This paper reports the study of Fatty Acid Methyl Ester Methyl Linoleate (FAME-MML C19H34O2) as a topping cycle for use at high temperature, and elevated pressure applications. Herein, FAME-MML is used as a working fluid in a refrigeration based electronics cooling thermal control system for use on Venus in-situ science missions. The local atmosphere of Venus poses many challenges for thermal control having the following local properties: 738.15 K, 9 MPa, 96% CO2/4% N2. The planetary studies of Venus will use electronics and instrumentation which dissipate an appreciable amount of waste heat. The FAME-MML working fluid has a critical point (799 K, 1.341 MPa, 238.05 kg·m⁻³) above the local Venus environment (738.15 K), thus allowing for latent heat transfer, and the use of an active refrigeration system for heat removal and payload thermal control. This study will present analysis of a cascaded system using FAME-MML in the vapor compression topping stage. To the author’s knowledge, the research presented herein is the first application of FAME-MML biodiesel fuel as a refrigerant. The operation of the FAME-MML at these elevated pressures and temperatures places the FAME-MML in the supercritical regime. The FAME-MML is considered herein to be a natural refrigerant since it is derived from Rapeseed oil, which is the third largest source of vegetable oil in the world. A MATLAB model has been developed to simulate the cascade cycle’s thermal heat rejection performance. A sub-model of the FAME-MML cycle is derived from the cascade cycle model. The MATLAB modelling employs the NIST REFPROP database in order to determine the thermodynamic state points comprising the refrigeration cycle. In order to correlate the analysis of the FAME-MML cycle, experimental results taken from an engineering prototype of the FAME-MML vapor compression system (compressor, throttling valve, heat exchangers) will be discussed and presented herein.