

# **Cambridge 302A/CFR Flight Recorder for Gliders Technical Manual and Specifications**

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Section:	Page #
1. Introduction	2
2. Installation	3
3. The 302A/CFR Front Panel	5
4. Hardware Block Diagram	7
5. Flight Recording	8
6. Utility Program	8
7. Flying with the 302A/CFR	16
8. Technical Specifications	18

### **Warranty**

This Cambridge Aero Instruments, Inc., product is guaranteed against defects for TWO YEARS from date of original purchase when used in gliders. The warranty is limited to faulty workmanship and/or materials. The unit must be returned to the factory or to an authorized repair station. This warranty is void if failure is due to accident, mishandling, or repairs performed by unauthorized persons. This warranty is given in lieu of all other warranties, expressed or implied.

### **Notice**

This instrument is not to be relied upon for navigation in flight. This instrument may be used with other Cambridge products as an aid to navigation performed by using required training and methods without this instrument.

## **1. Introduction**

The Cambridge Aero Instruments, Inc., 302A/CFR Flight Recorder combines a GPS receiver, barograph, and non-volatile memory in a single instrument that mounts in a standard 2.25" (57 mm) aircraft instrument panel opening. Flight logs produced by the Cambridge 302A/CFR conform to the secure flight recording requirements of the International Gliding Commission (IGC) of the Fédération Aéronautique Internationale (FAI) for competition flights and are designed for review and analysis using PC based flight reconstruction software which displays aircraft position, altitude, airspeed, and flight path.

The Cambridge 302A/CFR requires no in-flight attention from the pilot. A Pilot Event (PEV) button allows the pilot to set markers in the flight record as it is being made. An LED on the front of the instrument verifies the recorder's operational status.

Flight logs are transferred via the serial connector on the back of the instrument and a standard cable from the recorder to a laptop or hand-held personal computer. Flash memory is used for firmware as well as flight logs. Firmware upgrades are distributed via the Cambridge web site on the Internet.

The Cambridge 302A/CFR supports the 303-NAV navigation display or a PocketPC moving map system.

## **2. Installation**

The Cambridge 302A/CFR is delivered with all parts necessary for installation as follows:

1. A CFR Standard Power Cable (CAA-114)
2. A six foot (two meters) beige serial data cable (HA-349)
3. One copy of this Technical Manual and Specifications
4. One CD-ROM with all programs and documents in PDF format
5. A spare power cable (CAA-116)
6. A small screwdriver for the plug and connector strip (TL-001)
7. One GPS antenna with SMC connector (HA-435)

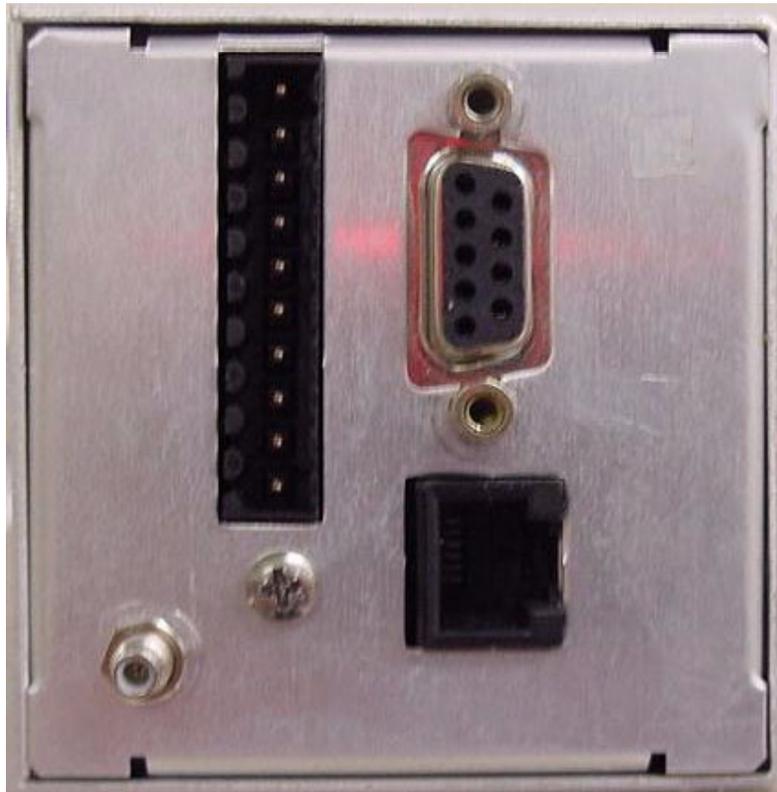
The Cambridge 302A/CFR supports an optional auxiliary NIMH battery pack (CA-117). During normal flight the instrument keeps the auxiliary battery charged. If the glider's main battery fails, the auxiliary battery maintains power to the instrument for at least two hours.

The instrument fits any standard 57 mm (2.25") round panel opening. An optional adapter is available to mount the instrument in an 80 mm (3.12") hole. When panel mounted, the serial data cable should be installed in a configuration which will allow access to accommodate transfer of data between the instrument and a laptop PC or hand held PDA.

The GPS antenna is nonmagnetic and will not interfere with the glider's compass. It is essential to mount the antenna in a position which gives it a good, unobstructed view of

the sky. Thin fiberglass instrument panel covers are transparent to GPS radio signals, allowing for the antenna to be mounted under the cover. Do not mount the antenna under the compass or near any other instrument or antenna (recommended spacing is one to two feet).

The unit can also be used in a removable or portable configuration.



**Power and Logic Connections** - A screw type 10-position connector attaches to the back of the instrument. Four of the ten pins are power related. Pin 1 or Pin 2 provide +12 volts to the 302A/CFR (see below). Pin 3 is for an optional Cambridge auxiliary battery (see below). Pin 10 is the ground connection. It is located at the TOP of the connector when fitted to the 302A/CFR. The CAA114 Power Cable (for use in the aircraft) has a pre-wired six position ground terminal strip in addition to the ground pin on the main ten position connector.

Pin 1 is for unswitched power to the 302A/CFR. If the positive terminal of of the glider battery is connected to pin 1, the 302A/CFR will be ON whenever the system switch is turned on.

Pin 2 is for switched primary power to the 302A/CFR. When the positive terminal of the battery is connected to pin 2, pressing the Pilot Event (PEV) button on the front of the instrument or pressing the ON button of the 303 display, if used, turns on the instrument.

Pin 3 is for the optional Cambridge auxiliary battery (CAA-117) only. This back up battery supplies power to the 302A/CFR in the event the glider's power fails, and it is charged from the glider's system during normal operation of the 302A/CFR. If the glider is in flight when a power failure occurs, the auxiliary battery will supply power until it is exhausted (at least two hours when properly charged). If the glider is not flying and the glider's battery fails or is disconnected, the 302A/CFR will recognize the situation and turn itself off after about two minutes of inactivity.

Note: The CAA116 spare power cable is supplied for use outside the aircraft, and it requires a 12 volt power supply. If you intend to use the 302A/CFR with a PC at home or elsewhere, an optional Cambridge 12 volt charger and adapter for the 302A/CFR is recommended (Cambridge part no. CAA140).

### **3. The 302A/CFR Front Panel**

With the instrument ON, flight recording is fully automatic, begins when the glider starts to move, and continues until at least two minutes after the aircraft stops moving. Flight logs are stored internally on non-volatile memory devices. Pilots cannot erase Cambridge 302A/CFR flight logs.



#### **Use of the PEV and LED**

Pressing the pushbutton PEV on the front of the instrument during flight marks flight events of interest on the digital record of the flight as it is made. The LED on the front of the instrument indicates instrument operation and flight logging status. The instrument can be in three possible states:

No GPS Fix: The LED stays on. The GPS receiver has not yet acquired sufficient GPS

signals to allow flight recording.

**No Motion:** The LED flashes slowly (approximately four times per second). GPS signals are OK, but flight recording is not occurring because the aircraft is not in motion.

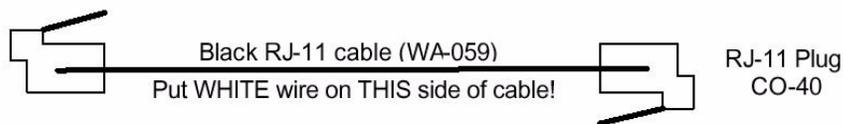
**Logging OK:** The LED flashes rapidly (approximately ten times per second). GPS signals are OK and the flight is being recorded. The flight log is annotated with UTC and the number of times the PEV button is pressed.

### **The Datacom Connector**

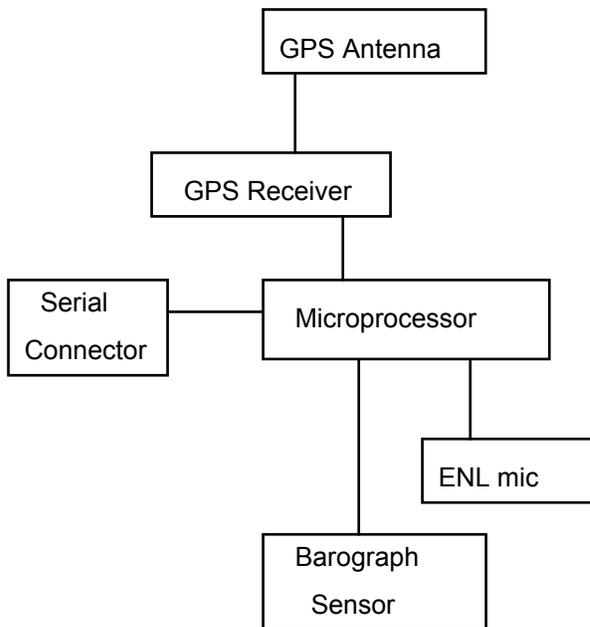
A Laptop or PocketPC connects to the 302A/CFR via a standard 9-pin serial Datacom connector located on the back. Flight logs are transferred to the PC using the "Transfer" application.

302A/CFR Flight Recorder operation is configured by the PC through the Datacom port.

The 302A also has an RJ-11 telephone type connector on the back which is used to create a link to the optional Cambridge 303-NAV display, allowing GPS position, altitude, and groundspeed data to be viewed on the display.



#### 4. Hardware Block Diagram



##### 4.1 GPS data:

A Garmin GPS-25 receiver/processor is used. It provides date/time/position, altitude, ground speed, and track. GPS data is updated 1/second. The antenna connector is type SMC. Power for the active antenna is supplied via the coaxial cable.

##### 4.2 Barograph Sensor:

Resolution is ~1 ft. at sea level. There is no tubing attachment to this sensor -- it reads cockpit pressure. Altitude is computed from absolute pressure using the ICAO standard atmosphere computed from a 5<sup>th</sup> order polynomial.

##### 4.3 Optional Engine Noise Level (ENL) Sensor:

A microphone, filtered amplifier, and amplitude detector records engine noise level.

## **5. Flight Recording**

Flight Recording with the Cambridge 302A/CFR is completely automatic and begins when (a.) the instrument receives sufficient GPS signals and (b.) the aircraft is put in motion. No pilot intervention is required. Once the GPS receiver has acquired enough satellite signals to obtain position fixes, the 302A/CFR begins logging data into a 30-second buffer. The logging interval is normally 1 second, but may be lengthened using the Utility Program (Section 6.) When the GPS derived ground speed exceeds a configurable threshold, the contents of the buffer are transferred to the flight log. As long as the ground speed exceeds the threshold value (usually 10 knots), logging continues. Logging continues for at least 2 minutes after ground speed falls below the threshold value. Logging before and after actual flight assures that take-off and landing data will be captured in the flight log.

Flight logs are divided into Flight Log Files. The time separation between logged fixes is used to decide when the instrument creates a new Flight Log File. The time separation is configured in the 302A/CFR Utility Program (Section 6). The default choice is 5 minutes. This assures that naturally contiguous flight cycles such as takeoff and landing practice are grouped into a single Flight Log file.

Cambridge 302A/CFR flight logs are stored in a stable, non-volatile memory. The Utility Program (Section 6) is used to transfer Flight Log Files from the 302A/CFR to a PC, laptop, or PocketPC. File names are based on the 302A/CFR serial number and GPS date. Up to 36 Flight Log files may be created in one calendar day.

## **6. The 302A/CFR Utility Program**

Connect the 302A/CFR to your PC using the serial cable which is provided with the instrument. In the alternative, you may connect the 302A/CFR to a laptop or PDA.

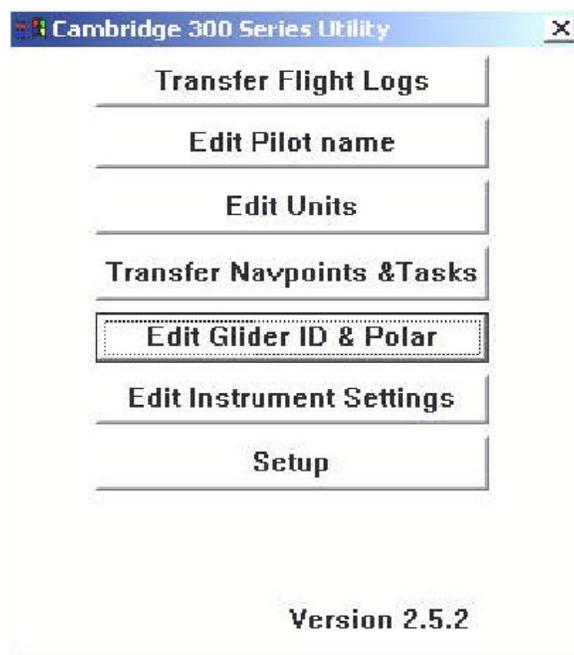
**Installation** - The software is provided on the CD-ROM which is supplied with the instrument. Select the version which is appropriate for the computer on which the program will run. The version for a PC installs in a routine manner. Double click on the executable file to start the Utility Program. Installing the Pocket PC version on a hand held PDA is more involved. Copy the program to the Compact Flash (CF), MultiMedia (MMC), or Secure (SD) card used by your hand held. With the card installed in the hand held, use File Explorer to copy the file into the "Start Menu" folder inside the "Windows" folder. The Utility program should appear in the Start Menu of your hand held. The Utility Program can also be transferred via Microsoft ActiveSync. This requires activation of file transfers from within the ActiveSync program. The advantage of CF transfer is having the Utility Program accessible even after the hand held's batteries become fully discharged.

**Operation** - Click on the "302 Utility" icon to see the Main Menu screen. Click on one of the menu buttons to access the labeled functions. Screens from the PC version of the Utility Program, Version 2.55, follow. The name at the top of each screen corresponds to the button label on the Main Menu. Click on the X box at the upper right corner of each screen to return to the Main Menu. To exit the Utility Program, click on the X box at the upper right corner of the Main Menu screen.

[Technical Note: The Utility Program releases the hand held or Pocket PC's serial dataport when it is not being used for data transfer. Leaving the Utility Program active in a hand held or Pocket PC does not result in interference with the functioning of other programs which use the hand held's or PocketPC's serial dataport.]

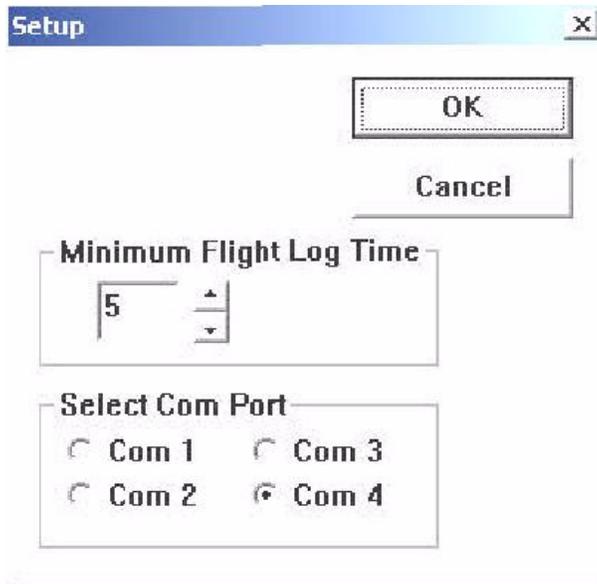
The Utility Program for the 302A/CFR uses the same software that is used for other products in the Cambridge 300 Series. Certain screen commands for the Cambridge 302 DDV flight recorder can be seen, but they are not highlighted and do not function with the Cambridge 302A/CFR. The applicable menu options are highlighted and can be selected to: (a.) set up and configure the instrument; (b.) enter the pilot's name, aircraft information, and flight declaration; and (c.) upload or download and transfer flight logs.

The Main Menu screen appears as follows:



Selection of a menu option is made by double clicking on the menu selection.

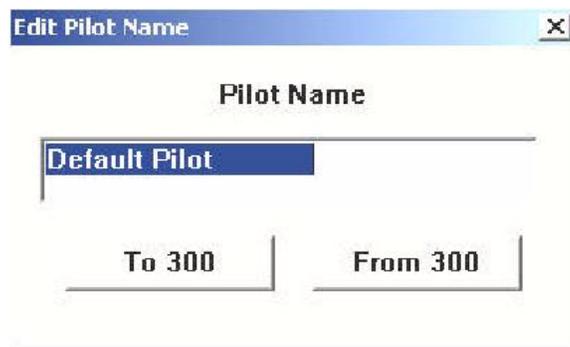
Start by clicking on "Setup." You will see the following screen:



The Minimum Flight Log Time option allows user selection of a minimum duration of flight necessary for the flight to be recorded. This feature eliminates creation of unwanted flight logs for non-flight motions of the glider for short periods of time. The Utility Program discards flight records of less time than the selected duration. The default setting for this time is five minutes.

The Setup screen also allows you to configure the serial datacom port. On most computers the serial datacom port is configured as COM 1. If this does not work, try COM 2. PC card serial port adapters are available for laptops which do not have a built-in serial datacom port. These adapters are typically configured to COM 4.

Return to the Main Menu and select the "Edit Pilot Name" option. You will see the following screen:



Copy the active pilot's name from the 302A/CFR by clicking on "From 300."

Type in a new pilot's name and send it to the 302A/CFR by clicking on "To 300."

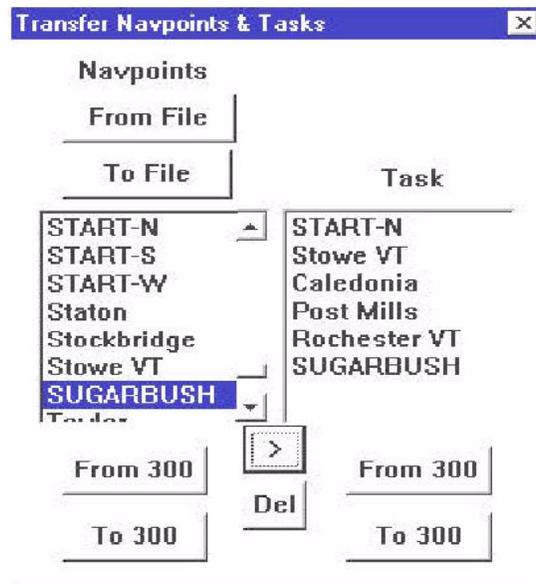
**[Note: The Utility Program deletes ALL pilot names entered via the Cambridge 303-NAV display!]**

Return to the Main Menu and select the "Edit Units" option. You will see the following screen:



Select from this screen the desired units of measurement for Altitude, Distance, and Speeds to be reported on the flight record. Click on "To 300" to send these choices to the 302A/CFR or "From 300" to obtain the current settings from the instrument.

Return to the Main Menu and select the "Transfer Navpoints & Tasks" option. You will see the following screen:



Click on "From File" to open a standard Microsoft browse window where you can select

a desired navpoint database file. A complete list of navpoint database files is provided on the Cambridge CD ROM which is supplied with the 302A/CFR. Navpoint database files can also be downloaded from links on the Cambridge web site ([www.cambridge-aero.com](http://www.cambridge-aero.com)). In the alternative, go to <http://acro.harvard.edu/SOARING/JL/LTP> and download a navpoint database for your gliderport. Click on "To 300" to transfer the navpoints to the 302A/CFR.

Navpoint databases can also be transferred from the 302A/CFR to the PC. Click on "From 300" to transfer a navpoint database from the instrument to the PC and view it on the screen. Click on the "To File" button to save the database in the PC. This technique also can be used to copy navpoint database files from one 302A/CFR to another.

You can also use this screen to declare a badge or record Task. Select "Task Navpoints" in the left window and click on the ">" button to move them into the right window. To delete a Task Navpoint, select it and then click on the "Del" button.

Return to the Main Menu and select the "Transfer Flight Logs" Option. You will see the following screen.



The Utility Program retrieves available Flight Log Files from the memory of the 302A/CFR. The most recent flights are listed at the top. The date and time when the flight started, duration in minutes, and pilot name are listed for each flight. To transfer a Flight Log File from the 302A/CFR to the PC, highlight the file and click on the "Transfer" button, or double click on the highlighted file. A prompt will ask you to browse for a folder into which the file is to be transferred. Flight Log File names conform to the standards required by the IGC. File transfer progress is shown at the bottom of the screen.

**[Note: Files are not saved unless you select "Transfer" or double click on the Flight Log File!]**

The "Verify Files" button is used to verify the security of a Flight Log File. Click on this

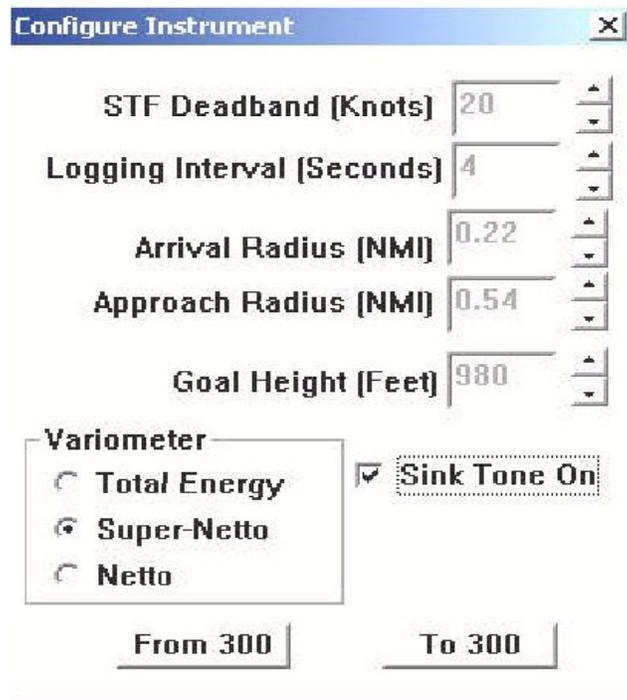
button and then highlight the file you wish to verify. The Utility Program will indicate whether the file passes or fails the security check.

Return to the Main Menu and select the "Edit Glider ID & Polar" option. You will see the following screen:

Type	ASW-20		
ID	asw		
Best L/D	40	Wing Area [Sq. M]	10.5
Best L/D speed kph	100	Dry Wt. Kg	350
V2, spd at 2m/s sink kph	175	Liters water	100
<input type="checkbox"/> Lock Configuration			
From File	To File	From 300	To 300

Enter the highlighted Type and ID information for your aircraft and click on the "To 300" button to send this data to the 302A/CFR. To determine what data is currently stored in the 302A/CFR, click on the "From 300" button. The "From File" and "To File" buttons allow this information to be stored in, or downloaded from, the PC as well.

Return to the Main Menu and select the "Edit Instrument Settings" option. You will see the following screen:



The first option on this screen which pertains to the 302A/CFR is the selection of a Logging Interval in seconds. A four second logging interval is recommended, since the 302A/CFR has a large flight log memory. Logging is completely automatic. Do not worry about running out of memory; the 302A/CFR memory loops once maximum storage of data is reached, so that the oldest log in memory is automatically erased and written over to make space for the newest flight log. Next, select the Arrival Radius and Approach Radius for your declared flight task. To get the current setting, click on "From 300." To send a new setting to the instrument, click on "To 300." The other menu options are visible but do not apply to the 302A/CFR.

**Troubleshooting** - Communication problems may occasionally occur. Check to make sure all connections are tight and correct. If you get an error message during any of the operations requiring communications, check that no other program is using the communications port.

When using the 302A/CFR with a PocketPC, you must QUIT any Windows CE Navigation program by selecting QUIT on the main menu; otherwise, the Utility Program will be unable to communicate with the Pocket-PC. If the PocketPC memory card is full and you try to transfer a flight log to it, both the PocketPC and the 302A/CFR will "crash." To clear this condition, reset the Pocket-PC and turn off power to the 302A/CFR, wait ten seconds, then turn it back on.

## **7. Flying with the 302A/CFR**

Cambridge Aero Instruments, Inc., pioneered secure GPS flight data recording for gliding competitions and for IGC/FAI certified badge and record flight certification. Working in cooperation with the IGC, Cambridge defined the basic security provisions for this class of instruments and wrote the draft specifications for the .IGC file format now required for all IGC approved secure flight data recorders. The complete IGC technical specification documents can be accessed at [www.fai.org/gliding/gnss/tech\\_spec\\_gnss.asp](http://www.fai.org/gliding/gnss/tech_spec_gnss.asp).

Since the IGC standards for GNSS (Global Navigation Satellite System) based flight recorders were first formulated in 1997, numerous modifications and improvements have been made. The original Cambridge GPS-NAV continues to be the premier GPS navigation and secure flight recording instrument for gliding, even though it no longer complies with the latest IGC technical specifications.

The Cambridge 302 Direct Digital Variometer (DDV) introduced state-of-the-art secure flight data recorder technology which complies fully with current IGC specifications, together with flight planning and computing features designed to give glider pilots a competitive edge. The 302A/CFR makes available the flight data recorder technology incorporated in the 302 without the digital variometer, flight planning, and computing features which make the 302 the preeminent instrument for competitive gliding today. Like the 302, the Cambridge 302A/CFR maximizes reliability and minimizes hassle, and its operation is completely automatic. This is in distinct contrast to other GNSS flight recorders which require clearing memory to avoid loss of flight data. When the 302A/CFR is properly installed and sufficient GPS signals are being received, absolutely no pilot intervention or care is required to accurately and completely log a flight.

Flight recording begins automatically when the glider begins to move. Pre-takeoff fixes are automatically logged as soon as the aircraft is in motion. Flight recording continues for the duration of the flight and continues for several minutes after the glider stops moving. The 302A/CFR can record more than 100 hours of glider flight at four second intervals. When the instrument's memory is full, it automatically deletes the oldest flight record and saves the newest flight data.

The 302A/CFR flight log preserves accurate date and time information received from GPS satellite transmissions, using Universal Coordinated Time (UTC), in addition to position and altitude data. The 302A/CFR uses time data to create a new Flight Log File anytime a gap in logged points greater than five minutes occurs. The "header" of a Flight Log File preserves data identifying the pilot, the glider, and the declared flight task. Header information can be accessed and edited from flight to flight using the Cambridge 303-NAV display and compatible programs using a PC or the Cambridge Pocket-PC. Header data is stored with each Flight Log File, so that pilot name and task declarations can be changed from flight to flight.

The Cambridge 302A/CFR provides for annotating Pilot Events (PEV) in the flight log. This is done simply by pressing the PEV button on the face plate of the instrument.

**Troubleshooting the 302A/CFR** - The 302A/CFR requires sufficient signals from GPS satellites (at least three) to operate correctly. Occasionally and in certain geographic locations GPS satellite coverage is insufficient to provide the required signals. Some other possible problems are:

A. No GPS position fixes in the flight log - If the flight log contains only pressure altitude recording, the GPS receiver probably is not working properly. Check to make sure the LED on the front of the instrument is flashing rapidly, an indication that adequate signal strength is being received. A marginally functioning GPS antenna or antenna mounting will cause interruptions in GPS logging.

The time required to lock in satellite signals depends on how long the GPS receiver has been off:

Less than 2 hours = 30 seconds to lock on

More than 2 hours but less than 30 days = up to five minutes to lock on

More than 30 days = up to 20 minutes to lock on

Note: Relocating the instrument to a new geographic location while it is off can require up to 20 minutes for the GPS receiver to find and lock onto sufficient signals when it is turned back on.

Occasionally the receiver will fail to lock onto the GPS satellite constellation. Turn the instrument off, wait ten seconds, and turn it back on to clear this fault. The GPS receiver may require up to 20 minutes to get a 3-D fix when it is in this "search the sky" mode.

B. The instrument fails to generate screens or to record a flight - Check all connections. If the unit does not process data properly, the microprocessor may have failed. Return the instrument to your dealer or to the factory for servicing or repair.

## **8. Technical Specifications**

Case Dimensions: 63 mm (2.48 inches) square x 136 mm (5.35 inches) long  
[Note: 9-pin datacom cable connector extends 50 mm (2 inches) behind case]

Weight: 470 grams (18 oz.), including connectors and GPS antenna.

Power supply: 8-16 Volts DC

Current at 12 volts: 350 mA

Standard Sensors:

GPS Date, Time, Position, Altitude, Ground Speed

Pressure Altitude (-1000 ft to 55,000 ft)

Optional Sensors:

Engine Noise Level

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