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K2-141 b is a transiting, small (1.5 Re) ultra-short-period (USP) planet discovered by the Kepler space telescope orbiting a K-dwarf host star every 6.7 hours. The planet's high surface temperature of more than 2000 K makes it an excellent target for thermal emission observations. Here we present 65 hours of continuous photometric observations of K2-141 b collected with Spitzer's IRAC Channel 2 at 4.5 micron spanning 10 full orbits of the planet. We measure an infrared eclipse depth of 142.9 ± 39.0 ppm and a peak to trough amplitude variation of 121 ± 43 ppm. The best fit model to the Spitzer data shows no significant thermal hotspot offset, in contrast to the previously observed offset for the well-studied USP planet 55 Cnc e. We also jointly analyze the new Spitzer observations with the photometry collected by Kepler during two separate K2 campaigns. We model the planetary emission with a range of toy models that include a reflective and a thermal contribution. With a two-temperature model, we measure a dayside temperature of 2049 ± 361 K and a night-side temperature that is consistent with zero (Tp,n < 1712 K at 2 sigma). Models with a steep dayside temperature gradient provide a better fit to the data than a uniform dayside temperature (ΔBIC = 22.2). We also find evidence for a non-zero geometric albedo Ag = 0.28 ± 0.07. We also compare the data to a physically motivated, pseudo-2D rock vapor model and a 1D turbulent boundary layer model. Both models fit the data well. Notably, we find that the optical eclipse depth can be explained by thermal emission from a hot inversion layer, rather than reflected light. A thermal inversion may also be responsible for the deep optical eclipse observed for another USP, Kepler-10 b. Finally, we significantly improve the ephemerides for K2-141 b and c, which will facilitate further follow-up observations of this interesting system with state-of-the art observatories like JWST.