Fig. S1. (A) 0.225 ms phase-shifted pulses across electrode pairs. Voltage recordings were measured on two different electrodes that were separated by 800 µm. Electrode 1 is shown in black, electrode 2 is shown in blue. The phase shift across electrode 1 and 2 was set at 0.225 ms. While the amplitude of the pulses was not affected by the timing of pulses from neighboring electrodes we did find a small overlap between the anodic phase of the first pulse with the cathodic phase of the second pulse. B) 0.3 ms phase-shifted pulses across electrode pairs. Phase-shifting the pulses by 0.3 ms removed any overlap of the pulses. (C) The slight overlap of the 0.225 ms phase-shift has no perceptual consequence. S05 and S06 could not discriminate between 0.225 ms and 0.3 ms stimuli using the same-different task described in the main paper.
S2 – Measuring the critical flicker fusion point (CFF) in retinal prosthesis subjects

We asked subjects to discriminate between two stimuli that differed in their frequency by reporting which of the two stimuli appeared to flicker and if both appeared to flicker, which was flickering more slowly (in practice, the higher frequency stimulus was always above the CFF) in a two-alternative forced-choice task. Due to constraints in the stimulation software, we could not hold the frequency of the higher frequency stimulus fixed, so instead we set the frequency of the high frequency stimulus to be 3x that of the lower frequency stimulus. The mean amplitude of the low and high frequency stimulus were brightness matched based on data collected in a separate brightness matching experiment carried out beforehand, but on each individual trial the high frequency stimulus was amplitude jittered to prevent subjects from using brightness cues to discriminate the two stimuli.

Fig. S2A shows data collected on a single electrode in S06 for two different pulse widths. The x-axis represents the frequency of the lower frequency stimulus and the y-axis represents the percentage of trials where S06 correctly reported that the lower frequency stimulus was the one that was flickering. Each data point represents 100 trials. As the frequency of the stimuli increase, the ability to discriminate which was the flickering stimulus declines.

We determined the point of CFF to be at the 75% correct point on the curve. Thus, for Fig. S2A, the CFF when using a 0.975 ms pulse width was 42.2 Hz, and 35.8 Hz for a 0.075 ms pulse width. The 50% point would be the frequency at which subjects could no longer discriminate the two stimuli, however, owing to the shape of the psychometric function, this point is difficult to estimate accurately.
This experiment was carried out on 2 electrodes for subject S05, and on 3 electrodes for subject S06. Fig. S2B shows mean CFF averaged across these electrodes, with mean standard errors calculated across electrodes. Statistically, we did not see a difference in the average CFF when using either a 0.075 ms pulse width or a 0.975 ms pulse width, though there was a difference between the two subjects in their ability to perform the task.

![Graph A](image1)
![Graph B](image2)

**Fig. S2.** (A) Evaluation of CFF for a single electrode in subject S06. Curves were fit with a Weibull function and the CFF was determined to be the 75% correct point on the curve. We compared each subject’s CFF on multiple, different electrodes when using either 0.075 or 0.975 ms pulse widths. (B) Average performance on the CFF task for subjects S05 and S06. Again, we compared two different pulse widths (the gray and red bars).