Langmuir probes are commonly used diagnostics in low-pressure plasma discharges (<1 Torr). At high pressure (>100 Torr), Langmuir probes may be used to determine the ion density of an ionized gas, such as a flame [1], under the assumption of local thermodynamic equilibrium and known temperature. Dielectric Barrier Discharges (DBD’s) are not LTE plasmas [2] so traditional high-pressure Langmuir probe techniques do not apply. Although plasma parameters may not be diagnosed using the Langmuir probe, the plasma current may be determined using a double Langmuir probe along with linear library least squares fitting. A double Langmuir probe with tips oriented perpendicular to the electric field in a parallel plate DBD system provides the shape function for the plasma current. When the plasma current shape function and sinusoidal current shape function are added in linear combination in an impedance matched system, the total current must be produced by the conservation of current for a DBD as shown in Figure 1 [3]. By taking advantage of current conservation, the plasma current shape function is translated into plasma current as shown in Figure 2.

More simplistic techniques exist, such as grounding one electrode and measuring the plasma current. For systems with large separation gaps (>3 cm) both electrodes may be at potential to provide sufficient voltage to generate a discharge in the parallel plate configuration. Plasma filaments attached to the probe occasionally complicate the double Langmuir probe technique. When plasma filaments are not attached to the Langmuir probe, the double Langmuir probe shows agreement with the plasma current measured from a grounded electrode.