The microwave spectra of three isotopomers of fluorobenzene-neon (normal, $^{22}$Ne and $d$-5) have been observed using a Fourier transform spectrometer. Twenty-two transitions were fit to eight constants. The dimer has a stacked structure with the neon over the fluorobenzene ring in the symmetry plane. The center of mass distance ($R_{cm}$) is 3.44(1) Å, with the neon sitting between the center of mass and the center of the ring. The rotational constants have been determined as $A = 1926.421(2)$ MHz, $B = 1645.236(3)$ MHz, and $C = 1279.734(1)$ MHz. The electric dipole moment was measured to be $|\mu_e| = 1.15(3)$ D, $|\mu_o| = 1.12(3)$ D, $|\mu_d| = 1.61(5)$ D.