Hexpert Systems

ZLog Z7

High Altitude Data Logging System

Introduction

ZLog was designed to provide a lightweight, compact device for measuring and recording data in high-altitude scientific experiments. ZLog also provides live altitude/pressure/temperature/voltage information at the field, via its onboard digital display, and log data through a USB or serial interface.

How It Works

The ZLog module uses a high-resolution barometric pressure sensor system to detect the minute changes in air pressure that occur due to changes in altitude. It is sensitive enough to detect altitude changes of less than one foot. Since it is so sensitive, it is also sensitive to changes in weather and local pressure variations. The designed use of this device is for measuring short-term altitude changes in high-altitude experimental balloons, rockets, or aircraft. Long-term altitude readings will vary considerable due the varying atmospheric conditions.

Key Features

- ❑ Displays altitude, pressure, temperatures, and voltage information in real-time.
- ❑ Tracks maximum altitude – find out how high your experiment reached!
- ❑ Record data for later review onto easily available microSD or microSDHC flash cards.
- ❑ Dual temperature sensor record both onboard temperature and external temperature.
- ❑ USB PC Interface built-in for configuration and data download/review.
- ❑ Firmware upgradeable.

System Requirements

- ❑ PC with one of the following operating systems: Win98, Windows ME, Windows NT, Windows 2000, Windows XP, Windows 7.
- ❑ Available USB port.
- ❑ 2 megabytes Hard Drive space.

Hardware

Figure 1 shows the ZLog hardware module. The module includes an onboard digital display for indicating current measurements or maximum altitude. Two pushbutton switches (S1 & S2) are used to control the device and to select current display mode.

A USB connector is used to interface to a PC for configuration, data logging, or firmware update.
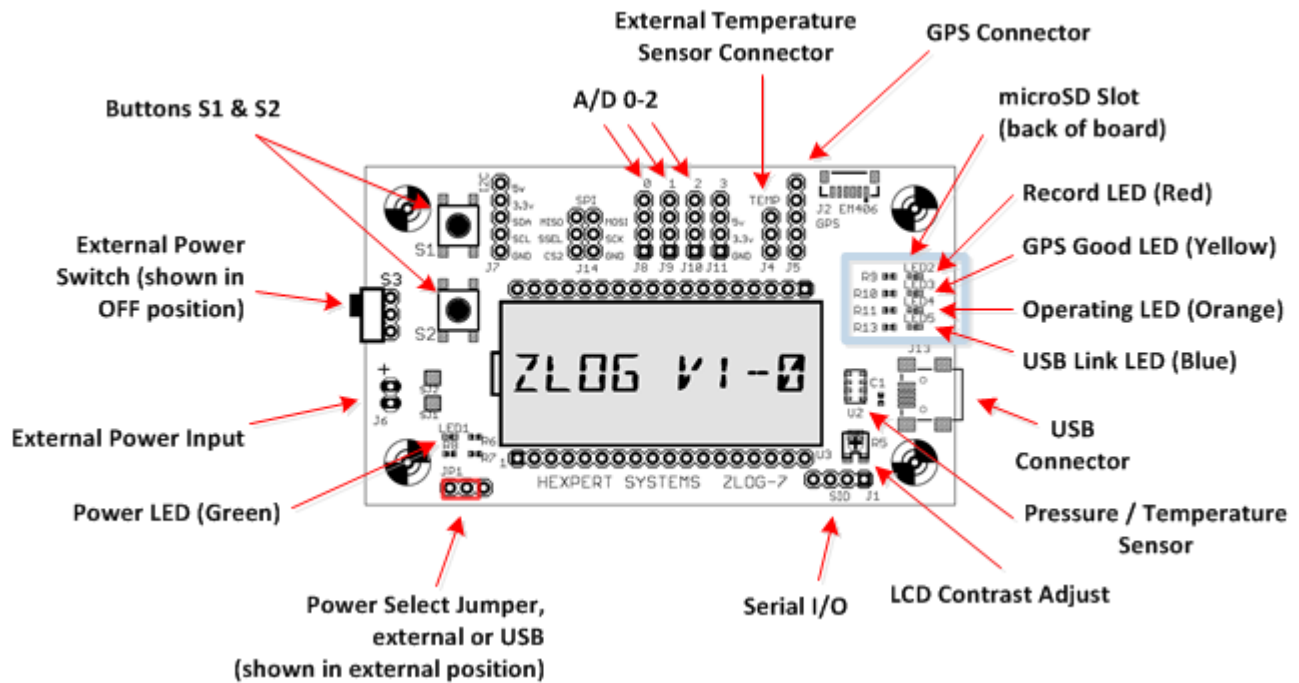

Figure 1. The ZLog Hardware.

Using the ZLog module

Powering the module

To power the ZLog module, provide voltage from 6v up to 30v to the terminal J6. Jumper JP1 should be positioned on the left 2 pins (towards the terminal) to select external power (see Figure 1). When using external power, switch S3 is used to turn on/off the power.

When connected to a PC USB port via a USB A-miniB cable, ZLog can be powered from the port. Put jumper JP1 on the right 2 pins to select USB bus power for the board.

ZLog will require approximately 40mA during operation.

Mounting the module

ZLog has 4 mounting holes in a rectangular arrangement, 3.0" on center by 1.5" on center. The holes are sized for #6 screws or bolts.

It is best to position ZLog where the sun cannot directly strike the sensor (tiny silver rectangle U2 to the right of the display). The sensor is light sensitive and the altitude readings can be affected by very strong light.

It is best to keep the board temperature above 0 degrees C to prevent freezing of the liquid crystal display. To measure ambient temperature, use the external temperature sensor, which is connected via a long cable so that it can be positioned to measure external temperatures down to negative 55 degrees C.

IMPORTANT:

- **Be sure that the module is not touching any metal surfaces. Shorting the metal contacts on the module could short the power system.**
- **Also be sure to keep the module away from water, fuel, or other liquids.**

Logging

ZLog uses a user-supplied commercially available microSD card to store data. microSD cards up to 2GB have been tested. MicroSDHC up to 32GB should be compatible but are still being verified. Some manufacturers do not fully comply with the spec, so be sure to test the logging prior to flight to make sure your card is compatible and your PC will read the card after logging some test data. You wouldn't want to fly to 100000 feet, only to find that you have no data on landing.

ZLog-7 records data once per second. Each second, approximately 60 bytes are recorded. If the GPS option is attached, it records 120 bytes.

With a 2GB microSD card, it can record for approximately 192 days with the GPS option. It will record twice as long without the GPS data. This is typically more than enough for most applications.

Configuration

To configure Z7, create a file on the microSD card named "startup.txt". This is a text file that contains a list of commands to setup the Z7. A sample is shown below:

```
BR=115200    ; serial baud rate
GB=9600      ; gps baud rate
GF=17        ; gps flags (GGA and RMC)
GL=1         ; gps logging 0=disabled, 1=enabled
AS=1         ; autostart 0=disabled, 1=enabled
ST=60        ; autostart seconds
AP=1         ; autostop 0=disabled, 1=enabled
PT=18000     ; autostop seconds
UA=0         ; units for altitude 0=feet, 1=meters
UT=0         ; units for temperature 0=fahrenheit, 1=Celsius
```

At powerup, the Z7 reads the microSD card and looks for the file named "startup.txt". It will then read each line and execute the command. After it has read all of the commands in the file, normal operation will proceed.

See the command list in Appendix B for additional commands.

Operation

During operation, the module continuously displays measured data. By default, the display will show altitude. The display will update several times per second. Note that this does not necessarily correlate to the sampling period. The buttons perform the following functions:

- ❑ Display select – pressing S1 will cycle through several different displays:
    - o Z <altitude>
    - o M <maximum altitude since powerup>
    - o Temperature internal and external (degrees F)
    - o P <pressure millibars>
    - o Elapsed time
    - o V <battery voltage>

        If GPS logging is enabled (GL=1), GPS data display is also possible:

    - o Latitude N/S
    - o Longitude E/W
    - o S <speed>
    - o H <heading>
    - o GZ <GPS Altitude>

- ❑ Recording Start/Stop – pressing S2 toggles recording of data to the flash card. When recording is enabled, the record LED (red) will flash indicating that recording is in progress and the display will briefly show the filename used (e.g. LOG0001…). Also, each time a sample is acquired and recorded, the acquire LED (yellow) will blink once. When recording is disabled, the record LED will remain dark.

    Each time recording is started, a new data set is recorded. When recording is stopped, the data set is closed. Data is recorded in comma separated variable (.csv) format, which can be opened by spreadsheet software such as Microsoft Excel or other data processing programs.

    Data files are named starting with "LOG" followed by a 4-digit number and a .csv extension. At powerup, ZLog will find the next available file name and continually sequentially from there for each new data set.

PC Interface

The ZLog module interfaces to the PC through a USB connector. This uses any standard USB A to mini-B cable. When connected to the PC, the Zlog module can be powered from the USB port by positioning the jumper on

A TTL level serial port is also available as J1. Pinout is shown below:

ZLOG-7

Serial I/O

- GND
- No connect
- RX
- TX
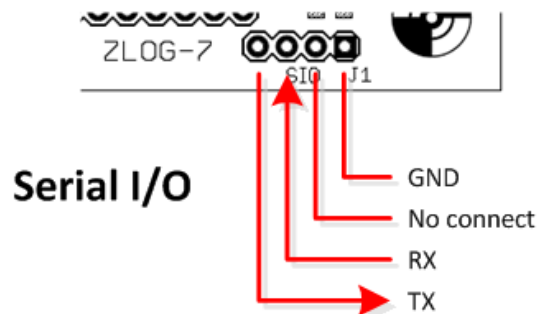
Default communication settings are 115200 baud, 8 data bits, no parity, 1 stop bit. The RX and TX pins are 5v tolerant.

External Sensors

Temperature

The external temperature probe uses a 3-pin cable and is connected at J4. Note the color coding of the wire in the diagram:

**External Temperature
Sensor Connector**

TEMP

3.3v

GND

J4
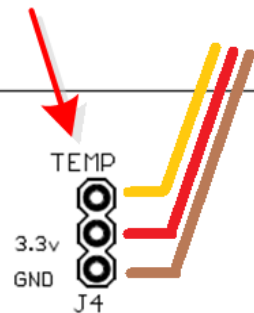
GPS

The ZLog-7 module can accept standard NMEA-0183 data from an external GPS module. The GPS module baud rate should match that set in the "startup.txt" configuration file. If that is not present, it will default to 4800. The GPS signals should be connected at the 5-pin header J5. Either the 5 volt or 3.3 volt pin can be used to power the GPS, depending on its requirements.

GPS Connector

When the GPS has a fix and is reporting valid data, the yellow LED will flash.

The GPS module should be positioned away from other electronics with the antenna side (silver square) toward the sky.
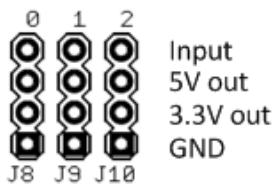
TXD
RXD
5v
3.3v
GND
J5
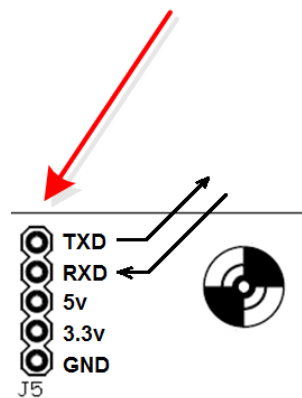
Analog to Digital inputs

The ZLog-7 module has 3 available analog to digital (A/D) input ports available. The ports can accept voltages between 0 and 3.3 volts. The ports use 10-bit successive approximation to do the conversion. The values of each port are logged in the data file as AD0, AD1, and AD2.
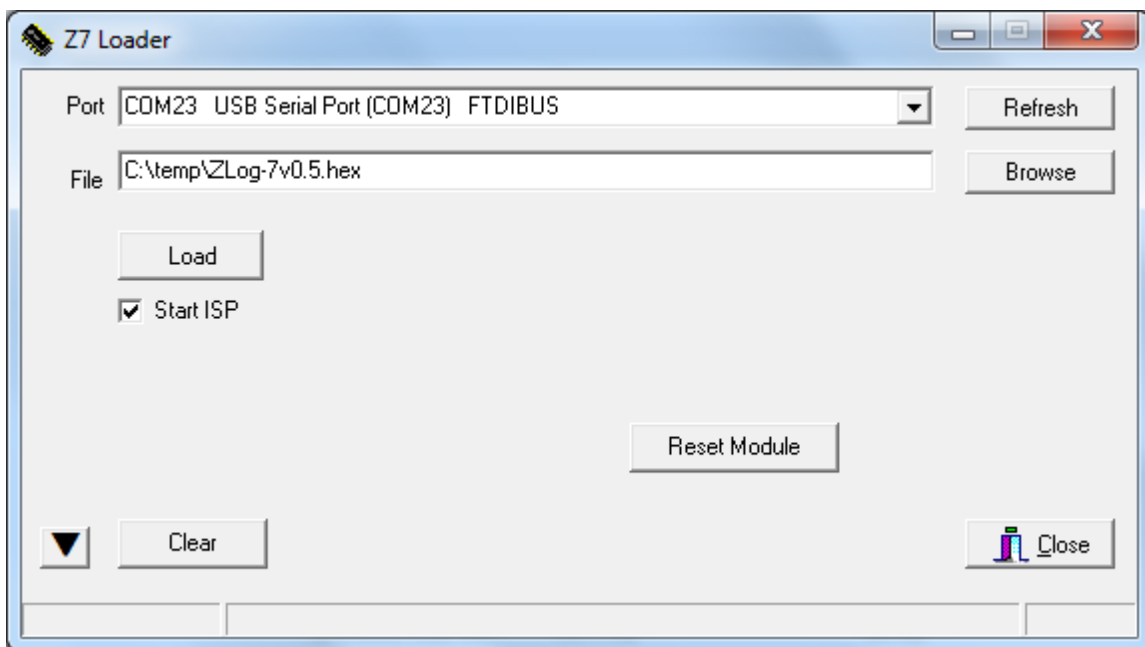
A/D 0-2

```
     0   1   2
    ⊙   ⊙   ⊙     Input
    ⊙   ⊙   ⊙     5V out
    ⊙   ⊙   ⊙     3.3V out
    ▣   ▣   ▣     GND
   J8  J9  J10
```

Appendix A. Firmware Upgrade.

1. Position jumper JP1 on the right 2 pins (toward the USB connector) to select USB power.
2. Connect the ZLog board to the PC using a USB A to USB mini-B connector.
3. Run the Z7 Loader program.
4. Select the proper port (FTDIBUS).
5. Select the firmware update file (*.hex).
6. Check the "Start ISP" box.
7. Click "Load".
8. ZLog should display "SWUPDATE" while updating.
9. When complete, ZLog will reset and resume normal operation. At startup it should display the new firmware version.
10. Click "Close".

Appendix B. Serial / Startup.txt command list

Command Format

<cmd>[=<value>]<CR>
 	
if =<value> is specified, then **set** the value.
if =<value> is not specified, then **get** the value.
 	
<CR> = 0x0D
 	
Examples:
 	
Get the current altitude:
 	
    AL<CR>
 	
Set AutoStart Recording to off:
 	
    AS=0<CR>

Commands

System (immediate execution on character receive)		**Set/Get**
!	Invoke Loader	S
*	Reset	S
Q	Repeat Last Command	-
<	Toggle Logging Output	S

Debug		**Set/Get**
DB	Debug (0=off, 1-n = level)	S/G
CD	Coefficient Dump	G
DD	Dump Calc Data	G
HA	High Altitude numeric test	G
TT	Temperature numeric test	G

General		Set/Get
SV	Show Version	G
CO	Open Config file "startup.txt" for writing (serial only)	-
CC	Close Config file	-
CW	Config Write – Write following command to startup.txt. Ex: "CW=SL=1" writes the line "SL=1" to the config file.	S
CR	Config Readback. Displays the contents of startup.txt	G
BR	Baud Rate. Sets debug serial port baud rate.	S/G

Measurements		Set/Get
AL	Display the Altitude	G
TI	Display the Temperature Internal	G
TE	Display the Temperature External	G
PR	Display the Pressure (millibar)	G

Display		Set/Get

ZR	Zero
	  0 = off (absolute mode)
	  1 = on (relative mode)
		S/G

MX	Show Max Altitude	G
MC	Max Altitude Clear	S

Auto Functions		Set/Get
AZ	Auto Zero 0 = off 1 = trigger 2 = powerup 3 = record	S/G
AS	Auto Start Record 0 = off 1 = time 2 = altitude 3 = trigger	S/G
ST	Start Time n = seconds	S/G
SA	Start Altitude n = feet / meters	S/G
AP	Auto Stop 0 = off 1 = time 2 = altitude	S/G
PT	Stop Time n = seconds	S/G
PA	Stop Altitude n = feet / meters	S/G
UA	Units Altitude 0 = feet 1 = meters	S/G
UP	Units Pressure 0 = millibars 1 = inHg	S/G

Recording		Set/Get

SL	Serial Log
	   0 = off
	   1 = on
		S

RC	Recording
	   0 = off
	   1 = on
		S

GPS		Set/Get

GL	Enable logging of GPS data
	   0 = disable
	   1 = enable
		S/G

GB	Set GPS baud rate	S/G
GS	Send a command string to the GPS e.g. "GS=SETMODE 2" would send "SETMODE 2" to the GPS.	S

GP	GPS Passthrough – displays incoming GPS data
	on the serial port.
	   0 = disable
	   1 = enable
		S/G

Appendix C. Specifications

Parameter	Value	Unit
Input Voltage	6 - 30	Volts
Input Current	40 (without GPS)	Milliamps
RXD, TXD pins	5 volt tolerant	Volts
Baud Rate (USB or SIO)	115,200 (default)	
Baud Rate (GPS)	4800 (default)	
Temperature Range	0 to +85	°C
Altitude Range (for maximum accuracy. Higher altitude measurements will begin to increase in error.)	-5000 to +102,000 -1526 to +30,510	Feet Meters
Altitude Resolution	1	Foot
Pressure Range	10 to 1200	millibar
Pressure Resolution	???	millibar
Recording Rate	1	Hz
Measured Temperature Range (external sensor)	-55 to +85	°C
Dimensions	3.5 x 2 x 0.5	Inch
Dimensions	89 x 51 x 13	mm
Weight	???	grams

Note: Specifications taken from component ratings and system limits and may not have been tested to the full extent of the specified ranges.