

USING THE GEODE WITH ACCELEROMETERS

Bill Honzik
July 2009

First, The Geode output files report data values referred to the Geode input (after the descaling factor given in the file header is applied), so voltage scaling attributable to the Geode is thereby taken care of.

People do sometimes want to use accelerometers with seismic recording systems such as the Geode. There are some issues that need to be addressed by the user. The Geode input is designed for geophones, which produce a floating differential signal. Accelerometer inputs are generally not floating, not differential, and often have a higher voltage range than the input range of the Geode. Given this, a direct connection can possibly be made, but the results may or may not be satisfactory, depending on the user's needs. The preferred method would be to insert an amplifier designed to convert the accelerometer output to a floating differential signal with a compatible range. If the user does not require the most demanding results, some compromises might be made.

The differential signal: this means that the signal is transmitted as the difference in the voltages of a pair of wires that are electrically balanced, as far as possible. Again, this means that the electrical circuit for one of the wires is practically identical to the electrical circuit of the other wire, in terms of the driving source, the driven input, and the electrical characteristics involving the environment (primarily the resistance and capacitance to the earth, or other objects). With such a balanced pair, the common voltage signals picked up from the environment (such as from nearby power lines) would be nearly identical, so the difference in this common mode "noise" would be practically zero compared to the differential signal of interest. But if the wire pairs are not balanced, then common mode noise might dominate, or at least be confused with, the signal of interest, particularly if the transmission cable is long. If the cable can be kept very short, this might not be a consequential problem.

Floating: this means that the differential signal comes from a source that has no other, or insignificant, connection to anything else, including the other sources for the other channels. Geophones fit this category quite well. But an accelerometer needs a power supply, and generally one would prefer to use the same power supply for several accelerometers, so they would not be floating relative to each other. The consequence is that the signal from one could become imposed to some degree on the signal of another (called crossfeed or crosstalk). Again, if the cables are short and there are not many accelerometers, compromising this feature might be acceptable to the user. With the Geode, it is particularly important not to have non-floating sources span across the 8-channel board boundaries, because this would allow a path for the common-mode noise of one board to be injected into the signals for the other board, and vice-versa.

TECHNICAL NOTE

Signal range: the Geode signal range, when jumpered to 0dB preamp gain, is +/- 1.4V. Accelerometers commonly put out signals in the range of 10V or more, and sometimes offset from zero by a significant amount, such as 5V. Connecting such an accelerometer directly to a Geode (ground reference to the negative input, signal output to the positive input) would create a large differential voltage that would saturate the Geode (though it should not damage it). Capacitive coupling might be used, but then the user would have to consider the consequences to the frequency response of the system. Or connecting the Geode's negative input to a DC voltage that is nearly equal to the average voltage of the accelerometer output might possible work. This offset reference voltage should be derived from the same voltage used to power the accelerometer, otherwise, fluctuations in one relative to the other would appear as signal. Also, the Geode and it's power supply would have to float relative to the accelerometers and their power supply, otherwise the resulting common mode voltage would saturate the common-mode handling portion of the Geode's differential input.

So there are many hurdles to making it work well, which is why it is recommended to use an amplifier for each accelerometer that is designed to solve these problems.