A chirped-pulse Fourier transform mm-wave spectrometer has been tested in analytical chemistry applications of headspace analysis of volatile species. A solid-state mm-wave light source (260-290 GHz) provides 30-50 mW of power. This power is sufficient to achieve optimal excitation of individual transitions of molecules with dipole moments larger than about 0.1 D. The chirped-pulse spectrometer has near 100% measurement duty cycle using a high-speed digitizer (4 GS/s) with signal accumulation in an FPGA. The combination of the ability to perform optimal pulse excitation and near 100% measurement duty cycle gives a spectrometer that is fully optimized for trace detection. The performance of the instrument is tested using an EPA sample (EPA VOC Mix 6 – Supelco) that contains a set of molecules that are fast eluting on gas chromatographs and, as a result, present analysis challenges to mass spectrometry. The ability to directly analyze the VOC mixture is tested by acquiring the full bandwidth (260-290 GHz) spectrum in a “high dynamic range” measurement mode that minimizes spurious spectrometer responses. The high-resolution of molecular rotational spectroscopy makes it easy to analyze this mixture without the need for chemical separation. The sensitivity of the instrument for individual molecule detection, where a single transition is polarized by the excitation pulse, is also tested. Detection limits in water will be reported. In the case of chloromethane, the detection limit (0.1 microgram/L), matches the sensitivity reported in the EPA measurement protocol (EPA Method 524) for GC/MS.