A chirped-pulse Fourier transform microwave spectrometer was used to record the rotational spectrum of methyl vinyl ketone (MVK, 3-butene-2-one) from 6 to 18.9 GHz. Two stable conformations were identified: the previously documented antiperiplanar (ap) conformer and synperiplanar (sp), which is reported for the first time in this microwave study. Methyl torsional analysis with XIAM resulted in $V_3$ barrier heights of 433.8(1) and 376.6(2) cm$^{-1}$ for ap- and sp-MVK, respectively. Heavy atom isotopic species were detected in natural abundance allowing bond lengths and angles of the molecular frames to be calculated through Kraitchman analysis. A comparison with ab initio calculations is included.