Setting the thresholds with the Standard Deviation (SD) percentage

The Mobius's [Extracted Spikes Advanced] module allows you to set spike thresholds by:

1. Sliding threshold bars in the single channel display.
2. Sliding threshold bars in all channel display.
3. Standard Deviation (SD) percentage.
4. Manually typing the value in a chart.

The SD percentage is a convenient tool to set thresholds for all 64 channels with just one click. By selecting a number and then clicking the [Set Thresholds] button, threshold moving bars automatically move to appropriate locations at all channels.

What is the "SD" in the Mobius?

Mobius processes data every 500 msec. The definition of the SD in the Mobius software is Standard Deviation of all signal amplitudes acquired for the instantaneous 500 msec (when the [Set Thresholds] is clicked). The formula used is:

$$SD(100\%) = \sqrt{\frac{(V(t_1)-u)^2 + (V(t_2)-u)^2 + (V(t_3)-u)^2 + \cdots\cdots + (V(t_N)-u)^2}{N}} \qquad u = \frac{1}{N}\sum_{n=1}^{N} V(t_n)$$

t_n: Sampling time N: Number of sampling time $V(t_n)$: Signal level at each samplings

When the [Set Thresholds] button is clicked while Mobius is stopped, the computation is performed for the data trace at the last 500 msec.

The "SD percentage"

The SD percentage selected (or typed) in the selector indicate the percentage over the SD. For example, selecting 400 will move threshold moving bars to the location of 400% over the SD (i.e., SD x 4) for both positive and negative signals.
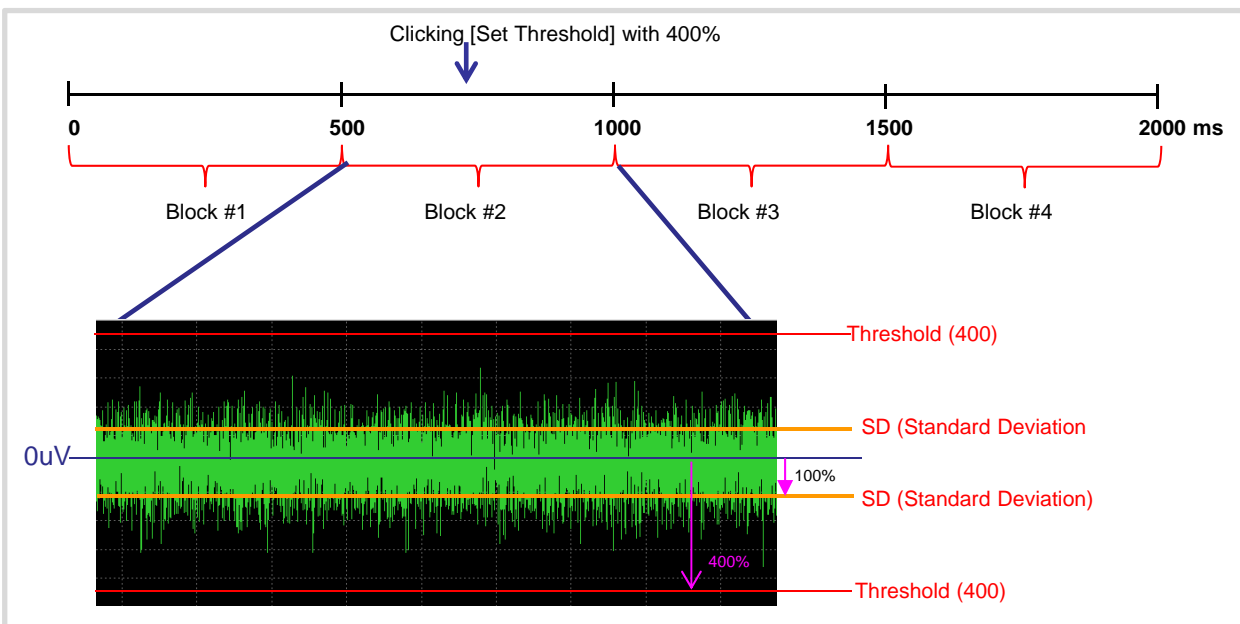

Figure 1. Example recording with SD (Standard Deviation) displayed and thresholds set at 400%.

Recommended settings

For setting the thresholds as the SD percentage in Mobius, 400-600 is generally recommended, although the number should be changed depending on type of cells or/and experimental conditions.

Generally, experimenters should set spike thresholds to be 400% over the SD of the noise during analysis of MEA electrophysiology data. Theoretically, 99.99% of Johnson noise—electrical baseline noise which does not include biological signals—stays within 400% of its own standard deviation (Figure 2).

However, Mobius's SD is computed over an arbitrary 500 msec window, which may include biological signals within this arbitrary window, and depends upon when the [Set Threshold] button is clicked. It is important to take this into consideration when the SD percentage is determined.
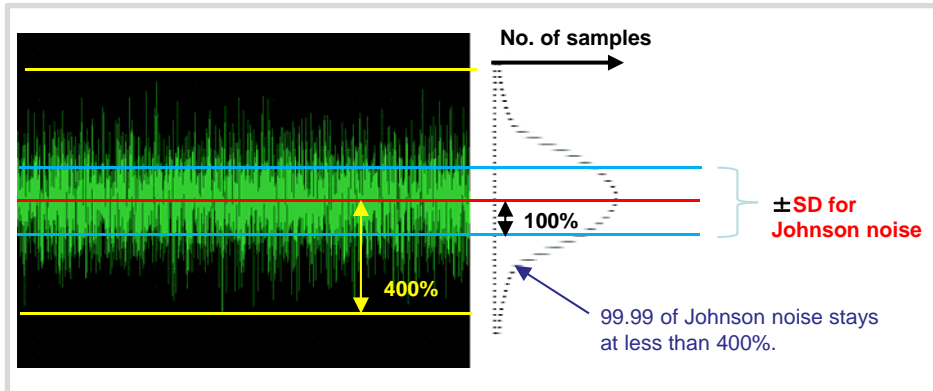
% over SD (1)	Probabilities to stay in (1)
260	99
330	99.9
390	99.99
440	99.999
490	99.9999

Figure 2. Nature for Johnson noise.