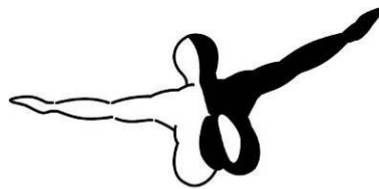




# AEROSOFT Flight Calculator



a e r o S O F T <sup>G M B H</sup>



## Index

<i>Index</i> .....	2
<i>Introduction</i> .....	4
<i>Copyrights</i> .....	4
<i>Credits</i> .....	5
<i>System requirements</i> .....	5
<i>Contact support</i> .....	5
<i>Layout</i> .....	6
<i>Finding your way around</i> .....	7
<i>Entering Data</i> .....	7
<i>Entering values and time</i> .....	8
<i>Calculator</i> .....	8
<i>Memory functions</i> .....	8
<i>Special use of Keys</i> .....	8
<i>Clearing and removing entered data</i> .....	8
<i>Hotkeys</i> .....	8
<i>Time/Speed/Distance functions (TSD)</i> .....	9
<i>Calculate Speed</i> .....	9
<i>Sample problem</i> .....	9
<i>Calculate Distance</i> .....	10
<i>Calculate Time</i> .....	11
<i>Sample problem</i> .....	11
<i>Calculate Fuel Endurance</i> .....	12
<i>Calculate Fuel Flow</i> .....	13
<i>Sample problem</i> .....	13
<i>Calculate Fuel Use</i> .....	14
<i>Sample problem</i> .....	14
<i>Altitude &amp; Airspeed functions (ALT)</i> .....	15
<i>Calibrated Airspeed</i> .....	15
<i>Sample problem</i> .....	15
<i>True Airspeed</i> .....	16
<i>Sample problem</i> .....	16
<i>Density Altitude</i> .....	17
<i>Sample problem</i> .....	17
<i>MACH</i> .....	17
<i>Wind Functions (WND)</i> .....	18
<i>Wind Direction and Wind Speed</i> .....	18
<i>Sample problem</i> .....	18
<i>Ground Speed and Heading</i> .....	19
<i>Sample problem</i> .....	19
<i>Wind Correction Angle (WCA), Cross Wind Component (XWC), Tail Wind Component (TWC)</i> .....	19
<i>Runway Crosswind</i> .....	20
<i>Sample problem</i> .....	20
<i>Magnetic Variation</i> .....	21
<i>Sample problem</i> .....	21
<i>Weight &amp; Balance</i> .....	22
<i>Center of Gravity</i> .....	22
<i>Weight Shift</i> .....	22
<i>Percentage Mean Aerodynamic Cord</i> .....	22
<i>Conversions (CNV)</i> .....	23
<i>Volume (VOL)</i> .....	23
<i>Weight (WT)</i> .....	23
<i>Weather (WX)</i> .....	23
<i>Distance (DIST)</i> .....	23



<i>Time &amp; Timer Functions (TMR)</i> .....	24
<i>Departure / Arrival Times</i> .....	24
<i>Stopwatch</i> .....	24
<i>Connection with FS2004 via FSUIPC</i> .....	25
<i>To use the connection</i> .....	25
<i>Two versions of Flight Calculator?</i> .....	25
<i>Skins</i> .....	25
<i>Settings (MEN)</i> .....	26
<i>Appendix A; Understanding Airspeeds</i> .....	27
<i>Indicated Airspeed (IAS)</i> .....	27
<i>Calibrated Airspeed (CAS) / Rectified Airspeed (RAS)</i> .....	27
<i>True Air Speed (TAS)</i> .....	27
<i>Ground Speed (GS)</i> .....	27
<i>Appendix B; Understanding Heading and Course</i> .....	28
<i>Magnetic Course (MC)</i> .....	28
<i>True Course (TC)</i> .....	28
<i>Magnetic Heading (MH)</i> .....	28
<i>True Heading (TH)</i> .....	28
<i>Compass Course (CC)</i> .....	28
<i>Compass Heading (CH)</i> .....	29
<i>Variation (VAR)</i> .....	29
<i>Appendix C; Understanding Altitudes</i> .....	30
<i>True Altitude (TA)</i> .....	30
<i>Absolute Altitude</i> .....	30
<i>Indicated Altitude</i> .....	30
<i>Pressure Altitude (PA)</i> .....	30
<i>Density Altitude (DA)</i> .....	30
<i>Appendix D; Standard Atmosphere</i> .....	31
<i>U.S. units standard atmosphere</i> .....	32



## Introduction

In this day and age it seems old fashioned to use a flight calculator in your cockpit. But that is a big misunderstanding as a GPS navigation system only knows where you are and where you have to go. A Flight Calculator does far more than just help you navigate. It can help you create your flight plan and enroute it can help you check if your actual flight is according to the schedule.

It will also help you convert weights, distances, volumes from one standard to another, it serves as a stopwatch (counting up and down) and it even gives tells you what GMT time is. In fact the amount of functions is so big you probably never use all of them. But with this in your pocket you'll have the answer to every calculation you could ever need.

The version created by Aerosoft is able to read information from FS2004 via FSUIPC and is programmed to be simple and easy to use. It is NOT a gauge but a standalone application and can be run on a separate computer (not being very graphical it will run on a veeeery slow computer. Using FSUIPC it can be linked via network.

If you run it on the same computer it can be run in 'transparent mode' so you will be able to see FS behind it.

Mathijs Kok  
AEROSOFT ConDev

## Copyrights

The manual, documentation, video images, software, and all the related materials are copyrighted and can not be copied, photocopied, translated or reduced to any electronic medium or machine legible form, neither completely nor in part, without the previous written consent of AEROSOFT. THE SOFTWARE IS FURNISHED «AS IS» AND IT DOES NOT COME FURNISHED WITH ANY GUARANTEE IMPLICIT OR EXPRESS. THE AUTHOR DECLINES EVERY RESPONSIBILITY FOR CONTINGENT MALFUNCTIONS, DECELERATION, AND ANY DRAWBACK THAT SHOULD ARISE, USING THIS SOFTWARE.

Copyright © 2004 AEROSOFT All rights reserved. Microsoft Windows, Windows® 95, Windows® 98, Windows ME, Windows® NT, Windows® 2000, Windows XP and Flight Simulator are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other Countries. All trademarks and brand names are trademarks or registered trademarks of the respective owners.

Copyrights are serious stuff. If you find any pirated copies of this software please notify us at [info@aerosoft-shop](mailto:info@aerosoft-shop). We will make sure reports of copyrights violation are rewarded.

Aerosoft GmbH  
Lindberghring 12  
D-33142 Büren, Germany  
[www.aerosoft.com](http://www.aerosoft.com)  
[www.aerosoft-shop.com](http://www.aerosoft-shop.com)



## Credits

Concept:	Mathijs Kok
Programming:	Koen Lamoen
Graphics:	Tim Taylor
Project Management:	Mathijs Kok
Manual, documentation:	Mathijs Kok
Installer:	Andreas Mügge
Beta testers:	Erik Bakker, Rob de Vries (thanks guys)

## System requirements

Pentium 300 MHz  
256 Mb RAM  
50 Mb of free available SPACE on the hard disk  
Sound card (optional)  
Microsoft Flight Simulator 2004 (NOT compatible with older versions) (optional)  
Windows 98, Windows 98 SE, Windows ME, Windows 2000, Windows XP,  
Windows 2003  
Adobe Acrobat® Reader 5 minimal to read and print the manual <sup>(1)</sup>

<sup>(1)</sup> Available for free, download at:

<http://www.adobe.com/prodindex/acrobat/readstep.html>

## Contact support

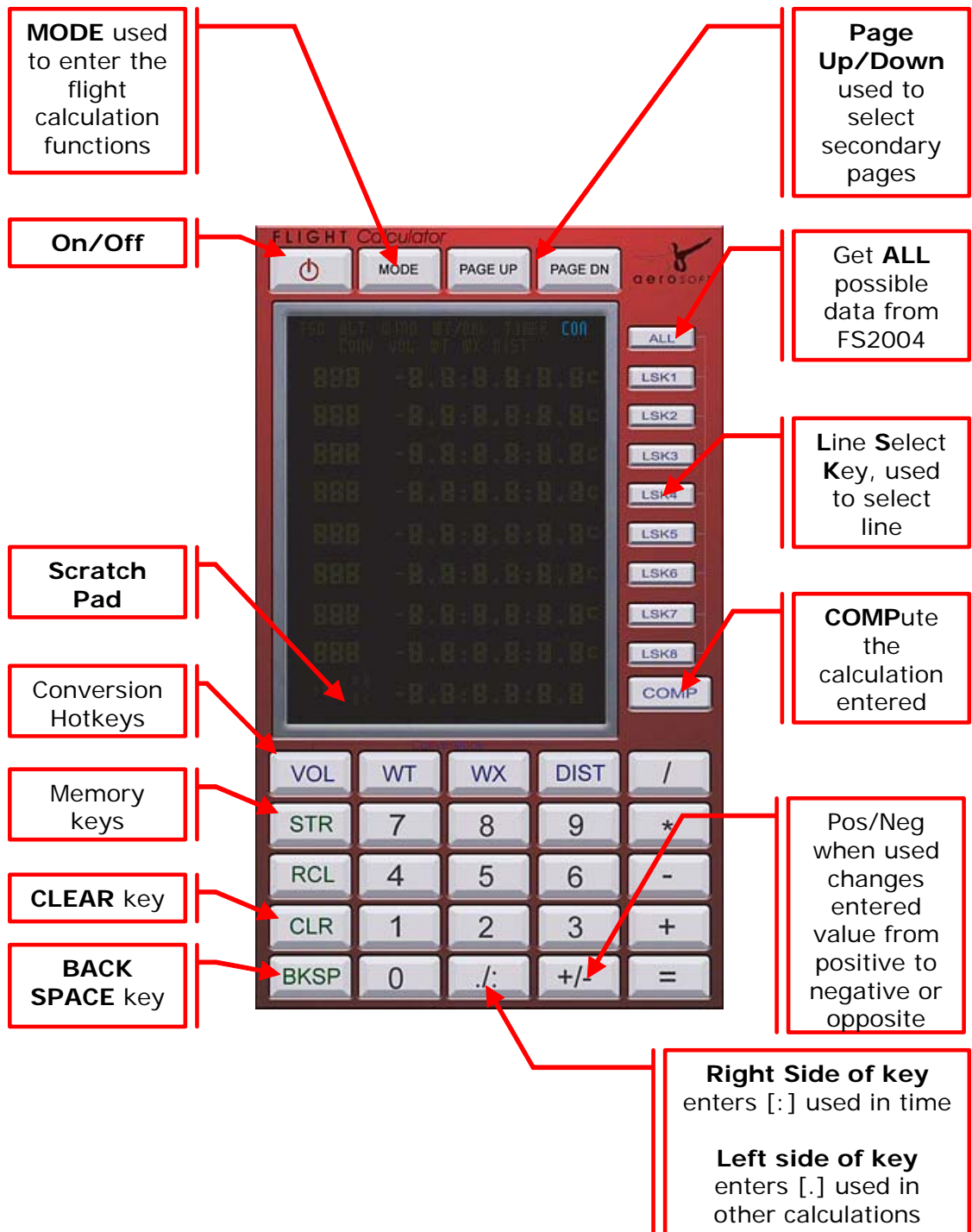
Support for this product is done by Aerosoft. We prefer to do support on the support forum for one simple reason, it is fast and efficient and because customers help customers when we are sleeping.

Aerosoft forums: <http://forum.aerosoft-shop.com/forum/index.php>

We feel strong about support. Buying one of our products gives you the right to waste our time with questions you feel might be silly. They are not.



## Layout

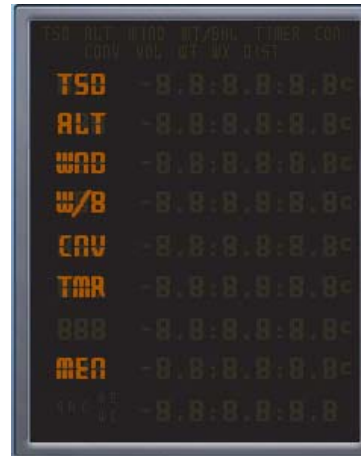




## Finding your way around

The aviation related functions are all hidden under the [MODE] key. When you press that one you will see the top menu.

(TSD)	Time, Speed, Distance
(ALT)	Altitude
(WND)	Wind
(W/B)	Weight and Balance
(CNV)	Conversions
(TMR)	Time & Timer
(MEN)	Setting Menu



In the explanation of the functions further in the manual you will see the 'path' to the function given like this;

MODE | WND | MAG,

meaning that you press [MODE], [WND] and [MAG] after each other. The [MODE] is a separate key and the others you select by pressing the Line Select key.

Every time you press [MODE] you are send back to the top menu and this is a fine way of getting out of a situation you don't understand.

## Entering Data

If you ever used a Flight Management Computer you will find the use of the Aerosoft Flight Calculator not too complex as it basically works the same. If you have never used one, it only takes a few seconds to understand it.



The trick is that you enter all data on the Scratch Pad and then copy it to the location where it is needed. It is best explained with an example. Let's say we want to enter a wind direction of 235°. Just enter [2] [3] [5] and you will see the digits appear in the scratch pad.



When you make a mistake just press [BKSP] and the last digit entered will be removed. To clear the Scratch Pad completely, press [CLR] [BKSP].

To copy the data to the WDR line just press the Line Select Key of the variable. In this case, press [LSK1] and you will see that 235 will be copied to the WDR line. The Scratch Pad will be cleared.

You can also copy anything you see on a LSK line to the scratch pad by just clicking the correct LSK. What was in that line will be copied to the scratch pad



## Entering values and time

The [./:] key has a double function; If you press the left side a "." will be inserted. For example if you need to enter a half a degree you enter 120.5. When you press the right side a ":" will be inserted. This is used to enter time. For example to enter nine o'clock you would enter "09:00".

Time can be entered in several formats.

10	= 10:00:00
1.5	= 1 hour, 30 minutes
01:30	= 1 hour, 30 minutes
01:30:15	= 1 hour, 30 minutes, 15 seconds

## Calculator

The Flight Calculator also functions as a (simple) calculator. Just use the numerical keyboard to enter the data, use [ENTER] to finalize the calculation. The calculator can be used at any moment, even if you are entering data for a Function. You can make good use of this when you need to do a calculation before entering something. For example, if you have three fuel tanks and need to add these up before entering it in the calculation that will result in the amount of hours you can fly. To do this, just add up all three tanks and copy the result to the LSK line where it is needed.

## Memory functions

The calculator has 8 memory locations you can use to store data in. For example if you are doing calculations that need several inputs you need to calculate before. You can do these calculations and store the results. Stored results are kept between sessions!

To store anything, copy it to the scratch pad and press [STR]. You will be presented with a screen showing the memory locations. Select one with the LSK key and the value will be stored. To retrieve the data simply press [RCL] at any moment. You will see the full memory again and can copy any value to the scratch pad by selecting the corresponding LSK.



## Special use of Keys

### Clearing and removing entered data

Press [BKSP] to remove the last added digit, or [CLR]-[CMP] to clear the display complete.

When [CLR] is pressed a small blue "C" appears indicating you are now in CLEAR mode. In clear mode pressing any of the [LKS] buttons will clear that line. Press [COMP] will clear the Scratch pad. Pressing the [CLR] will leave the CLEAR mode.

### Hotkeys

LSK1 to LSK can be selected with [F1] to [F8]  
[COMP] can be selected with [F12]





## Time/Speed/Distance functions (TSD)

The most used calculations in aviation are related to Time, Speed and Distance.

### Calculate Speed

MODE | TSD | SPD

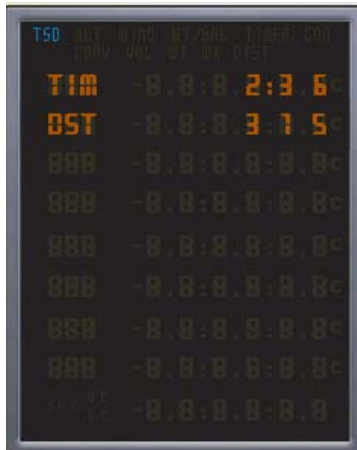
If you know how long it took you to fly a known distance, you can calculate the speed you flew.

ENTER

Time (TIM) Time spend enroute  
Distance (DST) The distance covered

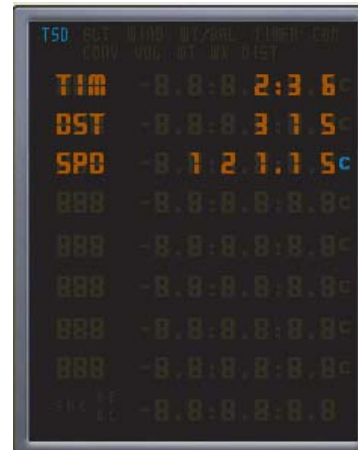
GIVEN

Speed (SPD) The resulting speed (Ground Speed)



### Sample problem

A simple problem but often something you need to do, for example to check if your wind calculations are correct. You enter Time and Distance and with a simple calculation the speed is calculated. As this is the correct speed over the ground, the



result is Ground Speed. In our example we flew 2 hours and 36 minutes and covered a distance of 316 miles. This results in a speed of 121 knots.



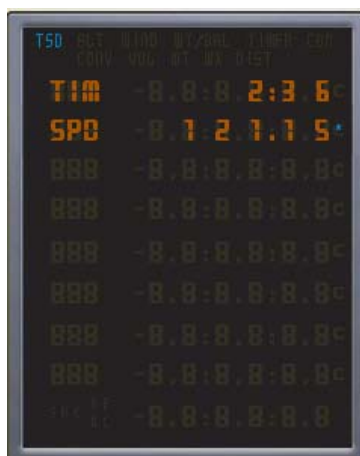
## Calculate Distance

MODE | TSD | DST

If you know how long you have flown and a known speed you can calculate how far you have flown. Most of the time Fuel Flow is expressed in Gallons per hour, but of course you can use any measure as long as you use the same in the complete calculation.

ENTER

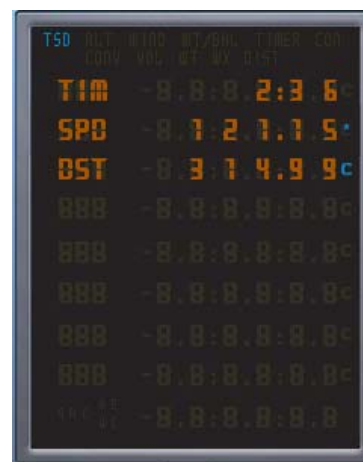
Time	(TIM)	Time spend enroute
Speed	(SPD)	The speed in Ground Speed
GIVEN		
Distance	(DST)	The distance covered



### Sample problem

Also not an overly complex problem, but one you will need to do very often. You know the time and speed and you can calculate the amount of distance you flew.

1





## Calculate Time

MODE | TSD | TSP

If you know how far you fly at a given speed you can calculate how long it will take you to fly that leg. This comes in handy when you plan your flight. Most of the time Fuel Flow is expressed in Gallons per hour, but of course you can use any measure as long as you use the same in the complete calculation.

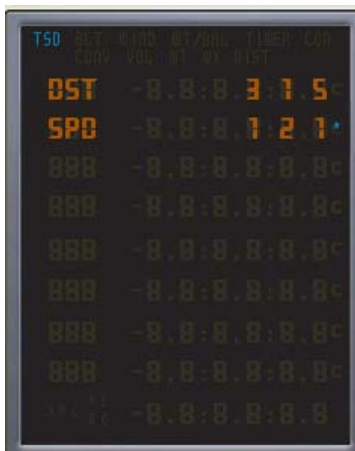
ENTER

Distance (DST) The distance covered

Speed (SPD) The speed

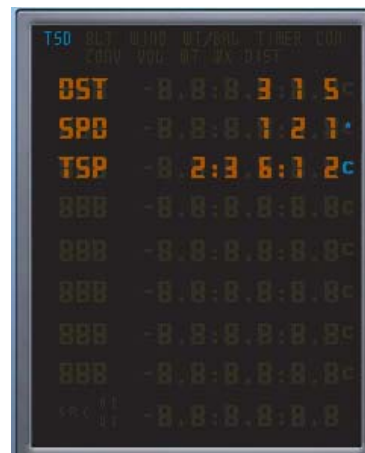
GIVEN

Time Spend (TSP) The time spend enroute



## Sample problem

Just as the two calculations above, this one is not complex, but vital for navigation. While you are doing your planning you need to enter how long each leg will take. We'll use the same data as we used before and end up with the result we expected.





## Calculate Fuel Endurance

MODE | TSD | TFL

If you know how much fuel you have and how much you burn per hour you can calculate how much time you can stay airborne. Most of the time Fuel Flow is expressed in Gallons per hour, but of course you can use any measure as long as you use the same in the complete calculation.

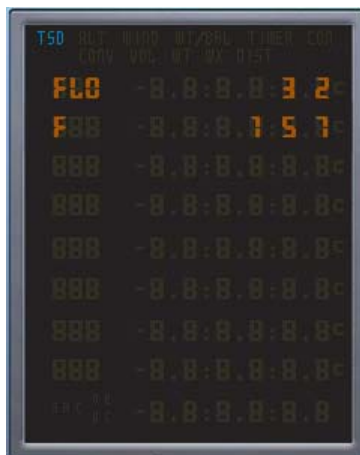
ENTER

Fuel Flow (FLO) Fuel burn per hour in Gallons per hour

Fuel Quantity (F) Fuel Quantity in Gallons

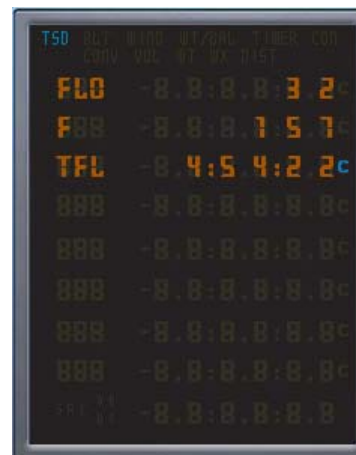
GIVEN

Time (TIM) Time spend enroute



### Sample problem

You know how much fuel you have and you know how much fuel you burn per hour. So how long can you fly? We'll use an example where we have 3 separate tanks and first have to combine the fuel in these tanks. We'll enter [118] [+] [45] [+] [112] [=] to add up the fuel in both



wings tanks and the fuel in the center tank. We copy the result (157) to the LSK2 and enter 32 as the Fuel Flow. We get the result and know that we can fly for about 5 hours at the current fuel flow.



## Calculate Fuel Flow

MODE | TSD | FLO

If you know how much fuel you carry and how long you have got to fly, you can calculate how much your fuel flow can be. Please keep in mind that this does not include any wind or speed corrections and that we use time and not distance for these calculations.

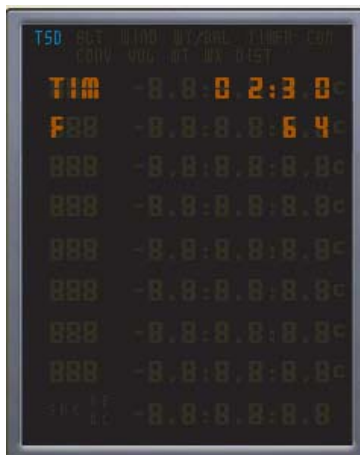
ENTER

Time (TIM) Time Enroute

Fuel Quantity (F) Fuel available in Gallons

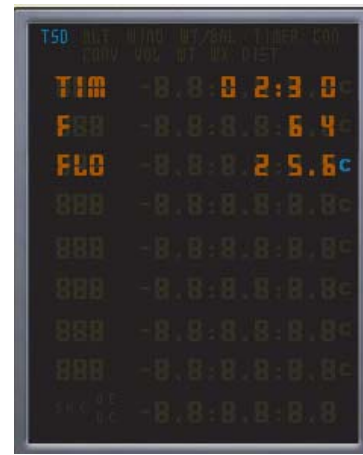
GIVEN

Fuel Flow (FLO) Fuel burn in Gallons per hour



### Sample problem

Now we know how much fuel we have and how long we'll have to fly and need to know what the maximum Fuel Flow could be. Certainly a calculation that is important when we are crossing water (or land that is not easy to land on). We enter two and half hours flying time and



we got 64 pounds of fuel left. The calculation shows that we have got to stay under 25.6 in our fuel flow.



## Calculate Fuel Use

MODE | TSD | F

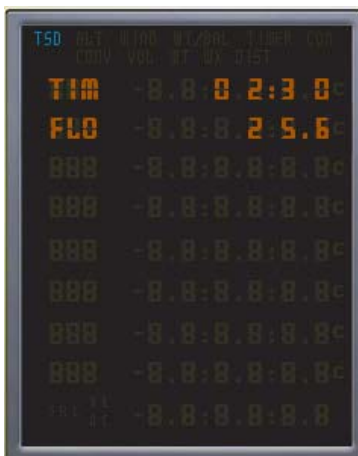
If you know how much your fuel flow is and how long you will fly you can calculate how much fuel you will burn. Most of the time Fuel Flow is expressed in Gallons per hour, but of course you can use any measure as long as you use the same in the complete calculation.

ENTER

Time (TIM) Time spend enroute  
Fuel Flow (FLO) Fuel burn in Gallons per hour

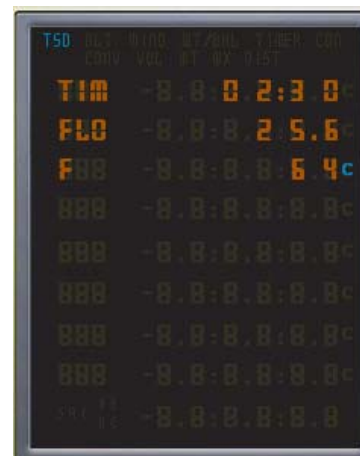
GIVEN

Fuel Quantity (F) Total fuel used in Gallons



### Sample problem

The same problem as the one above. But now we need to know how much fuel we need to load to fly a certain time. We enter the same data as above so we should get a similar result. Two and a half hours and we'll use 25.6 pounds per hour. The result is that we need to load 64 pounds



to fly this time.



## Altitude & Airspeed functions (ALT)

Appendix A gives a detailed explanation on the many kinds of speeds that are used in aviation. Appendix C has the same explanation on altitudes.

### Calibrated Airspeed

MODE | ALT | CAS

Your Airspeed Indicator displays Indicated Airspeed and this is affected by temperature and pressure. To find the Calibrated Airspeed (also known as Rectified Airspeed (RAS) you need to take these factors into account.

ENTER

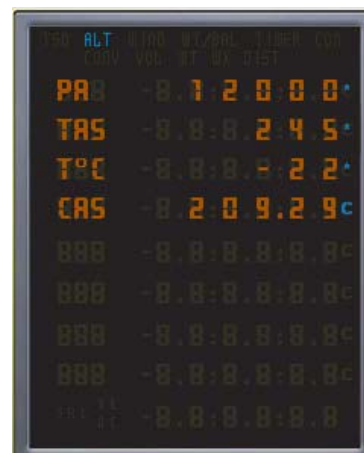
Pressure Altitude	(PA)	Altitude when altimeter is set to 29.92 in. Hg. In feet
True Airspeed	(TAS)	Actual speed of the aircraft through the airmass around it in Knots. If there is no wind it would be identical to Ground Speed.
True Temperature	(T°C)	True Temperature in Celsius
GIVEN		
Calibrated Airspeed	(CAS)	Airspeed compensated for temperature and air density. When corrected for placement and instrument deviations this is Indicated Air Speed, what you actually read on your airspeed indicator.



### Sample problem

You know you will have to fly 245 knots True Airspeed to arrive at your next waypoint on schedule and that you will cruise at 12.000 feet. You also know what the temperature will be. So we can calculate the Calibrated Airspeed, right?

After we enter a



pressure altitude of 12.000 (we don't really care how high we will cruise, we only care about the pressure, so we set barometric pressure and climb until we read 12.000 feet) and a temperature of minus 22C and the speed we calculate that the Calibrated Airspeed will be 209 knots. So if we see this on the Airspeed indicator we know we will arrive on time.



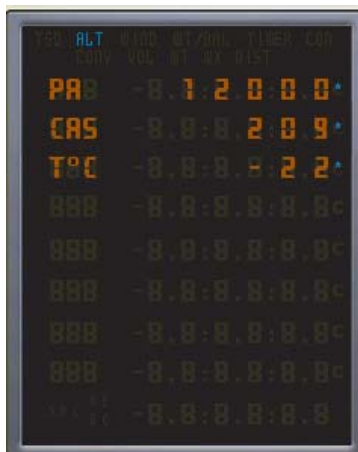
## True Airspeed

MODE | ALT | TAS

As your airspeed indicator displays Indicated Airspeed (and let's assume the instrument is perfect and the reading is actually the same the Calibrated Airspeed) you often want to know the airspeed corrected for the temperature and density. After all, if you want to calculate your Ground Speed, the only reading that will tell you how long it will take you to get somewhere, you need the True Airspeed.

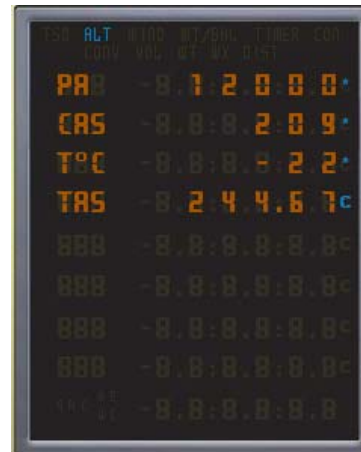
ENTER

Pressure Altitude	(PA)	Altitude when altimeter is set to 29.92 in. Hg. In feet
Calibrated Airspeed	(CAS)	Airspeed compensated for temperature and air density. When corrected for placement and instrument deviations this is Indicated Air Speed, what you actually read on your airspeed indicator.
True Temperature GIVEN	(T°C)	True Temperature in Celsius
True Airspeed	(TAS)	Actual speed of the aircraft through the airmass around it in Knots. If there is no wind it would be identical to Ground Speed.



### Sample problem

Now say we are flying at 209 knots on the airspeed indicator under the same conditions as the sample problem above. What is our corrected airspeed (so corrected for air density and temperature)? As we would expect the True Airspeed is much higher than the



Indicated Airspeed (let's assume it is the same as the Calibrated Airspeed for a moment).





## Density Altitude

MODE | ALT | DA

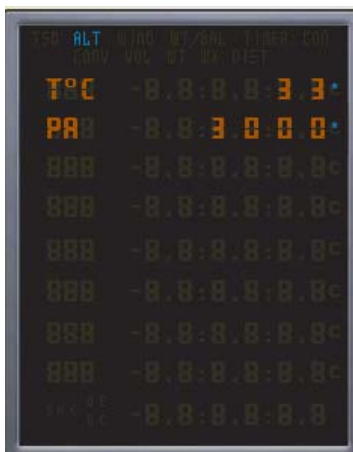
The altitude you see indicated on your altimeter (Pressure Altitude) is actually one of the least useful altitudes. For one thing because your aircraft does not care about it, it only cares about the Density Altitude because that is what it thinks it is at, that is what determines how the aircraft flies. So calculating it is very important.

ENTER

True Temperature	(T°C)	True Temperature in Celsius
Pressure Altitude	(PA)	Altitude when altimeter is set to 29.92 in. Hg. In feet

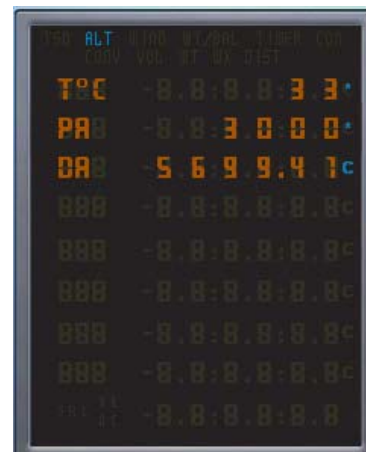
GIVEN

Density Altitude	(DA)	The altitude the airplane thinks it is at, and performs in accordance with.
------------------	------	---



### Sample problem

Say we flew an ultralight into a mountain airport located at 3000 feet when it was real cold. The Ultralight is not capable of operating at altitudes over 3500 feet. Now the temperature is rather warm and we need to know if we can still operate from the



airport. When we enter T°C 33 and Pressure Altitude 3000' we'll calculate the Density Altitude being 5700'. No way we can operate at that Density Altitude. We will have wait for the temperature to go down to 13 degrees before we can depart! Better wake up early tomorrow.

## MACH

MODE | ALT | M

Very high speeds are given in Mach (Mach 1 being the speed of sound) because it is not a fixed value but a value that depends on the conditions.

ENTER

True Airspeed	(TAS)	Actual speed of the aircraft through the airmass around it in Knots. If there is no wind it would be identical to Ground Speed.
---------------	-------	---

True Temperature	(T°C)	True Temperature in Celsius.
------------------	-------	------------------------------

GIVEN

Mach	(M)	Speed expressed in percentage of sound speed.
------	-----	---



## Wind Functions (WND)

As we all know all navigation would be a lot easier if it were not for wind. The Wind functions are subdivided into three groups. Wind Direction and/or Wind Speed, Heading and/or Ground Speed, Crosswind. There is a fourth group added that solves for Magnetic Variation. Appendix B has a detailed explanation on the many kinds of courses and headings used.

Please note that you can enter True North or Magnetic North values for Course/Heading/Wind Direction. But you have to stay in Magnetic or True in the whole calculation to avoid the results being incorrect!

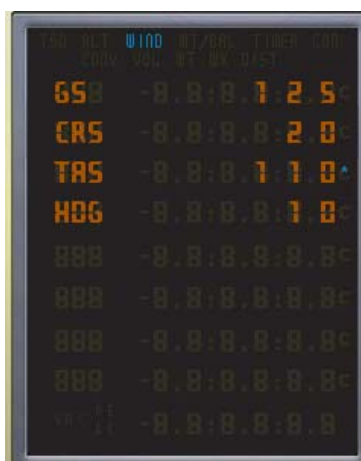
### *Wind Direction and Wind Speed*

MODE | WND | WDR or MODE | WND | WSP

If you know the course and heading (remember that course is what you are flying and heading is where your aircraft is pointing to) and your groundspeed and true airspeed (so corrected for barometric variations as altitude and temperature), you are able to calculate the wind that you encountered enroute.

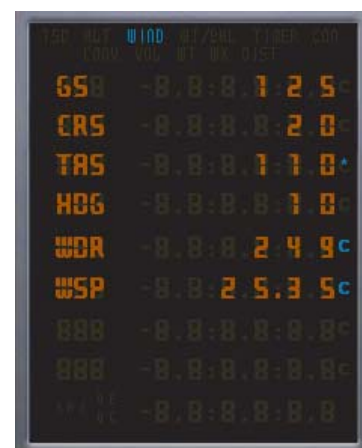
ENTER

Ground Speed	(GS)	Speed over ground.
Course	(CRS)	Direction you intend to go.
True Airspeed	(TAS)	Actual speed of the aircraft through the airmass around it in Knots. If there is no wind it would be identical to Ground Speed.
Heading	(HDG)	Direction the nose of the aircraft is pointing to.
GIVEN		
Wind Direction	(WDR)	Direction the wind is blowing from
Wind Speed	(WSP)	Speed of the wind in knots



### Sample problem

Say you are flying from one waypoint to the next and want to know about the wind you encountered enroute to use that as the wind for the next leg. If you flew the leg on Auto Pilot from VOR to VOR you would have all the information needed for this calculation. You enter the Ground Speed



(125 knots), Course (20°), your True Airspeed (110°) and the Heading (10°) you have flown and after pressing the COMP key you will be presented with the speed and direction of the wind.

The fact the Course was 20° and the Heading 10° means that we had wind from the left side and that shows as the Wind Direction calculated at 249°. The fact the Groundspeed was 15 knots higher then the True Airspeed means that the wind was from behind and certainly not on the nose.



## Ground Speed and Heading

MODE | WND | GS or MODE | WND | HDG

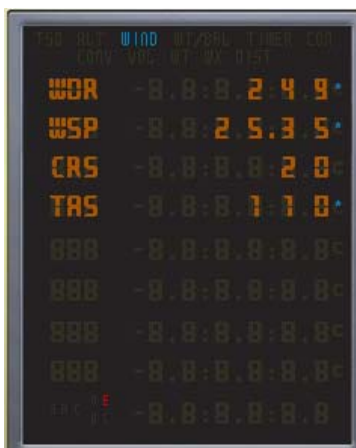
Ground Speed is important because it is the only speed that determines how long it takes you to fly from one location to another location. Heading is of course important because we need to know what we need to steer to stay on the plotted course.

### ENTER

Wind Direction	(WDR)	Direction the wind is blowing from.
Wind Speed	(WSP)	Speed of the wind in knots.
Course	(CRS)	Direction you intend to go.
True Airspeed	(TAS)	Actual speed of the aircraft through the airmass around it in Knots. If there is no wind it would be identical to Ground Speed.

### GIVEN

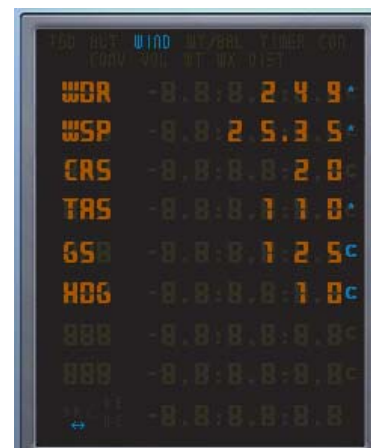
Ground Speed	(GS)	The resulting speed measured over the ground
Heading	(HDG)	The direction the nose of the aircraft should be pointed to stay on your course



### Sample problem

Say you are planning to fly from one VOR to another. You know what will be your airspeed and we have an accurate weather report, what will be the Groundspeed and what Heading do we have to fly?

To calculate this we enter Wind Direction



(249°), Wind Speed (25.43 knots), Course 20° and the True Airspeed. The result will be Ground Speed 125 knots, Heading 10°.

Note we are using the results of the previous calculation as input so we should know what to expect. Don't be surprised to see the result a bit different due to rounding of the data. If you are flying this kind of navigation you do not care very much for a single degree or a knot here and there. You most probably do not have an instrument precise enough to fly this precise.

## Wind Correction Angle (WCA,) Cross Wind Component (XWC), Tail Wind Component (TWC)

MODE | WND | GS | PageDown

MODE | WND | HDG | PageDown

These calculations are only visible AFTER you've calculated either Ground Speed or Heading (see above). After you've done these calculations you can press [PAGE DOWN] to see the WCA, XWC and TWC. You can press [PAGE UP] to go back to the previous page.



## Runway Crosswind

MODE | WND | XWC

Cross Wind is often defined as wind blowing across the path of a ship or aircraft. It pushes the aircraft from its path. Depending on the speed and direction of the wind and the heading and speed of the aircraft the crosswind this will be a factor. Every aircraft has Crosswind limits. The lighter the aircraft the lower these limits will be. To give you some idea, the Cessna 182 has a crosswind limit of 18 knots. The Headwind component is very important because a negative headwind component will mean you need more runway!

ENTER

Wind Direction (WDR) Direction the wind is blowing from.

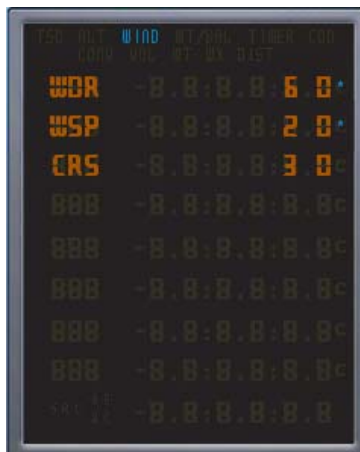
Wind Speed (WSP) Speed of the wind in knots.

Course (CRS) The direction you intend to travel.

GIVEN

Headwind component (HWC) The calculated wind on the nose or the tail.

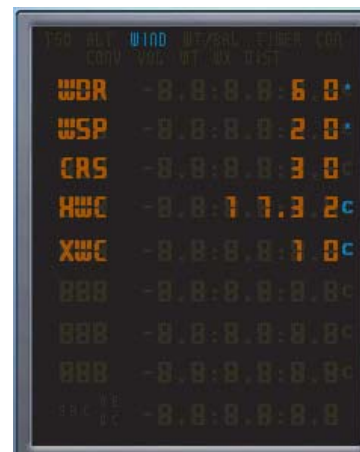
Crosswind component (XWC) The calculated wind from left or right.



### Sample problem

You are on the runway in your Cessna 182 but you are not completely sure that the Crosswind is within the limits of the aircraft. The 18 knots in the manual is a bit cautious, we'll do it with 20 knots, okay?

The wind is 60/20 and the runway is 03 (with



an actual course of 30°).

When we enter this data we'll end up with a Cross Wind of 17.3 knots (positive so coming from the right) and a Head Wind of 10 knots. Right in the limits. As we get a 10 knot headwind (positive means we got wind on the nose, negative means wind on your tail) we'll even use a bit less runway.



## Magnetic Variation

MODE | WND | MAG

Okay, this is not the most complex calculation but if you are flying a 300 mile leg over northern western Canada in a DHC2 Beaver you do NOT want to get this wrong because you'll end up very far from your destination, eating seal blubber with the friendly natives while waiting for fuel to be brought in. Seriously, people died because they got this wrong.

In most places of the world your compass will NOT point to the North Pole. Not only because each compass has its own deviation caused by the mass of the aircraft it is installed in, but also because of the local variations in the magnetic field of the earth. For example if you would fly due north (on your compass) over Seattle you would be flying actually a heading of 340° because of the -20° degree magnetic variation in this areas. On the other hand, your compass would be close to accurate over Chicago. Flying due north (again on your compass) would result on a true heading of 010° due to the +10° magnetic deviation in this area.

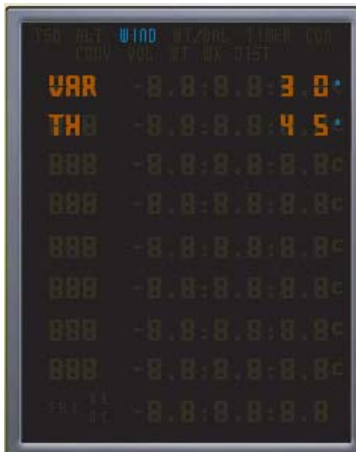
ENTER

Variation (VAR) The difference between Magnetic North and what your compass shows.

True Heading (TH) Your heading.

GIVEN

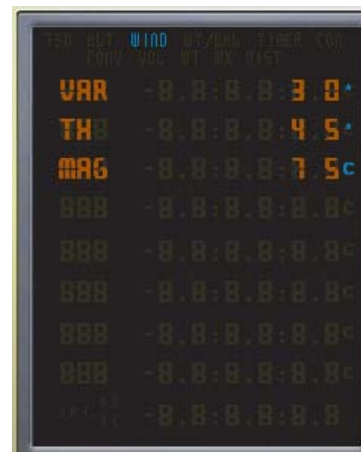
Magnetic Course (MAG) The resulting Magnetic Course you need to steer.



### Sample problem

Say we are flying a long distance over the Beaufort Sea (North of the Canada/Alaska border). The Magnetic Field of the earth is very strange there and the variation can be up to 60 degree there. We know we have to fly magnetic.

As we cross several different variations we



use the calculator while we do the calculations.

We start by finding the average variation for the Variation we find on the maps.

We do that by entering [35] [+] [40] [+] [50] [=] [/] [3] [=] and we end up with 30. We copy this to the VAR by pressing [LSK1]. For the heading we are going to fly we enter we are entering [45]. When we compute this we see that we will have to fly a magnetic heading of 75°. Keep in mind that variation can be positive and negative!



## Weight & Balance

The weight and balance functions are really far more complex than the other functions. They work fine, but we feel that detailed explanations of the parameters goes beyond what the average user will use. If you put it different, if you need these calculations you will understand them.

### ***Center of Gravity***

When you put a load in an aircraft that is not exactly in the Center of Gravity it will change the balance of the aircraft. As this seriously affects the flight characteristics of the aircraft you will need to calculate them carefully.

ENTER  
Gross Weight            (GWT)  
Weight                    (WT)  
 $\Delta$  Arm                    (dAR)  
GIVEN  
Center of Gravity        (CG)

### ***Weight Shift***

When you find that the CoG is outside the limits you are faced with the rather complex question of how far to shift a certain weight. In this calculation only one of the Delta values need to be entered. When you press [COMP] the other is calculated.

ENTER  
Gross Weight            (GWT)  
Weight to be            (WT)  
shifted  
 $\Delta$  Arm                    (dAR)  
 $\Delta$  Center of            (dCG)  
Gravity

### ***Percentage Mean Aerodynamic Cord***

MODE | W&B | %MC

Mean Aerodynamic Cord (MAC) is the average distance from the leading edge (front side) to the trailing edge (backside) of the wing. For safe operation the safe weight and balance must be within certain limits, usually expressed as percentage of MAC. The Center Of Gravity (CoG) must be inside a certain percentage of MAC determined by the aircraft manufacturer.

ENTER  
LEMAC                    (LMC)  
MAC                        (MAC)  
Center of Gravity        (CoG)  
GIVEN  
Percentage MAC          (%MC)



## Conversions (CNV)

One of the most simple but most used functions of the flight calculator is converting one measure into another. You can reach the conversions either by MODE | CNV, or by pressing one of the conversion mode buttons directly.

### ***Volume (VOL)***

You can convert between these values:

Litres (LTR)

Gallons (GAL)

Imperial Gallons (IPG)

Usage is simple, enter one of the values and press [COMP], this will calculate the other two values.

### ***Weight (WT)***

You can convert between these values:

Kilogram (KG)

Pounds (LB)

Usage is simple, enter one of the values and press [COMP], this will calculate the other value.

### ***Weather (WX)***

You can convert between these values:

Fahrenheit (°F)

Celsius (°C)

and

Millibars (MB)

Hectopascals (HP)

Inches of Mercury (IHG)

Millilitres Mercury (MHG)

Enter a temperature and press [COMP] to have the correct converted temperature displayed or enter a pressure and press [COMP] to have the other converted pressures displayed. Converting pressure works the same way.

### ***Distance (DIST)***

You can convert between these values:

Meter (MTR)

Kilometer (KM)

Feet (FT)

Inch (IN)

Nautical Mile (NM)

Statue Mile (SM)

Yard (YRD)

Usage is simple, enter one of the values and press [COMP], this will calculate the other values.



## Time & Timer Functions (TMR)

MODE | TMR

Time plays a very important role in aviation. You will often need to calculate with time to determine arrival time or to know when you need to be at a certain point. When you arrive at this mode screen you will see that the ever important GMT time is displayed above the local time of your location. You can reach the time functions by clicking on MODE and selecting LSK6 (TIME).

Keep in mind that the ./: button has two sides, the left side is used for [.), the right side for [:) and that time can be entered as standard time (HH:MM:SS) or in decimal of time (HH.mm.ss) ; 22:30:45 equals 22.50.75.

### ***Departure / Arrival Times***

The following times can be used or computed:

Departure Time (DEP)

Enroute Time (ENR)

Arrival Time (ARR)

Entering any of the two values and pressing [COMP] will compute the other value.

### ***Stopwatch***

You can also use the Flight Calculator as a stopwatch to measure time or to count down time. For this two functions are available:

Time Count Up (TUP)

Time Count Down (TDN)

After entering a time in the scratchpad pressing TUP or TDN will start the count from the time entered in the scratchpad. When TDN has counted to 0:0:0 it will continue with negative time, shown with a [-] in front. Pressing TUPD or TDND while the counting is being done will pause the count, pressing it again will restart. You can not enter a time value greater then 24 hours and time will always be displayed in HH:MM:SS





## Connection with FS2004 via FSUIPC

When a small blue [\*] appears on a LSK line it means this is data that can be received from FS2004 via FSUIPC. FSUIPC is not part of this product, it is a development from Pete Dowson. FSUIPC is also not required for the use of this product.

### ***To use the connection***

When Aerosoft Flight Calculator detects FS is running a blue "con" indication is shown top right of the display. We advise you to start FS first and the calculator only when FS is running. If you are expecting a connection but don't see it, just restart the calculator.

To receive the data from FS, press the [ALL] key. The values displayed are those reported by FS at the moment of retrieval and are not updated until you press the [ALL] key again.

### ***Two versions of Flight Calculator?***

There are two versions of Aerosoft Flight Calculator, one that is made for people who have a registered (paid) version of FSUIPC and one for people who do not have a registered version. For the latter version we pay the license costs to use the variables needed. So in functionality the two versions are 100% identical.

There are two versions because we feel that people who already own a registered version of FSUIPC should not be forced to pay again for the functionality.

## Skins

If you like the Aerosoft Flight Calculator to look different you can edit a lot. We kept all files as accessible as possible.

In the folder ..\FlightCalculator\Images you will find the skin images. You can just edit any of these and save it with a new name. The name HAS to be in this format; FC\_\*\_Large.jpg, where \* is a unique name.



## Settings (MEN)

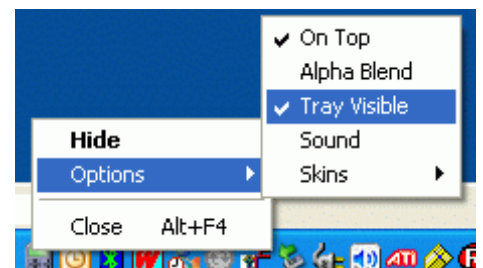
MODE | MEN

If you select MODE and then MEN you will get to the settings menu where you can edit some of the settings of the product.

Always On TOP	(OTP)	Set at [1] the Flight Calculator will always be on top of other windows. This is probably the most preferable setting. Set at [0] it will be a normal window and can be hidden beneath other windows. (Default = 1)
Alpha Blend	(ALP)	Set at [1] the Flight Calculator will be half transparent and you can see the background through it. This only functions on Windows 2000 and Windows XP. In the INI file you can set the level of transparency. (Default = 0)
Snap To Grid	(STG)	Set to [1] the flight calculator window will snap to a grid location making positioning a bit easier.
Tray Icon	(MTT)	Set at 1 there will be an icon of the Flight Calculator will have an icon the taskbar tray. You need it visible to have access to some other functions. (Default = 1)
Sound	(SND)	When set to [1] you will hear a short click when ever you press a key. (Default = 1)

When the Tray Icon option is activated a small icon is shown. If you right click on it you will get quick access to the settings that can also be found in the MEN option. But you can also select the skin using this interface. The **HIDE** option allows you to toggle the display of the calculator.

The settings are stored in an ini file located at ..Aerosoft\FlightCalculator\System\. The file is commented and can be edited directly by the user. The values stored in the memory locations are also saved here between sessions.





## Appendix A; Understanding Airspeeds

There are many airspeeds you will encounter while flying and it is important you understand what makes them difference. To understand what makes them different it helps to understand what would make them all the same. All speeds would be the same if;

- the airspeed indicator is perfect (actually impossible)
- you fly at sea level
- it's a 'standard' day (15°C )
- there is zero wind
- the air pressure is 29.92 inches of pressure

If any of these conditions are different there will be some differences in the speeds indicated. You will understand that during normal operations the speeds will differ. The flight Calculator will help you calculate from one to the other.

### ***Indicated Airspeed (IAS)***

The speed indicated by the Airspeed Indicator on your aircraft. This is the most important speed because it is the speed that your wings move through the air with. For the wings it does not matter that you fly in an ultralight with headwind of hurricane force. Even if you actually go backwards, your Airspeed indicator will show the speed of your aircraft through the surrounding air.

### ***Calibrated Airspeed (CAS) / Rectified Airspeed (RAS)***

Calibrated airspeed is the indicated airspeed corrected for installation and instrument errors. Although these errors are minimized by the manufacturer, they cannot be totally eliminated throughout the full range of operating speeds. At low speeds the error will be biggest. In most aircraft the IAS and CAS will be virtually identical at cruise speed.

### ***True Air Speed (TAS)***

True airspeed is the calibrated airspeed corrected for pressure altitude and temperature. With decreasing air density (increased altitude or temperature) your IAS will be decrease. In simple terms, if you keep the same speed (TAS) and climb your IAS will decrease. If you fly at the same speed, same altitude and same air pressure into colder air your IAS will increase.

### ***Ground Speed (GS)***

The speed of the aircraft over the ground. This is the speed that determines how long it takes you to fly from point A to point B. A car will always display Ground Speed.

### ***MACH (M)***

Fast-moving aircraft express their speed in Mach, the Mach number is the ratio of the TAS to the speed of sound. Mach 0.76 (often written as Mach .76) would mean you are flying 0.76 % of the speed of sound. Keep in mind that the speed of sound is variable with temperature.



## Appendix B; Understanding Heading and Course

Just as there are many ways of expressing the speed of the aircraft, there are many ways of expressing the direction the aircraft flies to. As you see below there are two variables that are combined, Magnetic/True/Compass and Heading/Course.

Magnetic versus True indicates if you fly using the Magnetic North or the Geographical North (True North). The two are NOT the same, the Magnetic North Pole is actually rather a long way from the Geographical North Pole and it actually is not fixed but it changes in location over time (think hours here, not centuries!). The closer you get to the North Pole the more bigger the difference in display. The difference between Magnetic and Compass is that Compass means the Heading/Course is corrected for compass errors (aka Deviation)

The difference between Course and Heading is that a course is a line between two points and a heading is what you actually fly to get there (in other words, where the nose of the aircraft points to). If you have a strong wind from your right side, you will have to point the nose slightly right of the course to stay on the line on the chart. In simple terms, the course is what you draw on the chart; the heading is what you will fly to stay on that line.

To complicate matters, your compass will have additional errors caused by the local deviation of the magnetic field. This is known as Variation and it is displayed on every aeronautical chart and Airport Approach chart.

### ***Magnetic Course (MC)***

The direction of a line between two points expressed in degrees in regard to the Magnetic North Pole

### ***True Course (TC)***

The direction of a line between two points expressed in degrees in regard to the True North.

### ***Magnetic Heading (MH)***

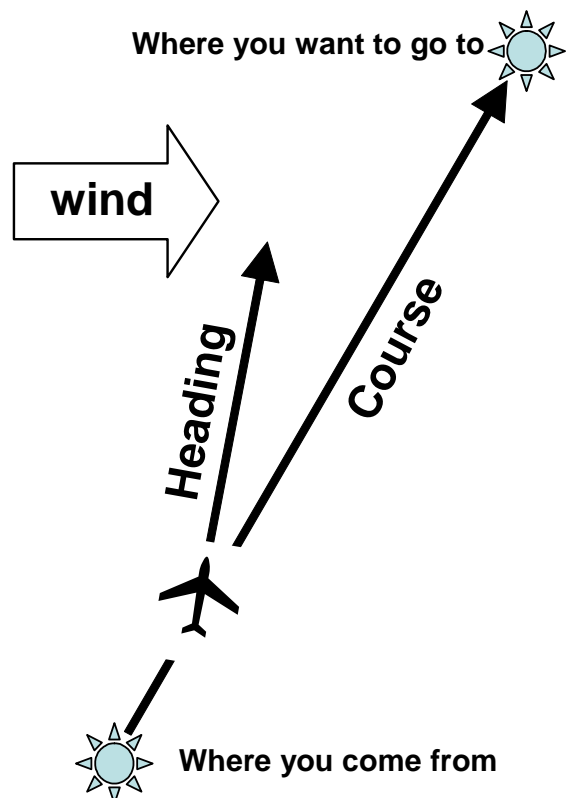
The direction the nose of the aircraft points to expressed in degrees in regard to the Magnetic North Pole.

### ***True Heading (TH)***

The direction the nose of the aircraft points to expressed in degrees in regard to the True North.

### ***Compass Course (CC)***

The Magnetic Heading corrected for errors caused by the compass and the way it is mounted in your aircraft.





## **Compass Heading (CH)**

The Magnetic Course corrected for errors caused by the compass and the way it is mounted in your aircraft. If you fly your route on a magnetic compass this is the actual heading you will fly.

## **Variation (VAR)**

The amount of degrees between Magnetic North and True North. Can be positive (east) or negative (west).

Complex? Yes, most pilots who learned to fly with magnetic compasses will agree. But if we take do it step by step it should be clear. Let's take all steps to get from a line on a map to a course to fly.

1. Plot the line on the map, this is True Course
2. When we add the winds aloft we need to include that, the result is True Heading
3. Adding the difference (variation) between True North and Magnetic North we end up with Magnetic Heading
4. Now we need to include the errors 'build in' our compass and the result is Compass Heading. This is what you actually fly.



## Appendix C; Understanding Altitudes

While flying there are three altitudes that should concern you. How high am I above the terrain, how high are the other aircraft in the surrounding flying and how high does the aircraft think it is. Let's start with the last one as it the most confusing.

The wings are control surfaces of your aircraft need a certain air density to perform. Your Cessna will simply not stay aloft if you slew up to 35.000 feet and let it go. It would fall out of the sky because there just is not enough air molecules to keep the aircraft in the air. But the density also decreases with increasing temperature (and moisture, but we'll ignore that). So when you are at an airport high in the mountains in high summer you might find that the runway is just not long enough to gain enough Airspeed to lift off. That is why the for take-off and landing the Density Altitude is the most important.

High to low, look out below

Your altitude can be 20% lower than indicated when it is cold

### ***True Altitude (TA)***

The actual altitude of the aircraft above sea level Mean Sea Level (MSL). This is the altitude given on charts. This is a fixed altitude for each point, it does NOT change with atmospheric conditions.

### ***Absolute Altitude***

The height of the aircraft Above Ground Level (AGL), the terrain just below the aircraft.

### ***Indicated Altitude***

Identical to True Altitude when at Standard Conditions.

### ***Pressure Altitude (PA)***

The altitude indicated after the altimeter is adjusted to 29.92 Millibars. This is the ONLY altitude used above the transition layer (in the US 18.000 feet) so all aircraft fly using the same altitude setting.

### ***Density Altitude (DA)***

The Pressure Altitude corrected for temperature variations.

Density Altitude is something that is often misunderstood, even by experienced pilots. The easiest way to understand it is to define it as this: Density Altitude is the altitude the aircraft THINKS it is at and performs in accordance with. Density altitude not only affects the takeoff distance and rate of climb, but also applies to the service ceiling of the airplane while en route.



## Appendix D; Standard Atmosphere

Height	Temperature	Pressure	Density
(m)	(C)	(hPa)	(kg/m3)
0	15	1013	1.2
1000	8.5	900	1.1
2000	2.0	800	1.00
3000	-4.5	700	0.91
4000	-11.0	620	0.82
5000	-17.5	540	0.74
6000	-24.0	470	0.66
7000	-30.5	410	0.59
8000	-37.0	360	0.53
9000	-43.5	310	0.47
10000	-50.0	260	0.41
11000	-56.5	230	0.36
12000	-56.5	190	0.31
13000	-56.5	170	0.27
14000	-56.5	140	0.23
15000	-56.5	120	0.19
16000	-56.5	100	0.17
17000	-56.5	90	0.14
18000	-56.5	75	0.12
19000	-56.5	65	0.10
20000	-56.5	55	0.088
21000	-55.5	47	0.075
22000	-54.5	40	0.064
23000	-53.5	34	0.054
24000	-52.5	29	0.046
25000	-51.5	25	0.039
26000	-50.5	22	0.034
27000	-49.5	18	0.029
28000	-48.5	16	0.025
29000	-47.5	14	0.021
30000	-46.5	12	0.018
31000	-45.5	10	0.015
32000	-44.5	8.7	0.013
33000	-41.7	7.5	0.011
34000	-38.9	6.5	0.0096
35000	-36.1	5.6	0.0082

***U.S. units standard atmosphere***

This table give density in slugs per cubic foot because it uses the American system of altitude in feet, pressure in inches of mercury and temperature in degrees Fahrenheit. While people often use pounds per cubic foot as a measure of density in the U.S., pounds are really a measure of force, not mass. Slugs are the correct measure of mass. You can multiply slugs by 32.2 for a rough value in pounds.

Altitude (ft)	Pressure (in. Hg)	Temp (F.)	Density slugs per cubic feet
0	29.92	59.0	0.002378
1,000	28.86	55.4	0.002309
2,000	27.82	51.9	0.002242
3,000	26.82	48.3	0.002176
4,000	25.84	44.7	0.002112
5,000	27.89	41.2	0.002049
6,000	23.98	37.6	0.001988
7,000	23.09	34.0	0.001928
8,000	22.22	30.5	0.001869
9,000	21.38	26.9	0.001812
10,000	20.57	23.3	0.001756
11,000	19.79	19.8	0.001701
12,000	19.02	16.2	0.001648
13,000	18.29	12.6	0.001596
14,000	17.57	9.1	0.001545
15,000	16.88	5.5	0.001496
16,000	16.21	1.9	0.001448
17,000	15.56	-1.6	0.001401
18,000	14.94	-5.2	0.001355
19,000	14.33	-8.8	0.001310
20,000	13.74	-12.3	0.001267
25,000	11.10	-30.15	
30,000	8.89	-47.98	
35,000	7.04	-68.72	
40,000	5.54	-69.70	
45,000	4.35	-69.70	
50,000	3.43	-69.70	
55,000	2.69	-69.70	
60,000	2.12	-69.70	
65,000	1.67	-69.70	
70,000	1.31	-69.70	
75,000	1.03	-69.70	
80,000	0.81	-69.70	
85,000	0.64	-64.80	
90,000	0.50	-56.57	
95,000	0.40	-48.34	
100,000	0.32	-40.11	