Oregon Research Electronics

Application Note

AL10x Acceleration Calibration

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1. Nominal Full Scale

The acceleration sensor in the AL10x products has a choice of 5 user selectable full scale settings: +/- 2g, +/-4g, +/-6g, +/-8g, +/-16g. These are not, however, the actual full scale values!

2. Sensor Data Format

Sensor data size is 16 bits signed (e.g. 15bits plus sign). This means that the largest possible positive number that the sensor can generate is 32767.

3. Sensor Sensitivity

For each full scale setting, there is a sensitivity value. This value represents the acceleration in "g units" represented by a change of 1 in the sensor value. For example, if the sensor reports a change from a value of 473 to 474, this indicates that the acceleration has changed by one "sensitivity unit".

Nominal Full Scale	Sensitivity
+/- 2g	0.06mg
+/- 4g	0.12mg
+/- 6g	0.18mg
+/- 8g	0.24mg
+/- 16h	0.73mg

Please note that the sensor manufacturer gives NO hint as to the tolerance of these values.

4. Actual Full Scale

The actual full scale is the product of the sensitivity and largest possible positive number that can be generated by the sensor.

Nominal Full Scale	Computation	Full Scale
+/- 2g	32767 * 0.06	1.966 g
+/- 4g	32767 * 0.12	3.932 g
+/- 6g	32767 * 0.18	5.898 g
+/- 8g	32767 * 0.24	7.864 g
+/- 16h	32767 * 0.73	23.92 g

5. Full Scale vs Sample Rate

Before the data is saved on the memory card, it is "processed". This processing controls the effective sample rate. It has the side effect of changing the recorded full scale depending on the sample rate. The relationships involved with this processing are shown in the next table. DIV represents the sample rate divisor that is used in the menu to set the sample rate. Sample rate is 100Hz/DIV. Full scale represents the largest positive value that can be generated for each sample rate; this is independent of the nominal sensor full scale.

DIV	Sample Rate	Computatiaon	Full Scale
4	25Hz	32767 * 4	131608
5	20Hz	32767 * 5	163835
6	16.67Hz	32767 * 6	196602
7	14.29zHz	32767 * 7	229369
8+	12.5Hz -	32767 * 8	262056

Note that all DIV values 8 or greater result in the same full scale of 262056.

For example, at 10Hz (and slower) sample rates with +/-2g full scale, 262056 represents +1.966 g. At 25Hz, 131068 represents +1.966 g. Yes, the resolution is higher at 10Hz than it is at 25Hz.

The values in the Full Scale column should never be exceeded (in recorded values) because they are simple integer multiples of the largest possible positive value in a 16-bit signed integer.

6. Number Representation in Recorded Data

Recorded data is 32 bits signed presented as text characters. Only the necessary number of characters (digits) are displayed. A sign character is added for negative values, only. Data is un-normalized sensor output.

7. Sensitivity Tolerance

The sensitivity tolerance is unspecified. However, a nominal temperature coefficient of sensitivity IS specified at 0.01 g/C (sign unspecified). Thus, at +/-2g, 10Hz, and 35C. a value of 262056 COULD represent 1.968 g or 1.964g or any value in-between.

8. Acceleration Normalizing

The actual full scale values in Section 4 and the full scale numbers vs sample rate in Section 5 can be combined to determine the recorded value that represents 1g. Once you have this number, the recorded data can be divided by the 1g value to determine the acceleration in g units.

For example, a 10Hz sample rate uses a DIV of 10, which falls in the 8+ row of the table. With a nominal sensor full scale of 2g, the 1g value is 133294. If there is a data value of 1674, it would represent an acceleration of 1674/133294 = 0.0126 g or 12.6 mg.

DIV	Full Scale	2g	4g	6g	8g	16g
4	131068	66667	33334	22222	16667	5479
5	163835	83334	41667	27778	20834	6849
6	196602	100001	50001	33334	25000	8219
7	229369	116668	58334	38889	29167	9589
8+	262056	133294	66647	44431	33323	10956

9. Offset

The sensor is subject to "zero offset". This offset is independent on each axis and has a temperature coefficient. While the offset is small (typically up to +/-40mg), it can be enough to effect the achievable maximum values when the acceleration is very close to full scale.

Summary

This application note shows how to convert acceleration readings recorded in AL10x csv data files into acceleration values in g units.