# ZLog Z7

High Altitude Data Logging System
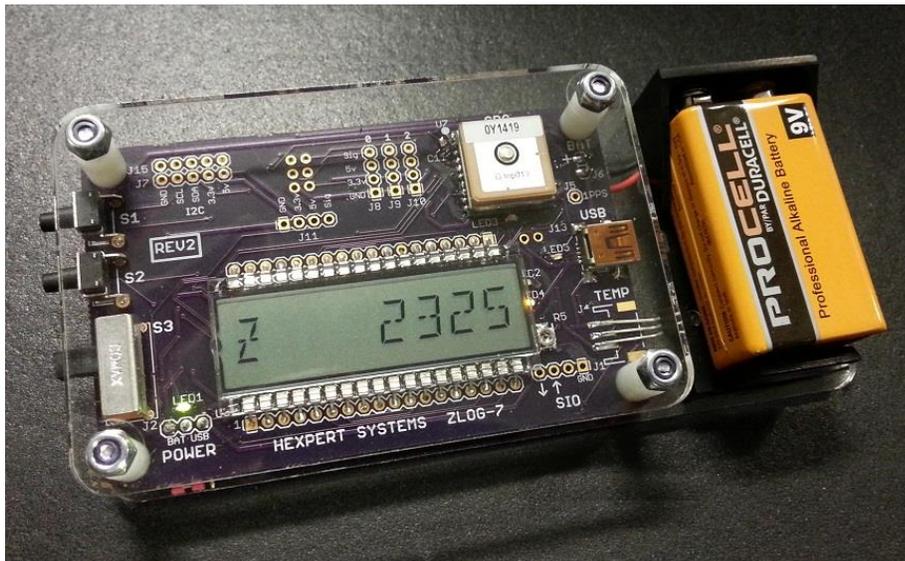
Introduction

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.
- ❑ Onboard GPS to record latitude, longitude, speed, heading and GPS altitude.
- ❑ 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, Windows 8.
- ❑ Available USB port.
- ❑ 2 megabytes Hard Drive space.

Quick Start

Install a microSD card, install battery, and turn on the power switch. Default values should get you up and running right away.

If there is no "startup.txt" file on the microSD card to configure ZLog, it will default to the settings shown below:

- Automatically start recording data 60 seconds after powerup.
- Automatically stop recording after 5 hours.
- Altitude units = feet.
- Temperature units = Fahrenheit.

GPS logging enabled (Rev2) or GPS logging disabled (Rev1).

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.
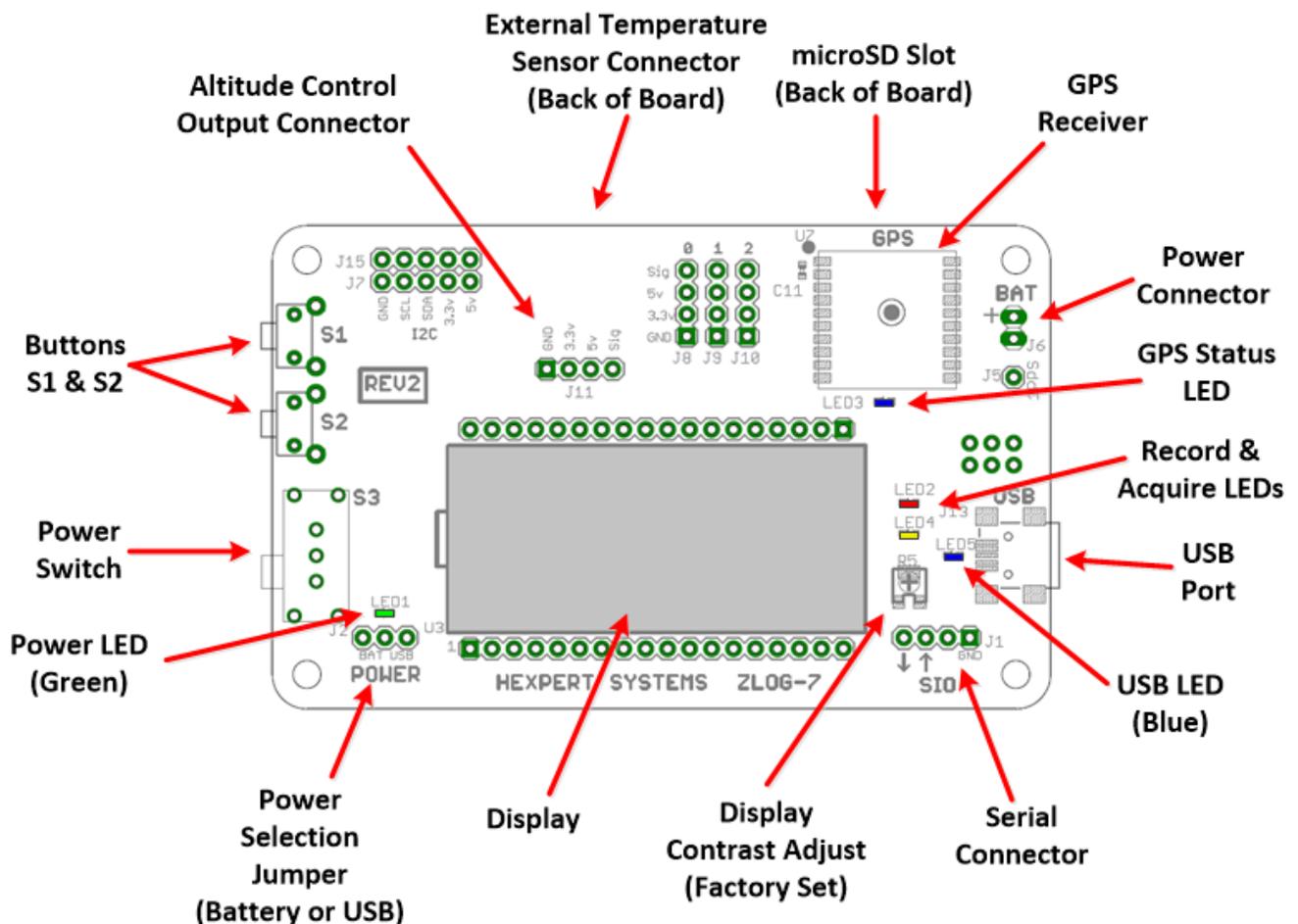

Figure 1. The ZLog Hardware.

Using the ZLog module

Powering the module

To power the ZLog module, provide voltage from 6v up to 30v to the terminal J6. Jumper J2 should be positioned on the left 2 pins to select external power (see Figure 1). When using external power, switch S3 is used to turn on/off the power.

The recommended power for the ZLog-7 is an Energizer Advanced Lithium 9v, part number LA522. A lithium battery performs better in cold temperatures than alkaline, NiCd, or NimH batteries.

When connected to a PC USB port via a USB A-miniB cable, ZLog can be powered from the port. Put jumper J2 on the right 2 pins to select USB bus power for the board.

ZLog will require approximately 75mA during operation.

Mounting the module

It is best to keep the board temperature above 0 degrees C to help prevent condensation on the board. 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 32GB have been tested. MicroSD and microSDHC cards up to 32GB should be compatible. 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 125 bytes are recorded.

With a 2GB microSD card, it can record for approximately 192 days. 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>
    - o HM <humidity %> (Rev2 only)

        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 JP1.

A TTL level serial port is also available as J1. Pinout is shown below:
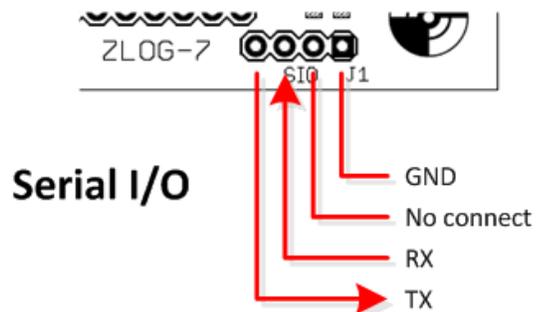
Default communication settings are 115200 baud, 8 data bits, no parity, 1 stop bit. The RX and TX pins are 5v tolerant.

External Sensors

Temperature

The external temperature probe uses a 3-pin cable and is connected at J4. The connector is keyed and will only plug in one way.

GPS

The ZLog-7 module can accept standard NMEA-0183 data from the onboard GPS module. When searching, the GPS LED3 will flash. When the GPS has a fix and is reporting valid data, LED3 will be solidly lit.

The GPS module should be positioned away from other electronics, faced toward the sky (board display facing up).

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
     [O]  [O]  [O]   Input
     [O]  [O]  [O]   5V out
     [O]  [O]  [O]   3.3V out
     [O]  [O]  [O]   GND
     J8   J9   J10
```
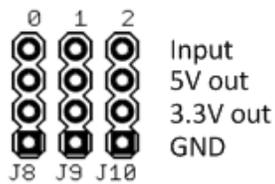
Altitude controlled output

As of firmware version 1.4, ZLog-7 supports the ability to control a digital output based on altitude. This might be useful to activate another piece of hardware based on altitude. For example, when the Hexpert Systems FET Switch is connected to J11, the digital output can switch a high current through a nichrome wire to cut off the balloon above a specified altitude or time.

By default, the altitude controlled output is disabled. Add the following lines to your startup.txt configuration file on your microSD to enable altitude controlled output:

```
ZM=2 ; altitude control mode - 2=pulse output high when altitude reached
ZP=3 ; pulse length in seconds
ZT=100000 ; altitude threshold
ZS=18000 ; altitude timeout in seconds
ZC=1 ; altitude control enabled
```

Options:

Altitude control mode (ZM):

    0 = output low below altitude threshold and high above threshold.
    1 = output high below altitude threshold and low above threshold.
    2 = output low below altitude threshold, pulse output high then low when altitude exceeds
        the threshold.
    3 = output high below altitude threshold, pulse output low then high when altitude exceeds
        the threshold.
    4 = output starts low, then goes high when timeout is exceeded.
    5 = output starts high, then goes low when timeout is exceeded.
    6 = output low below altitude threshold, pulse output high then low when altitude exceeds
        the threshold or timeout is exceeded.
    7 = output high below altitude threshold, pulse output low then high when altitude exceeds
        the threshold or timeout is exceeded.

Pulse length (ZP): enter a time in seconds. Applicable to pulse modes only.

Altitude threshold (ZT): the altitude above which the output is triggered.

Timeout (ZS): if a timed mode is selected, this is the time at which the output is triggered.

Control enable (ZC):

    0 = disabled.
    1 = enabled.

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".
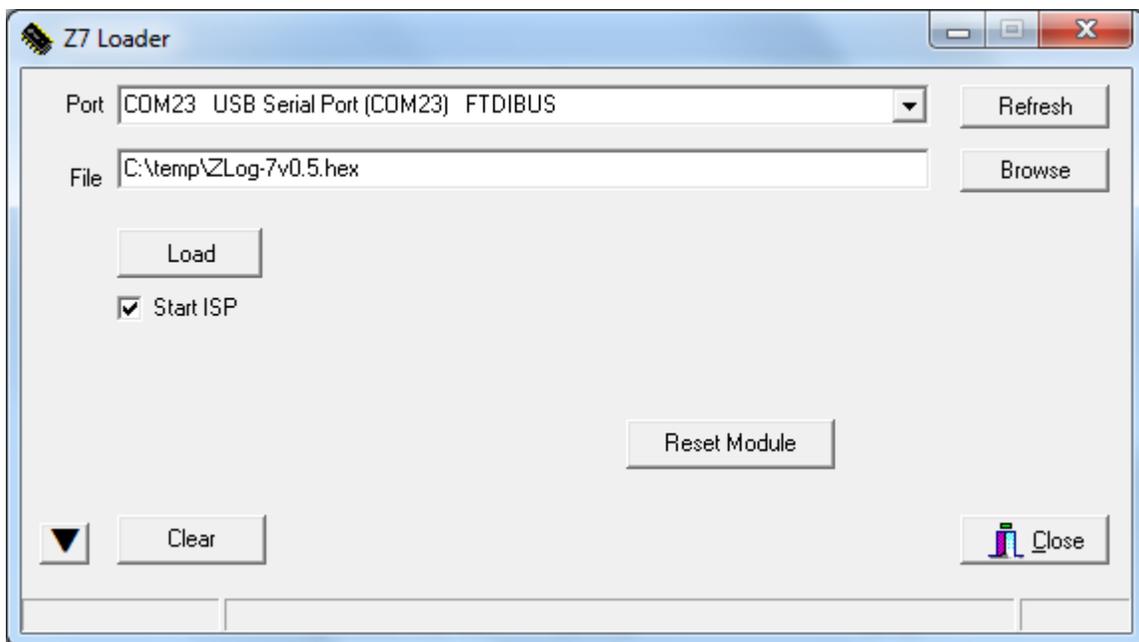
Appendix B. Serial / Startup.txt command list

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
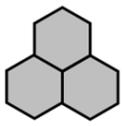
Auto Functions		Set/Get

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

Altitude Controlled Output		Set/Get

ZC	Altitude Control enable
	  0 = disabled
	  1 = enabled
		S/G

ZT	Altitude threshold to execute output	S/G

ZM	Altitude output Mode
	  0 = output pin low below altitude, high above
	  1 = output pin high below altitude, low above
	  2 = output pin low below, pulse above, then back low
	  3 = output pin high below, pulse above, then back high
	  4 = same as mode 0, with time limit
	  5 = same as mode 1, with time limit
	  6 = same as mode 2, with time limit
	  7 = same as mode 3, with time limit
		S/G

ZO	Altitude manual Output control. Gives manual control of output pin if AC=0. Get	S/G
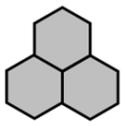
		returns current state of pin.
		  0 = output pin low
		  1 = output pin high	

	ZP	Altitude output Pulse length (sec)	
	ZS	Altitude control time limit (sec)	

Appendix C. Specifications

Parameter	Value	Unit
Input Voltage	6 - 30	volts
Input Current	75	milliamps
RXD, TXD pins	5 volt tolerant	volts
Baud Rate (USB or SIO)	115,200 (default)	
Baud Rate (GPS)	9600 (default)	
Temperature Range	0 to +85	°C
Pressure 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/meter
Pressure Range	10 to 1200	millibar
Pressure Resolution	???	millibar
Recording Rate	1	Hz
Measured Temperature Range (external sensor)	-55 to +85	°C
Dimensions (board only)	3.62 x 2.21 x 0.38 (92 x 56 x 10)	inch mm
Dimensions (board with acrylic enclosure and battery holder)	5.43 x 2.36 x 1.10 138 x 60 x 28	inch mm
Weight (board with acrylic enclosure and battery holder, 9v lithium battery installed)	5 141	ounces grams

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