Calculating Frequency, Duration, Amplitude, and Voltage Using a Legend

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Now that paper EEG instruments are pretty much a thing of the past, we no longer have the chart paper printed with 6 millimeter (mm) and 30 mm gridlines. One second (sec) of EEG data at a standard paper speed of 30 millimeters per second (mm/sec) is also a thing of the past.

In this article I want to review with you how simple it is to use a Legend. You will need a measurement ruler graduated into one mm segments. It would also be handy to have a calculator that can be set to divide to 3 decimal places. If you perform division by hand, please be sure to carry the results to 3 decimal places when calculating waveform duration.

I strongly recommend whenever you are doing calculation utilizing a Legend that you use a referential montage and the reference is not contaminated with EEG activity. This is because in a bipolar montage the waveforms are the result of two inputs active with EEG activity. The same can be said of a referential montage if the reference is contaminated.

Sometimes you will see a horizontal line drawn on an EEG sample. Beneath the line is a ‘time’ indicator. The line length represents how much distance, measured in millimeters (mm), is needed to show one second of data. By the way, every second contains 1,000 milliseconds (ms).

Sometimes you will see a vertical line drawn on an EEG sample. Next to the vertical line is a number in microvolts (µV).

The most common Legend is something called a gnomon. The g is silent so it is pronounced ‘no man’. It looks like the letter L rotated 90 degrees counter clockwise ( ).

Figure 1 shows a digital EEG sample. The gnomon is the thicker line with time and voltage indicators. Also placed upon the EEG waveforms are several different markers.

Take a mm ruler and measure the gnomon’s horizontal line. Then measure the gnomon’s vertical line.

On my print out, the horizontal line measures about 55 mm and represents 1 sec of time as indicated. The vertical line measures about 26 mm and represents 50 µV as indicated.

In this newsletter, I am certain the gnomon measurements are different than the numbers mentioned. This is one of the valuable aspects of having a Legend. Because regardless of the size of print out, or a digital EEG display monitor’s size, so long as there is a Legend all of the calculations described within this article are still applicable. Only the numbers change.

Look at the waveform on the left. Two vertical time line markers are placed. One is at the start of the wave and the other is at the end. I measure the distance, or duration, between them at about 7 mm.

Duration is the amount of time it takes a wave from when it starts to when it ends. Let’s calculate this wave’s duration. If you divide 7 mm by 55 mm the result is 0.127 sec, or 127 ms. This is the wave’s duration.

Frequency is the amount of time the same size wave could repeat itself within 1 sec. Remember 1 sec equals 1000 ms. So if you divide a wave’s duration into 1000 ms you then know the frequency. 127 ms goes into 1000 ms 7.874 times. Frequency’s unit of measure is hertz (Hz). So this wave’s frequency is 7.874 Hz.

If you know a waveform’s frequency in Hz it is very easy to determine the duration in ms. For example, if you divide 1 sec by 7.874 Hz the resultant duration is 0.127 sec or 127 ms.

Now let’s look at how we could calculate Amplitude and convert it into Voltage. Note that whenever you are calculating amplitude of a wave you should use a referential montage with a reference that is not contaminated with EEG activity.

Look at the waveform on the right. There are two markers that look like +. One is at the start of the wave. The other is at the peak of the wave. This is an example of where and how not to measure amplitude.

Instead, look closely at the vertical line extending downward from the peak to even with the start of the waveform. The amplitude of this wave measures about 12 mm.

To calculate the waveform’s Voltage you would divide the amplitude by the gnomon’s 26 mm distance that represents 50 µV. So 12 mm divided by 26 mm equals 0.462. Multiply 50 µV by this number 0.462 and the result is 23.1 µV.

I hope these tips help you learn how to use a Legend to calculate frequency, duration, amplitude, and voltage. That said, you probably notice the word about appears several times in the article and is in italic format. When trying to use a mm ruler, especially when the measurements line up somewhere between ruler markings, estimations become imprecise.

Wow, that was a lot of work utilizing a legend to obtain imprecise results. Fortunately, there is an easier way. Every digital EEG instrument’s software contains an assortment of different measurement markers and tools. These are very precise, easy to use and more accurate than utilizing a Legend.

Calculating frequency, duration, amplitude, and voltage using a Legend was covered in an ASET conference call on March 14, 2007. To learn more about conference calls in general, including how to participate in one real-time or how to obtain the finished product after the fact, like my conference call on this very topic, simply follow this link.

http://www.aset.org/show/Education/Conference_Call_Seminars

If you have any questions or comments about this article, contact me by email at bbyrum@ipa.net.