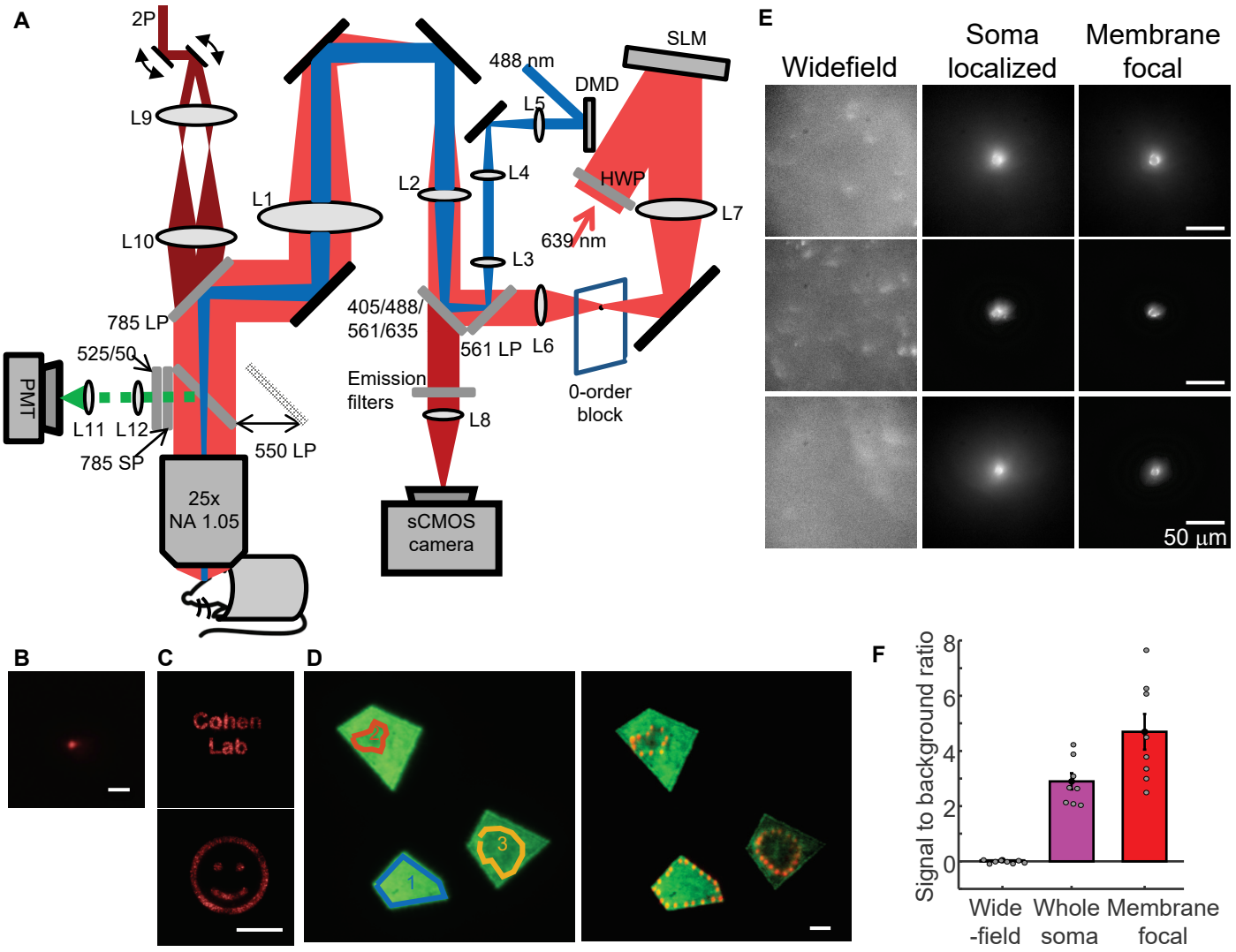

Methods S1. Instrumentation for holographic voltage imaging and patterned optogenetic stimulation, Related to STAR Methods Holographic Optical System. (**A**) Layout of the optical setup. The spatial light modulator (SLM) diffractively patterned the red laser (λ = 639 nm) into a set of discrete foci on the sample for holographic structured illumination excitation of a far red GEVI. The digital micromirror device (DMD) acted as a binary amplitude mask and projected a pattern of blue light onto the sample for targeted optogenetic activation of a blue-excited channelrhodopsin. Fluorescence from the sample was imaged onto a scientific CMOS camera. For two-photon (2P) imaging, pulsed infrared light (λ = 920 nm) was scanned by a pair of galvo mirrors. A dichroic mirror was inserted into the beam path to direct green fluorescence onto a photomultiplier (PMT). Parts list in Table S1. Not shown: beam expansion and polarization control optics for each of the laser beams. (**B**) Point-spread function of the red illumination. Scale bar 10 µm. (**C**) Diffractively patterned red light illumination patterns projected onto a homogeneous fluorescent test sample. Scale bar 50 µm. (**D**) Combination of patterned blue and red illumination. Left: Patterns of fluorescence excited by blue light projected onto a homogeneous fluorescent test sample. Target patterns for the red illumination were manually defined. Right: Superposition of image of the red illumination on the green fluorescence excited by blue illumination. Scale bar 10 µm. (**E**) Representative images in the SomArchon fluorescence channel showing wide-field, cell-localized whole soma, and holographic membrane focal illumination. Each row contains three images of the same field of view. (**F**) Quantification of the signal (fluorescence in the cell area) to background (fluorescence in the surrounding region) ratio for the three illumination schemes. Wide-field and membrane focal data are as in Fig. 1C.