A 500 kV pulsed power generator is used to feed a planar diode in order to study electron beam emission, propagation and focusing towards a target. The cathode diameter, as well as the anode-cathode distance, can be varied in order to change the emitted current which is governed by the Child-Langmuir law. In order to match the diode impedance to the generator impedance, a liquid resistance is placed in parallel to the diode. Various electrical and optical measurements are performed. The measurements of the main beam characteristics are compared with the predictions of the PIC code MAGIC. Cerenkov emission from a silica target is analyzed and compared with the predictions of the GEANT4 code. We pay particular attention to the beam homogeneity and to the dispersion in the beam velocity components when the electrons strike the target. Several cathode materials are compared. Finally, for high currents, we plan to study the propagation of the beam inside a rare gas as a function of pressure. An external solenoid can be used to focus the beam at the target location if necessary.