

1 **Electrical Identification and Selective Microstimulation of Neuronal**
2 **Compartments Based on Features of Extracellular Action Potentials**

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SUPPLEMENTARY FIGURE LEGENDS

1 **Supplementary Figure S1. Reliable detection of individual axonal APs triggered by extracellular** 2 **stimulation**

3 Exemplary waveforms of averaged and individual APs triggered consecutively from 4 different
4 stimulation sites and recorded at 3 distal axonal compartments are presented in panels (a) to (d). Colors
5 of averaged AP waveforms indicate occurrence times of negative AP peaks relative to the stimulation
6 time. Individual APs are colored in gray. Gray axonal contours serve as guide to the eye and are
7 estimated by observing relative changes in spatial position of the extracellular signal peaks across
8 consecutive 50- μ s time intervals, frame by frame. The four complete stimulation-triggered footprints
9 are presented in Fig. 2a-d and in Supplementary Movie S2. The stimulation spots in Supplementary
10 Fig. S1a-d correspond to those in Fig. 2a-d.

11 **Supplementary Figure S2. Correlations between features of the spontaneous AP footprint and** 12 **site-specific stimulation thresholds of proximal neuronal compartments**

13 (a) Correlations between stimulation threshold values and individual parameters extracted from
14 spontaneous AP footprints are presented in four graphs. Occurrence time of the negative peak in the
15 traces (1); occurrence time of the minimum in the 1st derivative of the traces (2); negative peak
16 amplitude of the extracellular traces (3) and peak-to-peak amplitudes (4) are correlated with the
17 corresponding stimulation threshold values extracted from stimulation maps of 14 neurons. Most
18 sensitive, second and third sensitive sites (M_{ss}, 2ndss and 3rdss), are color-coded by red, orange and
19 yellow respectively.

20 (b) Correlations between stimulation threshold values and individual parameters extracted from
21 spontaneous AP footprints are presented in four graphs. Spatial distance of the stimulation site from the
22 most sensitive site (1); distance of the stimulation site from the electrode featuring the peak trace (2);
23 distance of the stimulation site from the footprint's center of mass (3) and distance of the stimulation
24 site from the location of the initial trace (4) are correlated against corresponding stimulation threshold
25 values extracted from stimulation maps of 14 neurons. Most sensitive, second and third sensitive sites
26 (M_{ss}, 2ndss and 3rdss), are color-coded by red, orange and yellow respectively.

1 **Supplementary Figure S3. Spatiotemporal distribution of extracellular AP waveforms with**
2 **regard to neuronal morphology**

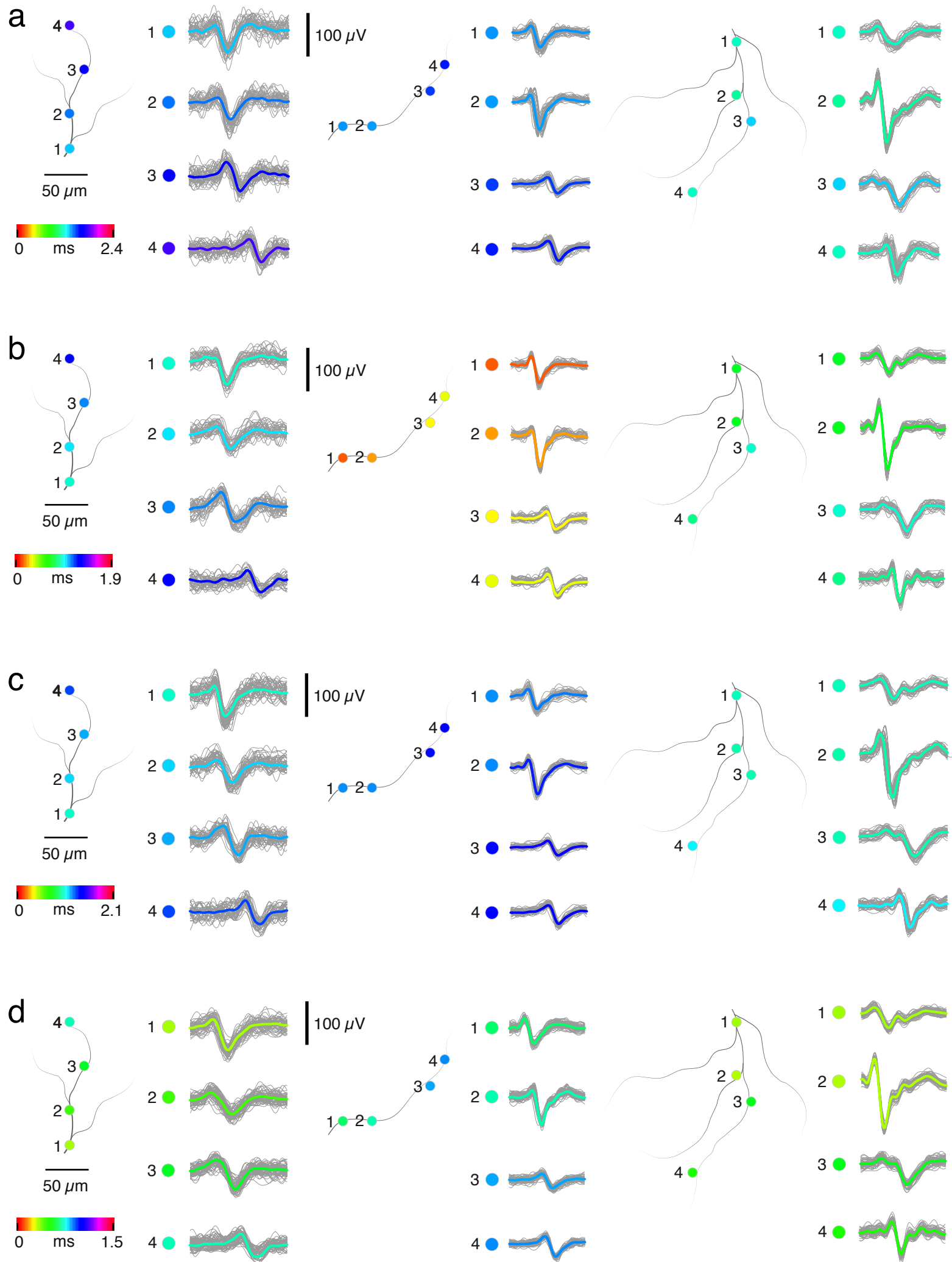
3 Spike-triggered footprint superimposed over a micrograph of the corresponding lipofected neuron.
4 Colors of AP waveforms indicate timing of their occurrence relative to the first recorded activity. In the
5 insets magnifying two axonal portions the distribution of axonal AP waveforms is displayed. The same
6 neuron is presented in Fig. 5, 8, Supplementary Fig. S4, and Supplementary Movie S5.

7 **Supplementary Figure S4. Influence of suprathreshold stimulation voltages on neuron's**
8 **activation reliability**

9 (a) (Left) Activation reliability map of threshold stimulation. Circle sizes indicate relative activation
10 reliability (%), and the colors represent activation failing points (no triggering of an AP, see Fig. 8).
11 Activation reliability represents the percentage of successfully evoked responses, whereas the
12 activation failing point represents the number of stimulations after which activation reliability dropped
13 below 95%. Three electrodes (numbered as 3, 4 and 8) were stimulated at 100 Hz at threshold voltages.
14 (Right) Reliability profiles for electrodes 3, 4 and 8 in the activation reliability map. Red dashed lines
15 indicate the activation failing thresholds and red circles projected on the x-axes indicate activation
16 failing points.

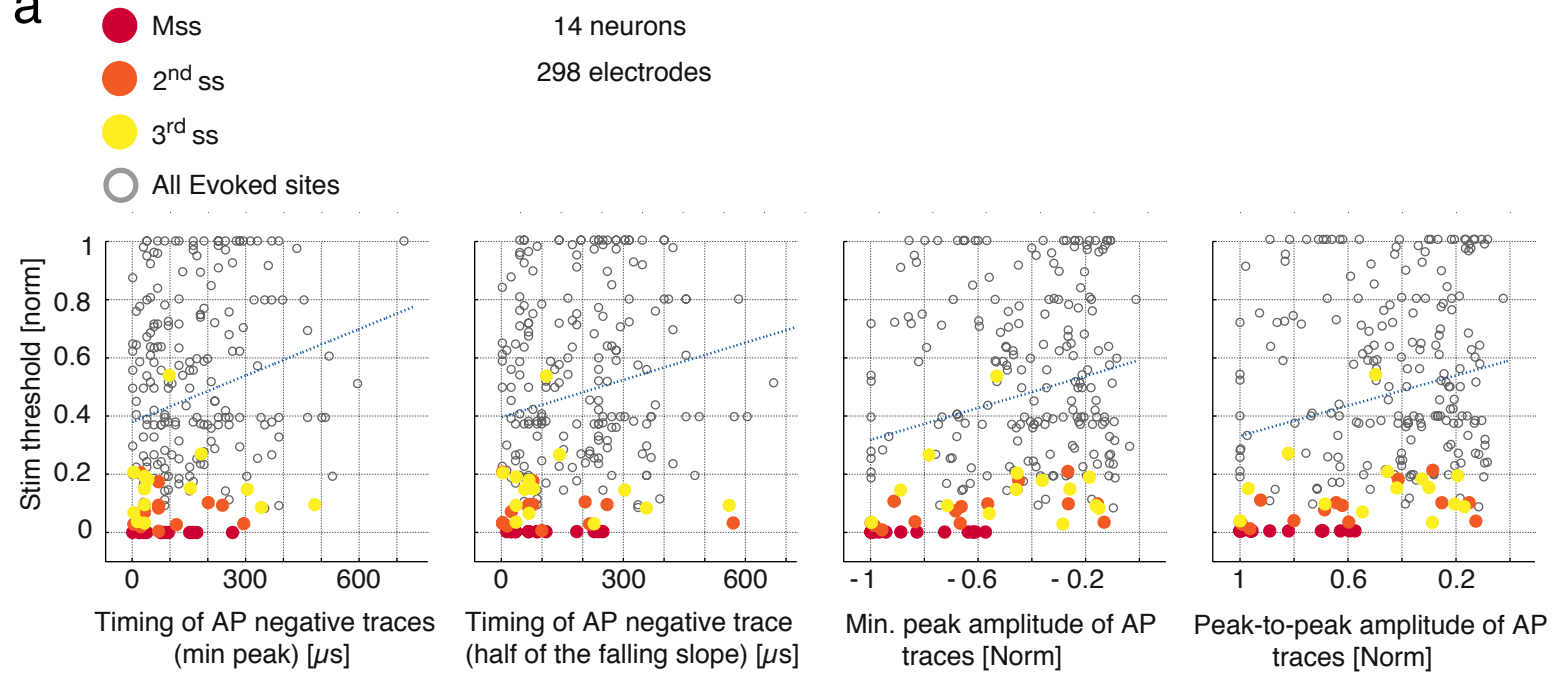
17 (b) (Left) Activation reliability map of suprathreshold stimulation. Circle sizes indicate relative
18 activation reliability (%), and the colors represent activation failing points (no triggering of an AP, see
19 Fig. 8). Activation reliability represents the percentage of successfully evoked responses, whereas the
20 activation failing point represents the number of stimulations after which activation reliability dropped
21 below 95%. Three electrodes (numbered as 3, 4 and 8) were stimulated at 100 Hz at suprathreshold
22 voltages. (Right) Reliability profiles for electrodes 3, 4 and 8 in the activation reliability map. Red
23 dashed lines indicate activation failing thresholds and red circles projected on the x-axes indicate
24 activation failing points.

Supplementary Figure S1

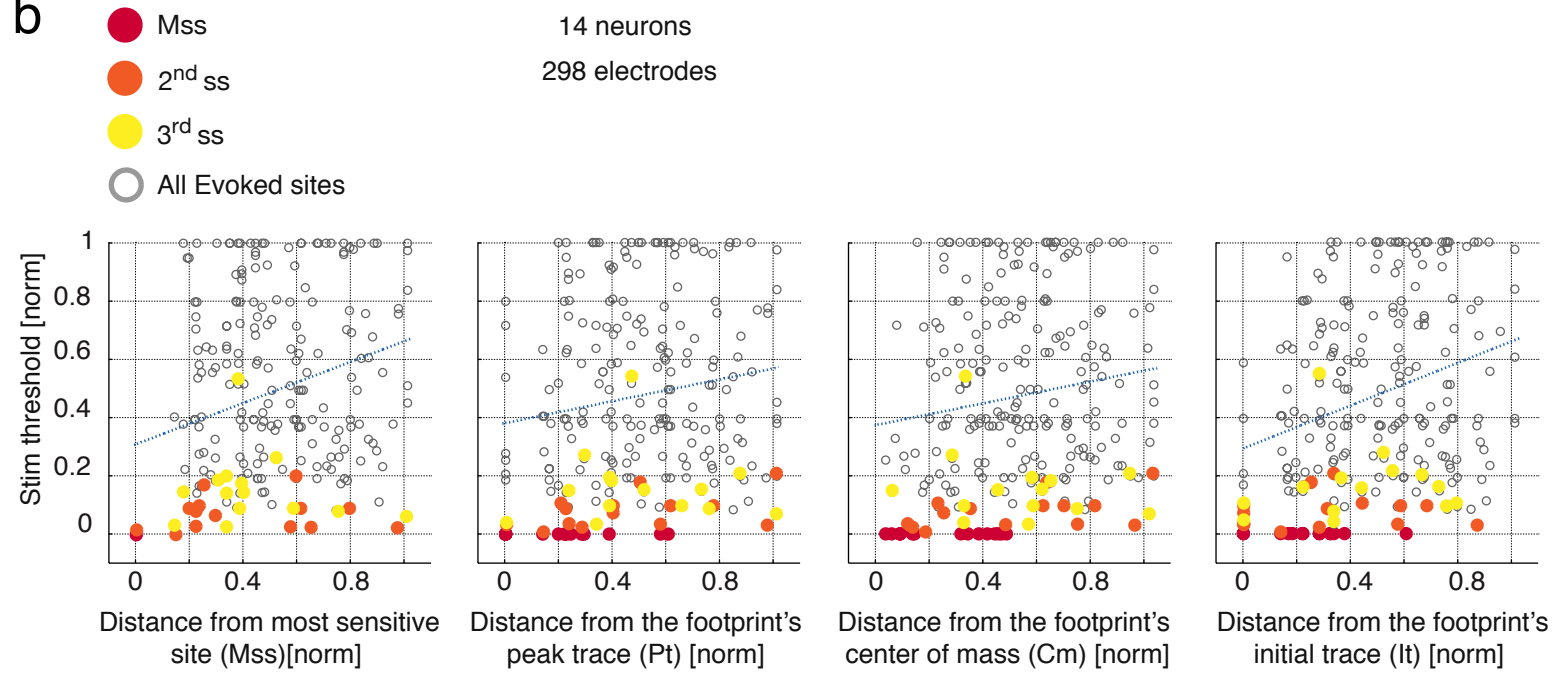


Supplementary Figure S2

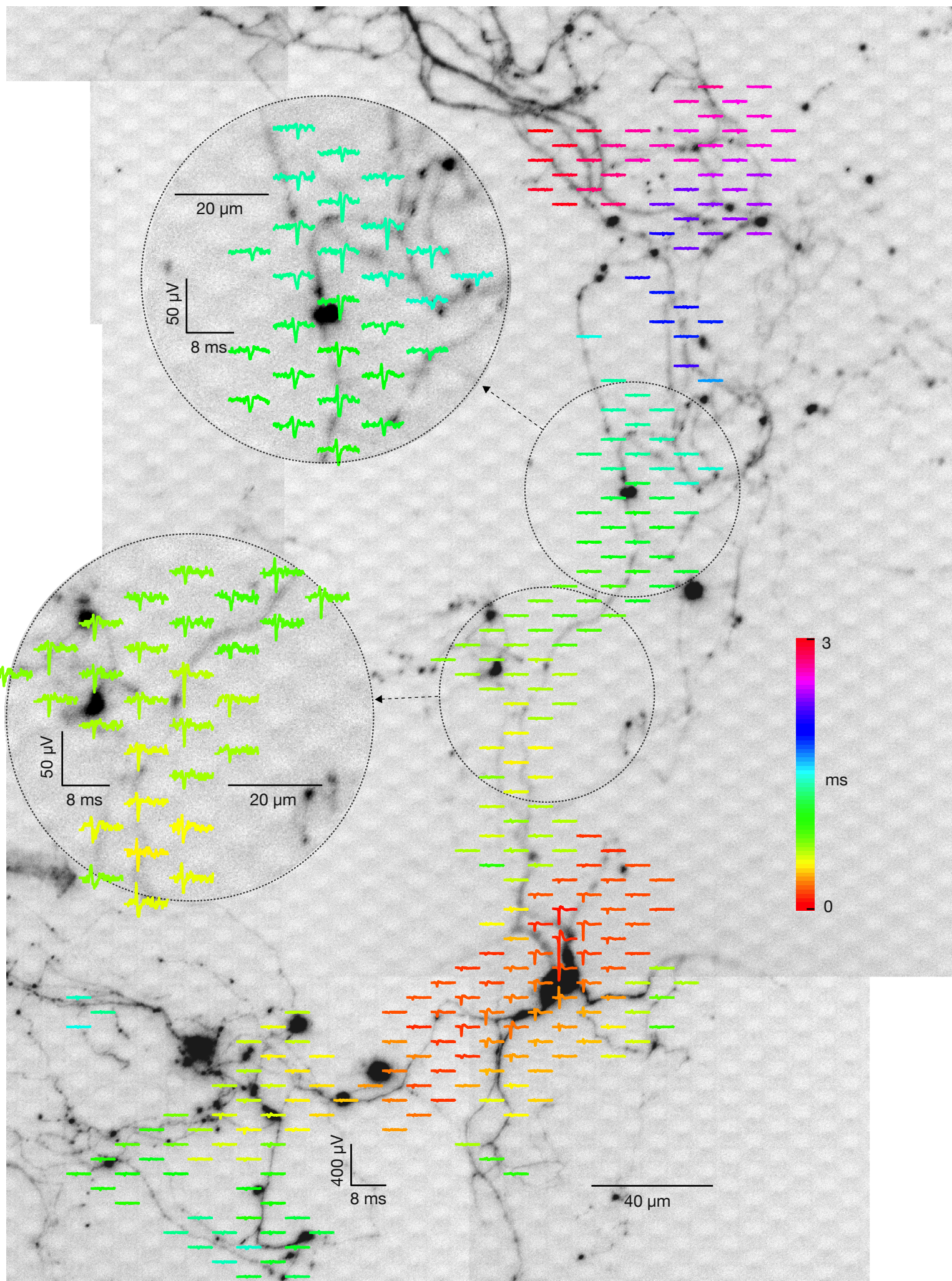
a



b



Supplementary Figure S3



Supplementary Figure S4

