Electrophysiological experiments and computational studies show that so-called ‘background’ synaptic activity received by neurons leads to a noisy membrane potential and that this noise can profoundly alter the input-output properties of neurons. However, the temporal characteristics of voltage changes caused by individual synaptic events are highly dependent on the structural properties of neurons and these vary widely. In the present study, we used passive, compartmental, models of the dendritic tree of a reconstructed feline neck motoneuron to test the hypothesis that the characteristics of noise depend on the number and distribution of active synapses on the dendritic tree. The magnitude and time course of the conductances of excitatory (E) and inhibitory (I) synapses were based on experimental observations. Noise was simulated using Poisson-distributed synapse release times (mean frequency: E: 20 Hz; I: 25 Hz) with a 2 ms refractory period. The average standard deviation (SD) of the somatic membrane potential from five 500 ms long simulations was used to calculate the noise. If synapses were uniformly distributed over the entire dendritic tree (i.e. same number of synapses per unit area), activation of few synapses resulted in a large degree of noise and the noise increased as the number of active synapses increased. For example, when the activity of the excitatory and inhibitory synapses was ‘balanced’ to keep the average membrane potential constant at 64 mV, SDs were 298, 356 and 499 μV following activation of 55E and 69I synapses, 110E and 137I synapses, and 220E and 275I synapses, respectively. Similar results were obtained when the average membrane potential was depolarized due to activation of more excitatory synapses (SDs of 562, 626 and 756 μV for 385E, 660E and 1210E synapses, respectively, and 137I synapses). When synapses were restricted to the proximal or middle or distal one-third of the dendritic tree, the magnitude of the noise became progressively smaller as the location of the active synapses was shifted distally (SDs of 495, 293 and 170 μV for the proximal, middle and distal one-thirds, respectively; balanced 108E and 135I synapses). These results demonstrate that fluctuations in membrane potential depend on the intensity of synaptic activity and the location of the active synapses on motoneurons. Thus, the ‘noise’ in the membrane potential of motoneurons may be tailored to meet specific input-output demands.