



1 Features

- High-precision 3-axis accelerometer and 3-axis gyroscope data logger
- Time-stamped values
- Rechargeable lithium-polymer battery
- Over 9 hours recording time
- Light weight: 25 g
- Dimensions: 57 mm x 40 mm x 20 mm
- Single button control
- Data recorded on microSD card in simple file format (CSV)
- User-selectable sample-rates and full-scale range values
- Accelerometer
 - Sample-rates: 40, 160, and 640 Hertz
 - Full-scale range: 2 g and 6 g
 - 16-bit resolution
- Gyroscope
 - Sample-rates: 40, 160, and 640 Hertz
 - Full-scale range: 250, 500, and 2000 degrees per second
 - 16-bit resolution

2 Description

The AG-1 is a data logger that captures acceleration and gyroscope measurements. The data is written onto a microSD card as CSV files (Comma Separated Values files). It uses a 2 GB microSD card and writes one file for both acceleration measurements and gyroscope measurements. Data is read by ejecting the microSD card and reading the data using a separate microSD card reader. Power is supplied through the use of a rechargeable lithium-polymer battery which can be recharged using a Micro-USB port.

3 Operation

3.1 General Operation

The AG-1 data logger has 3 modes of operation:

1. Off mode (light is off)
2. Idle mode (infrequent weak flash)
3. Logging mode (strong flashing light)

- To turn on the device, press and hold the button.
- To begin logging data, tap the button.
- To stop logging data, tap the button.
- To turn the device off, press and hold the button.

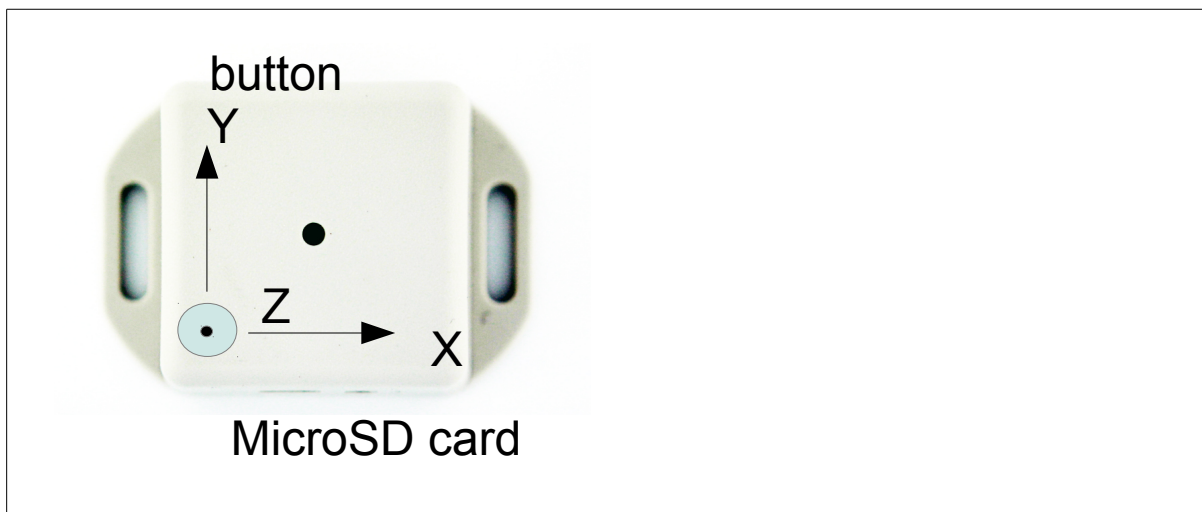
The button is recessed to prevent an unintentional press. It can be easily accessed through the use of a pen or other small pointed object.

The microSD card is also recessed and can be easily accessed through the use of a flat head screwdriver, the corner of a plastic card (such as a credit card), or other such object.

If the microSD card is not available upon an attempt to log data, the light will turn on (signaling “hang”) and the AG-1 will restart. If the microSD card is not properly formatted (in FAT16 or FAT32 format) upon an attempt to log data, the light will flash a quick series of short flashes (signaling “panic”) upon an attempt to log data.

A microSD card reader is **required** to read data from the device. To read the data, eject the microSD card and read the data using a microSD card reader. Note that the Micro-USB port is only used for charging the device and **does NOT allow read/write access to the microSD card**.

3.2 Orientation



The positive axis orientations are shown in the diagram above.

The positive value for the “Y” axis is towards the button so if you accelerate in the Y-direction, the acceleration value will be positive. The positive value for the “Z” axis out of the page (i.e. towards the top of the device) so if you accelerate upwards, the Z value will be positive. Note that if the device is left sitting on a table with the z-axis upwards, you will measure about +1g of acceleration in the Z direction although the device is stationary. This is due to the effect of gravity.

For the gyroscope data, each of the X,Y, Z values are for a rotation around each axis. For example, the Z-axis data is for a rotation around the Z-axis. The direction of rotation is determined by the right-hand-rule. Specifically, using your right-hand and putting your thumb in the direction of the positive axis, then a positive rotation is in the direction of your fingertips curled around the axis.

3.3 Typical Data File

AG-1 v20140114

sample-rate: 40 Hz

accel range: +/-2 g (+/-32768)

gyro range: +/-250 dps (+/-32768)

dt units: 83.33 ns

dt	accel(x)	y	z)	gyro(x	y	z)
317253	4645	-1574	15776	148	592	60
317361	4660	-1488	15699	303	174	4
317333	4748	-1487	15736	21	354	172
317323	4713	-1554	15816	206	-82	70
...

The top line shows the firmware version for the device. The second line (“sample-rate”) shows the sample-rate.

The third line (“accel range”) shows the acceleration value that corresponds to the maximum g setting. In the above case, a value of 32768 corresponds to 2 g, where 1 g is 1 gravitational force (equal to 9.807 m/s^2). Therefore, in the case where the z acceleration value equals 15441, this is equivalent to $(15441/32768)*2 = 0.9424 \text{ g}$.

The fourth line (“gyro range”) shows the gyroscope value that corresponds to the maximum gyroscope setting. In this case, a gyroscope value of 32768 corresponds to 250 dps, where dps is units of “degrees per second”.

Therefore, in the case where the z gyroscope value equals -424, this is equivalent to $(-424/32768)*250 = -3.234 \text{ dps}$.

The fifth line (“dt units”) shows the units of the delta time values, which show the time between samples. In the above case, the value of 317323 corresponds to a time difference between the third and fourth samples of $(317323*83.33 \text{ ns}) = 26.44 \text{ ms}$, which is equivalent to a sample-rate of $(1/26.44 \text{ ms}) = 37.8 \text{ Hz}$.

3.4 Typical Data File with the Gyroscope Disabled (Accelerometer-only)

```
AG-1 v20140114
sample-rate: 40 Hz
accel range: +/-2 g (+/-32768)
dt units: 83.33 ns
dt      accel(x)      y      z)
317119      6220      2124  14687
317104      6241      2796  15086
317196      7137      3094  14563
317168      7725      3223  14177
...          ...          ...    ...
```

Similar to the previous data file, the first line shows the firmware version number. The second line (“sample-rate”) shows the sample-rate. The third line (“accel range”) shows the acceleration value that corresponds to the maximum g setting. The fourth line (“dt units”) shows the units of the delta time values, which show the time between samples.

3.5 Configuring the Device

The AG-1 can be configured through the use of a “config.ini” text file that is placed in the main (root) level on the microSD card. Single-line comments are denoted by a semicolon.

The following is an example of a typical config.ini file:

```
; Set the sample-rate to 40 Hz
sr = 40
; Set accelerometer range to 2 g
ar = 2
; Set gyroscope range to 500 dps
gr = 500
```

The allowed sample-rates and full-scale values are the following:

- Sample-rates: 40, 160, and 640 Hz
- Accelerometer full-scale range values: 2 g and 6 g
- Gyroscope full-scale range values: 250, 500, and 2000 dps

If no config.ini file is present, the device defaults to the following values:

- Sample-rate: 40 Hz
- Accelerometer full-scale range: 2 g.
- Gyroscope full-scale range: 500 dps.

3.6 Charging

The AG-1 data logger can be charged by plugging in the device to a USB port through the use of a USB to Micro-USB cable. When charging, a red LED will remain on and will turn off once the device is fully charged.

3.7 Memory Card Format

The AG-1 data logger makes use of a 2 GB microSD card. The card must be formatted in FAT16 or FAT32 format.

For ease of use, the AG-1 can erase and format the microSD card into FAT16 format if the card is standard SD or FAT32 format if the card is SDHC through the following procedure:

- Put the device in off mode (light is off)
- Tap the button three times. The light will blink then stay on, indicating “Do you want to format the microSD card?”
- For “Yes”, press and hold the button to erase and format the microSD. For “No”, tap the button to return to off mode.

After formatting, the SD card is cleared except for the config.ini file which is left on the card so the user-selectable settings remain unchanged.

3.8 Firmware Update

To update the firmware on the device, use the following procedure:

- Plug in the USB port to a powered source to ensure the device has sufficient power.
- Download the firmware file from www.icewire.ca (FIRMWxxx.TXT)
- Format the microSD card
- Copy the firmware file onto the microSD card
- Place the microSD card in the device and turn on the device. At this point, the device will show a double flash showing that it recognizes new firmware is available on the microSD card
- For “Yes”, press and hold the button to update the firmware. For “No”, tap the button and the device will ignore the firmware file

4 Specifications

Recording Time (default settings used)

- 9.5 hours (battery powered limited)
- 195 hours for 2 GB SD card (SD card limited)

Accelerometer

Parameter	Test Conditions	Min	Typ	Max	Unit
Measurement range			±2 ±6		g
Resolution	Range ±2 g, sample-rate 40 Hz		1		mg
	Range ±2 g, sample-rate 160 Hz		2		mg
	Range ±2 g, sample-rate 640 Hz		4		mg

Gyroscope

Parameter	Test Conditions	Min	Typ	Max	Unit
Measurement range			±250 ±500 ±2000		dps (degrees per second)
Sensitivity	±250 dps		8.75		mdps/digit
	±500 dps		17.50		
	±2000 dps		70		
Digital zero-rate level	±250 dps		±10		dps
	±500 dps		±15		
	±2000 dps		±75		