Version 01 / 2004

GPS FLIGHT DATA RECORDER

ZANDER / SDI GP 941

MANUAL

content: page

Warning:

The recorder box must not be opened! A security feature will inhibit any valid recording after box was opened! The standard two year warranty is expired when box was opened!

This note does not apply to the battery compartment which is located next to the power supply connector and may be opened to replace the 9 Volt battery.

1. Introduction:

The flight data recorder GP941 (= „FDR“, „recorder“) consists of one housing with these functions inside:

- GPS receiver
- barometric altitude sensor
- electronics for recording and storing data
- microphone circuit for gliders with engine
- a Lithium battery 3.6V for data retention
- a 9V battery for data transfer between recorder and IBM compatible computer (= „PC“)

Externally connected are GPS antenna and connection to ZS1 which provides supply power to FDR.

The GP941 is intended to be used as a part of the glider computer ZS1 system; together with this glider computer the GP941 has these additional features:

- GPS data transfer to ZS1
- automatic photo sector signal to GP941
- declare and transfer a task from ZS1 to GP941
- waypoint lists and routes can be entered into recorder and brought to the glider, where these informations can be transferred to ZS1
- transfer of additional data from ZS1 to recorder which are included in the stored flight data: indicated airspeed, wind information, next waypoint selected.

Old glider computers SR940 and SR820D can be connected to GP941; for these glider computers see manuals GP941_e or MANFR03E.

For glider computers from other manufacturers or a palm PC this function can be used:

- NMEA data output with GPS data, barometric altitude and GP941 serial number

The GP941 also can also be used as a stand alone system without any glider computer connected. But in this configuration there is no information on reaching waypoints. To check GPS function of the recorder, this feature can be used:

- output for external light emitting diode (LED) mounted within the instrument panel

2. Installation into glider:

The GP941 recorder should be fixed to the glider, so that it can be removed easily.

If a glider computer is used with the recorder it is not necessary to see the blinking LED or hear the beeper of the recorder during flight. GPS function will be checked with the display of the glider computer. Without glider computer the blinking LED should be visible or an external LED should be mounted within the instrument panel.

For gliders with engines there is no special mounting necessary, as a microphone within the GP941 will record the noise level which is nearly independent of place for the recorder.

The power for GP941 is supplied via the connection to ZS1. The GP941 starts recording when the avionic main switch is turned on.

The GPS antenna is mounted horizontally. The antenna must have a undisturbed view all around. Metal, carbon parts and human body will hold off GPS signals from the satellites, glas fiber and acryl glas will not. A good place for the antenna is just under the cover of the instrument panel.

For cabling see cabling diagrams in ZS1 manual.

3. Turning on the GP941:

After turning on supply power to the recorder there is an acoustic signal from the recorder to show that it is operating:

2 x beep **= flight data recorder starts recording**

The red light (light emitting diode, LED) shows:

• • • • • • • • ... **= no GPS reception**

After about 2 minutes (glider away from buildings, GPS antenna unobstructed) the light emitting diode changes to:

• • • • • • ... **= GPS reception**

With a glider computer connected, the checking of GPS operation is done by watching the displayed GPS information: if GPS information is present then the recorder is functioning properly.

As soon as the recorder is supplied with power, data recording starts. Every four seconds a point is stored. Without GPS reception only time and barometric altitude are recorded, with GPS reception position and GPS altitude are recorded too. A record ends by turning off the power and leaving it off for more than 5 minutes or by establishing PC connection.

Short power cuts will not end a record.

Important:
The GP941 records always when power is applied; recording is active on the ground as well as in the air, independent of speed or altitude.

During PC connection there is no recording.

Recording within the GP941 is done in that way that the last 70 hours of recording time are always kept in the recorder. Flight data cannot be deleted, but the oldest flight data are overwritten by new flight data.

Begin and end of any recording are stored in a separate list within the GP941. This list will keep the last 200 records. With GPS reception, times for takeoff and landing are automatically inserted into this list (first takeoff and last landing).

If the GP941 was not used for more than 4 month or the position has changed for more than 500km compared to the last recording, it may take a longer time until GPS reception is available. After first reception the GP941 should be kept running for more than one hour, so that the GPS receiver can adapt to the new conditions. **This first recording should not be used for FAI or competition purposes**.

4. Connecting GP941 to PC:

The PC used must be IBM compatible and must have Windows 95 or later.

For installation of PC programs run the self unpacking file winzanXX.exe (XX = version number). The unpacked files are written to a new folder C:\Programme\WinZANXX. That means that every installation of a new version will get its own folder WinZANXX.

Important: you have to change the link to the WinZAN program on your desktop after every new installation to the new folder WinZANXX! Otherwise you will continue to use an old program version even if there is a new version on the PC.

Note: the installation of WinZAN is not areal installation. As files are only copied, the new folder may be renamed, copied or deleted at any time.

Connection from PC to GP941 is by a serial COM port. If no serial port is available, a special cable "USB-to-Serial Converter" is available in computer shops. With this special cable you get a CD with driver information; check that this CD supports your operating system. This cable gets a COM port number assigned during installation which is visible with the system manager information.

As there are many programs with automatic access to the serial port if it is present, it is recommended to use the "USB-to-Serial Converter" cable even if a serial port is available.

For connection to a COM port use the 9 pin to 9 pin extension cable which is plugged into the 9 pin socket besides the light emitting diode. Supply power to GP941 while communicating with a PC is provided by the 9 volt battery within GP941 accessible on the antenna connector side. This battery supplies power to GP941 for about 20 hours of communication to a PC before it should be replaced.

Power supply to GP941 can also be provided by the 12 volt supply from ZS1. As soon as the PC starts communicating the flight data recording function stops.

After start of WinZAN program the COM port number and the language can be changed. After that subprograms can be started. Subprogram WinZAN02 is used to read flight data from GP941 or to enter personal data into GP941. Flights can be evaluated with subprogram WinFDR32 (for ZAN files only).

Before using GP941 for flight data recording, the name and glider information should be entered into the recorder:

<u>To enter name and glider id into recorder:</u>
start program WinZAN; select COM port, language and press „o.k.“ button
select subprogram WinGP02.exe from the list and start it
with "special / personal data / write to GP" enter data into GP941
read back data for checking

<u>To read flight data from recorder:</u>
prepare a folder for flight data (must be on the same drive as the WinZANXX folder)
select subprogram WinGP02.exe
with "file / flight data / read from GP" read and save flight data

<u>To show flight:</u>
select WinFDR32.exe from list and start it
click on folder symbol
open flight data from the folder of your choice (ZAN files)
recorded flight data will be displayed

With WinGP02 you also can write waypoint lists, edit them, transfer them into GP941 or read them from GP941. You also can set up routes and save routes in a route file.

A short description of the waypoint and routes organization for the glider computer ZS1:

A waypoint list may have up to 990 entries. A route may have up to 20 entries selected from this list. The ZS1 uses five sets of routes (A, B, C, D and E). Each set of routes may contain up to 8 routes.

A route file consists of one set of routes with up to 8 routes.

The GP941 is prepared to store five sets of routes (number 1 to 5). These five sets of routes can be transfered to ZS1 five sets A to E.

Important: the routes always rely on a waypoint list. The same waypoint list which was used for assembling the routes must also be present in ZS1 to be able to use the preselected routes. The waypoint list must start with waypoint number 001 in ZS1.

If a route file is made up, one of the 8 routes of this file can be used for task declaration within GP941 using subprogram WinGP02.

Before reading back a flight declaration just after writing, you have to wait for 6 seconds.

Note:
Tasks must be declared always in this sequence: takeoff point, departure point, turnpoint(s), finish point, landing point. If takeoff point and departure point or finish point and landing point are the same, these points must be entered twice.

It is easier to enter the task with glider computer ZS1.

Important:
all entries made into GP941 for ZS1 purposes do not influence the recording of flight data; the GP941 is used for transport of data to the glider only. Entered waypoint list and route do not influence the task declaration within GP941 and are not used for information when rounding turnpoints.

5. How to use GP941:

Here are some suggestions for pilots and competition organizers:

<u>Flights during central competitions:</u>

Before takeoff waypoints must be loaded into ZS1. The coordinates of the waypoints must be exactly those which are used for the given tasks. Use only waypoint lists provided by the competition organizers!

Enter name, competition class and competition number into GP941.

Select the correct GPS alarm (Photo sector or circle) at glider computer ZS1.

The recorder must be turned on in time before takeoff, so that GPS reception is already active before takeoff.

In the air any point can be stored acurate by one second when the marker button is pressed and if the marker button is installed. These marks are in addition to the standard 4 second fix interval. Pressing the marker button also initiates a sequence of 10 more measurements with 1 second interval.

If ZS1 announces entering the photo sector or circle, an automatic mark signal is transmitted to the recorder, which adds 10 additional fixes with 1 second interval to the recording. This automatic mark signal is transmitted only once when entering the photo sector or circle.

After landing the recorder is turned off and is removed from the glider.The competition organizers will read the flight data from the recorder and evaluate the flight.

<u>Flights in a decentralised competition (recommendation):</u>

Before takeoff there should be done a written declaration signed by an official observer. This flight declaration must contain:

date of the intended flight
full name of the pilot
type of glider, competition class, glider registration number
used GNSS flight data recorder: manufacturer, type, serial number

The declared task can be written on the same paper or the flight declaration is marked with „task as written into flight data recorder“. If the task is done by writing then the task within the recorder should be ignored. If a task is declared by writing, the coordinates of all given points must be on the declaration. Only the coordinates are used for evaluation, the turnpoint names will be ignored.

This declaration is signed by the official observer and the pilot with date and time. The time is important to find out the latest valid declaration if several task declarations were done by writing.

The official observer takes care, that the named pilot with the named glider had the named recorder on board when taking off. The takeoff time must be noted.

If the task in the recorder is the valid task, this task can be changed up to the time of takeoff. The task change can be done by ZS1 or by PC.

After landing the task flown is written on the flight declaration and it must be marked if that was the declared task. The pilot signs this statement.

Takeof time and landing time are also written to the declaration. These important times must be confirmed by an official observer, as these times will tell, if the named recorder was used on this flight. If the flight ended with an outlanding then only the takeof time will confirmed.

Flight data can be read by any person from the recorder. A diskette with these data and the written declaration is send to an authorized evaluation center, where the flight data are checked for validity and the flight is evaluated.

The personal information written into the recorder should be ignored as pilot and glider information is always part of the written declaration. This would allow that the recorder can be used in other gliders or by other pilots who have no PC readily available to change these information.

FAI rules allow that task declarations can be made on paper or by entry into the recorder or both; the valid task declaration is always the last before takeoff. But this requires that the time must be written on the declaration paper when signing it.To avoid misunderstandings it is recommended to use only one type of declaration: by writing or by entry into the recorder.

FAI flights:

For FAI flights (world records, badges) with GNSS flight data recorders these informations are required:

Date of declaration

Time of declaration
Date of intended flight
Name of the pilot
Signature of the pilot
Type of glider
Registration number of glider

Manufacturer and type of flight data recorder	= ZANDER/SDI GP941
Serial number of flight data recorder	
Geodetic datum used	= WGS 84

Task: (Name and coordinates)
  takeoff point
  departure point
  turnpoints
  finish point
  landing point

Barometric pressure (QNH) at takeoff time
Elevation at takeoff
Takeoff time

Landing point
Landing time
Barometric pressure (QNH) at landing time

Name and signature of official observer

Valid calibration table of flight data recorder altimeter

6. NMEA Output:

The GP941 has two NMEA data outputs. These data can be used by some glider computers from other manufacturers or by palm PCs with programs to show airspace or map information.

The NMEA data transmitted by GP941 are these:

$GPRMC, ... RMC sentence with GPS data
$PZAN1,0123,ZAN1AA*cc barometric altitude (meter) and serial number of GP941

One NMEA output is connected to pin 8 of the power supply connector. Via the data cable to the glider computer this signal is brought to the instrument panel for further use. The GND connection is the minus of the 12V power supply battery.

Another NMEA output is available at pin 2 of the PC connector during flight data recording. The same pin is used for PC connection. Pin 5 of the PC connector is GND. So a palm PC serial cable can be plugged directly into the PC connector of GP941 to use the NMEA signal.

A palm PC connected to the PC connector of GP940 can also be supplied with external power. Within the GP941 there is a connection from pin 8 of the PC connector to pin 3 of the GP941 power supply connector. Via a modified data cable from GP941 to ZS1, a palm PC supply voltage can be brought to pin 3 of the power supply connector and from there to pin 8 of the PC connector.

So a palm PC connector to be plugged into the PC connector of GP941 should have these pin assignments:

Pin 2	RX-PC	
Pin 5	GND	
Pin 8	optional:	external power supply for palm PC (supplied at pin 3 at the the power supply connector side)

7. Technical data:

mechanical dimensions:	76 x 33 x 109 mm
weight	300 g
external power supply	10...14V / 120mA
operating temperature	-20...+60°C
GPS receiver	12 channel
geodetic datum used	WGS-84

Flight data recording:

recorded signals	time, barometric altitude, GPS position, GPS altitude DOP, 2D/3D, engine noise level with ZS1: indicated airspeed, measured wind, next WP
recording interval	4 seconds 10 x 1 second when pressing marker pushbutton
barometric altimeter:	
range	-500...+10 000m
resolution	1m
resolution of position	0.25 angular seconds
RAM memory	0.5 MB
recording time	70 hours
recording rate	typical 6.5 KB/hour
engine running sensor	microphone (sensor is standard in GP941)
Lithium battery 3.6V	fixed, for data retention (life time about 15 years)
9V battery	standard alkaline battery, replaceable for about 20 hours of data transfer to/from PC

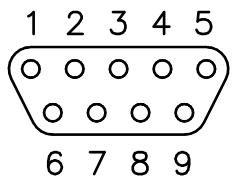
Note:

If the GP941 is not used for a longer period of time, it is advisable to remove the 9V battery to avoid damage due to leaking acid from the battery. If new battery is inserted, use plastic bag again to guard against leaking battery. The battery compartment is located besides the plug for power supply.

Use a new 9V battery when starting into a new gliding season.

8. Pin assignments of connectors:

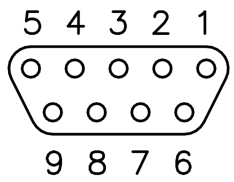
external power supply, connection to SR940



1 not used
2 ground/case/minus
3 charging +14V
4 marker switch — Minus
5 Recorder +12V
6 SR–RX
7 SR–TX
8 used
9 ext. LED — +12V/10mA

connection to ZS1:
only pins 2, 5, 6, 7 are used

connection to PC



1 not used
2 PC–RX
3 PC–TX
4 PC–DTR
5 ground/case/PC–GND
6 not used
7 PC–RTS
8 not used
9 not used

9. Calibration chart for altimeter of GP941:

According to FAI rules an altimeter calibration chart of the recorder must be used for altitude evaluation of recorded flights.

If altitude differences are relevant to a claimed flight, the calibration chart must not be older than two years or a calibration must be done within one month after the flight. Altitude differences are important for all flights, where the difference between release altitude and landing altitude is not much less than 1000m and for altitude gain flights.

If absolute altitude is concerned, the calibration chart must be not older than two years and a calibration must be done within one month after the flight. This is important only for absolute altitude world records.

The calibration chart can be done by the manufacturer of the recorder or by any institution certified by the national aero club.

To get an altitude trace of the GP941, the recorder must be put into a vacuum chamber and be suplied with 12V / 120mA (minus = pin 2, plus = pin 5 of 9 pin plug at the rear of the box besides the antenna connector - see „10. Pin assignments of connectors“). The GPS antenna is not connected.

When power is applied the GP941 starts recording. Now the ambient pressure is changed in steps from 0m to 10000m. As the recording rate of the GP941 is one sample every four seconds, the ambient pressure should stay enough stable at each step to get a good reading. Maximum calibration altitude is 10000m.

If it can be managed to operate the marker switch from the outside, the altitudes can be marked with one second acuracy. These marks can easily be found later in the data file for evaluation.

After all altitude steps were recorded, a PC can be connected to the 9 pin socket at the front besides the red light. Recorded flight data are read by DATA-ZAN.EXE.

Flight data can be converted to IGC format by CONV-ZAN.EXE. The IGC file is an ASCII file where altitude readings can be found easily. If the marker switch is used, the altitude belonging to the mark is always the next reading after the mark. Each „B“ line represents a reading:

B hhmmss ggmm.ddd N gggmm.ddd E V hhhhh ggggg iii nnn rr
(hhmmss = time, hhhhh = altitude reading)

Annex:

FAI approval for GPS flight recorder ZANDER / SDI GP941

The most important points are:

Required firmware version (program inside of flight recorder): version 2.04 or later
The version is shown when reading flights from flight recorder with PC; older versions must be upgraded by manufacturer for FAI approved flight validation.

Required hardware version: version 2 or later
The hardware version is the number left of decimal point of firmware version number; all GP941 produced until now have the hardware version number 2.

PC software: (DOS programs)

DATA-ZAN.EXE	version 18	dated Sept. 6, 2001	(to read flight data from FDR)
VALI-ZAN.EXE	version 18	dated Oct. 11, 2001	(to validate flight data files)
CONV-ZAN.EXE	version 18	dated Sept. 5, 2001	(to convert ZAN files to IGC files)

For FAI flight validation these versions or later versions of these programs must be used. Older versions of these programs must not be used for FAI purposes

Note: the DOS programs listed above are also valid for the old ZANDER GP940 flight recorder; so these programs replace the old DOS programs made for GP940.

The latest version of these DOS programs are available from IGC GNSS homepage.

Reading flights: in presense of an official observer
For FAI validation both ZAN and IGC files are necessary; one diskete with both files will be kept by the official observer, one diskette is for the pilot.

Position of GP941 within glider and type of fixture to glider: no requirements
The official observer has to check which type of recorder and which serial number is in the cockpit during takeoff.

Monitoring engine run in glider: by microphone
A test run of engine at the beginning or the end of the flight is not necessary for FAI purposes

Pressure altitude calibration: at this time every two years at the manufacturer or other institutions accepted by the national aero club. Maximum calibration altitude: 10 000 m.

Maximum flying altitude for FAI flight validation: 10 000 m

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THE FAI INTERNATIONAL GLIDING COMMISSION (IGC)
GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)
FLIGHT RECORDER APPROVAL COMMITTEE (GFAC)
References:
FAI web site: http://www.fai.org
IGC web site: http://www.fai.org/gliding
IGC GNSS web site: http://www.fai.org/gliding/gnss
IGC GNSS site for software: http://www.fai.org/gliding/gnss/freeware.asp
To: FAI for IGC email mailing list
Internet newsgroup rec.aviation.soaring
IGC GNSS web site under "List of Approvals"

Copy: Manufacturer concerned

30 October 2001

IGC APPROVAL
FOR ZANDER/SDI GP941 GNSS FLIGHT RECORDER

(i) This document gives formal approval from the above date for the undermentioned GNSS FR equipment to be used for validation of flights under the FAI Sporting Code Section 3 (Gliders and Motor Gliders), subject to the conditions and notes given later. IGC reserves the right to alter this approval in the future.

(ii) GFAC tests are concerned primarily with data accuracy, security, data transfer, conversion to and conformity of the output data with the standard *.IGC file format. Other aspects of the equipment may not be tested and are a matter between the FR manufacturer and customers.

(iii) The attention of NACs, officials and pilots is drawn to the latest edition of the FAI Sporting Code Section 3 (Gliding) including its annexes and amendments. Annex A to this code (SC3A) deals with competition matters, annex B to the Code (SC3B) deals with equipment used in flight validation, Annex C to the Code (SC3C) consists of guidelines and procedures for Official Observers, pilots, and other officials involved in the flight validation process. Copies of all of these documents may be obtained from the FAI/IGC web sites listed above and links are provided from the IGC web site. A separate document published by FAI is entitled "Technical Specification for IGC-Approved Flight Recorders" and is available through the IGC/GNSS web site shown above.

(iv) It is recommended that a copy of this approval including its two annexes is kept with each unit of the equipment.

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(Note that Zander is responsible for electronic design, FR firmware, PC software and IGC approval matters. Streamline Digital Instruments (SDI) of Staudach, Germany, is responsible for mechanical engineering and production. For matters concerning this approval for the GP941, contact should be made with Zander in the first instance, as shown above).

EQUIPMENT:

HARDWARE
Hardware Versions. Version 2 or later. This is shown in the header record of IGC-format flight files in the form "HF RHW Hardware version: 2".
Dimensions, connectors, light indicator. The FR consists of a rectangular metal case about 107 x 75 x 30 mm in size, weight of about 320 grammes. A 9mm circular BNC bayonet antenna connection is on one end together

with a male 9-pin RS232 connector, and a female RS232 on the other end together with a small red light indicator.
GPS receiver board. Garmin GPS25 parallel receiver capable of receiving data from up to 12 satellites for any one fix.
Pressure altitude sensor. Intresema (Switzerland) MS 5534A, compensated for temperature variation. The FR case is vented to atmosphere and records "cockpit static" pressure.
National regulations. These may apply to electrical and electronic equipment, such as the EC "CE" mark for compliance with EC directives on EMC and voltages. Compliance with such regulations is not the responsibility of FAI. This equipment has the EU CE mark.

FIRMWARE
Version 2.04 or later. This is shown in the header record of IGC-format flight files in the form "HF RFW Firmware Version: 2.04"

SOFTWARE
Program file functions. The short program file DATA-ZAN.EXE is for transferring flight data from the FR to a PC and automatically produces a *.ZAN binary file and an *.IGC file for the last flight, leaving a menu on screen for transfer of other flight data. The file CONV-ZAN.EXE is for conversion of a *.ZAN flight data file to the IGC format, if the IGC file is not available, or as a later check of the IGC file. The file VALI-ZAN.EXE checks the security and integrity of an *.IGC file, and ensures that data that is designed to be secure has not been altered since it was transferred from the FR.
Versions to be used. For correct operation, Version 18 or later of the program files must be used. The initial release date was 6 September 2001 for the V18 DATA and CONV programs, 11 October 2001 for the VALI program. These program files are backward compatible with the earlier Zander GP940 recorder.
Free availability. The DATA, CONV, and VALI files are copyright of the FR manufacturer but are freeware. The latest versions may be obtained from the IGC GNSS Internet site for software or through the IGC/GNSS site through a link. See the site titles given at the beginning of this document.

CONDITIONS OF APPROVAL:

Permitted Connections. The position of the connectors is described above under Hardware.

1.1 External antenna to 9mm circular BNC bayonet connector.

1.2 Custom-wired 9-pin RS232 female connector to the15-pin male connector on the case. For power, Pilot Event (PEV marker) button, also connection to a glider computer or display unit where available.

1.3 Male 9-pin RS232 connector to the15-pin female connector on the case, for transfer of flight data to and from a PC.

1.4 Extra peripheral units such as displays have not been tested as part of this IGC-approval and are a matter between the manufacturer and customers.

Security of the Equipment. GFAC is presently satisfied with the physical and electronic security of this equipment. See para 4 on security seals.

Installation in a glider. The FR may be fitted anywhere in the glider, subject to para 3.2 on sealing and that in Motor Gliders the position is suitable for recording Engine Noise Levels (ENL). If the GPS antenna is accessible to the crew in flight, no attempt must be made to inject data; any abuse of this may lead to a future requirement to place the antenna out of reach of the flight crew. Particularly in single-seat gliders, the position of any ancillary displays connected to the recorder should not be remote from sight lines used for pilot lookout and scan for other aircraft and gliders.

Motor gliders. A microphone and frequency filter and weighting system automatically produces an ENL (Engine Noise Level) value with each fix. ENL figures vary between 000 and 999 in steps of 004. The system is designed to emphasise any engine noise but at produce only low ENL values in normal quiet gliding flight. The FR should be positioned in the glider so that it can receive a high level of engine and/or propellor noise when power is being generated. GFAC has tested the FR in motor gliders with two-stroke and 4-stroke engines, but not with Wankel or electric power sources. For details of typical ENL values, see para B.4.
Electric engines. If an electric engine is to be used, GFAC should be notified beforehand so that tests can be carried out in order to establish ENL values.

Sealing of data ports and plugs: no present requirement, but no attempt must be made to pass unauthorised data into the FR.

Check of Installation in the Glider. There must be incontrovertible evidence that the particular FR was present in the glider for the flight concerned. This can be achieved either by observation at takeoff or landing or by sealing the FR to the glider at any time or date before takeoff and checking the seal after landing.

Observation of Installation before Takeoff or at Landing. The recorder may be sealed to the glider in accordance with 3.2. Otherwise, either a pre-flight check of the installation must be made and the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the FR installation is checked. This is to ensure that the installation is in accordance with the rules, and that another FR has not been substituted before the data is transferred to a PC after flight.

Sealing to the Glider before Flight. . If direct observation under para 3.1 cannot be achieved, the FR must be sealed to the glider by an OO at any time or date before flight so that it cannot be removed without breaking the seal. The sealing method must be acceptable to the NAC and IGC. Paper seals must be marked in a manner such that there is incontrovertible proof after the flight that seals have not been tampered with, such as by marking with the glider registration, the date, time and OO's name and signature. It should be possible for the OO to recognise the seal markings afterwards. The use of adhesive plastic tape is not satisfactory for IGC-approved sealing because it can be peeled off and re-fitted. Gummed paper tape is recommended, as used for sealing drum-type barographs. The OO must seal the FR unit to glider parts that are part of the minimum standard for flight. It is accepted that such parts can be removed for purposes such as servicing; such parts include the canopy frame, instrument panel, and centre-section bulkhead fittings. If the FR is sealed to such removable part, if such a part is transferred between gliders, any FR seal for the previous glider must be removed.

Security Seals, Physical and Electronic.

Physical Security. A silver-coloured tamper-evident seal with the manufacturer's name, is fitted over one of the case securing screws next to the maker's label. In addition, an internal security mechanism is included that activates if the case of the FR is opened. If the FR case has been opened, breaching physical security, subsequent IGC files will fail the VALI check (see para B3).

Electronic Security. If the internal security mechanism has been activated (such as by opening the case), any data in the memory will be lost, settings will revert to defaults, and the electronic security algorithms in the FR will be trashed. Any flight data files subsequently produced will fail the VALI test for electronic security. This test will also fail if the *.ZAN or *.IGC file has been altered in any way after being transferred from the FR.

FR found to be unsealed. If either physical or electronic security is found to have failed, the FR must be returned to the manufacturer or his appointed agent for investigation and resealing. A statement should be included on how the unit became unsealed.

Checks before re-sealing. Whenever any unit is resealed, the manufacturer or agent must carry out positive checks on the internal programs and wiring, and ensure that they work normally. If any evidence is found of tampering or unauthorised modification, a report must be made by the manufacturer or agent to the Chairman of GFAC and to the NAC of the owner. The IGC approval of that individual unit will be withdrawn until the unit is re-set and returned to the IGC-approved standard.

Analysis of Flight Data. Analysis for flights to be validated to IGC criteria should be through the use of a program which complies with IGC rules and procedures and is approved for this purpose by the relevant NAC. For a list of programs which are capable of reading and displaying flight data in the *.IGC file format, see the fai.org/gliding/gnss web site under the link to SOFTWARE (the full web reference is at the beginning of this document). Before a Flight Performance is officially validated, the authority responsible for validation must check that the data in the *.IGC file has originated from the Recorder concerned, and has not been altered after it was download from the Recorder to a PC. This is simply done by checking the IGC data file with an authorised copy of the VALI-ZAN.EXE short program. The VALI program is on a single file and must have originated from the current FAI/IGC web site for software at the beginning of this document. See Annex B for how to use the VALI program file with any IGC flight data file.

Manufacturer's Changes. Notification of any intended change to hardware, firmware or software must be made by the manufacturer to the Chairman of GFAC so that a decision can be made on any further testing which may be required. This includes changes of any sort, small or large. If in doubt, notify the change so that the responsibility for any possible action passes from the manufacturer to GFAC.

Ian Strachan
Chairman, IGC GFAC

Annexes:
A. Notes for owners and pilots
B. Notes for Official Observers and NACs

Any Queries to:
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Annex A to IGC Approval, dated 30 October 2001

NOTES FOR OWNERS AND PILOTS
PART OF IGC APPROVAL FOR ZANDER GP941 GNSS FR

To be read together with the main terms of approval to which this is an Annex. It is recommended that a copy of the approval document including annexes is kept with the equipment concerned, for the use of pilots and Official Observers.

Pilot's Responsibility. It is the responsibility of the pilot to ensure or to note the following:

Antenna - That the antenna is positioned in order to give sufficient signal strength for IGC purposes. No deliberate attempt must be made to inject data via the antenna, and any abuse of this may lead to a future requirement to position antennas out of reach of the flight crew.

Geodetic Datum. Latitudes and longitudes recorded by the FR must be to the WGS84 Geodetic Datum, or the flight data will be invalid for IGC purposes. This recorder is fixed on the WGS84 Datum. No pilot action is required except to ensure that other lat/long data such as for start, turn and finish points, is also entered to the WGS84 Geodetic Datum (IGC rule).

FR installation in the glider. The pilot must ensure that an OO has checked the place of the Flight Recorder in the glider and how it is fixed to the glider. If it may be difficult to find an OO immediately before takeoff, or to witness the landing, you should ask an OO to seal the FR to the glider, and this can be done at any time or date before flight. See para 3 in the conditions of approval. Regarding the position of any ancillary displays connected to the FR, see para 2.1 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

Takeoff - The pilot must ensure that the time and point of takeoff has been witnessed and recorded for comparison with that recorded by the GNSS FR, see para B1.2.

Connection to Ports. Although this approval does not presently require sealing of any ports or plugs, no attempt must be made to pass unauthorised data into the FR. See paras 2.3 and 3 in the conditions of approval.

Use in Motor Gliders (including self-sustainers): The internal microphone and associated circuitry automatically records an ENL (Engine Noise Level) value between 000 and 999 with each fix. The ENL system is automatically enabled and no pilot action is required. The FR should not be covered or insulated, although even so, automatic gain should continue to ensure high ENL readings under power.

A6.1 Cockpit noise. Pilots should note that other cockpit noises will produce ENL readings, and avoid those which could be mistaken for use of engine. Generally the frequency filtering built in to the FR will avoid any problems, but it should be noted that sideslipping and/or flight at high speed with the cockpit Direct Vision (DV) panel open can produce a low-frequency sound (organ pipe note) which will register as high ENL, as will spins and stall buffet, particularly in Motor Gliders if the engine bay doors flutter. Flight close to powered aircraft should also be avoided, except for normal aero-tow launches. For ENL levels that have been recorded on GFAC tests, see B.4.2.

After Flight - The pilot must ensure that the time and point of landing has been witnessed and recorded for comparison with that recorded by the Recorder (see para B2.1). Until an OO has witnessed the FR installation to the glider, the pilot must not alter the installation or remove the FR from the glider. The OO will carry out the actions given in para B2.3, and the OO's copy of the transferred flight data will be sent to the NAC. The OO does not personally have to transfer the data from the FR, but witnesses the transfer and takes or is given a copy on electronic media. Different rules may apply for competition flights, for which a central data transfer facility may be used, but for a flight to IGC record and badge rules, the above continues to apply.

A7.1. Use of Portable PC at the glider. So that there is no need to disturb the cockpit installation or any sealing to the glider, a portable (laptop/notebook) PC can be used for transferring the data at the glider. The portable PC may be owned by the pilot or any other person. It should be set up for ease of downloading, such as by easy access to the current DATA-ZAN.EXE program file or an equivalent program from the manufacturer that carries out the same function. Transfer of flight data is witnessed by the OO, and the flight data in both ZAN and IGC formats is then given to the OO on portable media such as a floppy diskette.

Calibration of Barograph Function. Pilots are advised to have a barograph calibration carried out either by the manufacturer or by an NAC-approved calibrator before any GNSS FR is used for a claimed flight performance. For the procedure, see para B5. A valid IGC-format file showing the pressure steps used in the calibration must be recorded and kept (Sporting Code rule). Altitude and height claims require a calibration for the flight performance concerned, and speed and distance claims need a calibration for calculating the altitude difference of the glider at the start and finish points. Also, the NAC or FAI may wish to compare pressure altitudes recorded on the FR for takeoff and at landing, with QNH pressures for the appropriate times recorded by a local meteorological office.

------------------- end of Annex A --------------------

Annex B to IGC Approval dated 30 October 2001

NOTES FOR OFFICIAL OBSERVERS AND NACs -
PART OF IGC APPROVAL FOR ZANDER GP941 GNSS FR

To be read together with the main terms of approval to which this is an Annex. It is recommended that a copy of this approval document is kept with the equipment concerned, for the use of pilots and Official Observers.

Installation and Takeoff Records

Installation in the Glider. An OO shall witness and record the position of the FR in the glider, the type and serial number of the particular FR, the glider type and registration, date and time. The individual serial number of the recorder consists of three characters made up of letters and/or numbers, and is shown on the case of the recorder. Before flight, if requested, the OO shall then seal the FR to the glider in a way acceptable to his NAC and to IGC, and such sealing may be at any time or date before flight. If sealing is not used, either a preflight check of the installation must be made after which the glider must be under continuous observation by an OO until it takes off on the claimed flight, or an OO must witness the landing and have the glider under continuous observation until the FR installation is checked. This is to ensure that the installation is correct, and that another FR has not been substituted in the glider before the data transfer (B2.3). See paras 2 and 3 of the Conditions of Approval. Regarding the position of any ancillary displays connected to the FR, see para 2.1 in the Conditions of Approval which refers to sight-lines and the need for pilot lookout and scan.

At Takeoff. The time and point of takeoff shall be recorded, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will be compared to the FR takeoff data.

Landing.

At Landing. The time and point of landing shall be recorded, either by an OO, other reliable witnesses, or by other means such as an Air Traffic Control or official Club log of takeoffs and landings. This will be compared to the FR landing data.

Checking the Installation of the FR. As soon as practicable after landing, an OO shall inspect the installation of the FR in the glider (including any sealing to the glider), so that this can be compared to the check described in para B1.1 above. The transfer of flight data shall then take place in accordance with B2.3.

Transferring the Flight Data. The flight data can be transferred to a portable PC at the glider, without disturbing the installation of the FR (see para A7.1). If a portable PC is not available, the OO shall check and break any sealing to the glider, and take the FR to a PC. If the OO is not familiar with the actions required, the pilot or another person may transfer the data while the OO witnesses the process. Security is maintained by electronic coding embedded in the FR which is then independently checked later at the NAC (and at FAI if the claim goes to them).

Method: This FR has a small internal battery and the use of external power is not essential for data to be transferred from FR to a PC. Use the standard IGC connector cable which has a 9-pin RS232 male connector for the FR and a RS232 female connector for the PC. The connector on the FR is the female RS232 on the end face that has the red light, not the male RS232 on the end face with the antenna connection. A current version of the short program file DATA-ZAN.EXE must be available on the PC. This program is available free from the IGC GNSS web site for software given at the beginning of this document, or through a link from the main fai.org/gliding/gnss web site. The DATA program file can be executed on either a floppy diskette or on the PC hard disk. When the DATA program is executed, the software version is shown at the top of the menu (see under software on page 1, which gives the required version). This program file executes in the normal way such as either by typing at a DOS prompt ADATA-ZAN, enter@; or by double-clicking "DATA-ZAN" in a Windows file list (File Manager for W3x, Windows Explorer for W95/98/ME or NT/2000). If settings such as the COM port, Baud rate, etc. need to be changed, the help menu is accessed by typing the file name, space, hyphen, then the letter h.

Files produced. This process will automatically produce both a *.ZAN binary format file and an *.IGC-format flight data file both with the file name YMDCXXXF, where Y=year, M=month, D=day, C= manufacturer, XXX = FR Serial Number/letters and F = flight number of the day (full key, Appendix 1 to the IGC GNSS FR Specification, also listed in Annex C to the Sporting Code, SC3C).
OO's Copy. A copy of both the *.ZAN and *.IGC files shall be retained securely by the OO such as by immediately copying them to a separate diskette or PC card, or by the use of the OO's own PC. These files shall be retained by the OO in safe keeping for later checking and analysis under NAC/IGC procedures.

Storage media. The OO may keep the required data files on a floppy diskette or other industry-standard portable storage media. The hard disk of a PC may also be used but the OO must be able to positively identify the flight data files as being from the flight concerned.

Competitions: Different rules may apply for competition flights, for which a central data transfer facility may be used. For ease of identification within the competition, file names may be changed, for instance to the glider competition number or the pilot's name. Integrity of data within the file is preserved by the electronic security system and may be checked at any time by using the VALI-ZAN program file.

Analysis of Flight Data Files. A Data Analyst approved by the NAC will then evaluate the flight using an analysis program approved by the NAC concerned (list, see the IGC GNSS web site under SOFTWARE). In addition to checking flight data, an authenticated version of the file VALI-ZAN.EXE shall be used by the NAC and by FAI (if the data goes to them) to check the electronic security coding, that the FR had not been interfered with, and that the flight data in the *.IGC file has not been altered since it was transferred from the FR. The version number of the VALI file is shown at the top of the screen when the file is executed. The latest version of VALI-ZAN should be used and is available from the IGC GNSS web site for software given at the beginning of this document.

Method: at the appropriate prompt or run function, type VALI-ZAN.EXE followed by a space and the name of the file to be checked. The messages "electronic seal o.k." and "security check o.k."should appear. If there is a problem the messages will be "Electronic seal faulty! Flight data invalid! Return FDR to manufacturer for reset!"; in this case the NAC or other validating authority must investigate the reason. It should be noted that GFAC tests include ensuring that the change of a single character in an otherwise-correct IGC file, cause the VALI program to fail as indicated above.

Means of Propulsion (MoP) Record - Motor Gliders. The MoP must either be sealed or inoperative, or the built-in microphone system used that records a three-number Engine Noise Level (ENL) with each fix on the IGC file. See para 2.2 for more details on the ENL system. ENL values recorded on GFAC tests are given below, in the sequence of a flight.

ENL during launching. During winch and aerotow launches, higher average ENL values are to be expected than when soaring (B4.3). Up to ENL 180 for winch and 160 for aerotow have been recorded. During the ground roll, short-term higher values up to 348 have been seen, probably due to wheel rumble.

ENL during engine running. On engine running at powers needed to climb, an increase to over 700 ENL is expected. Over 900 is typical for a two-stroke engine, over 700 for a 4-stroke. An ENL value of 999 has been recorded with a two-stroke engine running at full power. During engine running, these high ENLs are produced for a significant time, and when altitude and speed are analysed it can be seen that substantial energy is being added, which can therefore be attributed to energy not associated with soaring. The values quoted above are for 2- and 4-stroke engines. Wankel (rotary) and electric engines have not been tested. There is no reason to believe that Wankel engines will not produce similar values to 4-strokes.

B.4.2.1. Electric Power. If an electric engine is to be used, please contact GFAC as soon as possible so that tests can be carried out.

ENL during gliding flight. ENL readings of less than 050 indicate normal gliding flight in a quiet cockpit environment. In a high-speed glide or in an aerodynamically-noisy glider, ENL may increase to about 200. Short periods of higher ENL while gliding (up to about 300 ENL) may indicate aerodynamic noises such as due to airbrakes, lowering the undercarriage, sideslip, etc, and are normal before landing. Particularly, sideslip or high speed with the cockpit Direct Vision (DV) panel open can produce low frequency noise (Aorgan-pipe@ effect) and ENL readings of up to 340 have been recorded. High ENL may also be recorded during stalling and spinning, particularly if the engine doors flutter or vibrate (move slightly in and out due to stall buffet, producing a clattering noise). Finally, where the engine is mounted on a retractable pylon, a high ENL reading will be shown if flying with the pylon up and engine not running, due to the high aerodynamic noise.

ENL during the approach to land. ENL values are always higher on a landing approach due to aerodynamic noises such as due to airbrakes, undercarriage, sideslip, turbulence, etc. Short-term peaks due to specific actions such as opening airbrakes, lowering undercarriage, etc., will be noted as well as a generally higher level of ENL because the glider is no longer aerodynamically clean. ENL values of up to 300 have been recorded, although 216 is more typical in an aerodynamically noisy glider, and 100 in a quiet machine.

ENL during landing. During ground contact during takeoff and landing, short-duration ENL readings up to 348 have been recorded, probably due to wheel rumble. Unlike engine running these last only for a short time, showing a short spike on the noise/time trace.

ENL analysis. It is normally easy to see when an engine has been running and when it has not. Other data such as rates of climb and groundspeed, will indicate whether or not non-atmospheric energy is being added. Short term peaks in ENL (10 seconds or so) may be due to the other factors mentioned above such as undercarriage and/or airbrake movement, sideslip, open DV panel/sideslip/high airspeed, the nearby passage of a powered aircraft, etc. If in doubt, email the *.IGC file to the GFAC Chairman for further analysis and advice (see earlier for email address).

Altitude analysis and calibration. Flight data files will be analysed in accordance with Sporting Code procedures. Part of this is to compare the general shapes of the GNSS and pressure altitude fix records with time and to ensure that no major differences are seen that could indicate malpractice or manufactured (false) data. As part of this process, the FR can be calibrated in an altitude chamber in the same way as a drum barograph.

Calibration method, making a calibration table. Recording at 4 second intervals starts when power is connected to the recorder, no special switching is required. The calibrator will record the pressure steps used, for later comparison with the flight file. The stabilised pressure immediately before the altitude is changed to the next level, will be taken as the appropriate value unless the calibrator certifies otherwise. After the calibration, the data file containing the pressure steps is transferred to a PC as if it was flight data (see B2.3 above); this may be done by an NAC-approved person other than the calibrator who may not have this knowledge. The IGC format calibration data file will then be analyzed, compared to the calibration pressure steps, and a correction table produced and authenticated by by an NAC-approved person (for instance an OO or GNSS FR Data Analyst). The correction table will list true against indicated altitudes. This table can then be used to adjust pressure altitudes which are recorded during flight performances and which require correction before validation to IGC criteria. These include takeoff, start and landing altitudes for altitude difference and for comparison with independently-recorded QNH readings, and low and high points on gain-of-height and altitude claims. Only pressure altitude is valid for IGC altitude purposes except for proof of flight continuity (no intermediate landing) where GNSS altitude may also be used.

GPS altitude figures recorded in the IGC file. Occasional short-duration differences in the shape of the GPS altitude/time graph have been noted when compared to the pressure altitude figures. This is not unusual with

GPS receivers operating without a local differential beacon The altitude accuracy from satellite-based systems will not be as good as accuracy in lat/long, because satellite geometry is not as favourable for obtaining accurate altitude fixes compared to horizontal position. This effect may be increased by less-than-ideal antenna positioning in some gliders. Lat/long fix accuracy is not affected and is typical of that for a 12 channel GPS system, but data analysts and NAC officials should allow for the above when comparing the GPS altitude and pressure altitude records.

Maximum Altitudes Recorded in the IGC file.

Pressure Altitude. The recorder is designed to have a pressure altitude capability up to 10km (32,808ft). Above this altitude, figures may be recorded but accuracy is not guaranteed.

GNSS altitude. The GP 941 has 16-bit resolution and the maximum positive recorded value is theoretically 32,767m (107,503ft). However, US limitations on the recording of GPS altitude by non-military GPS receivers may limit recording to 60,000ft (18,288m).

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