Introduction
After two years of research and real-life tests, we are really proud to introduce the C-Probe. We are sure that it will change the meaning of “situation awareness” in the free-flight world. The C-Probe is shaped around its Pitot tube, but it contains much more than that.

Here are a few technical details about the C-Probe:

- Real Pitot tube, based on a differential pressure sensor with a resolution of 0.1 Pa.
- Three-axis gyroscope (measures up to 2000°/s).
- Three-axis accelerometer (up to 8 g per axis, with a resolution of 0.1 g).
- Gyroscope-stabilized magnetic compass (1° resolution).
- Thermometer (from -40°C to 80°C, 0.1° resolution).
- Hygrometer (from 0 to 100% RH, 0.1% resolution).
- High resolution absolute pressure sensor (10 cm).
- BlueTooth™ and cabled serial connections.
- 30 hours battery life with BlueTooth™ connection and 60 hours with serial connection.

All the data provided by these sensors can be displayed and further analyzed by our flight computers, to provide the pilot with a huge, and up to now unheard of, set of data. At present, our C-Pilot PRO can exploit the C-Probe to determine or implement the following:

- Wind speed and direction, even while flying straight.
- Instantaneous glide ratio, after calculating out horizontal air movements.
- True air speed (TAS).
- Total-energy-compensated variometer.
- Estimated cloud-base height.

Glide and speed-to-fly calculations can be performed with an extremely high accuracy and will allow the pilot to take the correct decisions and optimize his/her flight performance. As usual, other software features will be added in the future and will be made available for free to our customers.

The Compass Team

How to take care of your C-Probe
Let us give you some advices to take advantage of the features of your C-Probe and to keep it functional and in order:

- The C-Probe can be charged from any 5 V mini-USB chargers with a current output of at least 1 A. Anyway, we strongly advice using the charger provided by Compass.
- Do not place other electronic equipment too close to the C-Probe: they could disturb to or be disturbed by it.
- Do not expose the C-Probe to temperatures above 50°C (122°F) or lower than -20°C (-4°F) for
long periods. Do not leave the C-Probe in your car during winter or during the hottest months.

- In the case of accidental drop in water, do not switch the C-Probe on! In case of drop in salty water, rinse thoroughly with fresh water. Wait till everything is perfectly dry before trying to switch the device on again.

  Warning: damages due to contact with water are not covered by the warranty. Disassembling the instrument will void the warranty. Please send it back to Compass to have it checked. Tell us exactly what happened.

- Take care that the C-Probe is positioned and held in place appropriately in your flight equipment. Use the Velcro provided and the safety line. If the device falls down while flying it may cause severe damages to persons and objects. It is your responsibility to insure that it is properly held in place.

- If you are using an external power source connected to the mini USB plug while outdoor and it starts raining, please unplug it.

Getting to know your C-Probe

- **On/Off slider.** Switches on and off your unit. When you switch your C-Probe on, the green LED lights up for five seconds and then start flashing. If it does not, please recharge the unit before use.

- **USB connector.** Allows recharging the internal Li-ion battery. Two-to-three hours are enough for a full charge. During the recharge progress, the red LED will be on. It will switch itself off when the charge is complete.

- **2.5 mm Jack connector.** Outputs the data in RS232 modes (optional cable not provided).

- **Pitot tube.** Samples the total and static pressures in order to calculate your airspeed. The total pressure is sampled from the port at the end of the tube. The static one is sampled by the four
tiny holes around the tube. During normal usage, please do not cover any of them. The tube has to be aligned with the airflow. For optimal operation the alignment should be within 30°.

**Cockpit installation**

The C-Probe can conveniently be installed in your cockpit as in the following examples.

The Pitot tube is made of semi-rigid material: you can delicately bend it in order to align it to the airflow. Anyway, please, **do not bend the Pitot tube between the static ports and its tip**. Doing so may damage the unit and may lead to inaccurate measurements.

⚠️ Please be extremely careful when installing the C-Probe, especially if you fly paragliders: the Pitot tube must be positioned in such a way that it will not interfere with wing recovery following deflations or other configurations out of the normal flight envelope.

The C-Probe measures its orientation with respect to the North. This very important parameter affects the calculation of the wind speed and direction while flying straight. It is therefore necessary to align the body of the C-Probe with the flight direction, as in the previous pictures.

Please DON’T do as shown here:
Connecting the C-Probe to the C-Pilot PRO

The C-Pilot PRO can fully exploit the C-Probe to determine several flight parameters or implement accurate navigation features. Once the two are connected, C-Pilot PRO automatically recognizes the C-Probe and starts using the incoming data. There are two ways to connect the two: via serial cable (the cable pinout is shown in the Appendix) or via BlueTooth™.

BlueTooth™ connection

First of all, make sure that the BT module of your C-Pilot PRO is switched on. You should see the BT icon in the navigation page:

![C-Pilot PRO icon with BlueTooth™](image)

If you do not see it, please switch the BT module on (see the C-Pilot PRO user manual). Open the C-Probe page, from: C-Pilot PRO menu/setup/accessories/C-Probe.

![C-Probe page](image)

Data, shown in the upper half of the page, appear grayed out because no connection has been established yet.
Switch on your C-Probe, wait till the green LED starts flashing (it takes five seconds) and press the BT button. If you have already paired your C-Probe with your C-Pilot PRO in the past, you will be asked if you wish to reconnect to the same device or search for other C-Probes, otherwise C-Pilot PRO automatically starts searching and will display in a list the C-Probes found.

Select yours and press **Select Device**. C-Pilot PRO will start showing the data incoming from the C-Probe.

After the first time, the **connection can be established automatically** as soon as you switch on both the C-Probe and the C-Pilot PRO if you select the **Automatic BlueTooth** option.

The factory-default name of the C-Probes is – guess – **C-Probe**. This is how these devices are shown when searched for via BlueTooth™. If you want to be able to distinguish yours from others’, you can change the name of your C-Probe by means of the **rename C-Probe** button. The new setting will be permanently stored in the memory of your C-Probe.

**Serial connection**
The C-Probe outputs the data via its serial port at a rate of 115200 bauds: please make sure that the serial port of your C-Pilot PRO is configured at such baud rate (see the C-Pilot PRO user manual for details). After connecting the two via serial cable (not provided) and switching them on, C-Pilot PRO will automatically recognize the C-Probe and no further action is required to the pilot.

**Calibrations**
The C-Probes are individually calibrated before being shipped from the factory. Anyway they might occasionally need to be recalibrated. We have made the calibration procedures as easy as possible, but we invite you to read these few paragraphs to fully understand when and how such procedures are needed.

**Pitot tube calibration**
The Pitot tube measures the difference between the total pressure, sampled by its front port, and the static pressure, sampled by four static holes. The C-Pilot PRO exploits this quantity to calculate your indicated airspeed (IAS) and your true airspeed (TAS).

The differential pressure is determined by a state-of-the-art sensor which is accurately calibrated and temperature compensated at factory. Yet, there are two parameters that require periodical adjustments: offset and scale.

**The offset**
Even when no differential pressure is applied, the sensor will report a tiny, non-zero reading. The offset is very easy to remove: just keep the C-Probe protected from the wind and hit the **calibrate zero** button in the C-Probe page. In the absence of relative wind, even a tiny offset can yield a significant airspeed reading due to the non-linear relationship between differential pressure and airspeed.

For example, at ground level, a 1-Pascal offset translates to approx 5 km/h in airspeed. This **might seem** a significant value compared to the typical speeds of slow free-flight wings such as paragliders.
It is important to note, however, that this does not mean that measured airspeeds will be affected by a 5-km/h error! Again, this is due to the non-linear relationship between airspeed and differential pressure. Here are just a couple of examples:

- At 30 km/h, the same offset (1 Pa) will yield a reading of 30.3 km/h.
- At 60 km/h, the instrument will read 60.2 km/h.
- At 120 km/h, the instrument will read 120.1 km/h.

It is easy to see that at increasing airspeeds, the offset rapidly become negligible. Even at 30 km/h the error introduced by a 1-Pa offset is just 0.3 km/h.

If you paraglide, we suggest to recalibrate the offset only when the airspeed indicated in the absence of relative wind gets larger than 10 km/h. With such an offset, at 30 km/h the instrument would read 31.6 km/h.

**The scale**

While with conventional airspeed sensors calibrating the scale is typically a nightmare, the C-Probe and C-Pilot make this fully automatic and transparent to the pilot, thanks to our patent-pending automatic calibration system. Just go fly and the Pitot tube will get more and more accurate, automatically compensating also for effects that are very difficult to take into account, such as less-than-perfect alignment of the tube with the airflow and distorted airflow around the harness and pilot.

To take advantage of the automatic calibration, please check that the Automatic calibration checkbox in the C-Probe page is activated. Calibration is performed automatically by the C-Pilot PRO when you fly circles, i.e. while thermalling. The calculated optimal correction factor is displayed by the Airspeed correction factor button.

It is also possible to change the scale manually by disabling the Automatic calibration checkbox and entering the desired correction value by means of the Airspeed correction factor button.

**Compass calibration**

The C-Probe features a magnetometer that allows determining the hearth magnetic field and the magnetic heading.

Magnetic field sources, such as batteries, iron tools, radio/variometer speakers, etc. in close proximity to the C-Probe can introduce errors in the measurements yielding unpredictable results.

It is therefore extremely important to perform a calibration of the compass before flying! The C-Pilot PRO exploits the measured magnetic heading to determine the wind speed and direction also while flying straight: even a few-degrees error in the heading can lead to large errors in wind calculation.

The C-Probe can determine the spurious magnetic fields during the calibration of its compass and subtract them from the measured value to give an accurate heading. To this end, after activating the
calibration routine (compass calibration button in the C-Probe page of the C-Pilot PRO), the C-Probe and **all the possible sources of errors** should be rotated 360° around the three main axis of the C-Probe.

When all the rotations are completed, press the **Stop compass calibration** button.

For example, if you suspect that the speaker of the radio causes disturbances to the compass and you normally keep your radio in your cockpit, the entire cockpit should be rotated, so that the C-Probe and the radio undergo the same motion. If, after the calibration procedure, the radio and the C-Probe change their relative position, the calibration should be performed again.

**Limitation of liability**

The manufacturer reserves the right to modify the devices or the devices specifications in this manual without prior notice.

It is absolutely forbidden to use the device for different uses other than those for which it has been devised for, as inferred to in this manual. When using the features in this device, obey all laws and respect privacy and legitimate rights of others.

**EXCEPT TO THE EXTENT PROHIBITED BY APPLICABLE LAW, UNDER NO CIRCUMSTANCES SHALL THE MANUFACTURER BE LIABLE FOR CONSEQUENTIAL DAMAGES SUSTAINED IN CONNECTION WITH SAID PRODUCT AND THE MANUFACTURER NEITHER ASSUMES NOR AUTHORIZES ANY REPRESENTATIVE OR OTHER PERSON TO ASSUME FOR IT ANY OBLIGATION OR LIABILITY OTHER THAN SUCH AS IS EXPRESSLY SET FORTH HEREIN.**

All trademarks in this manual are property of their respective owners.
Safety instructions
Please read the following safety instructions carefully. Not following them may be dangerous and/or illegal. Please read carefully the user manual for further details.

- SWITCHING ON IN SAFE ENVIRONMENTS: do not switch the device on when prohibited or whenever it could cause any interference or danger.

- ROAD SAFETY: do not operate the device while driving.

- INTERFERENCE: all wireless devices may be susceptible to interference, which could affect the performance of other appliances (TV, radio, ...).

- SWITCH OFF IN HOSPITALS: follow any restrictions. Switch the device off in hospitals or near medical equipment (hearing aid equipment, pacemaker ...) the device could cause interference. Also keep a distance of 20 cm between pacemaker and device.

- SWITCH OFF IN AIRCRAFT: follow any restrictions. Wireless and digital devices can cause interference with aircraft equipment.

- SWITCH OFF WHEN REFUELLING: do not use the device at refuelling point. Switch off near petrol stations or fuel depots and chemical plants. The device could interfere with the correct functioning of the electronic equipment.

- SWITCH OFF NEAR BLASTING: follow any restrictions. Do not use the device where blasting is in progress.

- USE THE DEVICE SENSIBLY: do not use the device for any uses other than those it has been built for. Keep to the instructions as explained in the product manual.

- QUALIFIED SERVICE: only qualified personnel may install or repair this product.

- ACCESSORIES AND BATTERIES: use only approved accessories and batteries. Do not use incompatible products. The use of nonstandard products can cause damage to the device and/or people.

- AVOID GETTING THE DEVICE WET: the device is not water-resistant, keep it dry. Contact with water or any other liquid could cause serious damage to the device.

Manufacturer’s limited warranty
This warranty does not limit the user’s (statutory) rights under any applicable national laws relating to the sale of consumer products.
During the warranty period, the Manufacturer or the Manufacturer authorized service company will, in a reasonable time, remedy defects in materials, design, and workmanship free of charge by repairing. The manufacturer will, in accordance with this limited warranty (unless otherwise required by law), remedy defects by repair or, should the Manufacturer in its discretion deem it necessary, replace the product.

This limited warranty is only valid and enforceable in the country where the user has purchased the product provided that the same product has been intended for sale in that country by the manufacturer. However, if the user has purchased the product in a member state of the European Union, Iceland, Norway, Switzerland or Turkey and such product was originally intended by the Manufacturer for sale in one of these countries, this limited warranty service may apply because of country specific elements in the products.

Warranty period
The warranty period starts at the time of product’s original purchase by the first end-user. The product may consist of several different parts and different parts may be covered by a different warranty period. The different warranty periods are:

- 24 months for the device;
- 90 days for the media on which any software or the user manual is provided (es. CD ROM, DVD ...).

As far as national laws permit, the warranty period will not be extended or renewed or otherwise affected due to subsequent resale, repair or replacement of the product authorized by the manufacturer.

How to get warranty service
In the event of a product (or accessories) defect, please return it to a service company authorized by the manufacturer or to the manufacturer himself.

Any claim of the affected product (or accessory) is subject to notifying, either a service company authorized by the manufacturer or the manufacturer, of the alleged defect within a reasonable time of it having come to attention and in any event no later than before the expiry of the warranty period.

To make use of this warranty, in the event of the affected product (or accessory), it is necessary to return it to the service centre authorized by the manufacturer or to the manufacturer, together with the original proof of purchase.

What the warranty does not cover
This limited warranty does not cover the user manuals or any third party software, setting, content, data or links, whether included or downloaded in the product, whether included during installment, assembly, shipping or at any other time in the delivery chain or otherwise and in any way acquired by the user. The manufacturer does not warrant that any of its software: will work in combination, as to customer requirements, with any hardware or software provided by a third party and that the operation of any software will be uninterrupted or error free or that any defects in the software are correctable or will be corrected.
This limited warranty does not cover:

- normal wear and tear of the Product (including, without limitation, wear and tear of batteries or displays);
- defects caused by rough handling (including, without limitation, defects caused by sharp items, by bending, compressing or dropping, dropping in water, etc.);
- defects or damage caused by misuse of the Product, including use that is contrary to the instructions provided by the Manufacturer (e.g. as set out in the Product’s user guide);
- defects caused by other factors/acts beyond the reasonable control of the Manufacturer.

This Limited Warranty does not cover defects or damage caused to the Product by misuse with, or connection to, any product, accessory, software and/or services not produced or supplied by the Manufacturer or by use of the Product for any other use than for intended use of the Product.

This Limited Warranty does not cover defects caused by the fact that the battery has been short-circuited or by the fact that the seals of the battery enclosure or the cells are broken or show evidence of tampering or by the fact that the battery has been used in equipment other than those for which it has been specified.

This Limited Warranty is not enforceable if the Product has been opened, modified or repaired by anyone other than a service centre authorized by the Manufacturer, if it is repaired using unauthorized spare parts or, if the Product’s serial number has been removed, erased, defaced, altered or are illegible in any way and this shall be determined in the sole discretion of the Manufacturer.

This Limited Warranty is not enforceable if the Product has been exposed to moisture, to dampness or to extreme thermal or environmental conditions or to rapid changes in such conditions, to corrosion, to oxidation, to spillage of food or liquid or to influence from chemical products.

Other Important Notices

Please remember to make back-up copies or keep written records of all important content and data stored in your Product, because content and data may be lost during repair or replacement of the Product.

All replaced parts of the Product or accessories shall automatically become the property of the Manufacturer.

If the Product is found to be not covered by the terms and conditions of this Limited Warranty, the Manufacturer and its authorized service companies reserve the right to charge a handling fee for repairs/servicing. When repairing or replacing the Product, the Manufacturer may use products or parts that are new, equivalent to new or re-conditioned.

The Product may contain country specific elements/components/settings/software. If the Product has been re-exported from its original destination country to another country, the Product may contain
specific elements/components/settings/software that cannot be considered a defect under this Limited Warranty.

In the event of Product repair, the Manufacturer and/or authorized service companies will restore the country specific settings where the Product was destined for sale and will in no way be liable for the loss of any changes of such settings carried out by the use, which in the same way cannot be considered a defect under this limited warranty.

**Limitation of the manufacturer’s liability**

This Limited Warranty is your sole and exclusive remedy against the Manufacturer and the Manufacturer’s sole and exclusive liability in respect of defects in the Product. This Limited Warranty replaces all other warranties and liabilities of the Manufacturer, whether oral, written, (non-mandatory) statutory, contractual, in tort or otherwise, (including, without limitation, and where permitted by applicable law, any implied conditions, warranties or other terms as to satisfactory quality or fitness for purpose).

However, this Limited Warranty shall neither exclude nor limit:

- any legal rights of the user under the applicable national laws;
- any rights against the seller of the Product.

To the extent permitted by applicable law, the Manufacturer does not assume any liability for loss of or damage to or corruption of data, for any loss of profit, loss of use of Products or function, loss of business, loss of contracts, loss of revenues or loss of anticipated savings, increased costs or expenses or for any indirect loss or damage, consequential loss or damage or special loss or damage.

To the extent permitted by applicable law, the Manufacturer’s liability shall be limited to the purchase value of the Product. The above limitations shall not apply in case of gross negligence or intentional misconduct of the Manufacturer or in case of death or personal injury resulting from the Manufacturer’s proven negligence.

NOTE! Your Product is a sophisticated electronic device. The Manufacturer strongly encourages the user to carefully observe the user manual and instructions provided with and for the Product. Please also note that the Product might contain high precision displays, which could get scratched or otherwise damaged, if not handled carefully.
### Specifications

<table>
<thead>
<tr>
<th>Size</th>
<th>30 mm x 27 mm x 124 mm w/o Pitot tube; 30 mm x 27 mm x 395 mm with tube</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature</td>
<td>From -20°C to 60°C</td>
</tr>
<tr>
<td>Operating altitude range</td>
<td>From 0 to 8000 m</td>
</tr>
<tr>
<td>Connectivity</td>
<td>BlueTooth™ and serial (RS232)</td>
</tr>
</tbody>
</table>
Appendix

Serial cable pinout

C-Probe to C-Pilot PRO

C-Probe to DB9

C-Probe output strings

$PCPROBE,T,Q0,Q1,Q2,Q3,ax,ay,az,temp,rh,batt,delta_press,abs_press,C,

- "T" after "$PCPROBE" indicates that the string contains data. Data are represented as signed, 16-bit hexadecimal integers. The only exception is abs_press which is in signed 24-bits hex format.
• Q0, Q1, Q2, Q3: 3D orientation of the C-Probe in quaternion format. Heading, pitch, and roll can be calculated as follows:
  
  q0 = Q0 * 0.001;
  q1 = Q1 * 0.001;
  q2 = Q2 * 0.001;
  q3 = Q3 * 0.001;

  sin_pitch = -2 * (q0 * q2 - q3 * q1);
  If sin_pitch > 1 or sin_pitch < -1, discard the data
  pitch = asin(sin_pitch);
  heading = M_PI + atan2(2*(q1 * q2 + q3 * q0), q3 * q3 - q0 * q0 - q1 * q1 + q2 * q2);
  roll = atan2( 2 * (q0 * q1 + q3 * q2), q3 * q3 + q0 * q0 - q1 * q1 - q2 * q2);

• ax, ay, az: x, y, z components of the acceleration in units of 0.001 g.
• temp: temperature in units of 0.1°C.
• rh: relative humidity in units of 0.1%.
• batt: battery level from 0 to 100%.
• delta_press: differential pressure (dynamic – static) in units of 0.1 Pa.
• abs_press: absolute pressure in units of 1/400 Pa
• C: is transmitted only if the C-Probe is being charged. In this case, heat produced by the charging process is likely to affect the readings of the temperature and humidity sensors.

Example
$PCPROBE,T,FD92,FF93,00D9,FD18,017E,FEDB,0370,0075,00D6,0064,001C,000000,,

(q0, q1, q2, q3) = (-0.622, -0.109, 0.217, -0.744)

(ax, ay, az) = (0.382, -0.293, 0.880)

Temp = 11.7°C

RH = 21.4%

Batt = 100%

Differential pressure dp = 2.8 Pa. For an air density d=1.2 kg/m³ (at air level, for example) the speed is sqrt(2 dp / d) = 2.16 m/s = 7.78 km/h.

Absolute pressure = 0 (the absolute pressure sensor has to be enabled via software, see below)

Not charging.

$PCPROBE,COMPASSCALIBRATION
The calibration of the accelerometers and of the magnetometers is being performed

$PCPROBE,GYROCALIBRATION,n,m
The calibration of the gyroscopes is being performed. “m” is the number of steps required. “n” is the current step. The percentage of work performed is 100 * n / m.
$PCPROBE, FW,f
Firmware version. f = 0xNNMM, where NN is the major version number and MM the minor number.

$PCPROBE, NAME,s
“s” is the name of the C-Probe. When searched for as a BlueTooth device, it is found as C-Probe-“s”.

For example: $PCPROBE, NAME,Vinc means that the C-Probe will be detected as C-Probe-Vinc.

The name can be set by the user (see below).

C-Probe command input format
All the strings are case sensitive.

$PCPILOT,C,COMPCALON
$PCPILOT,C,COMPCALOFF

Start and stop compass and accelerometers calibration. To perform the calibration, the user has to send
the start command, then rotate steadily the C-Probe 360° around its x, y, and z axis (the order and the
rotation direction is not important), and then send the stop command. While the calibration is in
progress, the C-Probe will send the $PCPROBE,COMPASSCALIBRATION string.

This is needed to remove magnetic offsets. For example if the probe is placed near the speaker of a
radio or near any magnetic object. To cancel the effect of magnetic offset also the cause of the
disturbance has to rotate with the C-Probe. In the case of paragliders, it is convenient to rotate the
entire cockpit.

$PCPILOT,C,CALZERO

Calibrate the zero of the differential pressure. The C-Probe should not be exposed to wind/air
movements. It might be useful after severe changes in temperature, if the calculated air speed while
standing still is larger than 8-10 km/h.

$PCPILOT,C,CALGYRO

Calibrate the zero of the gyroscopes. While the calibration is in progress, the device should be held still
(there is no need to hold it horizontal, though). While the calibration is in progress, the C-Probe will send
the $PCPROBE,GYROCALIBRATION,n,m string. This calibration is performed at factory. It is quite unlikely
that the user will ever need to do it again.

$PCPILOT,C,SETNAME,name

Change the name of the C-Probe. If “name” is “Vinc”, for example, the C-Probe will be detected as “C-
Probe-Vinc”. The maximum length of “name” is 15 chars.

$PCPILOT,C,BAROON
$PCPILOT,C,BARIOFF

Switch on/off the absolute barometric sensor of the C-Probe. When the sensor is switched off, the
absolute pressure is reported as zero.
$PCPILOT,C,GETFW
Query the firmware version. The C-Probe answers with the “$PCPROBE,FW,f” string.

$PCPILOT,C,GETNAME
Query the name of the C-Probe. The C-Probe answers with the “$PCPROBE,NAME,s” string.