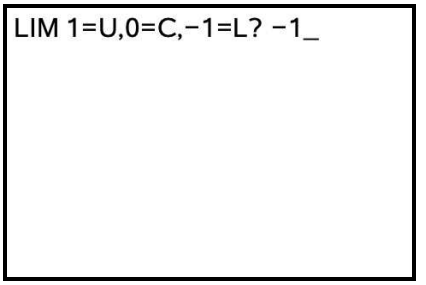
Enter the IC in minutes of arc, positive when OFF the scale and negative when ON the scale: -2.5. The stored IC is used in sight reductions without asking when SR mode is OFF (see [S2][5]); with SR mode VERIFY it is asked for on each sight, with this setting offered.

[S2][3] Height of Eye (HE)

The height of eye is entered in feet or meters, as chosen in [S4][3]. See SR mode, [S2][5].

[S2][4] Limb

The default limb for Sun and Moon sights is stored here: 1 upper, 0 center, -1 lower. Normally this would be the lower limb.



Limb

Entering 0 computes to the center of the body. This can be used for some artificial-horizon sights where the direct and reflected images are superimposed in the sextant.

If you have the lower limb stored and choose to take an upper limb sight, change this setting for that sight, or switch to SR mode VERIFY and StarPilot asks for the limb on each sight.

[S2][5] SR Mode

SR mode stands for Sight Reduction mode. It can be set to VERIFY or OFF. Choose VERIFY when working problems that are not related to each other (different dates, places, bodies), as in textbook exercises and exam preparation: StarPilot asks for all the inputs for each sight reduction.

When doing sights underway, or a sequence of similar sights from the same time and place, OFF is much more convenient: the stored settings for HE, IC, limb and DR position are used for each sight, and only the body, WT and Hs are asked for.

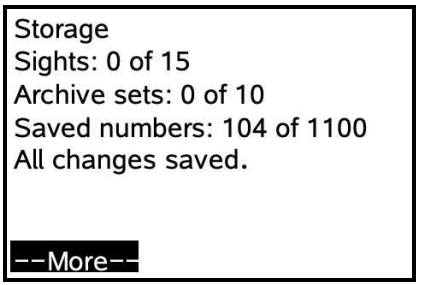
In OFF mode it is important to check these settings, since they are used without asking. Check them with [S1][6].

All prompts have defaults. As you enter data, StarPilot remembers it, and when you run the same or a similar function again it offers the data you entered before. Press [enter] to accept the value offered, or type over it. Values stored in the settings take precedence over these remembered values: a date stored in the settings is the one offered whenever the date is asked for. With the date set to 0 in the settings, StarPilot offers the last date you entered.

With SR mode OFF, StarPilot uses the values in the settings without asking for them; where a setting is 0 (as after Set Defaults), it asks, offering the remembered value, as in VERIFY mode. SR mode applies to all StarPilot functions, not only to sight reductions.

[S2][6] Storage

Storage shows how many sights and archive sets the document holds and how full its saved state is, and it brings sets of sights in from StarPilot on another platform. It is described in the chapter "Your Sights: Keeping Them and Moving Them".



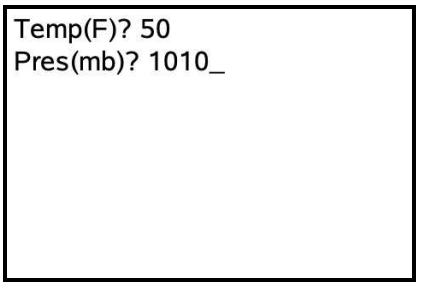
Storage

In StarPilot-89 this entry was PC Mode, the precision of Precompute. StarPilot for TI-Nspire computes every body at full precision in every function, so the setting is gone.

[S3] Settings 3

[S3][2] Temperature and Pressure

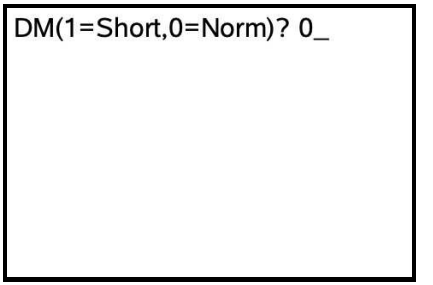
Temperature and pressure are asked for in the units set in [S4][3]. The defaults are 50°F and 1010 mb, which correspond to no additional correction in the Nautical Almanac's refraction table.



Temperature and pressure

Extreme temperatures and pressures change the atmospheric refraction correction. Enter valid temperature and pressure if low-altitude sights are taken in extreme conditions. See Set Defaults, [S4][2], for the other defaults.

[S3][3] Dip Mode for Dip Short



Dip mode

Normal is the usual choice, for sights using the true sea horizon, or more specifically the visible horizon as cut off by the actual curvature of the earth.

When using a shoreline beneath the sighted object as the horizon instead of a proper sea horizon, the dip correction must be figured in a special manner, called Dip Short. It is needed whenever we are actually seeing the shoreline and not the true curvature of the earth. Dip short depends on the height of eye and on the distance to the shoreline directly below the object sighted.

To decide whether dip short is needed, compare the square root of HE in feet with the distance to the shoreline in nautical miles. If the distance is larger, you are seeing the curvature of the earth cut off the shoreline and can do sight reductions in the normal manner. If not, use Dip Short (set

dip mode to short), and StarPilot asks for the distance to the shore with each sight.

Dip short is very useful for sextant practice on inland waters, even rather small lakes; it is usually much better practice than an artificial horizon. Take the sights, figure Zn from the sight reduction, then return to the chart and, from the known practice location and Zn, measure the distance to the shoreline.

Underway, dip short can also, though rarely, be of value if you get close to shore without knowing where you are and the only sextant sight is of the Sun or Moon over nearby land.

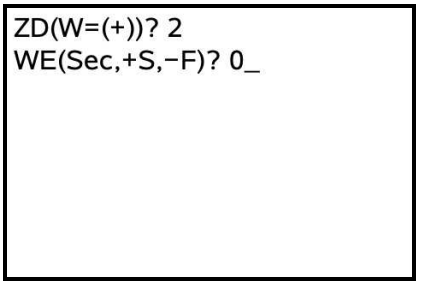
[S3][4] Hc Min, Max, Max Mag Cutoff

Hc Min and Hc Max set the limits for the body searches of the Sight Planner [2][2] and Star/Planet ID [2][5]: bodies higher than Hc Max or lower than Hc Min are not shown. Max Mag is the magnitude cutoff: the Sight Planner stops looking for stars, and goes on to the planets, once all the stars of that magnitude or brighter have been found. The default 2.0 always includes the bright stars; larger numbers include fainter stars, which clutter the screen and rarely help with sight selection.

The defaults for Hc are 10^o and 80^o. Lower sights have larger uncertainties from refraction, and higher sights are more difficult to take and require more careful analysis. Although 2.0 usually gets all the bright stars you need, sometimes there are not enough and you have to go higher; more often you can get by with a lower number, maybe 1.5. Once you settle on values, they typically serve for many nights of a voyage.

[S3][5] UT Offsets (ZD/WE)

StarPilot navigates using Watch Time (WT), defined by UT = WT + WE + ZD, where WE is the watch error (fast is -) and ZD the zone description (east is -). The two are entered here in two steps, as shown below. UT is the same as GMT.



UT offsets: ZD 2, WE 0

[S3][6] Maximum Number of Sights

StarPilot keeps up to 60 sights in its current sequence. With this setting you can limit that number, which helps your bookkeeping and keeps reviews and some computations short. A running fix uses all stored sights, so if you have more in the list than you want, the results may be wrong or not optimum.

Type the number you want at the prompt; a number over 60 is taken as 60. By default StarPilot keeps the last 15 sights: when a sixteenth is taken, the first in the sequence is discarded. It is not the oldest sight by time that goes, but the one reduced first. With a maximum of 15, when #16 is entered, #1 is discarded, #2 becomes #1, and your new sight becomes #15.

[S4] Settings 4

[S4][1] Index

Returns to the main menu.

[S4][2] Resetting Factory Defaults

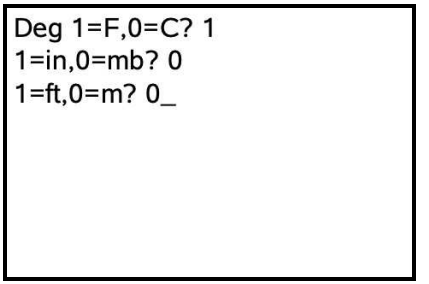
This function is introduced in the Introduction. It results in the following:

- The date is cleared.
- The DR Lat/Lon is cleared.
- The Dest Lat/Lon is cleared.
- DR mode is set to OFF.
- The limb is set to CENTER.
- Dip mode is set to NORMAL.
- The index error is set to 0.
- The height of eye is set to 0.
- Units are set to ^{o}F, mb and ft.
- Temperature is set to 50^{o}F.
- Pressure is set to 1010 millibars.
- Magnetic variation is set to 0.
- ZD is set to 0.
- Watch error is set to 0.
- Course, speed and log are each set to 0.
- Hc Min/Max/Max Mag are set to 10^{o} / 80^{o} / 2.0.
- SR mode is set to VERIFY.
- The maximum number of sights is set to 15.
- The Sight Planner's control options are set to Step 8, Slop 16, Grid Wt 0.7, Mag Wt 0.2, Hc Wt 0.1.
- All sights in the current sequence are cleared.

The Sight Archive and the remembered entries are kept.

[S4][3] Units

Here you choose the units for temperature, pressure and height.



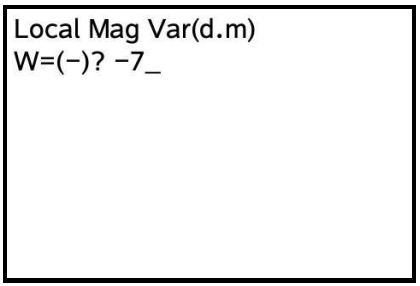
Units

Typing 1 then [enter] at the first question sets temperatures in Fahrenheit (0 is Celsius); the 0 at the second sets pressure in millibars (1 is inches); and the 0 at the third sets heights in meters (1 is feet). The last [enter] returns you to the **Settings 4** menu.

[S4][4] Local Magnetic Variation

StarPilot by default shows and asks for bearings as true. Setting a magnetic variation makes it

show and ask for magnetic bearings, marked (M). Westerly variations are entered as negative. Some functions, such as the current sailings, work only in true; others, such as Star/Planet ID, take either. In all cases the prompts show (T) or (M) according to the variation set.



Local magnetic variation: 7°W

To change the variation from 0° to 7°W, run this entry and enter -7 as shown.

[S4][5] Setting the DR Mode

The DR mode determines how Update DR and several other functions work. StarPilot has 3 DR modes: Off, Speed (speed and time) and Log. The default is Off: all functions that use course, speed or time ask for what they need. This is simple and easy to use, but not the most efficient.

The Speed mode assumes the traditional method of DR by speed and time: the logbook records positions and course changes by the time of the event, and the speed in force.

In Speed mode each DR position stored is tied to a time and a speed. You can update the DR by telling StarPilot the next time you care about: it knows the time of the last DR position, your course and your speed, so it computes the new DR and stores it.

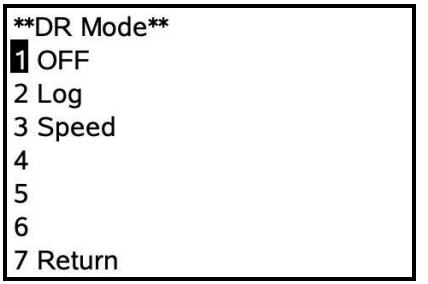
The Log mode assumes you keep DR records by log reading. It works like the Speed mode, but to update the DR you give the next log reading you care about.

With these two modes we can project our position two ways: by telling StarPilot we ran 45.8 miles on our course (Log mode), or that we ran for 12h 30m on our course at our speed (Speed mode). It is simple to switch between modes to use whichever is more convenient.

These computations can be part of the ongoing navigation or a simple navigation computation. Once a computation is done, you can update the stored DR with the result or just abandon it. If you update the DR, the stored DR Lat and Lon change to the new values; in Log mode the DR log is updated as well, and in Speed mode the DR time.

With this function you can almost literally type your logbook into StarPilot, line by line, and figure the final DR position, entering the new course and speed as you come to them.

When run, the DR Mode function first asks for the mode, then goes on to Course/Speed ([S1][5]) to set the course, speed, DR log and DR time that the mode needs.

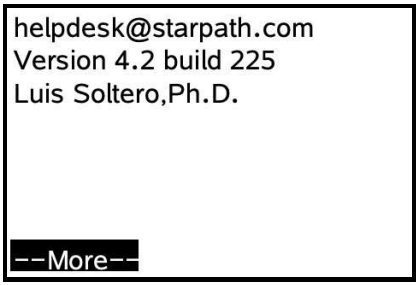


*The **DR Mode** menu*

The most common mode is likely Speed, unless you specifically use log readings or distance run. We include the Log mode since it is the most accurate way to keep DR records underway in small craft at sea: at each course change we record the log reading, which measures our progress better than the corresponding time and speed.

[S4][6] Support Info

This screen gives the version and build, for example Version 4.2 build 225 (the same as the first screen shows while StarPilot unlocks), and the address for technical support, helpdesk@starpath.com. Give the version and build when you write about StarPilot. The fastest source of help with StarPilot is on-line, at the support pages of starpath.com: updates and a list of FAQs are kept there.



Support Info

[2] Celestial Bodies

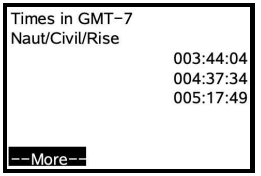
The functions in this menu compute properties of celestial bodies: the times of rise and set, sight planning, sight analysis, precomputed altitudes, and star and planet identification. Most of them use values stored in the Settings menus.

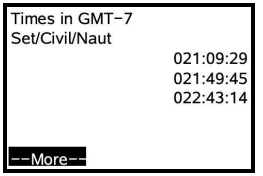


*The **Celestial Bodies** menu*

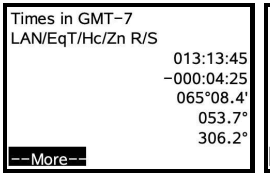
[2][1] Sunrise, Set, Twilight, and LAN

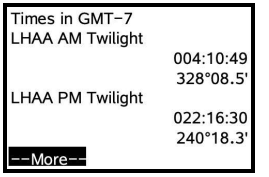
Sunrise/LAN/Sunset computes the times of sunrise, sunset, nautical and civil twilight, and meridian passage (LAN). It also gives the Sun's bearing at rising and setting, its height at LAN, and the LHA Aries at the midpoint between nautical and civil twilight. The input is the DR position and the date. To compute 4 July 2000 at 47°39′N, 122°20′W, enter these in the settings; to see local times, set the ZD in [S3][5], here +7 for PDT. Then:





Sunrise/LAN/Sunset: morning twilights and rise; set and evening twilights





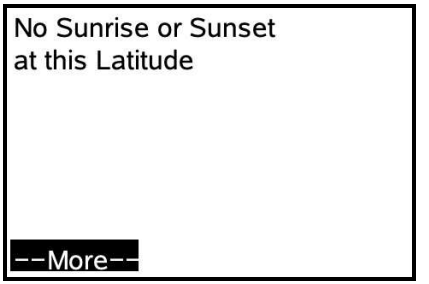
LAN, the equation of time, Hc at LAN, Zn at rise and set; LHA Aries at the twilights

EqT is the equation of time, the difference between 12:00 UT and the UT of LAN observed at Lon 0°. Zn R and Zn S are the Sun's azimuths at sunrise and sunset.

The LHA Aries values are for setting up a Star Finder or Pub 249 for sight planning and star identification, although StarPilot performs these planning functions itself.

The bearing of sunrise and sunset relative to 090° and 270° is called the amplitude of the Sun.

When the Sun does not rise or set In high latitudes, near the solstices, the Sun may stay above or below the horizon all day. Then StarPilot says so instead of giving times:



No sunrise or sunset at this latitude

No Sunrise or Sunset at this Latitude means polar day or polar night. For the rare dates and latitudes where the Sun does cross the horizon but StarPilot cannot find the crossing within the day, it says StarPilot cannot compute sunrise and sunset for this date at this latitude. A twilight that never comes (in summer at high latitudes the Sun may never get 6 or 12 degrees below the horizon) is said in words: No nautical twilight, No civil twilight, or No twilight.

[2][2] Sight Planner

The Sight Planner draws a radar-like picture of the sky at a given time and place. It can also find the best bodies to shoot for the best possible fix: this feature, Find Sights, is described in the next section.



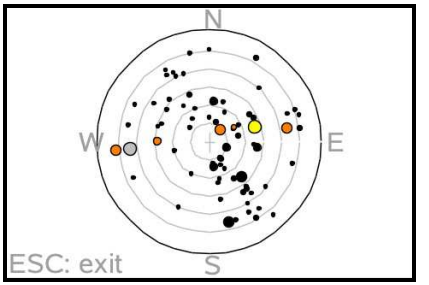
*The **Sight Planner** menu*

The inputs are the date, the time and the DR position. The settings in [S3][4] also apply: the upper and lower limits on Hc and the magnitude cutoff of the stars to look for. Please review that section for important details.

Compute Sky gets the ball rolling. Best Sights, Replot Sky and List Bodies work after Compute Sky has run. Cntl Options and Find Sights control the Find Sights feature of the next section; ignore them for now.

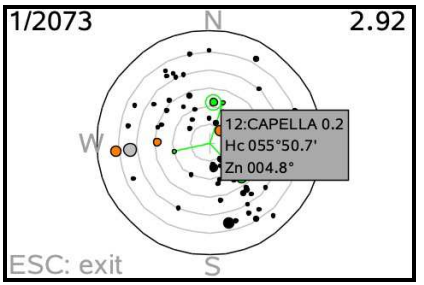
StarPilot searches its almanac for the visible stars and planets and draws the sky: the horizon is the outer circle, the zenith the center, north up and east right. Stars are dots, sized by brightness; planets are orange disks, the Moon a gray disk, and the Sun a yellow disk.

For example, the sky at 1400 GMT on 15 July 1998 from 12°N, 68°W (Hc 10 to 80, magnitude cutoff 3.5):

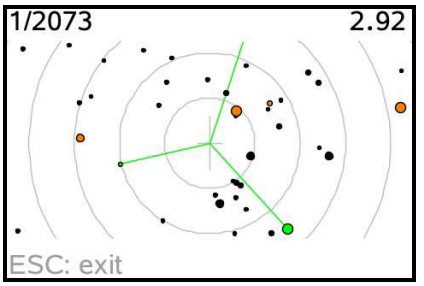


The sky, 1400 GMT 15 July 1998, 12°N 68°W

To see a body's data, touch it with the touchpad's pointer: a popup gives its name and magnitude, its Hc and its Zn. A click keeps the body selected (ringed in green) and its popup shown until you choose another. To look closer, [+] draws the sky a fifth larger about the body under the pointer (or the selected one), a little more at each press, up to 6 times, and the subtraction key [-] zooms out again; the arrows move the picture an eighth of the screen each way, and [0] shows the whole sky again. [esc] leaves the picture and returns to the Sight Planner menu.



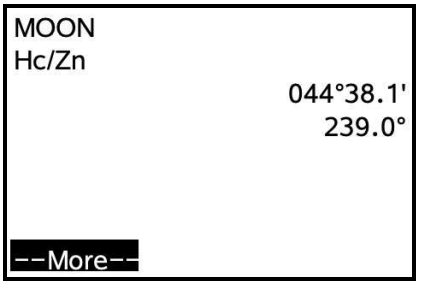
A body's popup, here Capella (clicked)



[+] five times: the sky picture zoomed about its middle

The keys of the sky picture are listed together in Plot Controls, in the Introduction.

When you leave the picture, List Bodies lists all the bodies shown, one page each. For example, at 2200 GMT on 1 January 1998 at 12°N, 68°W, the Moon's page is:



List Bodies: the Moon, 2200 GMT 1 January 1998

Replot Sky draws the picture again without searching the almanac again, so you can move between the picture and the lists. Best Sights works when Find Sights has been used.

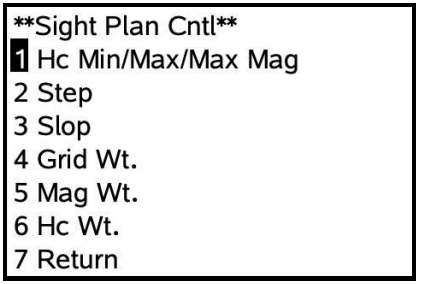
StarPilot computes the bodies at full precision here as everywhere, so the popups' Hc and Zn can be used directly for setting the sextant.

See starpath.com for notes on choosing the best star and planet combinations for sight taking.

Find Sights

The Sight Planner's Find Sights feature (also called the Find Sights Optimizer, or simply the Optimizer) computes sets of 3 bodies, or triads, that give the best running fixes.

Control Options



*The **Sight Plan Cntl** menu (Cntl Options)*

The control options set how the planner and the optimizer work.

Hc Min/Max/Max Mag are used by both the planner and the optimizer to limit the search: bodies

higher than Hc Max or lower than Hc Min are not shown, and only bodies as bright as Max Mag or brighter are.

Step, Slop, Grid Wt., Mag Wt. and Hc Wt. control the optimizer; the planner alone ignores them.

The planner calls the optimizer once it has found the bodies that meet the search limits. The optimizer lays a grid of 3 lines meeting at the center of the sky picture and running out to the horizon about 120 degrees apart. Stars close to the grid are candidates for running fix triads.

Step sets how coarsely, in degrees, the grid turns through the sky from 0, 120, 240 to 120, 240, 360. A Step of 8 defines grids at (0, 120, 240), (8, 128, 248), (16, 136, 256), and so on. A smaller step takes longer; a larger one is faster, with a possible loss in quality. Step must be a whole number from 1 to 120.

Slop sets how far in degrees a body may be from the grid and still be considered for a triad. To find all possible triads Slop must be at least twice the Step. More than twice gives many duplicate triads, which must be removed before the optimizer weighs them; less may miss some triads.

A Step of 8 with a Slop of 16 has been found to be a good compromise. If a sky gives few triads (or none) decrease the Step and/or increase the Slop.

Once all possible triads are found, the optimizer weighs them for sight and fix quality. Grid Wt, Mag Wt and Hc Wt set what makes a triad good. Grid Wt sets how close to the grid the bodies must be: 1 means very important, 0 means any triad within the Slop is good. Mag Wt and Hc Wt set the importance of brightness and of similar altitudes: 1 makes bright triads (or triads at similar altitudes) better, 0 makes brightness (or altitude) unimportant. The defaults are Grid Wt 0.7, Mag Wt 0.2 and Hc Wt 0.1. To prefer brighter triads, increase Mag Wt.

Find Sights

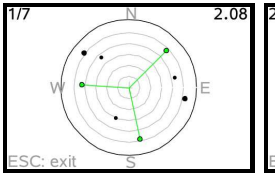


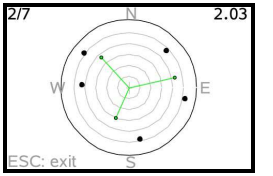
*The **Find Sights** menu*

The Find Sights menu chooses the bodies the optimizer considers. OFF turns the optimizer off: the Sight Planner shows the sky with no triads, as in the previous section. Stars turns it on for stars only. Stars+Moon, Stars+Planets and Stars+Moon+Planets include those bodies. The optimizer never uses the Sun, and it counts the planets' magnitude as 0 when weighing triads.

Compute Sky starts it. First the almanac is searched, then the optimizer computes the triads, and finally the sky is drawn with the best triad.

Rerunning the 1 January 1998 example with stars only, Hc Max 80, Hc Min 10 and Max Mag 1.5 gives 7 triads:

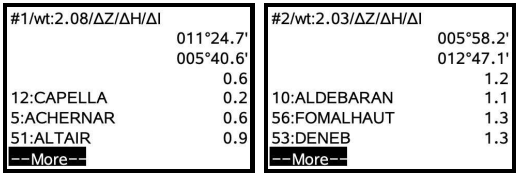




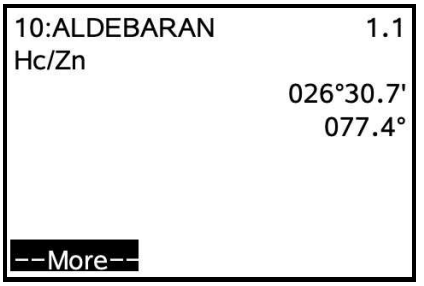
Triad 1 of 7 (weight 2.08) and triad 2 of 7 (2.03)

The picture first shows the best triad. The 1/7 at the top left says triad 1 of 7 is shown; at the top right is its weight, 2.08. Press [enter] (or [tab]) for the next triad, and the sign key [(-)] (or shift+[tab]) for the previous one: triad 2 has weight 2.03. The arrows, [+], [-] and [0] move and zoom the picture as in the plain sky picture. The popups work here as in the plain sky picture.

[esc] returns to the Sight Planner menu. Best Sights then lists the triads: first a summary page for each triad, with ΔZ, ΔH and ΔI, the computed weights for grid, Hc and magnitude, and the names of the three bodies; then a page for each of its bodies.



Best Sights: triads 1 and 2



Aldebaran in triad 2

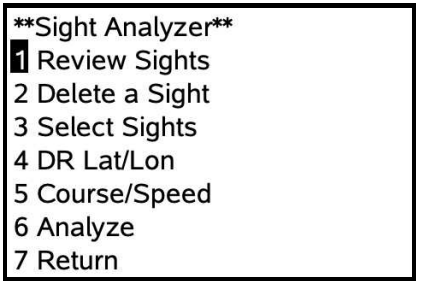
For triad 2, Aldebaran is at Hc 26°30.7′, Zn 077.4°.

Replot Sky draws the picture again, and List Bodies lists all the bodies found.

[2][3] Sight Analyzer

To learn about this process, see the article on the Fit-Slope Method on David Burch's Navigation Blog. Use ZD = 0 for the Sight Analyzer: its WT is always UTC.

The goal is to average a series of sights in effect, to find which one represents the full set. StarPilot computes the theoretical values of the altitude over the time of the sights stored, taking the vessel's motion into account, and compares the slope of these values with the actual sights. This shows which sights are outside the normal scatter, so they can be deleted or ignored, and lets you choose the best of the set.



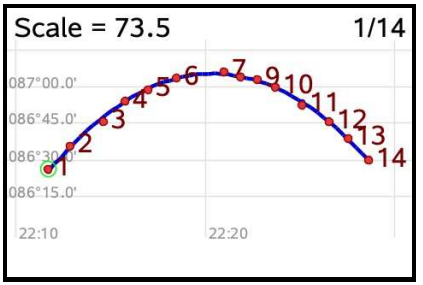
*The **Sight Analyzer** menu*

To use the Sight Analyzer, enter a set of sights of the same body over a reasonably short time (10 to 20 minutes or so) with the normal Sight Reduction function. Then set DR mode to Speed, the DR time to the time of the earliest sight, the DR position for that time, and the course and speed made good over the sight period: the menu's DR Lat/Lon and Course/Speed entries are the Settings 1 functions, here for convenience.

Select Sights chooses the sights to analyze: one by one (1, 2, 3), in ranges (4-9), or any combination (1, 3, 5, 7-10, 12-15). The Analyzer takes

the DR position as your position at the time of the EARLIEST sight selected, whatever order they are stored or listed in; it puts the selected sights in time order and advances the DR from the earliest to each of the others.

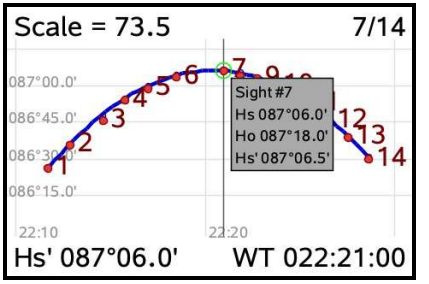
Analyze then draws your sights against time: each sight's Hs is a filled red point, with its number beside it. For each sight it also computes the altitude the sextant should have read at that time (the computed altitude with every correction undone, so that it compares with Hs directly), shown as an open circle, and draws the line that fits these best (by least squares: a gentle curve, or a straight line for two sights). Time runs left to right and altitude upward. Sights far from the line are most likely wrong.



*Analyze: the 14 sights of the *1982-LAN sample (see below) against the computed line*

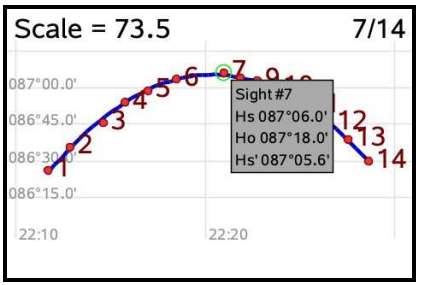
You can move the line, to find the fit with about as many sights above it as below it. With the touchpad, rest the pointer on a sight to see its popup: Sight #, then its Hs, Ho and Hs' (the line's altitude for it). A click redraws the line through the point you clicked, with the same shape, and a grey line marks the time of the click. Without the touchpad, [tab] and shift+[tab] select the next or previous sight on the screen, ringed in green, with its popup, going round from the last to the first; [enter] redraws the line through the selected sight. Choose a sight on the line as your best: that one sight is as good for a fix as, or better than, all the sights plotted together. Moving the line changes only the drawing and the popups' Hs': nothing is stored, and each Analyze starts again from the computed line.

To look closer, [+] draws the graph a fifth larger about the selected sight, a little more at each press (up to 16 times), and [-] zooms out again, as far as all the sights. The arrows move the graph an eighth of the screen each way, and [0] shows all the sights again. Scale = at the top left is the graph's height in minutes of arc (it shrinks as you zoom), with light grid lines labelled in altitude on the left and in watch time at the bottom; the selected sight and the count are at the top right. After a click (or [enter]) a grey line marks that time, and the bottom row reads Hs', the line's altitude there, and its WT; they stay as you zoom and move the graph.



[enter] on sight 7: the line through it, Hs' and WT on the bottom row

The graph's keys are listed together in Plot Controls, in the Introduction.



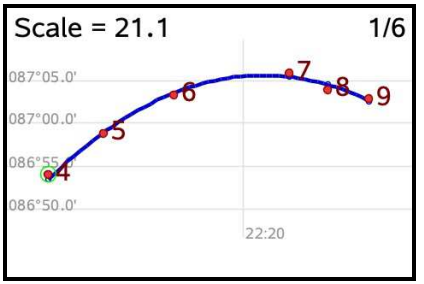
[tab] to sight 7, with its popup

This works for any sights. Those taken before or after LAN can be used for a reduction to the meridian (see older editions of Bowditch).

The Analyzer works on the sights you select, so keep each analysis to one short sequence of sights of the same body. Alternatively, enter sights in short sets, analyze them, keep the best of each set and delete the rest, then reduce the next set.

LAN Analysis Using the Sight Analyzer

The example is a set of 14 high LAN sights, peaking at about 87°, from July 1982 in the tropics (it is not common practice to take sights this high). It is one of StarPilot's sample sight sets: open the Sight Archive ([4][4]), move to *1982-LAN after slot 9, and Restore it. Then select the sights around the peak (Select Sights, 4-9) and Analyze.



Analyze: the 1982 LAN sights, 4 to 9

With the Analyzer we see that even with these few sights we have a good LAN: every sight lies within 0.6′ of the line. Sight 8, near the end, is the lowest, 0.6′ below it. The highest sight, 7, at 87°06.0′, is only 0.3′ above the line's peak of 87°05.7′, about half a minute after it: our peak height is reasonable for the LAN even though we slightly missed the actual peak time. You could use the LAN utility [6][5][1] to get a longitude as well as a latitude from these sights.

[2][4] Precompute

Precompute computes Hc and Zn for a body when planning sights, working problems from a textbook, or evaluating sight data. It works exactly like Sight Reduction, except that it shows the computed values instead of an intercept, and it files no sight. It computes at full precision, as every StarPilot for TI-Nspire function does.[1]

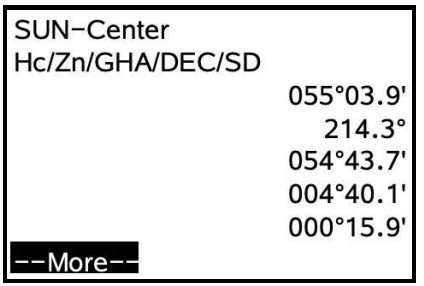


*Precompute is item 4 of the **Celestial Bodies** menu*

[1] StarPilot-89 offered a faster, less precise mode for Precompute (PC Mode, [S2][6]). The TI-Nspire has no need of it: its Precompute takes a moment even for the Moon and planets.

Option 5, Nautical Almanac, lets you enter a GHA and Dec directly: StarPilot computes the LHA from the stored longitude and uses the stored latitude to find Hc and Zn. To enter an LHA, give it as the GHA and set Lon 0. For a sequence of these, store Lat/Lon 0/0 in [S1][3] and StarPilot asks for them each time instead of reading stored values.

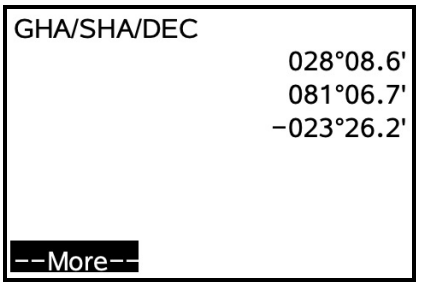
To precompute the Sun, for example: this function reads the date and DR from the settings when they are not zero, so either store what you want there or set them to zero to be asked. After setting the stored date and DR to zero, the input and result look like this:



Precompute, the Sun: Hc, Zn, GHA, Dec and SD

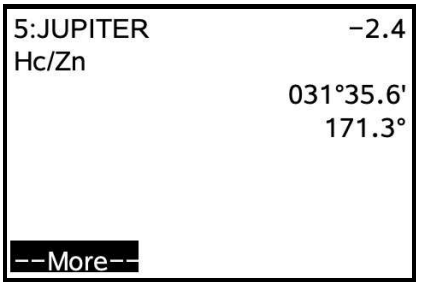
[2][5] Star and Planet ID

With this function you can identify a star or planet from its altitude and bearing. See Appendix 6 on how to find GHA Aries. Say we want to identify a bright body observed at GMT 21h 07m 26s on 10 September 1996 at an altitude of 31°36′ bearing 171°T, from DR 34°30′N, 36°30′W, height of eye 10 feet. After the inputs StarPilot shows the GHA, SHA and Dec that the observation points to:



Star/Planet ID: the observed body's GHA, SHA and Dec

Press [enter] to search the internal star and planet catalog for all bodies within 5° of the observation: first the Sun and Moon, then the stars from the brightest, then the planets. Each body found is shown with its number, name, magnitude, Hc and Zn; press [enter] to go on, [esc] to stop.



The search finds Jupiter

Here Jupiter, a very bright body (magnitude -2.4), meets the search criteria. A body of magnitude 2.1 would be 4.5 magnitudes fainter, some 60 times dimmer (see The Star Finder Book).

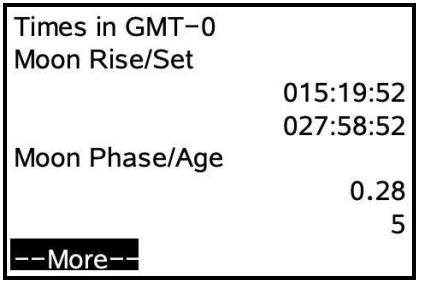
Star and Planet ID reads the Hc limits in [S3][4]: a body outside them is not found. StarPilot will not find a star at Hc 8° when Hc Min is 10°: open

the range first. The stars are searched in order of brightness, so bright stars that match always come before dim ones.

With dip mode set to Short ([S3][3]), StarPilot also asks Shore Dist(nm)? after the altitude and before the bearing, and uses it for the dip, as in a sight reduction. The distance must be more than zero: a distance of 0 or less gets No result: check inputs.

[2][6] Moon Rise, Set, Phase, Age

The example computes moonrise for 2 February 1998 at 12°N, 068°W.



Moonrise and set, phase and age

The first part shows the watch times (GMT - ZD) of moonrise and moonset. Times greater than 24 are on the next day: subtract 24 (027:58:52 means tomorrow at 03:58:52). The second part gives the Moon's phase and age. The phase is 1 at full Moon and 0 at new Moon; the age is the day of the Moon's cycle, day 1 the new Moon and about day 14 the full Moon.

[3] Sight Reductions

StarPilot reduces sights of the Sun, Moon, five planets and 190 selected stars easily, accurately and quickly, with its perpetual internal almanac. This section describes how.

To follow the next examples, first Set Defaults ([S4][2]) so that we start at the same place. In particular, this sets SR mode to VERIFY, so that all inputs are asked for each sight. Please review [S2][5], which explains the SR mode.



*The **Sight Reduction** menu*

[3][1] Sun Sight Reduction

The procedure is best shown by an example. Suppose we wish to reduce a Sun sight with these data:

- GMT 15h 35m 42s, Date Sept 10, 1996
- DR Latitude $34^{o}55'$N, DR Longitude $35^{o}50'$W
- Hs $54^{o}58.8'$ for a lower limb Sun
- HE 10 feet, IC $2.5'$ (that is, $2.5'$ OFF the scale)

GMT, Greenwich Mean Time, is the traditional name for the modern universal coordinated time (UTC). It is what we call watch time (WT) when the zone description (ZD) and watch error (WE) are 0.

After Set Defaults, return to the main menu and select Sight Reduction, [3]:

Select Sun. StarPilot tells you that this is sight number 1 and asks for the time of the sight. In StarPilot all times are entered as watch times, defined by GMT = WT + WE + ZD, where the watch error in seconds and the zone description in hours are stored in [S3][5]. The defaults are both 0, which makes WT the same as GMT.

Now enter the data, observing the data entry conventions of the Quick Start and the Introduction, and press [enter] after each value. [enter] commits the value: correct errors before pressing it, with the arrows, [del] and [clear]. The inputs are WT 15.3542, day 10, month 9, year 1996, Lat 34.550, Lon -35.500, IC 2.5, HE 10, limb -1, Hs 54.588.

Note the minus in -35.500 for $35^{o}50.0'$W, and the -1 for the lower limb. IC is the index error in decimal minutes. It is added to the sextant reading Hs, so it has a minus for on-the-scale errors and no sign for off-the-scale errors: if it's on, take it off.



The Sun sight's result

The result shows the body sighted, the sight number, a review of the input (WT and Hs), then the azimuth Zn and the altitude intercept, called here Int, usually called a or the a-value. Here a = 9.6′ Toward 214.3°, where Zn is always a true bearing. Int(nm) is the intercept in nautical miles: positive values are TOWARD, negative values AWAY.

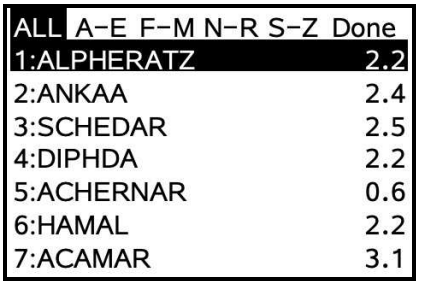
StarPilot records this sight for a later LOP plot or celestial fix ([4]).

If you see an obvious error in the input, note the sight number, press [enter], then [5] to delete the sight so it can be entered again: see [3][5].

[3][2] Star Sight Reduction

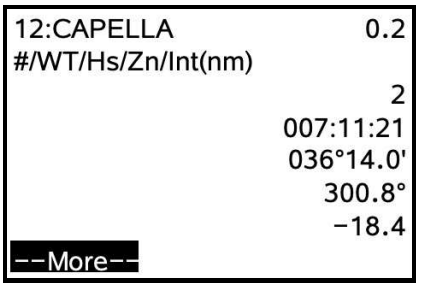
To reduce star sights, select Star from the Sight Reduction menu. Sample: Capella, GMT 7h 11m 21s, May 2, 1988, DR 49°32′N, 165°12′W, IC −3.0′, HE 16 ft, Hs 36°14′.

Again StarPilot tells you the sight number (2) and asks for the WT and the date, then for the body number of the star: its number in the Nautical Almanac (StarPilot's catalogue numbers the Almanac's 57 navigational stars as the Almanac does, and then the others). You need not know the numbers: enter 0 and StarPilot shows the star list (see The Star Selector below). Moving down the list we learn that Capella is #12, magnitude 0.2. Highlight it and press [enter]: the body number prompt comes back with 12 filled in.



The star list, all stars

If you know the number, simply type it. Completing the data entry gives:



The star sight's result

The output is the star's number, name and magnitude, followed by the same data as for the Sun sight: a = 18.4′ Away, 300.8°.

To prepare and evaluate star sights, StarPilot offers star and planet identification and a complete Sight Planner: see [2][2] and [2][5].

The Star Selector

The star selector appears when you enter 0 for a star's number in a sight reduction, and from List Stars in the Celestial Utilities menu. It lists StarPilot's 190 stars, the Nautical Almanac's navigational stars first in their Almanac order.[2]

The top row is a toolbar: ALL A-E F-M N-R S-Z Done, the active tab in reverse. ALL lists every star in catalogue order; a letter tab lists the stars whose names begin with those letters, alphabetically. The keys:

- [1] to [5] choose a tab, and [6] is Done; the left and right arrows move to the previous or next tab.
- The up and down arrows move the highlight.
- [enter] picks the highlighted star (in a sight reduction) and returns its number.
- [esc] (or Done) leaves without choosing.

ALL A-E F-M N-R S-Z Done	
7:ACAMAR	3.1
5:ACHERNAR	0.6
30:ACRUX	1.1
181:Adhafera	3.2
19:ADHARA	1.6
161:Albireo	3.2
70:Alcyone	3.0

ALL A-E F-M N-R S-Z Done	
44:SABIK	2.6
172:Scheat	2.6
3:SCHEDAR	2.5
45:SHAULA	1.7
65:Sheratan	2.7
94:Sigma Puppis	3.3
18:SIRIUS	−1.6

The A-E and S-Z tabs

StarPilot remembers the tab and the star you last highlighted while the document stays open.

[2] StarPilot-89 listed 173 stars. StarPilot for TI-Nspire has StarPilot for PC's catalogue of 190.

[3][3] Moon Sight Reduction

Moon, lower limb: GMT 10h 01m 04s, October 22, 1996, IC −1.7′, HE 18 feet, DR 26°20′S, 99°27′E, Hs 33°39.3′.

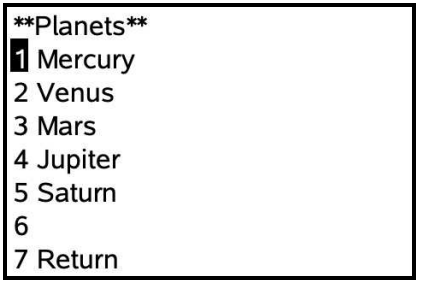
Select [3] and enter these data. The answer is a = 12.3′ Away, 079.9°:



The Moon sight's result

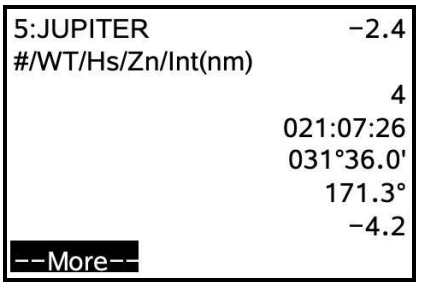
[3][4] Planet Sight Reduction

Select Planet for a planet sight reduction; StarPilot shows the **Planets** menu:



*The **Planets** menu*

Here is an example: Jupiter, GMT 21h 07m 26s, Sept 10, 1996, DR 34°30′N, 36°30′W, Hs 31°36.0′, IC 0, HE 10 feet.



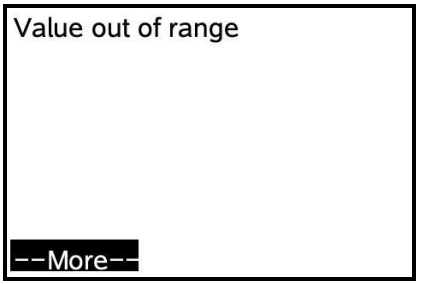
The planet sight's result

This is sight #4: a = 4.2′ Away, 171.3°. Although these sights are numbered as we do them in this series of examples, they are unrelated and not part of any fix. The 5 before Jupiter is the planet's number in StarPilot, which counts 6 planets (Mercury, Venus, Earth, Mars, Jupiter and Saturn).

[3][5] Delete a Sight

The last step of each sight reduction shows the input used and the result. If there is clearly an error in the input, note the sight number and use this option to delete it at once. [3][5] deletes one sight whose number you know: the last one (offered) or any other. When a sight is deleted, the sequence is renumbered without it.

To delete sight number 5, for example:



Delete a Sight: number 5 does not exist

If you have been following the examples, sight number 5 does not exist, so StarPilot answers Value out of range. Had it existed, it would have been removed. If you start to delete a sight and change your mind, press [esc].

Another way to delete a sight is to review the list of all sights and press [del] when the one you want is on the screen; the set is renumbered as before. With this method, described next in [4][1], you need not know the sight number. From the Sight Reduction menu, the quickest way to Review Sights is through the Celestial Fix menu, where it is the first item.

[3][6] Celestial Fix

This entry goes straight to the Celestial Fix menu without going back to the main menu, where it is [4].

[4] Celestial Fix

StarPilot records a series of sights over time and, given 2 or more, advances them to a common time and computes a position fix, which we call a celestial fix. It can also draw the LOPs of the sights, for you to pick the fix with the arrows. Plotted LOPs can be advanced to a common time or not, as you choose.



*The **Celestial Fix** menu*

Generally the first step in any fix is to review the sights stored, with option [1] of this menu. If you did so now you would see the 4 sights of the last examples, but it would make no sense to compute a fix from them: they are from different times and places. So to show how celestial fixes work, let us start again with a new set of data.

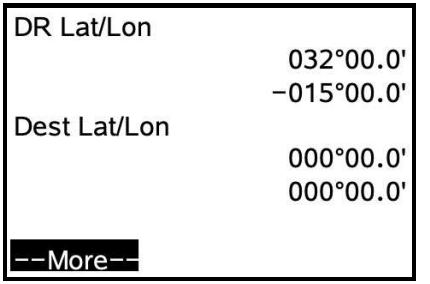
3-Star Fix Example

On July 6, 1996 a vessel traveling at 20 knots on a heading of 325°T, at approximately 32°N, 15°W, made the following 3 observations. The index error was 0.0 and the height of eye 10 ft. The times are GMT, and there was no watch error.

1. Regulus (#26), WT 20h 39m 23s, Hs 25°00.6′.
2. Antares (#42), WT 20h 45m 47s, Hs 27°05.7′.
3. Kochab (#40), WT 21h 10m 34s, Hs 47°27.6′.

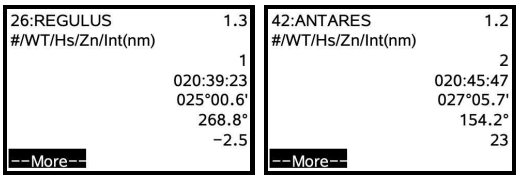
Since most of the parameters of these 3 sights are the same, it is quickest to set them up in the settings first and use SR mode OFF, which reads them from the settings for each sight:

1. Reset StarPilot to its defaults, [S4][2]. In practice this step is not necessary (you would generally just use [4][6], New Sequence); we do it here for a common starting point.
2. Set the date in [S1][2].
3. Set the DR position in [S1][3], and HE 10 in [S2][3]. IC 0 is set by the defaults.
4. Set SR mode to OFF in [S2][5].
5. Check your input with View Settings, [S1][6]:

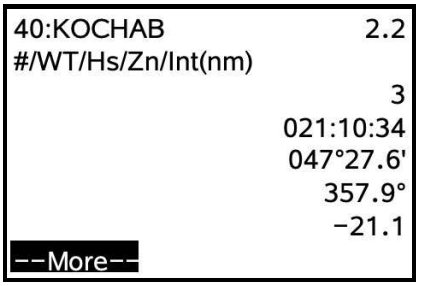


View Settings for the 3-star fix

Now enter the 3 star sights as explained in [3][2]:



Regulus and Antares



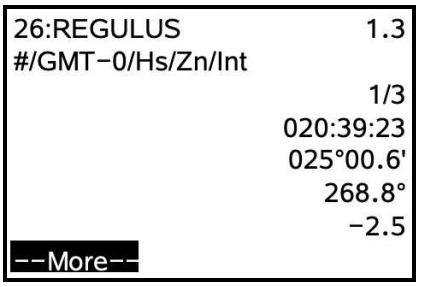
Kochab

(Antares' intercept shows as 23 for 23.0, as StarPilot-89 showed it.)

[4][1] Review Sights

Review Sights shows the sights stored, one page each. It is a way to check that you have what you want before computing a fix, to correct a sight, and another way to delete one: [r] recomputes the sight shown (below), and [del] removes it and renumbers the rest. The left and right arrows step through the sights, [enter] goes to the next, and [esc] returns to the menu.

If you run Review Sights now you should see the 3 star sights you just entered. On each page, 2/3 means the 2nd sight of a set of 3.



Review Sights: the first of 3

The intercepts shown in Review Sights depend on the DR mode, [S4][5], though this never affects the fix. With DR mode OFF, as here, they are the intercepts of the sight reductions: they are not advanced, and do not know the vessel was moving. When you compute a fix you are asked for the course and speed, and all are adjusted then.

With DR mode Speed, Review Sights first uses the stored course, speed and DR position to advance each sight to a common time, the time of the earliest sight, and shows the intercepts at that time. This is crucial for evaluating a set of sights of the same body from a moving vessel, but means nothing for these three sights of different bodies. It has no influence on the fix either, which always asks for course and speed.

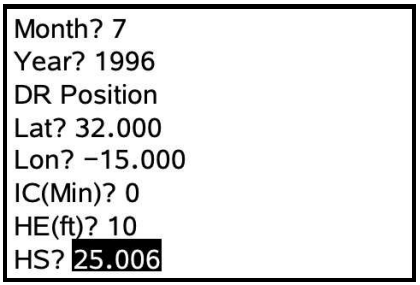
DR mode Log works like DR mode OFF in Review Sights; the Log mode makes a difference only in Update DR.

Recompute: Correcting a Sight

To correct a sight, press [r] at its page. StarPilot asks for the sight again under Recompute #1 (the sight's number), each question offering what the sight holds: WT?, the date, the DR position (Lat?, Lon?), IC(Min)?, HE(ft)?, the limb

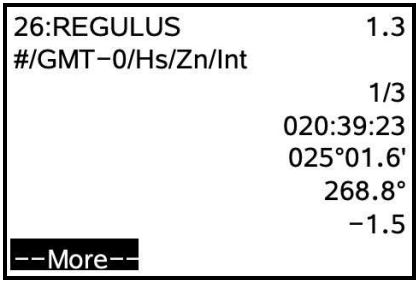
for the Sun and Moon, HS? and, when the sight had a shore distance or Dip Short is on, Shore Dist(nm)?. [enter] keeps a value; type a new one to change it. Every question is asked, whatever the SR mode. The sight is then reduced again, with the other settings as they are now, and keeps its number and its place among the sights; its page comes back with the new Zn and intercept. [esc] at any question leaves the sight as it was. The settings themselves are not changed.

Say the first of the 3 star sights should have read Hs $25^{o}01.6'$. At its page press [r], then [enter] through to HS?:



Recompute: the sight's own values offered, down to HS?

Type 25.016 and press [enter]. Regulus is reduced again in its place, and the intercept moves by the minute that Hs moved:



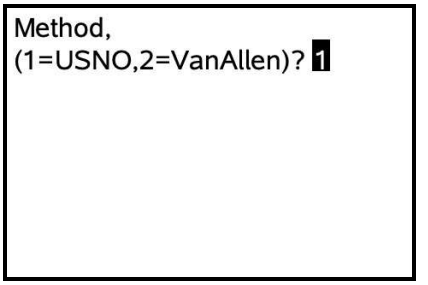
The sight recomputed: Hs 025°01.6', intercept -1.5

The body is the sight's own and is not asked: to change the body, delete the sight and reduce it again. A star or planet sight entered from Nautical Almanac data (Appendix 5) names no star or planet that StarPilot could reduce again, so it cannot be recomputed: StarPilot says This sight was entered from almanac data, so it cannot be recomputed. and leaves it as it was.

[4][2] Fix by Computation

With a set of sights stored, you can get a fix two ways: by direct computation, [4][2], or by plotting the LOPs and picking the fix yourself, [4][3].

StarPilot first asks which method to use: Method, then (1=USNO,2=VanAllen)?. 1, the default, is the USNO method; 2 is the Van Allen method, which crosses two sights directly (see Van Allen: Two Sights Crossed Directly, below).



Fix by Computation: the method, 1 (USNO) offered

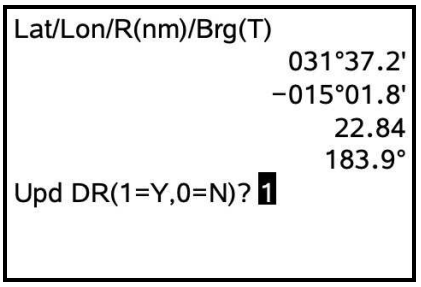
The USNO method is the standard US Naval Observatory algorithm given in the Nautical Almanac: the lines of position are advanced to a common time and a least-squares fit gives the fix.

StarPilot asks for the speed in knots, then the course (magnetic if a variation is set, otherwise true) and the time (WT) of the fix. Each question offers the value in the settings, as StarPilot for PC does: the speed and course of Course/Speed, [S1][5], and the DR time as the fix time. A set restored from the Sight Archive brings its own speed, course and DR time, so [enter] through the questions computes the fix as the set was meant. The fix time can be the time of one of the sights or any other time. All sights are advanced (or retarded) to that time. A speed of 0 skips the course and time questions and does not advance the LOPs. The DR position for the fix need not be the one of the sight reductions: all sights are recomputed for the fix.

If you are not moving (speed 0), the time of the fix does not matter: StarPilot takes it that you stayed in one place and took the sights at various times.

When reducing sights by tables we use assumed positions. With a calculator there is no separate assumed position: all sights are reduced from the stored or advanced DR position. With the USNO method, when the DR is more than 20 miles off, StarPilot repeats the computation from the improved position until it settles; only the final fix is shown.

For the 3 star sights, the USNO method ([enter] at the method), with speed 20, course 325 and fix time 21:



Fix by Computation: the 3-star fix

R(nm)/Brg(T) are the distance and course, by rhumb line, from the DR position you entered to the computed fix: valuable for evaluating your overall navigation. In summary, the 3 star sights give a fix of $31^{o}37.2'$N, $15^{o}01.8'$W, 22.8 miles from where we thought we were, in the direction 183.9^{o}T.

Answering 1 to Upd DR(1=Y,0=N)? stores the fix as the DR position. Answer 0 for this example. The full effect depends on the DR mode (see [5]): in Speed mode, 1 updates the stored DR position and the DR time; in Log mode, StarPilot updates the position and turns the Log mode off, since the log readings during the sights are not known. You can switch back to Log mode then and enter the right log reading.

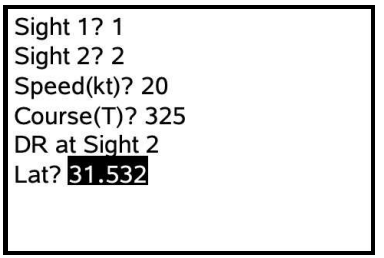
Please review the Quick Start examples for more.

Van Allen: Two Sights Crossed Directly

The Van Allen method, 2 at the method question, takes exactly two sights and computes where their two circles of equal altitude cross, directly: no assumed position and no repeated computation. Two such circles cross at two points. StarPilot gives the one nearer the DR as the fix, and the

other one with its distance from the DR, so that you can see which crossing you are at. When the two sights were taken at different times while moving, the earlier sight's circle is carried along the course and speed to the time of the later sight.

1. Press [2] at (1=USNO,2=VanAllen)? and [enter].
2. Sight 1? and Sight 2? ask for the two sights by their Review Sights numbers, offering 1 and 2. With exactly two sights stored, StarPilot takes them without asking. They must be two different sights of the sequence: the same number twice gets Name two different sights: this names the same sight twice., a number the sequence does not have gets Name two of this document's sights by their Review Sights numbers., and both are asked again.
3. Speed(kt)? and, when moving, the course (magnetic if a variation is set, otherwise true), as for the USNO method.
4. DR at Sight 2 (the later of the two; here sight 2): Lat? and Lon? offer the DR position carried to that sight's time along the course and speed, as Update DR would carry it. Press [enter] to take it, or type another. The DR only picks the nearer crossing and gives the distance and bearing to the fix; the fix itself does not depend on it.

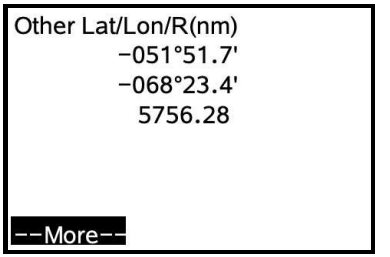


Van Allen: the two sights, the run and the DR at the later sight

5. The answer, Lat/Lon/R(nm)/Brg(T)/Cut: the fix, its distance and true bearing from the DR, and the cut, the angle at which the two lines of position cross. [enter] shows the other crossing, Other Lat/Lon/R(nm), usually far away; it is blank when the two circles only touch.



Van Allen: the fix of Regulus and Antares, with the cut



Van Allen: the other crossing

6. Upd DR(1=Y,0=N)?: 1 stores the fix as the DR at the time of the later sight, with the course and speed of the run.

For the 3 star sights, Regulus and Antares (sights 1 and 2) with speed 20 and course 325 give the

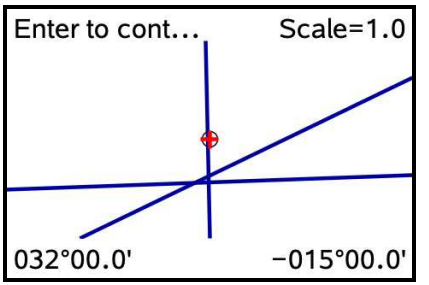
fix 31°35.3′N, 14°57.9′W, 18.16 miles in direction 189.6°T from the DR at Antares's time, with a cut of 65.1°. The other crossing, 51°51.7′S, 68°23.4′W, is 5,756 miles away. The USNO fix of all three sights is about 4 miles from this one: two sights give a fix, and a third shows how well the sights agree.

A shallow cut makes a fix sensitive to errors in the sights. When the cut is under 20°, StarPilot adds a page after the answer: The lines of position cross at 6°: an error of 0.1' in either altitude moves the fix 0.94 nm. (with the cut and the distance for your sights). When the two circles do not meet, StarPilot says The circles of equal altitude do not meet: no fix., and when the two bodies' geographic positions coincide, The two bodies' geographic positions coincide: no fix.; the fix is left blank and nothing is stored.

[4][3] Fix by Plotting LOPs

Fix by Plotting draws the LOPs on the screen, for you to pick the fix from the plot.

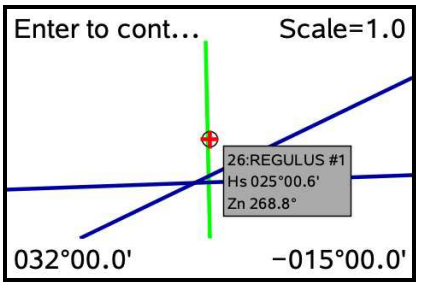
It first asks for the vessel's speed during the sights. Speed 0 plots the LOPs at once, without advancing them. Any other speed brings the course and fix time questions, as in Fix by Computation, and the LOPs are advanced to that time. Either way the DR position is at the center of the screen, with a circle around it.



Fix by Plotting: the three LOPs and the DR

The first plot shows the DR (the circle) about 23 miles north of the intersections, as the computed fix told us. The scale of the first plot is set from the distance between the DR and the farthest intersection. Its height covers about 4.4 times that distance; the lines run to the plot's edges, never into the rows of text above and below it. The latitude and longitude of the cursor (the red cross) are shown at the bottom of the screen. Move the cursor with the arrows into the cocked hat of intersections, then press [enter] to read the cursor's position, with its distance and bearing from the DR.

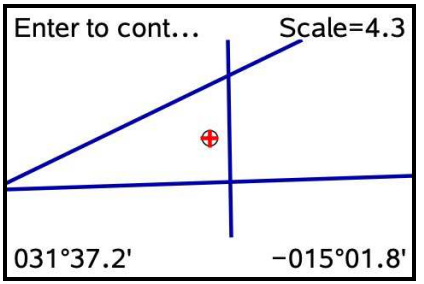
North is up, east is right, and the plot is drawn to plotting-sheet scale, so a line's angle on the screen is its true angle. The screen's width shows more longitude than the plot's height shows latitude; nothing is stretched. With the touchpad, rest the pointer on a line to see which sight it is: the body and the sight's number (as in Review Sights), its Hs and its Zn. A click puts the cursor where you clicked and does nothing else; [enter] then reads it. Without the touchpad, [tab] and shift+[tab] select each line in turn, drawn green, with the same popup.



[tab]: the first line, Regulus, with its popup

After [enter] StarPilot shows the position you picked, with its distance and bearing from the DR, and asks Upd DR(1=Y,0=N)?: 1 stores it as the DR; 0, the default, stores nothing. Either way the plot comes back as you left it, for another pick. [esc] leaves the plot.

To look closer, press [+]: the plot is drawn a fifth larger about the cursor, a little more at each press, and the cursor stays on the same spot of the chart; Scale= shows how many times larger. [-] zooms out again, as far as the first plot. When the cursor reaches an edge of the plot, the next arrow moves the plot an eighth of the screen instead, the cursor staying at the edge, so you can follow a line off the screen. [0] shows the first plot again.



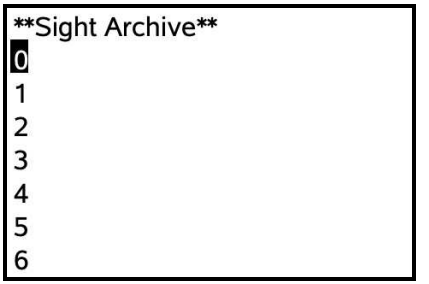
[+] eight times: the plot 4.3 times larger, the cursor at the computed fix

The plot's keys are listed together in Plot Controls, in the Introduction.

To compare the USNO fix with the plot directly, update the DR to the USNO fix when you compute it, then plot: the cursor starts at the DR, and [+] enlarges the plot about it.

[4][4] The Sight Archive

The Sight Archive keeps up to ten sets of sights, each with the settings in force when it was saved, in slots numbered 0 to 9. After slot 9 come StarPilot's sample sight sets, marked with a star (*1982-LAN, *3-sunlines, ...), which you can view and restore but not change.



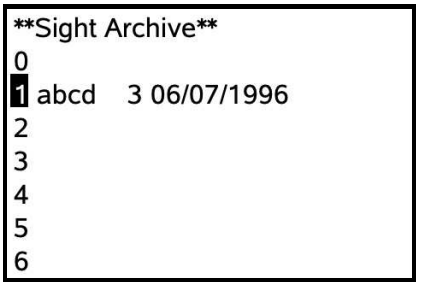
The Sight Archive

The arrows move through the list; a digit key jumps to that slot. [enter] on a free slot saves the current sights there, under a name you give (Filename?: a letter, then letters and digits, 6 at most). [enter] on a used slot shows its actions:

- View: the set's settings and sights, without changing anything.
- Restore: makes the set the current sights and settings (About to restore, 1 to confirm).

- New: saves the current sights into this slot, replacing what is there (About to overwrite).
- Ren: gives the set a new name.
- Del: deletes the set ([del] on the list does the same).
- Del All: deletes every set (About to zap ALL).
- Done: back to the list.

[esc] returns to the Celestial Fix menu. The list shows each set's name, its number of sights and the date of its first sight:



The 3 star sights archived as "abcd"

The archive lives inside your StarPilot document, and it is kept only when the document is saved. Think of it as a scratch pad, not as your record: the chapter "Your Sights: Keeping Them and Moving Them" explains how to keep the record on another platform, and how to bring sets back.[3]

[3] StarPilot-89 kept its archive as calculator variables, with a comment of up to 256 characters each, and moved them to a computer with TI-Connect. The TI-Nspire's archive has ten numbered slots and no comment editor; sets move through the clipboard instead (see "Your Sights").

[4][5] Delete a Sight

This is the function described in [3][5]: it removes one sight by its number. Remember that the numbers change when one is deleted. Another way is Review Sights, [4][1], pressing [del] at the sight in view.

[4][6] New Sequence (Del All)

To remove all the stored sights but leave all the settings as they are, use New Sequence (Del ALL(1=Y,0=N)?, 1 to confirm). This is the usual way to move on to a new set of sights underway. If you have many settings to change as well, Set Defaults, [S4][2], may be better.

[5] Updating DR Position

It is often useful to find a DR position from logbook data without plotting the track on a chart or plotting sheet. StarPilot does this with Update DR. Considerable effort has gone into making it convenient and versatile, since it is so central to the day's work in ocean navigation.

How Update DR works, and how it works with the Celestial Fix functions, depends on two settings: the DR mode, [S4][5], and Course/Speed, [S1][5].

With DR mode OFF, Update DR asks for your course and the distance run in nautical miles, then computes the new DR position. If no DR position is stored in the settings, it first asks for the starting point. At the end it asks whether to update the stored DR position to the new one.

For example, we are at 47°39′N, 126°50′W, and our log reads 100.0. We wish to find our new position after sailing 123.7 miles on course 245°T. We do this first in the Off mode, then in the Log and Speed modes. From the main menu, [1][3] goes to the DR Lat/Lon input: type 47.39 and -126.50.

If you make an entry error, or decide to leave without changing the DR, press [esc]: the old values remain. If in doubt, check with View Settings, [S1][6]. If need be, set the magnetic variation to 0, [S4][4], so that courses are entered as true.

SR Mode and Update DR

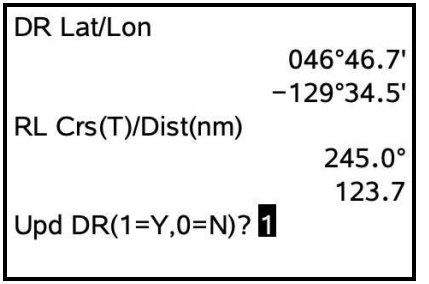
Update DR works with SR mode VERIFY or OFF (see [S2][5]). With SR mode OFF, StarPilot uses the DR position stored in the settings without asking. This is very convenient when entering a DR track, since much less is typed; make sure a valid DR position is stored before you start, and check the results before storing them.

With SR mode VERIFY, StarPilot asks for the DR position each time, offering the stored position: just check it and press [enter].

The following examples assume SR mode OFF. You can work them either way; with VERIFY the screens show more.

DR Mode OFF

Set DR mode OFF in [S4][5]. Then from the main menu press [5] for Update DR and enter the course and the distance run. [enter] then gives:



Update DR, DR mode OFF

Entering 1 stores the new position as the DR; 0 just quits. Select 0, since we want to do other examples. (If you select 1, StarPilot updates the position, then asks whether to change the course and speed (Upd C/S); if you say yes, it first asks for the DR mode, since the Off mode does not use them.)

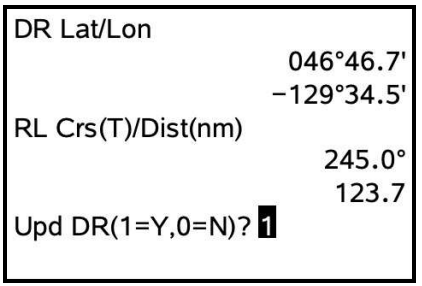
The screen shows the new DR position and a summary of the leg just computed: a double

check that we entered the right values, of more interest in the Speed mode. These values may differ by a few tenths from what we entered: they are an independent second computation of the rhumb line from the departure point to the new position.

DR Mode Log

Set DR mode Log in [S4][5]. StarPilot asks for the log (enter 100) and the course (enter 245). In this mode, to figure our position 123.7 miles on, we note that our log will then read 223.7. (If we were not using real log readings, we could enter 0 for the current log and 123.7 for the computation, which is like the Off mode.)

Now run Update DR from the main menu: all you enter is the log reading of interest, 223.7, to get the new DR position. You get the same screen as in the Off mode.



Update DR, DR mode Log: the same position

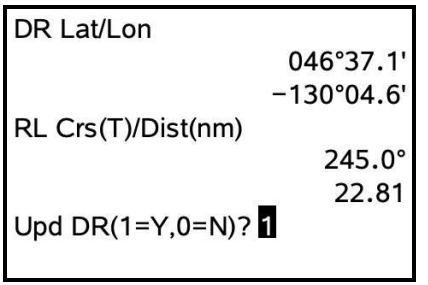
If you say Yes here (key [1]), this position replaces the stored one, and the stored log goes from 100.0 to 223.7. To carry on with these examples, choose Yes with [1], then [0] for no course change for now.

DR Mode Speed

First check with View Settings, [S1][6], what we have so far: the new DR position, a log of 223.7 and a course of 245.

To do DR by speed and time, change the DR mode to Speed, and enter DR time 12.04, course 245, speed 8.5.

Now where will we be at DR time 1445? From the main menu, run Update DR, enter 14.45, answer 0 at Next day?(1=Y,0=N), and you should get:



Update DR, DR mode Speed: 12.04 to 14.45 at 8.5 knots

Again the bottom part is the RL (rhumb line) distance from departure to destination. It should be very nearly the run of the input: 14.45 - 12.04 = 2h 41m at 8.5 kts = 22.8 miles (see Speed/Time/Dist, [6][1]).

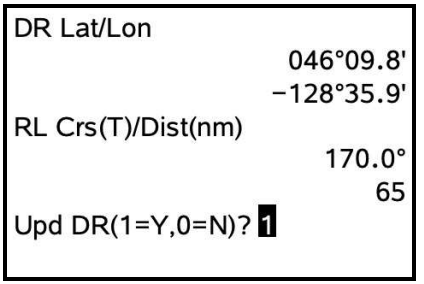
Updating the DR now stores the new position along with the new DR time, 14.45. Do this, and check with View Settings.

Here is a logbook sample A to compute, in Log mode:

- Log 102, course 245°, position 47.39, -126.50

- Log 150, course 260°
- Log 178, course 270°
- Log 190, course 170°
- Log 255, course 170°: find the position.

Using Update DR in Log mode you should get 46.098, -128.359:

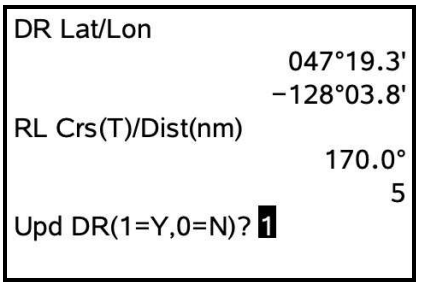


Logbook sample A

Likewise sample B (unrelated to A), in Speed mode:

- WT 12.04, course 245°, speed 8.5, position 47.39, -126.50
- WT 15.12, course 260°, speed 7.0
- WT 18.06, course 270°, speed 7.5
- WT 19.00, course 170°, speed 6.0
- WT 19.50, course 170°, speed 6.0: find the position.

Using Update DR in Speed mode (answering 0 at each Next day?) you should get 47.193, -128.038:



Logbook sample B

Note on DR Over Midnight

In Speed mode, Update DR asks for the new DR time and then Next day?(1=Y,0=N). Answer 1 when the new time is on the next day: the run crosses midnight (24 hours are added) and, if you update the DR, the date moves forward one day (the set date if one is set, otherwise the date last entered). Answer 0 for the same day. A time earlier than the stored DR time then moves the DR back along the reciprocal course, and StarPilot says so: DR moved BACK. In the Log mode this is not an issue. You can do running fixes that span midnight in any time zone, since the date is stored with every sight reduction.

DR Mode and the Review Sights Display

With DR mode Speed, Review Sights, [4][1], uses the course and speed to advance the sights before showing them, to the time of the earliest sight in the list. So for the most logical presentation, keep the stored DR position consistent with the DR track at the time of the sights: set the DR mode to Speed (again, even if it is set already) and enter any valid time and point on the DR track. You could then run Update DR to the

time of the earliest sight to check against your records, although if your input was right this is not needed: StarPilot updates the DR before presenting each sight.

Normally this is not a concern, since the fix is computed right wherever the DR is (it may take a few iterations to converge). But things work more smoothly and make more sense if the DR position corresponds to the sight time. Needless to say, do it this way if you wish to test your GPS with celestial, or vice versa.

[6] Utilities

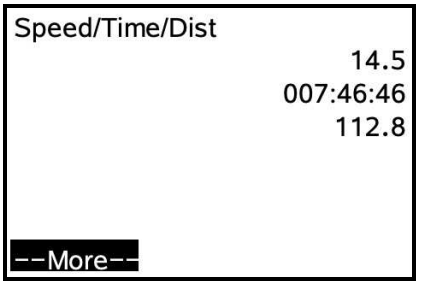
Besides the celestial navigation aids already described, StarPilot provides a host of general-purpose navigation functions, reached through a series of menus starting with Utilities. The functions are grouped loosely by kind: the Route Sailings menu, for example, holds the various ways to compute routes from point to point.



*The **Utilities** menu*

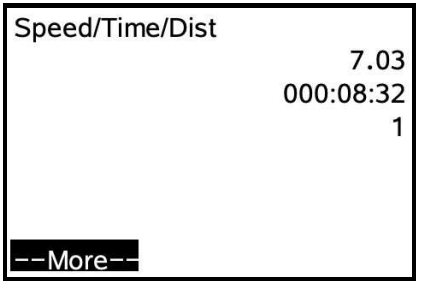
[6][1] Speed, Time, Distance

Speed, time and distance computations are needed daily in marine navigation. StarPilot asks for the three values: enter 0 for the one you wish to compute. How long does it take to go 112.8 miles at 14.5 kts?



Speed/Time/Dist: the time

The answer is 7h 46m 46s. Suppose you run a measured mile in 8m 32s. What was your speed?

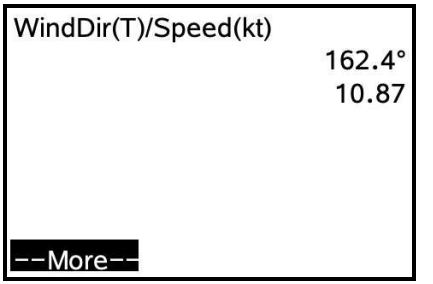


Speed/Time/Dist: the speed

The answer is 7.03 kts.

[6][2] True Wind Direction

Sailing and power-driven vessels alike often need the true wind speed and direction when only the apparent wind is known. Given a course of 115^{o} (true or magnetic, it does not matter: the output is relative to the input), 6.5 knots, an apparent wind direction of 145^{o} (that is, from 30^{o} on the starboard bow) and an apparent wind speed of 16 knots, the true wind is:

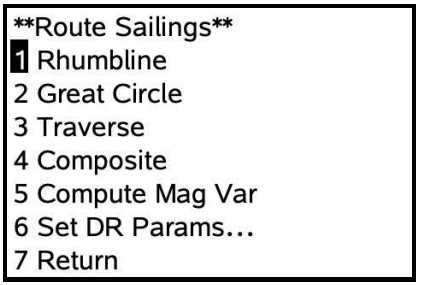


True Wind

The true wind is from 162.4° at 10.87 knots. The example uses actual wind directions. If you prefer relative values, set the course to 000, and all input and output are then relative: an apparent wind of 16 kt at 30° on the bow, at 6.5 kts, comes from a true wind of 10.9 kts at 47.4° on the bow. The faster you go, the more you push the wind forward.

[6][3] Route Sailings

These functions compute routes from a starting position to a destination. They use the DR and Dest positions stored in the settings when these are set. Option [6] goes to the settings to change them.

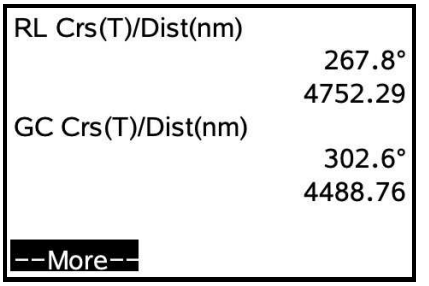


*The **Route Sailings** menu*

[6][3][1] Rhumb Line

The Rhumb Line (RL) function computes the straight-line course to the destination on a Mercator chart and its distance: the one true course that takes you from departure to destination on a constant heading, with no current, leeway or other errors.

Consider the course from San Francisco, at 37°50.8′N, 122°25.5′W, to Yokohama, at 34°52′N, 139°42′E:

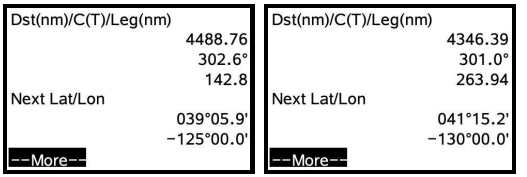


Rhumb Line, with the great circle for comparison

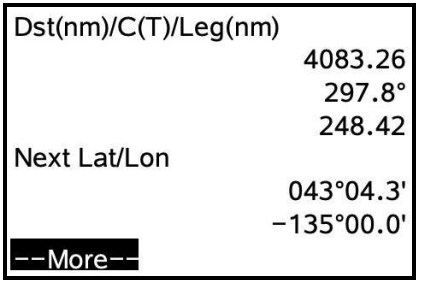
For comparison, the Great Circle results are shown with each RL computation. They are the shortest distance, but the shortest route is a curved track on a Mercator chart; the GC course shown is the initial heading of the great circle route. Here the straight-line course of 267.8°T takes you there in 4752.3 miles, whereas the shortest route is a curved one, starting off at a higher course of 302.6°T but eventually being a lower one, 4488.8 miles long.

[6][3][2] Great Circle Sailing

The Great Circle function computes the great circle distance between two points and the course to a series of waypoints on the great circle route, one at each interval of longitude you choose (5° is typical). For San Francisco to Yokohama, with legs of 5°:



Great circle legs 1 and 2

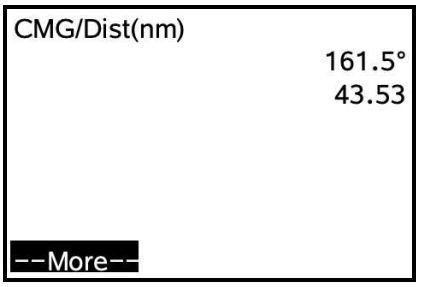


Leg 3

and so on until the destination is reached. The longitude goes up 5° at each step, and you are told the corresponding latitude for plotting the route on a Mercator chart. Each screen gives the distance left to travel (in nautical miles), the initial course of the leg (generally steered as the rhumb line to the next waypoint) and the leg's length.

[6][3][3] Traverse Sailing

Traverse sailing finds the single equivalent course for a series of headings and distances (CD), or of waypoints (Wpt), as might result from a sailing vessel beating its way to a windward point. It first asks for the format: 1 for course and distance, 0 for waypoints. With the courses and distances 158° 15.5 nm, 135° 33.7 nm and 259° 16.1 nm (enter each distance, then its course; a distance of 0 ends the list), the course made good (CMG) and distance are:

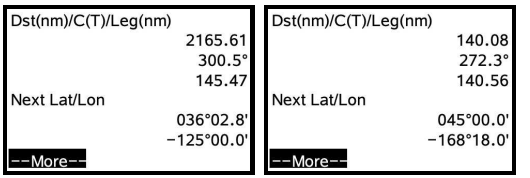


Traverse: CMG and distance

[6][3][4] Composite Sailing

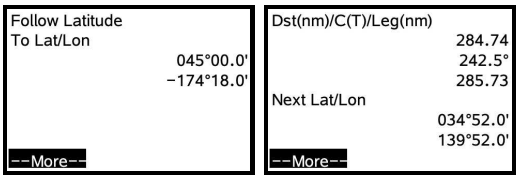
Composite sailing is a hybrid of great circle sailing. When the great circle between two points carries a vessel to a higher latitude than desired, composite sailing can be used to good advantage: a great circle from the departure to the limiting latitude, then a course along the limiting parallel, then a second great circle to the destination.

For the route from California at 34°50.8′N, 122°25.5′W to Japan at 34°52′N, 139°52′E with a limiting latitude of 45°N, legs of 5°:

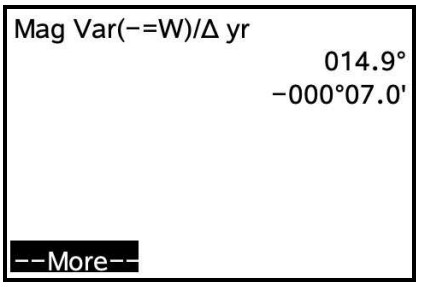


The first leg, and the leg that reaches 45°N

First a great circle up to latitude 45°N. At the limiting latitude, we follow the parallel to the meridian where the second great circle starts, and then follow that great circle to the destination:



Along the parallel, and the last leg to Yokohama



Compute Mag Var

[6][3][5] Compute Magnetic Variation

This function computes the magnetic variation for any location on Earth at sea level, with one exception: near the magnetic poles the horizontal field is too weak for a variation to be meaningful, compass navigation there is unreliable, and the computed variation should not be relied on. The magnetic poles move over the years, so that region depends on the date as well as the position. Westerly variations are shown as negative.

StarPilot's model of the Earth's field is the International Geomagnetic Reference Field, 14th generation (IGRF-14), valid from 1 January 1900 through 1 January 2030. Within that range the variation is shown normally. For dates in the five years either side, the value is extrapolated and StarPilot adds two lines, Extrapolated value and IGRF valid 1900-2030; treat such values with more caution the further the date is from the valid range. Before 1895 it says No magnetic variation before 1895., and after 1 January 2035 No magnetic variation after 2035. StarPilot for PC uses the same limits.

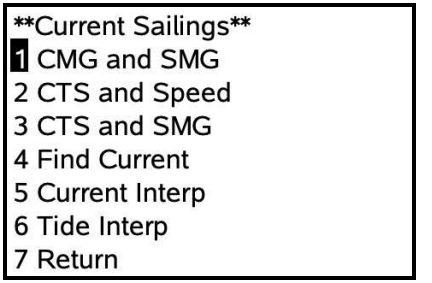
The annual change shown with the variation is the model's rate of change for its current five-year period. It changes on 1 January of each model epoch year (1905, 1910, ... 2025); the step is usually a few tenths of a minute per year but can be several minutes per year at high latitudes. The variation itself does not jump at these dates.

[6][3][6] Set DR Params

Takes you to the Settings 1 menu to change the DR or destination for a route computation.

[6][4] Current Sailings

The Current Sailings functions solve the usual vector problems of planning around currents.

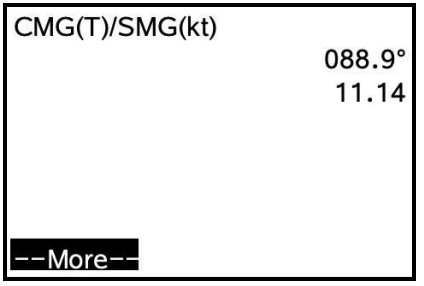


*The **Current Sailings** menu*

All current sailings override the magnetic variation: all input and output are labeled True, since current sets are usually given true. If you work in magnetic for other headings, convert magnetic headings to true first, and the output to magnetic if needed. The set is always the true direction toward which the current flows, and the drift is always in knots. (You can use all-magnetic inputs and get magnetic outputs, but the labels still say T.)

[6][4][1] Course and Speed Made Good through a Current

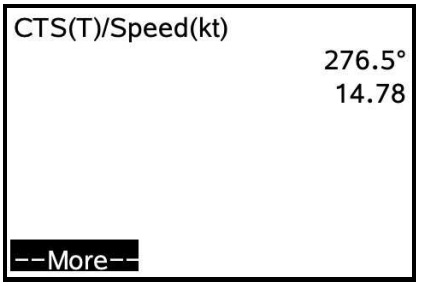
CMG and SMG computes the course and speed made good from the course steered, the speed through the water, and the set and drift of the current. Course steered 080°T, speed 10 knots, set toward 140°T, drift 2 knots:



CMG and SMG

[6][4][2] Course and Speed to Steer for a CMG and SMG

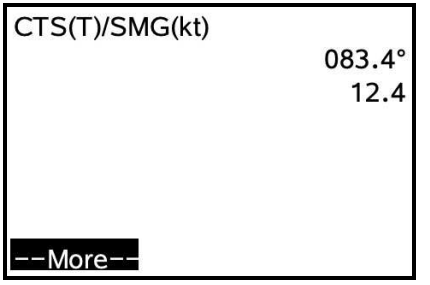
CTS and Speed computes the true course to steer and the knotmeter speed needed to make good a given course and speed, with a known set and drift. This comes up when the arrival time matters after a passage through current: you know the CMG and the distance, and the time you have, so you know the SMG needed. What course do you steer, and how fast should you go? (The answer may not be achievable with your vessel.) CMG 265°T, SMG 15 knots, set 185°T, drift 3 knots:



CTS and Speed

[6][4][3] Course to Steer at a Given Speed for a CMG

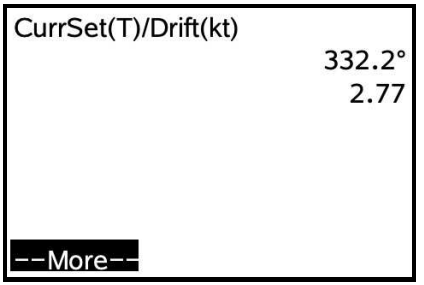
CTS and SMG computes the course to steer and the speed made good from the course to make good and the speed through the water, with a known set and drift. Speed 12 knots, CMG 095°T, set 170°T, drift 2.5 knots:



CTS and SMG

[6][4][4] Find Current from GPS

Enter your knotmeter speed and course steered, and the SOG and COG from the GPS: this function computes the set and drift that account for the difference. Course 200°T at 7.5 kts by the knotmeter; the GPS shows 220°T at 6.0 kts. The current is 2.77 kts toward 332.2°T:

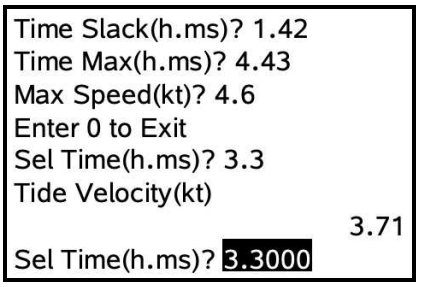


Find Current

Do not use instantaneous values: watch the GPS, compass and knotmeter for some time to have realistic averages. (True or compass headings both work, provided both inputs are the same kind; the set is then in that kind too.)

[6][4][5] Tidal Current Interpolator

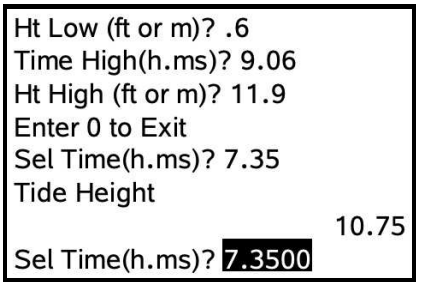
Current Interp finds the speed of a tidal stream from the times of slack water and maximum current and the maximum speed. To find the speed at 3h 30m, with slack water at 1h 42m and a maximum of 4.6 knots at 4h 43m:



Current Interp

[6][4][6] Tide Height Interpolator

Tide Interp computes the height of the tide at any time from the times and heights of low and high water. The height at 7h 35m, with low water at 1h 45m, 0.6 feet, and high water at 9h 06m, 11.9 feet:



Tide Interp

The height is shown in the units of the input. Both interpolators offer to compute more values from the same input.

[6][5] Celestial Utilities

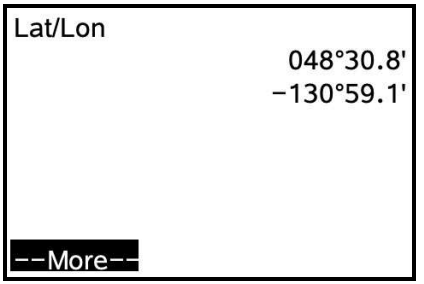


*The **Celestial Utils** menu*

These functions do miscellaneous tasks based on celestial sights. They read the Settings, such as the date and DR.

[6][5][1] Meridian Passage of the Sun for Lat and Lon

Measure the peak height of the Sun at noon and note the GMT: the height gives your latitude, the time your longitude. For example, Hs max for a lower limb Sun viewed to the south on 4 March 2000 at 20h 55m 30s was $35^{o}15.2'$, IC $2.0'$ On, HE 9 ft. Enter Hs as a positive number; StarPilot then asks -1=S,1=N?, whether the Sun was to the south (-1) or north (1). The position is $48^{o}30.8'$N, $130^{o}59.1'$W:

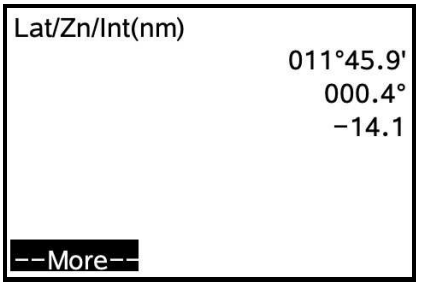


Lat/Lon by meridian passage

This function reads the settings, so if they are not zero to begin with, set them properly first. Although an accurate peak height is relatively easy to get underway, an accurate time of the peak is not: much care is needed to find it from a series of sights. In general a running fix from two sets of sunlines is a more reliable way to find position from the Sun. To use this function best, take a series of sights spanning LAN and analyze them with the Sight Analyzer, [2][3], for the best Hs max and time of LAN.

[6][5][2] Polaris Sights for Latitude and Azimuth

Lat by Polaris finds the latitude from the pole star. A vessel at DR 12^{o}N, 68^{o}W observes Polaris at $12^{o}30'$ at 2200 GMT on 1 January 1998, from a height of eye of 10 feet with no index error. The latitude, the azimuth of Polaris and the intercept are:



Lat by Polaris

This also gives the azimuth of Polaris for compass or gyro calibration, or for any surveying that needs a precise bearing reference. LOPs from Polaris can also be had from the ordinary star sight reduction, [3][2].

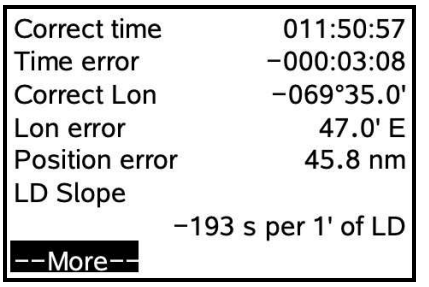
[6][5][3] GMT by Lunar Distance

The lunar distance method for finding time (lunars) was developed in the mid 1700s to check chronometers and so find longitude. The method here can set time to within a minute, sometimes rather better. It is not as accurate as a radio time signal, but it is there in case an accident prevents setting time by more conventional means.

Time can be found by measuring the angle between the Moon and the Sun, a planet, or any of StarPilot's stars. Lunar-solar distances give the best time, then lunar-planetary, and lunar-stellar the worst: the faster the bodies move against each other, the better. With a lunar-solar distance, $1'$ of arc error in the angle makes about 2 minutes of error in time, so the angle must be measured as accurately as possible.

With IC 0 and HE 10 ft, to find the GMT from the Sun's outer limb and the Moon's inner limb at an angle of $62^o41.8'$ on June 19, 1998 at $12^o46'$N, $70^o22'$W, at approximately 11h 54m 05s GMT: after the time, date and position, StarPilot asks for the body the Moon is measured against (the **Body for Lunars** menu: Sun, Star, Planet, or the same with Nautical Almanac data), then the limbs (the **Moon-Body Limb** menu: 1 Inner-inner or 2 Inner-outer), then the angle.

"Inner" is always the Moon's bright limb, the edge you bring the other object to. Inner-outer means the Sun's far limb for a Sun lunar, and the Moon's far limb for a star or planet, which have no limb of their own. Never measure to the inside of the crescent. In this example (the Sun's outer limb, the Moon's inner limb) choose 2, Inner-outer.



The result

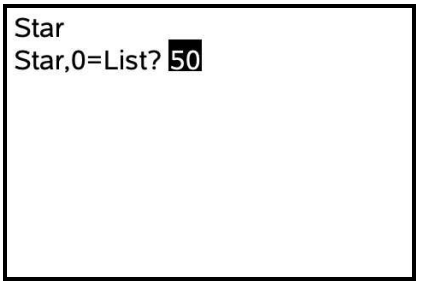
StarPilot shows the answer on one screen: the Correct time, the Time error (the correct time less the watch time you entered: the whole correction, negative when the watch is fast), the Correct Lon, the Lon error and Position error (how far the DR longitude was from the lunar's, east or west, and that distance in nautical miles), and the slope in words: LD Slope, -193 s per 1' of LD, the seconds of time that one minute of error in the measured distance would move the answer.

Each pass evaluates the lunar distance at two epochs a little under an hour apart, fits a straight line through them, and reads off the time at your cleared distance; the next pass starts from the time and longitude the one before produced. StarPilot repeats the pass until it moves the time by less than a second, usually in two or three passes, and shows only that settled answer. If a lunar has not settled after 50 passes, StarPilot says so: the time shown is then the last one tried, not a converged answer. And if it settles more than two hours from the watch time, further than a lunar distance can place it, StarPilot says that too: the answer is then arithmetic, not a fix.

See the celestial navigation and StarPilot sections of starpath.com for more on lunars.

[6][5][4] List Stars

List Stars shows the star selector of [3][2]: each star's number, name and magnitude, with the toolbar to narrow the list by name. The first 57 are the Nautical Almanac's navigational stars, in its order. Polaris, which has no number in the Almanac, is 58 in StarPilot.



List Stars, the N-R tab

[6][5][5] Sight Reductions Using External Almanac Data

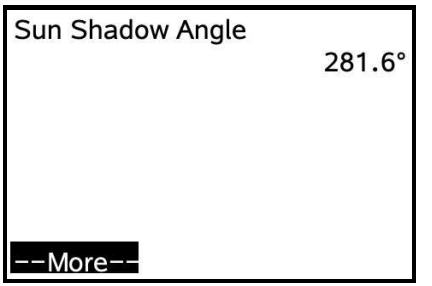
See Appendix 5.

[6][5][6] Compass Calibration

An accurate way to check a compass is to compare the vessel's compass heading with the shadow of the Sun cast across the compass. This works at the dock or far out of sight of land.

Compass Cal predicts where the Sun's shadow should fall on the compass from the GMT, the DR position and the local magnetic variation. The difference between that bearing and the shadow's actual reading is the compass deviation on the current heading. To swing a compass, or to make a deviation card, do this on each of the cardinal and intercardinal headings.

For a vessel at 35°15′N, 70°25′W on June 3, 1975 at 1330 GMT, with a variation of 7°15′W (westerly variations are entered as negative, [S4][4]; the (d.m) in the prompt is a reminder of the format):



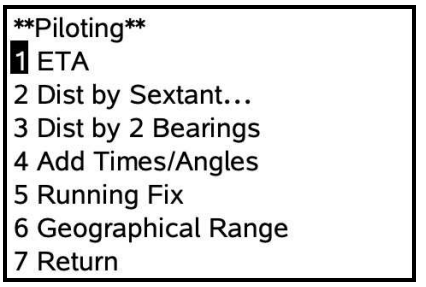
Compass Cal: the Sun's shadow

If your compass pin's shadow is at 280°, your compass reads 1.6° low on that heading. As in most functions of this menu, StarPilot does not ask for the DR or the variation if they are set in the Settings ([S1][3], [S4][4]).

You can do this with Precompute as well, with more arithmetic: the Sun's Zn is 094.3°T, its reciprocal 274.3°T, which is 281.6°M with the variation of 7.25°. The bearing of any body can be used for a compass check this way.

[6][6] Piloting

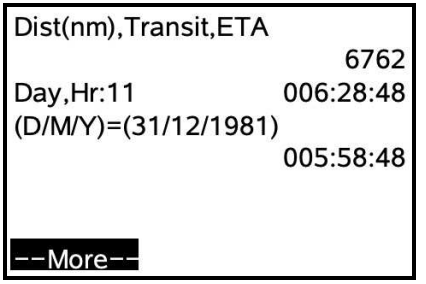
The Piloting menu holds routines that help in piloting a vessel, and ETA.



*The **Piloting** menu*

[6][6][1] ETA

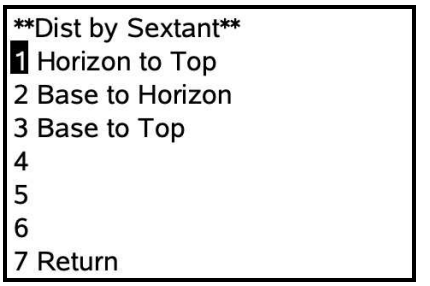
ETA computes the estimated time of arrival in the destination's time zone, from the great circle distance or a distance you give. It can include a fixed delay along the way (Bunk, for bunkering). Example (from a USCG exam): leave Cape Town at 0530 (ZD -1) on 20 Dec 1981, bound for New York at ZD +5, SMG 25 kts, distance 6762 miles. What is the arrival time with no delays underway? This function reads the stored ZD, date, DR and destination when they are not zero; Set Defaults ([S4][2]) clears them all, so that everything is asked for. Otherwise check the settings ([S1][6]).



ETA

The first question chooses the distance: 1 for the great circle (StarPilot then asks for the DR and destination and computes it), 0 (Other) to enter it. Then come the WT, date and ZD of departure, the delay, the SMG, the distance and the destination ZD. The arrival is 0558:48 on 31 December.

[6][6][2] Distance Off by Vertical Sextant Angle



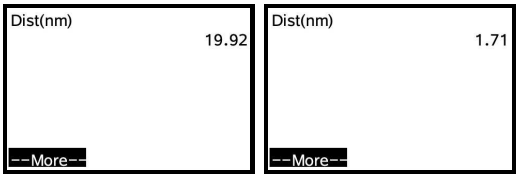
*The **Dist by Sextant** menu*

The sextant is a powerful piloting tool for finding the distance off a landmark of known height, from tens of miles down to less than a mile. It can also find the distance off objects of unknown height, provided they are fairly close and viewed from a greater height of eye.

There are three methods: 1, horizon to top (the base hidden below the horizon); 2, base to horizon (the base showing, closer than the horizon); and 3, base to top. The inputs are IC and HE (asked every time, whatever the SR mode, which applies only to sight reductions) and the sextant angle. Method 3 needs no HE, since it assumes you see the base wherever you are.

Typical examples, with IC 2.0′ (off the scale) and HE 30 feet:

- Method 1: a mountain 3520 ft high, Hs $1^o34'$: 19.9 nm.
- Method 1: the same mountain, Hs $0^o25'$: 47.35 nm (a very clear day).
- Method 2: base to horizon $12'$: 0.88 nm at HE 30 ft. (At HE 9 ft it is 0.3 nm; at HE 80 ft, 2.0 nm.) This is one way to see how far off a shoreline must be to serve for an index error check, and it can sometimes tell how far off a vessel is.
- Method 3: a hill 460 ft high, Hs $2^o30'$: 1.7 nm. This is the most common use for close-in piloting; method 1 is more common for coastal runs and for judging large distances off at landfall.



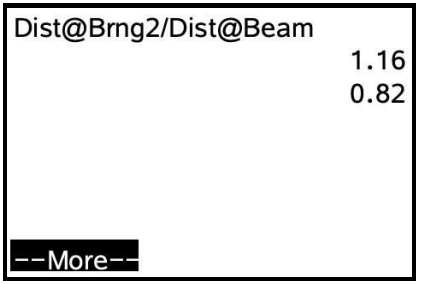
Methods 1 and 3

Method 2 is not common: it needs more precise measurements than are usually available. All 3 methods lend themselves to testing by radar or GPS, so that when those aids are not available we can fall back on the trusty sextant.

[6][6][3] Distance Off by Two Bearings

This function computes the distance off at the second bearing, and the distance at which you will pass abeam, from two bearings and the distance run between them. It assumes a constant course. The bearings are bow bearings: the difference between the actual bearing and the vessel's heading.

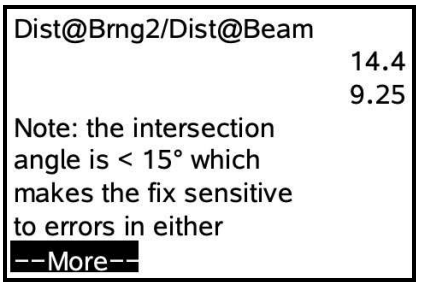
For example, with an angle on the bow to an object of 18^o (B1), and after a run of 1.7 nautical miles an angle of 45^o (B2), you are 1.16 miles off the object, and if you carry on on the same course it will pass 0.82 miles off when abeam.



Dist by 2 Bearings

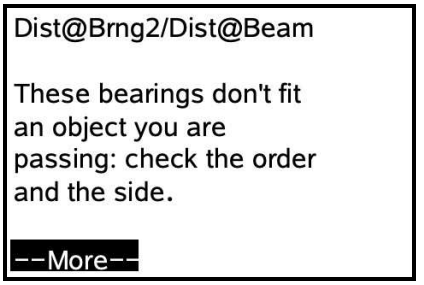
This is a versatile piloting technique: for charted objects it gives a position fix, but it can also be used without a chart.

The answer depends on the angle between the two lines of bearing, the change in bearing B2 - B1. If the two bearings are within 1^o of each other, or of each other's reciprocal, the lines do not cross and there is no distance to give: StarPilot says These bearings give lines of position that do not cross, so there is no fix. Under 15^o it gives the distances, and under them David Burch's note: Note: the intersection angle is < 15° which makes the fix sensitive to errors in either bearing.



Bearings 30 and 40, run 5: the distances and the note

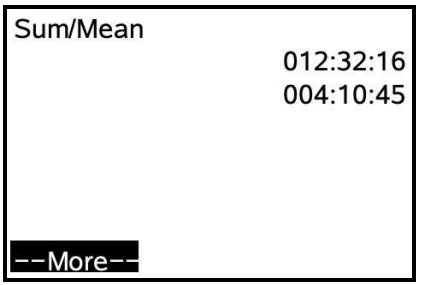
The bearings must also fit an object being passed. If the distance off comes out zero or negative, as with 045 then 030 on the same side, StarPilot gives no distances and says These bearings don't fit an object you are passing: check the order and the side. To port, an object's bearing draws aft as 315 then 300: that is right, and gives 2.73 and 2.37 for a run of 1.



Bearings 045 then 030: they don't fit an object being passed

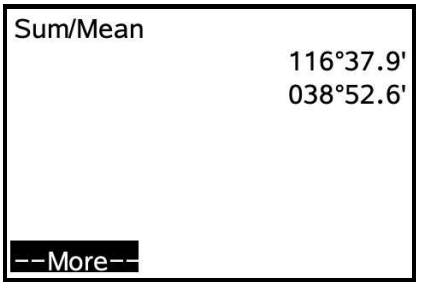
[6][6][4] Add Times and Angles

This function adds or subtracts times in h.ms format, or angles in d.m format; it asks which (1 times, 2 angles). The average is shown too. Enter 0 to end the entries. The time example is 12h 4m 12s - 32m + 1h 0m 4s = 12h 32m 16s:



Add Times

The angle example is $120^o43.0' + 5^o58.4' - 10^o3.5' = 116^o37.9'$:



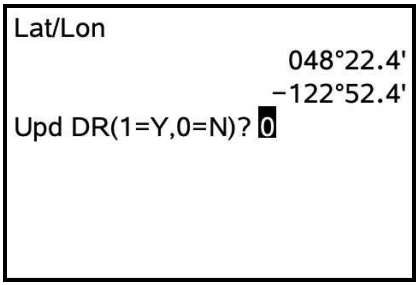
Add Angles

[6][6][5] Running Fix

Running Fix finds your position from bearings of one landmark, or of two landmarks, taken at different times while underway: the first line of bearing is advanced by your run between the two times, and crossed with the second. StarPilot asks for the time of the first bearing (Time A), the landmark's position (Lat A, Lon A) and the bearing (true, or magnetic if a variation is set); whether the second bearing is of the same landmark; the time of the second bearing (Time B),

the second landmark's position if it is another, and the second bearing; and the speed and course made good between the two (SMG, CMG).

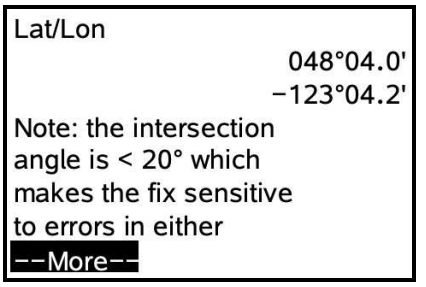
Example: at 1h 00m, bearing 023°T of a landmark at 48°25.6′N, 122°58.6′W; at 2h 00m, bearing 143°T of a second landmark at 48°19.5′N, 122°49.1′W; SMG 5 kts, CMG 110°T. The fix is at 48°22.4′N, 122°52.4′W:



Running Fix: the fix

StarPilot then asks Upd DR(1=Y,0=N)?: 1 stores the fix as the DR position, with the course and speed, the second landmark as the destination, and Time B as the DR time.

When the two lines of bearing cross at a shallow angle the fix is uncertain. If the bearings are within 1° of each other, or of each other's reciprocal, the lines do not cross: StarPilot gives no fix and says so. Under 20° it gives the fix, and under it David Burch's note: Note: the intersection angle is < 20° which makes the fix sensitive to errors in either bearing.



Bearings 023 and 033: the fix (48°04.0′N, 123°04.2′W*) and the note*

[6][6][6] Geographical Range

Geographical range is needed to predict the visible range of a light or of land from the object's height above the water. StarPilot asks for the height of eye and the height of the object. A light 125 ft high, seen from 10 feet above the sea, has a geographical range of 16.77 nautical miles:



Geographical Range

The geographical range is the distance at which the object first appears or disappears over the horizon from a given height of eye. The visible range of a navigation light is the smaller of its geographical range and its luminous range, which

depends on the visibility and can be read from tables in the Light List; in clear weather it is the charted nominal range.

Appendix 1: Almanac Precision

StarPilot-89 used three internal precision levels (Fast, Normal and High) to keep its planning functions quick on the TI-89. StarPilot for TI-Nspire has one: every function, from sight reductions and fixes to the Sight Planner, Star/Planet ID, Precompute and moonrise, computes the bodies at full precision, with the almanac of StarPilot for PC. The TI-Nspire is fast enough that nothing needs to trade accuracy for time.

Its almanac matches the precision of the Nautical Almanac; specific comparisons may differ by a tenth or two of a minute, the limit of the Nautical Almanac's own stated precision. Briefly:

- The Sun and planets: StarPilot for PC's planetary theory, with corrections for nutation and aberration.
- The Moon: the ELP 2000-82B lunar theory (Chapront-Touzé and Chapront), with nutation and aberration.
- The stars: positions from the catalogue for the equator and equinox of J2000.0, proper motion applied from that epoch, precessed to the mean equator and equinox of date, with nutation and aberration.

Appendix 2: Capturing Screens

You may want to capture StarPilot's screens: for a record of fixes or fits, to paste into a logbook, or to e-mail to a friend. With the calculator connected to your computer by its USB cable:

1. Open TI's software for the calculator: TI-Nspire CX II Connect (in the browser; the CX II), TI-Nspire Computer Link Software (the original CX), or the TI-Nspire CX Student Software or CX Premium Teacher Software.
2. Set up StarPilot to show the screen you want.
3. Choose the software's screen capture command (Capture Screen).
4. Copy the image, or save it to a file, and paste it into a graphics program, a document or an e-mail.

The screens in this guide were captured from the TI-Nspire CX Premium Teacher Software running StarPilot, at the handheld's screen size.

Appendix 3: Transferring Data to and from a Computer

This is now the chapter "Your Sights: Keeping Them and Moving Them": sets of sights go out through the calculator's clipboard, into StarPilot on your computer or your phone, and come back the same way with Import ([S2][6]).

Appendix 4: Installation Notes

This appendix is not needed if Starpath put StarPilot on your calculator.

Hardware and OS StarPilot runs on the TI-Nspire CX and CX II (including the CAS models): both are supported. It was developed and tested on a TI-Nspire CX II with OS 6.4. To see

your calculator's OS version, press [home], then Settings, then Status.

Installing StarPilot Your StarPilot document is made for your calculator: it carries the calculator's ID, and opens only on that calculator. You need a computer running Windows or macOS, a supported web browser (Google Chrome 90 or later, or, on Windows, Microsoft Edge 90 or later), and the USB cable that came with your calculator (see "What you need" in the Introduction). Copy the document to the calculator with TI's software:

1. Connect the calculator to your computer with its USB cable, and turn it on.
2. On a TI-Nspire CX II, open TI-Nspire CX II Connect at nspireconnect.ti.com in the browser. An original TI-Nspire CX uses TI's TI-Nspire Computer Link Software (free; it supports the TI-Nspire CX, not the CX II), or the TI-Nspire CX Student Software or CX Premium Teacher Software, which also work on the CX II; TI-Nspire CX II Connect does not support the original CX.
3. Send StarPilot.tns to the calculator. TI-Nspire CX II Connect puts it at the top of My Documents.
4. On the calculator, open My Documents and open StarPilot.

The first time you open it, StarPilot shows its main menu after a second or two. The calculator marks a document fresh from the computer as changed (the "*" by its name), and asks Save changes? when you close it, until its first save; after that it asks only when something has changed.

If StarPilot does not open

- This StarPilot is registered to another calculator.: this copy was made for a different calculator. Copy your own to this one, or contact Starpath.
- No calculator ID.: the document is open on a computer, or on software that has no calculator ID. StarPilot shows only the sights the document holds, so that you can copy them out (see "Your Sights").
- StarPilot could not start. or StarPilot stopped: with a reason: note the line shown and contact Starpath at helpdesk@starpath.com; close the document without saving and open it again.

Upgrading A new version of StarPilot is a new document. Before you start using it, move your sights to StarPilot on another platform, and bring them back into the new copy with Import if you want them there: see "Upgrading StarPilot" in the chapter "Your Sights: Keeping Them and Moving Them". Keep the old document until you have checked that the new one holds what you need.

Uninstalling To remove StarPilot, delete its document from My Documents. Its sights and settings go with it: move them out first.

Appendix 5: Sight Reductions Using External Almanac Data

This is function [6][5][5] (and Precompute's Nautical Almanac, [2][4][5]). It puts you into

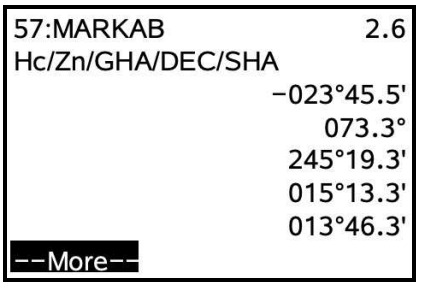
the normal sight reduction, but when it comes to the almanac data that is usually computed automatically, it asks you for data from a Nautical Almanac instead. First the GHA at the whole hour of the sight (for a star, the GHA of Aries), in whatever time system you have chosen, called GHA0; then the GHA at the next hour, GHA1. If your sight time is 13:43:12, GHA0 is the value at WT 13 and GHA1 the value at WT 14. Likewise DEC0 and DEC1 (and the SHA for a star). A few steps later it asks for one more value from the almanac: the SD for the Sun, the HP for the Moon (whose semi-diameter is computed from the HP), or the additional correction for a planet. It then completes the sight reduction.

You need not enter d or v values: they follow from the inputs. You should get the same as with the internal almanac, to within a minute or so in most cases. You can see the values StarPilot itself uses with Precompute, [2][4].

Appendix 6: Find GHA Aries

There is no menu item for GHA Aries, but we can find it indirectly. GHA star = GHA Aries + SHA star, so GHA Aries = GHA star - SHA star. Precompute ([2][4][2]) any star to get its GHA and SHA, then subtract; if negative, add 360°. The latitude and longitude do not matter. Use Markab (#57), with the lowest SHA, to minimize the extra correction.

Example: find GHA Aries on 9 Nov 2002 at 12h 12m 12s UTC. WT 12.1212, day 9, month 11, year 2002, star 57, Lat 0, Lon 0:



Precompute, Markab: its GHA and SHA

GHA Aries = 245°19.3′ - 013°46.3′ = 231°33.0′.

Appendix 7: If the Calculator Is Reset

StarPilot-89 kept a copy of itself in the TI-89's archive memory and could be reloaded from it. On the TI-Nspire, StarPilot is a document in the calculator's flash memory, which survives a flat battery and a restart of the calculator. If the document is ever lost (a reset of the calculator's memory, a deleted file), copy your StarPilot.tns to the calculator again from your computer (Appendix 4): keep a copy of it there. The sights and settings of a lost document are lost with it, unless you had moved them to StarPilot on another platform.

Appendix 8: Almanac Accuracy

StarPilot for TI-Nspire computes with StarPilot for PC's almanac and formulas, so its accuracy

is StarPilot for PC's. Its answers were checked against StarPilot for PC's on 2,647 test cases covering the sight reductions, fixes, route and current sailings, piloting, sunrise and moonrise, the Sight Planner and Sight Analyzer, and lunars: every value agrees to within 0.0001 of its unit (0.006 minutes of arc, 0.4 seconds of time, 0.0002 nautical miles).

Appendix 9: License Agreement

This is the agreement under which StarPilot is licensed, the same text as StarPilot for PC's.

End-User License Agreement

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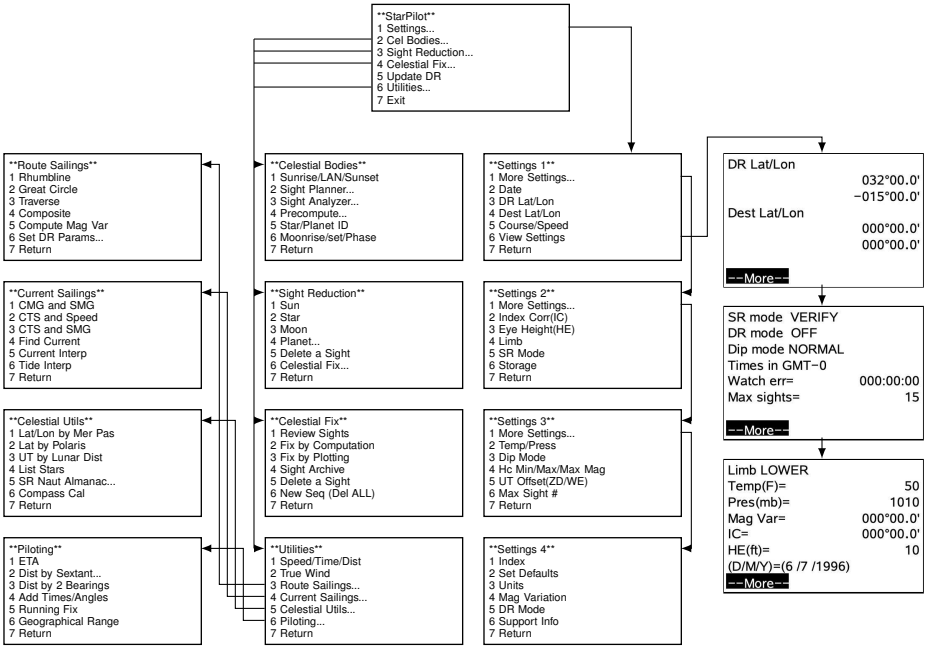
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MENU MAP



Setting	**location**
Course/Speed	[S1][5]
Date	[S1][2]
Dest Lat/Lon	[S1][4]
Dip Mode	[S3][3]
DR Lat/Lon	[S1][3]
DR Mode	[S4][5]
Eye Height(HE)	[S2][3]
Hc Min/Max/Max Mag	[S3][4]
Index Corr(IC)	[S2][2]
Limb	[S2][4]

Setting	**location**
Mag Variation	[S4][4]
Max Sight #	[S3][6]
Set Defaults	[S4][2]
SR Mode	[S2][5]
Storage	[S2][6]
Support Info	[S4][6]
Temp/Press	[S3][2]
Units	[S4][3]
UT Offset(ZD/WE)	[S3][5]
View Settings	[S1][6]

The menus as the program shows them (generated from its menu tables). The menus deeper down (the Sight Planner, the Sight Analyzer, Precompute, Planets, the Sight Archive, Storage and the others) are in their chapters. On the right, View Settings' pages, [S1][6].