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THEORETICAL ANALYSIS OF ARC CONSTRICTION

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1. PHYSICAL DESCRIPTION

The physics of the thermionic converter shown schematically on Figure 1 is governed by strong electrode-plasma interactions (emissions, surface scattering, charge exchange) and weak interactions (diffusion, radiation) at the maximum interelectrode plasma radius. The physical processes are thus mostly convective in thin sheaths in front of the electrodes and mostly diffusive and radiative in the plasma bulk. The physical boundaries are open boundaries to particle transfer (electrons emitted or absorbed by the electrodes, all particles diffusing through some maximum plasma radius) and to convective, conductive and radiative heat transfer.

In a first approximation the thermionic converter may be described by a one-dimensional classical transport theory. Two main limitations prevent such a theory to provide more than a qualitative pattern of the converter physics one is the existence in the sheaths of strong nonequilibrium processes which cannot be formulated classically, the second is the existence of radial inhomogeneities at the maximum plasma radius which propagate themselves into the plasma and at the plasma-sheath interface and thus cannot be modelled by onedimensional plasma theory. The two-dimensional effects may be significant as a result of the sheath sensitivity to radial plasma variations and of the strong sheath-plasma coupling. The current-voltage characteristic of the converter is thus the result of an integrated current density over the collector area for which the boundary conditions at each r determine the regime (ignited/unignited) of the local current density. A current redistribution strongly weighted at small radii (arc constriction) limits the converter performance and opens questions on constriction reduction possibilities.

2. PROBLEM DEFINITION

The questions addressed in the present analysis are the following:

What are the main contributors to the loss of current at high voltage in the thermionic converter?

Is arc constriction observable theoretically and what are the conditions of its occurrence?

The resulting theoretical problem is formulated below:

Given electrode properties expressed by temperature T , work function Φ , electron reflection coefficient R_e and ion reflection coefficient R_i , and given boundary conditions in the gas outside the interelectrode region, find the particle and energy fluxes in the interelectrode region at variable converter output voltage. The cylindrical symmetry of the converter reduces the mathematical problem to a Two-Dimensional analysis over a region encompassing part of the interelectrode plasma and part of the ionized gas outside the electrodes as indicated on Figure 1.

As symmetry and continuity conditions result in zero radial derivatives of all parameters at $r=0$ (which may be replaced for computational purposes with $r=r_{\min} \neq 0$ at which the same condition applies) and as the radial derivatives at $r=r_{\max}$ at considerable distance outside the electrode edge are small or negligible, and also as the boundary conditions at the metal electrodes are independent of radius, the Two-Dimensional effects result from radial variation of the boundary conditions along the guard ring surface, and radial variation of the neutral properties related to radiational effects. The data on guard ring and neutral cesium condition is provided by experimental observations.

3. MATHEMATICAL FORMULATION

3.1. EQUATIONS

The parameters which describe the detailed physics of the diode are the particle state parameters and the electrical voltage:

n_e	electron density
T_e	electron temperature
V	electric potential
n_i	ion density
T_i	ion temperature
n_n	neutral density
T_n	neutral temperature

Their solution over the entire electrode to electrode space leads to the evaluation of the following set of dependent parameters.

$\vec{\Gamma}_e$	electron flux
$\vec{q}_e$	electron heat flux
$\vec{\Gamma}_i$	ion flux
$\vec{E}$	electric field
$\vec{J}$	electric current

The above parameters are determined from the equations listed hereafter:

Electron particle continuity:

(solved for n_e in the open domain plasma)

$$\text{div} (-A' \text{ grad } T_e - B' \text{ grad } n_e + C' \text{ grad } V) = S \quad (3.1)$$

Electron energy continuity:

(solved for T_e in the open domain plasma)

$$\text{div } (-A'' \text{ grad } T_e - B'' \text{ grad } n_e + C'' \text{ grad } V) = W + Q \quad (3.2)$$

Ion particle continuity:

(solved for V in the open domain plasma)

$$\text{div } (-A^i \text{ grad } T_i - B^i \text{ grad } n_i - C^i \text{ grad } V) = S \quad (3.3)$$

Quasineutrality condition:

(solved for n_i in the open domain plasma)

$$n_i = n_e \quad (3.4)$$

Ion - neutral thermalization condition:

(solved for T_i in the open domain plasma)

$$T_i = T_n \quad (3.5)$$

Neutral high conductivity condition:

(solved for T_n in the closed domain plasma)

$$T_n(z) = T_E + \frac{z}{d} (T_C - T_E) \quad (3.6)$$

Perfect gas law:

(solved for n_n in the closed domain plasma)

$$n_n = \frac{p_n}{kT_n} = \frac{p - n_i kT_i - n_e kT_e}{kT_n} \quad (3.7)$$

Electron flux continuity at the emitter sheath-plasma interface:

(solved for n_e at the emitter plasma boundary)

$$\Gamma_{eo} = -\Gamma_{Po} + \Gamma_E \exp\left(-\frac{-e(-\phi_E - V_o)}{kT_E}\right) \equiv X_o^1 \quad (3.8)$$

for $-V_o > \phi_E$ thus $-V_o = \phi_E + V_E$

$$\Gamma_{eo} = -\Gamma_{Po} \exp\left(-\frac{e(\phi_E + V_o)}{kT_o}\right) + \Gamma_E \equiv X_o^2 \quad (3.9)$$

for $-V_o < \phi_E$ thus $-V_o = \phi_E - V_E$

Electron flux continuity at the collector sheath-plasma interface:

(solved for n_e at the collector plasma boundary)

$$\Gamma_{ed} = +\Gamma_{Pd} - \Gamma_C \exp\left(-\frac{e(-\phi_C - V_{out} - V_d)}{kT_C}\right) \equiv X_d^3 \quad (3.10)$$

for $-V_d > \phi_C + V_{out}$ thus $-V_d = -V_C + \phi_C + V_{out}$

$$\Gamma_{ed} = +\Gamma_{Pd} \exp\left(-\frac{e(\phi_C + V_{out} + V_d)}{kT_d}\right) - \Gamma_C \equiv X_o^4 \quad (3.11)$$

for $-V_d < \phi_C + V_{out}$ thus $-V_d = -V_C + \phi_C + V_{out}$

Electron flux condition at the plasma radius equal with the
electrode radius:

(solved for n_e at the maximum plasma radius)

The equation depends on the geometry and boundary

conditions of the region exterior to the inter-

electrode space.

(3.12)

Electron energy flux continuity at the emitter sheath-plasma inter-
face: .

(solved for T_e at the emitter plasma boundary)

$$q_{eo} = -\Gamma_{Po} 2kT_o + \Gamma_E \exp \frac{e(\phi_E + V_o)}{kT_E} 2kT_E \equiv Y_o^1 \quad (3.13)$$

for $-V_o > \phi_E$

$$q_{eo} = -\Gamma_{Po} \left(-\frac{e(\phi_E + V_o)}{kT_o} \right) [2kT_o + e(\phi_E + V_o)] \\ + \Gamma_E [2kT_E + e(\phi_E + V_o)] \equiv Y_o^2 \quad (3.14)$$

for $-V_o < \phi_E$

Electron energy flux continuity at the collector sheath-plasma
interface:

(solved for T_e at the collector plasma boundary)

$$q_{ed} = \Gamma_{Pd} 2kT_d - \Gamma_C \exp \frac{e(\phi_C + V_{out} + V_d)}{kT_C} 2kT_C \equiv Y_d^3 \quad (3.15)$$

for $-V_d > \phi_C + V_{out}$

$$q_{ed} = \Gamma_{Pd} \exp \left(-\frac{e(\phi_C + V_{out} + V_d)}{kT_d} \right) [2kT_d + e(\phi_C + V_{out} + V_d)] \\ - \Gamma_C [2kT_C + e(\phi_C + V_{out} + V_d)] \equiv Y_d^4 \quad (3.16)$$

for $-V_d < \phi_C + V_{out}$

Electron energy flux condition at the plasma radius equal with the electrode radius:

(solved for T_e at the maximum plasma radius)

The equation depends on the geometry and boundary conditions of the region exterior to the interelectrode space. (3.17)

Ion flux continuity at the emitter sheath-plasma interface:

(solved for the electrostatic potential V at the emitter plasma boundary)

$$\Gamma_{io} = -\Gamma_{Po}^i \exp \frac{e(\phi_E + V_o)}{kT_E} + \Gamma_E^i \equiv Z_O^1 \quad (3.18)$$

for $-V_o > \phi_E$

$$\Gamma_{io} = -\Gamma_{Po}^i + \Gamma_E^i \exp \left(-\frac{e(\phi_E + V_o)}{kT_E} \right) \equiv Z_O^2 \quad (3.19)$$

for $-V_o < \phi_E$

Ion flux continuity at the collector sheath-plasma interface:

(solved for V at the collector plasma boundary)

$$\Gamma_{id} = \Gamma_{Pd}^i \exp \frac{e(\phi_C + V_{out} + V_d)}{kT_C} - \Gamma_C^i \equiv Z_d^3 \quad (3.20)$$

for $-V_d > \phi_C + V_{out}$

$$\Gamma_{id} = \Gamma_{Pd}^i - \Gamma_C^i \exp \left(-\frac{e(\phi_C + V_{out} + V_d)}{kT_C} \right) \equiv Z_d^4 \quad (3.21)$$

for $-V_d < \phi_C + V_{out}$

Ion flux condition at the plasma radius equal with the electrode radius:

(solved for V at the maximum plasma radius)

The equation depends on the geometry and boundary conditions of the region exterior to the interelectrode space. (3.22)

The particle and energy fluxes symbolized in equations (3.8) - (3.21) are defined below. The subscripts "e" and subscript/superscript "i" refer to electrons and ions, "E,C,P" refer to emitter, collector respectively plasma, and the second subscript "o,d" refers to the location $z=0$, $z=d$ at which the fluxes are evaluated. The electrode particle currents Γ_E , Γ_C are thermionically emitted. The plasma current Γ_P represents the random current entering the sheath and finally being absorbed by the electrodes.

$$\Gamma_e = -A' \text{ grad } kT_e - B' \text{ grad } n_e + C' \text{ grad } V \quad (3.23)$$

$$q_e = -A'' \text{ grad } kT_e - B'' \text{ grad } n_e + C'' \text{ grad } V \quad (3.24)$$

$$\Gamma_i = -A^i \text{ grad } kT_i - B^i \text{ grad } n_i - C^i \text{ grad } V \quad (3.25)$$

$$\Gamma_{Po} = n_o \frac{\overline{kT_o}}{2\pi m} (1 - R_{eE}) \quad (3.26)$$

$$\Gamma_E = AT_E^2 \frac{1}{e} \exp \left(- \frac{e\phi_E}{kT_E} \right) \quad (3.27)$$

$$\Gamma_{Pd} = n_d \frac{\overline{kT_d}}{2\pi m} (1 - R_{eC}) \quad (3.28)$$

$$\Gamma_C = AT_C^2 \frac{1}{e} \exp \left(- \frac{e\phi_C}{kT_C} \right) \quad (3.29)$$

$$\Gamma_{Po}^i = n_o \frac{\overline{kT_{no}}}{2\pi M} (1 - R_{iE}) \quad (3.30)$$

$$\Gamma_E^i = \quad (3.31)$$

$$\Gamma_{Pd}^i = n_d \frac{\overline{kT_{nd}}}{2\pi M} (1 - R_{iC}) \quad (3.32)$$

$$\Gamma_C^i = \quad (3.33)$$

3. 2. SUPPLEMENTARY TRANSPORT FUNCTIONS

The undefined functions appearing in equations (3.1) - (3.12) are described in ENCOTH TM80-20, Functions Called by Transport Equations. They are summarized below:

Functions of transport coefficients and state parameters called by particle and energy fluxes:

$$A', B', C', A'', B'', C'', A^i, B^i, C^i$$

which are expressed in terms of transport coefficients in (3.34) - (3.42).

Source functions: in particle transport equations:

$$S, SV_l^*$$

Collisional energy transfer functions: in energy transport eqs:

$$Q_{en}^{el}, Q_{ei}, Q_{en}^{inel}$$

Field acceleration function in energy transport equation:

$$W$$

Cesium vapor pressure function: as function of reservoir temperature:

$$P_{Cs}$$

The coefficients $A^i, \dots, C^i$ are related to the classical transport coefficients as indicated:

$$A' = \frac{\mu_e}{e} n_e (1 + k_e^T) \quad (3.34)$$

$$B' = \frac{\mu_e}{e} kT_e \quad (3.35)$$

$$C' = \mu_e n_e \quad (3.36)$$

$$A'' = \left(\frac{5}{2} + k_e^T\right) kT_e A' + \frac{\kappa_e}{k} \quad (3.37)$$

$$B'' = \left(\frac{5}{2} + k_e^T\right) kT_e B' \quad (3.38)$$

$$C'' = \left(\frac{5}{2} + k_e^T\right) kT_e C' \quad (3.39)$$

$$A^i = \frac{\mu_i}{e} n_i (1 + k_i^T) \quad (3.40)$$

$$B^i = \frac{\mu_i}{e} kT_i \quad (3.41)$$

$$C^i = \mu_i n_i \quad (3.42)$$

3.3 SOLUTION

The solution of equations (3.1) - (3.22) for the parameters n, T_e, V over a two-dimensional system including its boundary is performed in three steps:

The first consists in solving numerically the transport equations (3.1) - (3.3) for the parameters n, T_e, V with fixed boundary conditions. The functions solved for in equations (3.4) - (3.7) are utilised in equations (3.1) - (3.3). The numerical finite difference algorithm substituting expressions of the general form $\partial/\partial z(C\partial X/\partial z)$ is:

$$\begin{aligned} \left[\frac{\partial}{\partial z} \left(C \frac{\partial X}{\partial z} \right) \right]_i &= \frac{1}{2\Delta z^2} C_i (X_{i-1} - 2X_i + X_{i+1}) \\ &+ \frac{1}{2\Delta z^2} [C_{i-1}X_{i-1} - (C_{i-1} + C_{i+1})X_i + C_{i+1}X_{i+1}] \end{aligned} \quad (3.43)$$

which implies:

$$\frac{\partial^2 X}{\partial z^2} = \frac{1}{\Delta z^2} (X_{i-1} - 2X_i + X_{i+1}) \quad (3.44)$$

$$\frac{\partial X}{\partial z} = \frac{X_{i+1} - X_{i-1}}{2\Delta z} \quad (3.45)$$

$$\frac{\partial C}{\partial z} = \frac{C_{i+1} - C_{i-1}}{2\Delta z} \quad (3.46)$$

Equations (3.1) - (3.3) are thus transformed into linear combinations of the functions n, T_e, V values at any given grid point (i, j) and of their values at the four closest neighbouring points $(i-1, j)$, $(i+1, j)$, $(i, j-1)$, $(i, j+1)$. They are solved by a relaxation technique.

The second step consists in solving equations (3.8) - (3.22) for the spatial gradients of the parameters n, T_e, V . Through simple algebra one obtains:

$$\text{grad } n = \frac{k(1+k_e^T)}{\kappa_e} \frac{n_i}{kT_e + kT_i} \left[\left(\frac{5}{2} + k_e^T \right) kT_e X - Y \right] - \frac{e}{\mu_i} \frac{1}{kT_e + kT_i} Z \quad (3.47)$$

$$\text{grad } kT_e = \frac{k}{\kappa_e} \left[\left(\frac{5}{2} + k_e^T \right) kT_e X - Y \right] \quad (3.48)$$

$$\begin{aligned} \text{grad } V = & \frac{k(1+k_e^T)}{\kappa_e} \frac{kT_i}{kT_e + kT_i} \left[\left(\frac{5}{2} + k_e^T \right) kT_e X - Y \right] + \\ & + \frac{1}{\mu_e} \frac{kT_i}{n_e (kT_e + kT_i)} X - \frac{1}{\mu_i} \frac{kT_e}{n_e (kT_e + kT_i)} Z \end{aligned} \quad (3.49)$$

The third step consists in finding the common solution of the transport equations (3.1) - (3.3) and of the boundary equations (3.8) - (3.22), these two sets of equations being solved independently for parametric boundary values leading in general to inconsistent boundary slopes of the parameters n, T_e, V derived from either one of the two sets of equations. The solution is found by iteratively varying the boundary values such as to reduce to zero the angles between the curves derived from transport equations respectively boundary conditions.

4. RESULTS

The mathematical domain representing the plasma, electrode sheaths and weakly ionized gas region of a Thermionic Diode is illustrated on Figure 1.

The converter electrical current is estimated directly from the electron and ion particle fluxes (3.23), (3.25) based on the spatial distribution of the electron/ion density n , temperatures T_e , T_i , electrical voltage V and on the knowledge of the transport coefficients as function of the above parameters.

Density, temperature and voltage spatial distributions were obtained according to the solution described in paragraph 3.3. They are represented on Figures 4,6,7 and 8.

The numerically evaluated profiles of Figure 4 are applicable to an experimental converter (Thermoelectron Diode 36) and may be compared with numerical evaluations performed at Thermoelectron (Numerical Solution of the Thermionic Diode Plasma Equation, Report No. TE4237-148-78) shown on Figure 5. The state parameters and electrical potential of Figures 4 and 5 agree well for three out of four analysed cases, however the current densities are quite different: evaluated 2.42 A/cm² for reference 5.2 A/cm², 52.5 for 7 A/cm², 5.65 for 8 A/cm² and 10.1 for 9.5 A/cm². Several causes may explain the discrepancies: the values of the boundary parameters at $z=0$ and $z=d$ are only approximately equal for the compared cases; there are differences in the expressions of the electron transport coefficients; and there is an additional collisional term in the energy conservation equation solved in the present study.

Figure 6 illustrates the change in density or voltage profile of the 8 A/cm^2 case of Figure 4 when the corresponding boundary conditions are adjusted to match the sheath conditions. In order to eliminate the coupling effect of the three parameters n , T_e , V , two are being held fixed at all z 's including boundaries during the iterative adjustment of the "floating" boundary values. In this manner the observed change in density and voltage is due to the variation of the respective parameter boundary values and to the change in transport coefficients following the variation of the same singled parameter. Ion flux continuity is claimed for solving density plasma boundary values and electron flux continuity is claimed for solving voltage plasma boundary values.

A two-dimensional parameter distribution over the grided region indicated on Figure 1 is displayed on Figure 7. The choice of the integration domain is such as to acceptably assume that the radial variation of the parameters is zero at both minimum and maximum radius. The parameter distribution is controlled in the present example by the arbitrary boundary values close to the electrode and ring surfaces which preponderantly determine the plasma behavior. Letting these boundary values float until they are adjusted by requirements of flux continuity changes significantly the electrical current pattern as seen by comparing the results represented on Figure 8 obtained by floating the density boundary values, and the results represented on Figure 7.

The nonlinear character of the solutions exemplified above is attributed to the coefficients $A^i, \dots, C^i$ of equations (3.23) - (3.25) which are calculated as function of density and temperature as shown on Figure 2.

Solutions of the parameter boundary slope at the sheath-plasma interface as function of parameter boundary values were found by solving simultaneously the boundary equations (3.47) - (3.49). They are represented on Figure 3 as function of density for parametric temperature and output voltage. Similar solutions of slope at the boundary versus local values were constructed from a series of transport equations solutions. Based on the behavior of the boundary slope predicted by transport equations as compared with boundary slope requested by boundary (flux matching) equations, a numerical iterative scheme was developed for an overall mathematical solution over a closed domain including its boundaries. It consists in a guided successive incremental variation of T_e, V, n at the emitter and collector plasma boundary which minimizes a function of all six differences (three parameters times two boundaries $z=0, z=d$) between the predicted and the requested slopes. A diode current-voltage characteristic is produced by repeating the computational loop described above for various values of the output voltage. New values for the collector boundary slopes are thus obtained which induce changes in the parameter profiles and subsequently in current density.

5. CONCLUSIONS

The conclusions drawn from the present stage of results may be summarized as follows:

The simultaneous solution of electron and ion transport in the plasma and collisionless transport in the sheaths has a stable numerical solution and can be solved by the method described and illustrated above.

The sensitivity of the solution to the net flux compatible with electrode surface conditions shows the large impact which surface physics may have on the improvement of the diode performance. Quantitative results can be safely accepted only after a comparative analysis of various sheath model effect.

Two-dimensional effects occur from the radial variation of neutral particle state and boundary conditions on the guard ring which are supplied by experiments. Neutral excited state and radiational cooling are likely to be significant and need to be introduced in the model.

A system analysis of the diode is imperative in order to determine the requested computational accuracy of various parameters and reliably interpret the physical origin of the limitations in both values and radial redistribution (constriction) of the electrical current.

Converter cross-section (Termoelectron 4237-38-79)

Figure 1

Schematic domain of theoretical analysis and reference to an experimental converter

Figure 2

Coefficients of gradients in equations (3.23) - (3.24)
density dependence.

A' AP

B' BP

C' CP

A'' APP

B'' BPP

C'' CPP

Figure 3

Gradients of n, T_e, V resulting from particle and energy
flux matching at the plasma-sheath interface.

Emitter Interface: gradients versus n_e for parametric T_e

Collector Interface: gradients versus n_e for parametric V_{out}

Figure 4

One-Dimensional plasma profiles for fixed boundary conditions.

Reference Diode: TECO Diode 36

$$T_E = 1600^{\circ}\text{K}$$

$$T_C = 900^{\circ}\text{K}$$

$$\Phi_E = 2.4593 \text{ V}$$

$$\Phi_C = 1.61 \text{ V}$$

$$T_{\text{res}} = 564^{\circ}\text{K}$$

$$d = 5 \text{ mils}$$

"1" 5.2 A/cm²
 "4" 7 "
 "7" 8 "
 "0" 9.5 "

Figure 4a

"1" 5.2 A/cm²
 "2" 7 "
 "3" 8 "
 "4" 9.5 "

Figure 4b

"1" 5.2 A/cm²
 "2" 7 "
 "3" 8 "
 "4" 9.5 "

Figure 4c

"1" 5.2 A/cm²
 "2" 7 "
 "3" 8 "
 "4" 9.5 "

Figure 4d

Figure 5

Thermoelectron reference diode for the one - dimensional
profiles represented on Figure 4.

(Thermoelectron Diode 36)

Density Distribution as a Function of Current for the Case $T_E = 1600 K$, $T_C = 900 K$, $T_R = 564 K$, and $d = 125 \mu m$ (5 mils)

Motive Diagram for the Case $T_E = 1600 K$, $T_C = 900 K$, $T_R = 564 K$, and $d = 125 \mu m$ (5 mils)

Distribution of Electron Temperature for the Case $T_E = 1600 K$, $T_C = 900 K$, $T_R = 564 K$, and $d = 125 \mu m$ (5 mils)

Figure 6

One-Dimensional plasma profiles for floating boundary conditions applied to one parameter holding the remaining two parameters fixed.

"1" Density corresponding to 8A on Fig 4

$T_e(z)$ and $V(z)$ correspond to 8a on Fig 4

"2" Density profile after matching boundary conditions

Figure 6a

"2" Voltage correspond-
ing to 8A On Fig 4

$n(z)$, $T_e(z)$ corres-
pond to 8A on Fig 4

"1" Voltage profile
after matching
boundary conditions

Figure 6b

Figure 7

Two-Dimensional plasma profiles for fixed boundary conditions.

Figure 8

Two-Dimensional floating density profiles for fixed
temperature and voltage profiles represented on
Figure 7.

Figure 8

Table 1

Values for the profiles represented on Figure 4: 5.2 A/cm²

ELECTRON TEMPERATURE (DEG-K)	ELECTRON CURRENT Z-COMP. (A/CM**2)	PARTICLE SOURCE (1/(CM**3*S))	ION MOBILITY (CGS)
.300E+04	2.43	.170E+20	.333E+05
.291E+04	2.42	.152E+20	.347E+05
.286E+04	2.42	.128E+20	.362E+05
.282E+04	2.42	.100E+20	.373E+05
.277E+04	2.42	.694E+19	.386E+05
.270E+04	2.42	.416E+19	.399E+05
.261E+04	2.42	.203E+19	.411E+05
.247E+04	2.41	.709E+18	.421E+05
.226E+04	2.41	.126E+18	.433E+05
.192E+04	2.41	.382E+16	.444E+05
ELECTRON DENSITY (1/CM**3)	TOTAL CURRENT Z-COMP. (A/CM**2)	ELECTRON MOBILITY (CGS)	ION THERMAL DIFFUSION (CGS)
.390E+13	2.42	.406E+08	-.100
.554E+13	2.42	.433E+08	-.100
.627E+13	2.42	.465E+08	-.100
.635E+13	2.42	.492E+08	-.100
.596E+13	2.42	.526E+08	-.100
.529E+13	2.42	.560E+08	-.100
.448E+13	2.42	.595E+08	-.100
.365E+13	2.42	.626E+08	-.100
.281E+13	2.42	.660E+08	-.100
.200E+13	2.42	.694E+08	-.100
VOLTAGE (V)		ELECTRON THERMAL DIFFUSION (CGS)	
-.716E-02		.904E-01	
-.700E-02		.114	
-.700E-02		.129	
-.707E-02		.137	
-.720E-02		.141	
-.739E-02		.141	
-.762E-02		.141	
-.790E-02		.138	
-.825E-02		.122	
-.870E-02		.099E-01	
		ELECTRON CONDUCTION (CGS)	
		44.3	
		64.7	
		77.0	
		81.5	
		80.6	
		75.2	
		66.5	
		55.2	
		42.3	
		27.9	

Figure 4: 7 A/cm²

ELECTRON TEMPERATURE (DEG-K)		ELECTRON CURRENT Z-COMP. (A/CM**2)		PARTICLE SOURCE (1/(CM**3*S))		ION MOBILITY (CGS)	
.285E+04		52.6		.157E+20		.333E+05	
.255E+04		52.6		.213E+20		.347E+05	
.274E+04		52.6		.898E+20		.362E+05	
.288E+04		52.5		.212E+21		.373E+05	
.298E+04		52.4		.345E+21		.386E+05	
.304E+04		52.3		.418E+21		.399E+05	
.306E+04		52.2		.369E+21		.411E+05	
.301E+04		52.1		.209E+21		.421E+05	
.279E+04		52.0		.435E+20		.433E+05	
.270E+04		52.2		.329E+19		.444E+05	
ELECTRON DENSITY (1/CM**3)		TOTAL CURRENT Z-COMP. (A/CM**2)		ELECTRON MOBILITY (CGS)		ION THERMAL DIFFUSION (CGS)	
.680E+13		52.5		.396E+08		-.180	
.473E+14		52.5		.338E+08		-.180	
.792E+14		52.5		.322E+08		-.180	
.104E+15		52.5		.315E+08		-.180	
.117E+15		52.4		.321E+08		-.180	
.116E+15		52.4		.338E+08		-.180	
.101E+15		52.4		.371E+08		-.180	
.740E+14		52.4		.424E+08		-.180	
.418E+14		52.3		.502E+08		-.180	
.520E+13		52.4		.687E+08		-.180	
VOLTAGE (V)				ELECTRON THERMAL DIFFUSION (CGS)			
-.553E-02				.125			
-.485E-02				.353			
-.461E-02				.409			
-.449E-02				.435			
-.448E-02				.446			
-.458E-02				.447			
-.482E-02				.435			
-.524E-02				.407			
-.598E-02				.367			
-.786E-02				.156			
				ELECTRON CONDUCTION (CGS)			
				71.2			
				326.			
				521.			
				677.			
				789.			
				838.			
				806.			
				677.			
				445.			
				89.6			

Figure 4: 8 A/cm²

ELECTRON TEMPERATURE	ELECTRON CURRENT Z-COMP. (A/CM**2)
.263E+04	5.78
.267E+04	5.77
.272E+04	5.75
.277E+04	5.72
.282E+04	5.68
.287E+04	5.64
.291E+04	5.59
.296E+04	5.54
.301E+04	5.49
.307E+04	5.45
ELECTRON DENSITY	TOTAL CURRENT Z-COMP. (A/CM**2)
.360E+14	5.66
.642E+14	5.66
.862E+14	5.66
.102E+15	5.65
.110E+15	5.65
.111E+15	5.64
.103E+15	5.64
.892E+14	5.64
.684E+14	5.64
.430E+14	5.63
VOLTAGE	ELECTRON CURRENT R-COMP. (A/CM**2)
-.560E-02	.0 .0 .0
-.518E-02	
-.495E-02	
-.481E-02	
-.475E-02	
-.474E-02	
-.479E-02	
-.491E-02	
-.513E-02	
-.553E-02	

Figure 4: 9.5 A/cm²

ELECTRON TEMPERATURE (DEG-K)	ELECTRON CURRENT Z-COMP. (A/CM**2)	PARTICLE SOURCE (1/(CM**3*S))	ION MOBILITY (CGS)
.268E+04	10.5	.139E+21	.333E+05
.271E+04	10.4	.207E+21	.347E+05
.275E+04	10.4	.272E+21	.362E+05
.279E+04	10.3	.356E+21	.373E+05
.284E+04	10.2	.460E+21	.386E+05
.289E+04	10.1	.580E+21	.399E+05
.294E+04	9.96	.721E+21	.411E+05
.300E+04	9.79	.827E+21	.421E+05
.306E+04	9.60	.838E+21	.433E+05
.313E+04	9.40	.714E+21	.444E+05
ELECTRON DENSITY (1/CM**3)	TOTAL CURRENT Z-COMP. (A/CM**2)	ELECTRON MOBILITY (CGS)	ION THERMAL DIFFUSION (CGS)
.159E+15	10.1	.229E+08	-.180
.243E+15	10.0	.173E+08	-.180
.314E+15	10.1	.174E+08	-.180
.367E+15	10.1	.164E+08	-.180
.397E+15	10.1	.161E+08	-.180
.404E+15	10.1	.135E+08	-.180
.387E+15	10.1	.177E+08	-.180
.343E+15	10.1	.199E+08	-.180
.273E+15	10.1	.238E+08	-.180
.180E+15	10.1	.314E+08	-.180
VOLTAGE (V)		ELECTRON THERMAL DIFFUSION (CGS)	
-.353E-02		.475	
-.317E-02		.548	
-.296E-02		.575	
-.284E-02		.593	
-.277E-02		.604	
-.274E-02		.607	
-.277E-02		.604	
-.286E-02		.592	
-.304E-02		.570	
-.340E-02		.522	
		ELECTRON CONDUCTION (CGS)	
		670.	
		894.	
		.105E+04	
		.116E+04	
		.125E+04	
		.132E+04	
		.137E+04	
		.140E+04	
		.135E+04	
		.121E+04	

Table 2

Values for profiles represented on Figure 6

ELECTRON TEMPERATURE (DEG-K)									
.267E+04	.266E+04	.260E+04	.251E+04	.240E+04	.228E+04	.217E+04	.208E+04	.202E+04	.201E+04
.270E+04	.271E+04	.271E+04	.270E+04	.263E+04	.250E+04	.234E+04	.219E+04	.209E+04	.206E+04
.276E+04	.277E+04	.280E+04	.281E+04	.276E+04	.263E+04	.245E+04	.226E+04	.212E+04	.209E+04
.261E+04	.282E+04	.286E+04	.289E+04	.284E+04	.271E+04	.251E+04	.230E+04	.215E+04	.211E+04
.285E+04	.287E+04	.292E+04	.294E+04	.289E+04	.275E+04	.254E+04	.231E+04	.216E+04	.212E+04
.290E+04	.291E+04	.295E+04	.297E+04	.292E+04	.276E+04	.254E+04	.232E+04	.215E+04	.211E+04
.294E+04	.295E+04	.298E+04	.298E+04	.291E+04	.275E+04	.253E+04	.230E+04	.214E+04	.210E+04
.298E+04	.299E+04	.300E+04	.297E+04	.288E+04	.271E+04	.240E+04	.227E+04	.212E+04	.208E+04
.334E+04	.303E+04	.300E+04	.293E+04	.280E+04	.262E+04	.241E+04	.222E+04	.208E+04	.205E+04
.312E+04	.310E+04	.300E+04	.285E+04	.266E+04	.247E+04	.228E+04	.213E+04	.203E+04	.201E+04
ELECTRON DENSITY (1/CM**3)									
.401E+15	.348E+15	.289E+15	.932E+14	.339E+14	.108E+14	.342E+13	.123E+13	.604E+12	.495E+12
.557E+15	.503E+15	.338E+15	.163E+15	.610E+14	.185E+14	.542E+13	.167E+13	.911E+12	.768E+12
.660E+15	.607E+15	.417E+15	.216E+15	.832E+14	.251E+14	.715E+13	.241E+13	.114E+13	.957E+12
.727E+15	.675E+15	.476E+15	.253E+15	.990E+14	.299E+14	.841E+13	.279E+13	.130E+13	.108E+13
.758E+15	.706E+15	.502E+15	.279E+15	.106E+15	.319E+14	.897E+13	.297E+13	.137E+13	.113E+13
.756E+15	.704E+15	.498E+15	.265E+15	.104E+15	.312E+14	.802E+13	.292E+13	.136E+13	.112E+13
.721E+15	.667E+15	.463E+15	.242E+15	.929E+14	.280E+14	.798E+13	.268E+13	.126E+13	.105E+13
.650E+15	.596E+15	.401E+15	.203E+15	.765E+14	.231E+14	.671E+13	.229E+13	.110E+13	.930E+12
.539E+15	.486E+15	.314E+15	.153E+15	.565E+14	.173E+14	.517E+13	.179E+13	.880E+12	.750E+12
.367E+15	.340E+15	.208E+15	.567E+14	.359E+14	.115E+14	.361E+13	.126E+13	.607E+12	.498E+12
VOLTAGE (V)									
-.357E-02	-.369E-02	-.413E-02	-.462E-02	-.566E-02	-.656E-02	-.740E-02	-.809E-02	-.854E-02	-.866E-02
-.330E-02	-.338E-02	-.373E-02	-.433E-02	-.515E-02	-.612E-02	-.705E-02	-.780E-02	-.828E-02	-.839E-02
-.314E-02	-.321E-02	-.351E-02	-.405E-02	-.486E-02	-.585E-02	-.683E-02	-.762E-02	-.813E-02	-.825E-02
-.304E-02	-.310E-02	-.337E-02	-.389E-02	-.469E-02	-.569E-02	-.670E-02	-.751E-02	-.805E-02	-.817E-02
-.298E-02	-.304E-02	-.330E-02	-.382E-02	-.462E-02	-.563E-02	-.664E-02	-.747E-02	-.801E-02	-.814E-02
-.296E-02	-.302E-02	-.329E-02	-.382E-02	-.463E-02	-.565E-02	-.666E-02	-.748E-02	-.802E-02	-.815E-02
-.298E-02	-.304E-02	-.334E-02	-.387E-02	-.472E-02	-.574E-02	-.674E-02	-.754E-02	-.807E-02	-.819E-02
.305E-02	-.312E-02	-.345E-02	-.425E-02	-.490E-02	-.591E-02	-.688E-02	-.766E-02	-.816E-02	-.827E-02
-.319E-02	-.328E-02	-.366E-02	-.431E-02	-.518E-02	-.616E-02	-.709E-02	-.783E-02	-.831E-02	-.841E-02
-.344E-02	-.356E-02	-.402E-02	-.472E-02	-.559E-02	-.651E-02	-.737E-02	-.808E-02	-.854E-02	-.866E-02
ELECTRON CURRENT Z-COMP. (A/CM**2)									
1.17	.998	.575	.153	-.743E-01	-.891E-01	-.283E-01	-.569E-02	-.750E-03	-.442E-03
.313	.266	.177	.319	.474	.276	.779E-01	.152E-01	.164E-02	.641E-03
-.339	-.269	-.745E-01	.423	.848	.537	.156	.309E-01	.398E-02	.103E-02
-.725	-.606	-.203	.475	.962	.631	.191	.367E-01	.610E-02	.303E-02
-.926	-.777	-.227	.501	.897	.563	.176	.332E-01	.715E-02	.396E-02
-1.22	-.830	-.185	.512	.695	.393	.124	.301E-01	.746E-02	.451E-02
-1.09	-.857	-.146	.476	.438	.176	.590E-01	.149E-01	.665E-02	.460E-02
-1.13	-.874	-.134	.374	.179	.335E-03	.368E-02	.411E-02	.437E-02	.367E-02
-1.11	-.886	-.231	.125	-.137E-02	-.632E-01	-.190E-01	-.316E-02	.171E-02	.203E-02
-.602	-.782	-.554	-.310	-.822E-01	.197E-02	.127E-02	-.776E-03	-.265E-03	-.354E-03
TOTAL CURRENT Z-COMP. (A/CM**2)									
.397	.238	-.266E-01	-.182	-.198	-.122	-.363E-01	-.815E-02	-.194E-02	-.154E-02
-.307	-.337	-.337	.123E-01	.353	.242	.695E-01	.128E-01	.578E-03	-.233E-03
-.631	-.762	-.492	.165	.734	.587	.149	.288E-01	.312E-02	.116E-02
-1.09	-.964	-.499	.295	.887	.610	.186	.372E-01	.552E-02	.259E-02
-1.14	-.979	-.372	.427	.871	.556	.175	.377E-01	.692E-02	.378E-02
-1.05	-.848	-.152	.559	.722	.401	.126	.306E-01	.761E-02	.462E-02
-.910	-.658	.771E-01	.643	.586	.198	.643E-01	.163E-01	.719E-02	.500E-02
-.708	-.428	.282	.643	.291	.322E-01	.115E-01	.639E-02	.526E-02	.436E-02
-.397	-.167	.362	.467	.131	-.269E-01	-.987E-02	-.387E-03	.295E-02	.306E-02
.161	.235	.193	.749E-01	.539E-01	.380E-01	.105E-01	.217E-02	.129E-02	.121E-02
ELECTRON CURRENT R-COMP. (A/CM**2)									
.0	-2.34	-4.74	-5.14	-3.28	-1.20	-.291	-.520E-01	-.504E-02	.0
.0	-2.23	-4.14	-4.34	-2.66	-1.08	-.251	-.413E-01	-.476E-02	.0
.0	-1.54	-2.58	-2.44	-1.58	-.625	-.158	-.292E-01	-.508E-02	.0
.0	-.877	-1.14	-.634	-.184	-.916E-01	-.411E-01	-.136E-01	-.377E-02	.0
.0	-.329	.210E-01	.776	.984	.362	.664E-01	.113E-02	-.255E-02	.0
.0	.661E-01	.790	1.66	1.56	.646	.143	.179E-01	-.468E-03	.0
.0	.326	1.24	1.95	1.64	.656	.171	.286E-01	.265E-02	.0
.0	.564	1.43	1.66	1.87	.442	.122	.279E-01	.493E-02	.0
.0	1.10	1.58	.910	.735E-01	-.346E-02	.192E-01	.167E-01	.665E-02	.0
.0	2.68	2.54	.247	-.976	-.486	-.130	-.111E-01	.619E-02	.0
TOTAL CURRENT R-COMP. (A/CM**2)									
.0	-2.47	-4.89							

Table 3

Values for the profiles represented on Figure 7

ELECTRON TEMPERATURE (DEG-K)									
.267E+04	.266E+04	.260E+04	.251E+04	.240E+04	.228E+04	.217E+04	.208E+04	.202E+04	.201E+04
.270E+04	.271E+04	.271E+04	.270E+04	.263E+04	.250E+04	.234E+04	.219E+04	.209E+04	.206E+04
.276E+04	.277E+04	.280E+04	.281E+04	.276E+04	.263E+04	.245E+04	.226E+04	.212E+04	.209E+04
.281E+04	.282E+04	.286E+04	.289E+04	.284E+04	.271E+04	.251E+04	.230E+04	.215E+04	.211E+04
.285E+04	.287E+04	.292E+04	.294E+04	.289E+04	.275E+04	.254E+04	.231E+04	.216E+04	.212E+04
.290E+04	.291E+04	.295E+04	.297E+04	.292E+04	.276E+04	.254E+04	.232E+04	.215E+04	.211E+04
.294E+04	.295E+04	.298E+04	.298E+04	.291E+04	.275E+04	.253E+04	.230E+04	.214E+04	.210E+04
.298E+04	.299E+04	.303E+04	.297E+04	.288E+04	.271E+04	.248E+04	.227E+04	.212E+04	.208E+04
.304E+04	.303E+04	.300E+04	.293E+04	.280E+04	.262E+04	.241E+04	.222E+04	.206E+04	.205E+04
.312E+04	.310E+04	.300E+04	.285E+04	.266E+04	.247E+04	.213E+04	.203E+04	.203E+04	.201E+04
ELECTRON DENSITY (1/CM**3)									
.149E+15	.146E+15	.133E+15	.113E+15	.896E+14	.643E+14	.404E+14	.210E+14	.831E+13	.501E+13
.241E+15	.240E+15	.233E+15	.206E+15	.154E+15	.957E+14	.530E+14	.265E+14	.120E+14	.877E+13
.314E+15	.315E+15	.313E+15	.280E+15	.204E+15	.121E+15	.620E+14	.300E+14	.147E+14	.113E+14
.369E+15	.371E+15	.371E+15	.334E+15	.241E+15	.138E+15	.690E+14	.337E+14	.164E+14	.129E+14
.399E+15	.401E+15	.402E+15	.361E+15	.258E+15	.146E+15	.730E+14	.351E+14	.170E+14	.135E+14
.404E+15	.406E+15	.404E+15	.359E+15	.255E+15	.145E+15	.727E+14	.349E+14	.167E+14	.131E+14
.383E+15	.384E+15	.376E+15	.338E+15	.234E+15	.135E+15	.690E+14	.334E+14	.155E+14	.119E+14
.337E+15	.336E+15	.323E+15	.279E+15	.199E+15	.118E+15	.630E+14	.307E+14	.135E+14	.982E+13
.267E+15	.264E+15	.248E+15	.211E+15	.155E+15	.979E+14	.552E+14	.270E+14	.107E+14	.697E+13
.179E+15	.175E+15	.159E+15	.135E+15	.106E+15	.755E+14	.465E+14	.226E+14	.737E+13	.335E+13
VOLTAGE (V)									
-.357E-02	-.369E-02	-.413E-02	-.482E-02	-.566E-02	-.656E-02	-.740E-02	-.809E-02	-.854E-02	-.866E-02
-.330E-02	-.338E-02	-.373E-02	-.433E-02	-.515E-02	-.612E-02	-.705E-02	-.780E-02	-.820E-02	-.839E-02
-.314E-02	-.321E-02	-.351E-02	-.405E-02	-.486E-02	-.585E-02	-.683E-02	-.742E-02	-.813E-02	-.825E-02
-.304E-02	-.310E-02	-.337E-02	-.389E-02	-.469E-02	-.569E-02	-.670E-02	-.751E-02	-.805E-02	-.817E-02
-.296E-02	-.304E-02	-.330E-02	-.382E-02	-.462E-02	-.563E-02	-.664E-02	-.747E-02	-.801E-02	-.814E-02
-.296E-02	-.302E-02	-.329E-02	-.382E-02	-.463E-02	-.565E-02	-.666E-02	-.748E-02	-.802E-02	-.815E-02
-.298E-02	-.304E-02	-.334E-02	-.389E-02	-.472E-02	-.574E-02	-.674E-02	-.754E-02	-.807E-02	-.819E-02
-.305E-02	-.312E-02	-.345E-02	-.405E-02	-.490E-02	-.591E-02	-.688E-02	-.766E-02	-.816E-02	-.827E-02
-.319E-02	-.328E-02	-.366E-02	-.431E-02	-.518E-02	-.616E-02	-.709E-02	-.783E-02	-.831E-02	-.841E-02
-.344E-02	-.356E-02	-.402E-02	-.472E-02	-.559E-02	-.651E-02	-.737E-02	-.808E-02	-.854E-02	-.866E-02
ELECTRON MOBILITY (CGS)									
.230E+08	.231E+08	.237E+08	.249E+08	.261E+08	.281E+08	.300E+08	.341E+08	.374E+08	.386E+08
.193E+08	.194E+08	.197E+08	.209E+08	.236E+08	.278E+08	.317E+08	.358E+08	.392E+08	.403E+08
.174E+08	.174E+08	.177E+08	.189E+08	.221E+08	.274E+08	.329E+08	.375E+08	.414E+08	.425E+08
.164E+08	.164E+08	.166E+08	.178E+08	.213E+08	.272E+08	.339E+08	.390E+08	.432E+08	.444E+08
.161E+08	.161E+08	.164E+08	.177E+08	.214E+08	.278E+08	.352E+08	.410E+08	.457E+08	.469E+08
.166E+08	.166E+08	.169E+08	.184E+08	.223E+08	.292E+08	.368E+08	.431E+08	.493E+08	.498E+08
.170E+08	.170E+08	.183E+08	.199E+08	.241E+08	.309E+08	.389E+08	.455E+08	.514E+08	.531E+08
.202E+08	.201E+08	.207E+08	.225E+08	.267E+08	.334E+08	.411E+08	.480E+08	.546E+08	.566E+08
.240E+08	.242E+08	.250E+08	.269E+08	.307E+08	.360E+08	.436E+08	.511E+08	.580E+08	.614E+08
.314E+08	.317E+08	.328E+08	.342E+08	.369E+08	.410E+08	.463E+08	.545E+08	.639E+08	.679E+08
ELECTRON THERMAL DIFFUSION (CGS)									
.475	.474	.460	.457	.439	.406	.352	.271	.165	.121
.540	.539	.535	.522	.494	.447	.387	.306	.212	.178
.574	.573	.569	.556	.525	.473	.410	.332	.244	.215
.593	.592	.586	.575	.543	.490	.425	.349	.265	.237
.603	.603	.598	.585	.553	.501	.436	.363	.278	.250
.627	.606	.602	.586	.557	.506	.443	.370	.284	.250
.603	.603	.598	.585	.554	.507	.446	.373	.283	.250
.591	.590	.586	.573	.546	.501	.445	.371	.272	.234
.569	.568	.563	.552	.530	.493	.443	.365	.252	.201
.522	.521	.517	.515	.505	.482	.439	.355	.214	.135
ELECTRON CONDUCTION (CGS)									
604.	654.	684.	529.	433.	330.	229.	136.	62.4	39.9
670.	891.	880.	824.	691.	501.	310.	183.	93.9	71.5
.105E+04	.106E+04	.106E+04	.104E+04	.881.	.635.	.395.	.222.	.120.	.95.9
.117E+04	.118E+04	.121E+04	.119E+04	.102E+04	.731.	.453.	.253.	.138.	.113.
.126E+04	.128E+04	.132E+04	.129E+04	.111E+04	.795.	.492.	.274.	.151.	.124.
.133E+04	.134E+04	.138E+04	.134E+04	.115E+04	.823.	.512.	.286.	.156.	.127.
.137E+04	.138E+04	.140E+04	.134E+04	.113E+04	.813.	.511.	.286.	.153.	.122.
.136E+04	.138E+04	.137E+04	.128E+04	.100E+04	.766.	.488.	.276.	.142.	.109.
.133E+04	.132E+04	.127E+04	.114E+04	.934.	.685.	.445.	.256.	.122.	.84.7
.120E+04	.110E+04	.108E+04	.922.	.746.	.560.	.386.	.225.	.91.6	.46.5

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Table 3 (Cont.)

ION MOBILITY (CGS)									
.333E+05	.333E+05	.333E+05	.333E+05	.333E+05	.333E+05	.333E+05	.333E+05	.333E+05	.333E+05
.347E+05	.347E+05	.347E+05	.347E+05	.347E+05	.347E+05	.347E+05	.347E+05	.347E+05	.347E+05
.362E+05	.362E+05	.362E+05	.362E+05	.362E+05	.362E+05	.362E+05	.362E+05	.362E+05	.362E+05
.373E+05	.373E+05	.373E+05	.373E+05	.373E+05	.373E+05	.373E+05	.373E+05	.373E+05	.373E+05
.386E+05	.386E+05	.386E+05	.386E+05	.386E+05	.386E+05	.386E+05	.386E+05	.386E+05	.386E+05
.399E+05	.399E+05	.399E+05	.399E+05	.399E+05	.399E+05	.399E+05	.399E+05	.399E+05	.399E+05
.411E+05	.411E+05	.411E+05	.411E+05	.411E+05	.411E+05	.411E+05	.411E+05	.411E+05	.411E+05
.421E+05	.421E+05	.421E+05	.421E+05	.421E+05	.421E+05	.421E+05	.421E+05	.421E+05	.421E+05
.433E+05	.433E+05	.433E+05	.433E+05	.433E+05	.433E+05	.433E+05	.433E+05	.433E+05	.433E+05
.444E+05	.444E+05	.444E+05	.444E+05	.444E+05	.444E+05	.444E+05	.444E+05	.444E+05	.444E+05
ION THERMAL DIFFUSION (CGS)									
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180	-.180
PARTICLE SOURCE (1/(CM**3*S))									
.130E+21	.121E+21	.772E+20	.368E+20	.130E+20	.330E+19	.787E+18	.237E+18	.723E+17	.423E+17
.201E+21	.209E+21	.200E+21	.174E+21	.920E+20	.279E+20	.533E+19	.906E+18	.175E+18	.106E+18
.285E+21	.313E+21	.385E+21	.389E+21	.231E+21	.715E+20	.127E+20	.165E+19	.268E+18	.164E+18
.391E+21	.429E+21	.573E+21	.613E+21	.383E+21	.117E+21	.195E+20	.231E+19	.344E+18	.200E+18
.505E+21	.555E+21	.744E+21	.784E+21	.483E+21	.144E+21	.230E+20	.252E+19	.356E+18	.205E+18
.619E+21	.670E+21	.843E+21	.851E+21	.500E+21	.144E+21	.223E+20	.241E+19	.320E+18	.182E+18
.712E+21	.753E+21	.869E+21	.779E+21	.431E+21	.118E+21	.184E+20	.190E+19	.251E+18	.140E+18
.767E+21	.787E+21	.787E+21	.616E+21	.297E+21	.801E+20	.120E+20	.130E+19	.171E+18	.921E+17
.756E+21	.739E+21	.607E+21	.386E+21	.156E+21	.384E+20	.562E+19	.684E+18	.946E+17	.474E+17
.684E+21	.621E+21	.380E+21	.167E+21	.496E+20	.106E+20	.141E+19	.201E+18	.385E+17	.160E+17
ELECTRON CURRENT Z-COMP. (A/CM**2)									
58.9	47.8	35.7	13.6	-9.89	-22.4	-19.8	-10.9	-.968	2.68
48.3	41.5	30.7	12.5	-6.98	-17.3	-15.6	-8.53	-.938	1.58
37.2	33.2	24.9	11.3	-3.24	-11.2	-10.6	-5.89	-.843	.717
25.8	23.7	18.4	9.92	.977	-4.35	-4.99	-3.07	-.671	.693E-01
14.1	13.3	11.4	8.41	5.45	2.95	1.02	-.750E-01	-.461	-.492
1.97	2.50	4.20	6.87	10.1	10.5	7.30	3.08	-.271	-1.13
-10.7	-8.63	-3.03	5.44	14.9	18.2	13.8	6.40	-.168	-2.02
-24.0	-19.8	-9.93	4.25	19.7	25.9	20.3	9.90	-.282	-3.39
-38.0	-30.2	-16.0	3.36	24.2	33.4	26.8	13.6	-.352	-5.43
-52.5	-30.9	-20.6	2.67	28.1	40.5	33.2	17.5	-.528	-8.19
TOTAL CURRENT Z-COMP. (A/CM**2)									
58.6	47.5	35.3	13.2	-10.2	-22.6	-19.9	-11.0	-.984	2.66
48.0	41.2	30.4	12.1	-7.28	-17.5	-15.7	-8.56	-.952	1.57
37.0	32.9	24.6	10.9	-3.50	-11.3	-10.7	-5.92	-.854	.700
25.6	23.4	18.1	9.67	.800	-4.44	-5.03	-3.09	-.678	.640E-01
14.0	13.2	11.3	8.30	5.38	2.92	1.00	-.811E-01	-.463	-.494
1.94	2.49	4.22	6.93	10.2	10.6	7.31	3.08	-.269	-1.12
-10.6	-8.51	-2.85	5.66	15.1	18.3	13.8	6.41	-.162	-2.02
-23.8	-19.5	-9.59	4.62	20.0	26.1	20.4	9.93	-.171	-3.38
-37.6	-29.8	-15.5	3.83	24.6	33.0	26.9	13.6	-.336	-5.41
-52.0	-30.3	-20.0	3.21	28.4	40.8	33.3	17.6	-.509	-8.17
ELECTRON CURRENT R-COMP. (A/CM**2)									
.0	-23.4	-40.1	-47.5	-42.2	-30.0	-14.0	-2.15	2.46	.0
.0	-28.9	-54.3	-66.0	-59.1	-39.8	-17.8	-3.22	1.94	.0
.0	-31.4	-61.7	-76.0	-68.6	-45.9	-20.7	-4.28	1.34	.0
.0	-32.8	-66.0	-81.8	-74.4	-49.8	-22.8	-5.04	.955	.0
.0	-34.0	-69.2	-85.9	-78.3	-52.5	-24.1	-5.40	.917	.0
.0	-35.3	-71.6	-88.5	-80.5	-53.9	-24.8	-5.22	1.30	.0
.0	-36.6	-73.3	-89.7	-81.2	-54.2	-24.7	-4.53	2.15	.0
.0	-37.7	-73.7	-88.8	-79.9	-53.1	-24.2	-3.42	3.43	.0
.0	-37.8	-71.3	-84.4	-76.1	-50.9	-23.2	-2.06	5.08	.0
.0	-34.9	-63.0	-73.3	-67.6	-46.4	-21.7	-.812	6.64	.0
TOTAL CURRENT R-COMP. (A/CM**2)									
.0	-23.4	-40.2	-47.6	-42.3	-30.1	-14.0	-2.17	2.45	.0
.0	-28.9	-54.4	-66.2	-59.3	-39.9	-17.8	-3.24	1.93	.0
.0	-31.4	-61.8	-76.2	-68.8	-46.0	-20.8	-4.31	1.33	.0
.0	-32.8	-66.1	-82.1	-74.7	-50.0	-22.9	-5.07	.945	.0
.0	-34.1	-69.3	-86.2	-78.6	-52.7	-24.2	-5.43	.906	.0
.0	-35.3	-71.6	-88.8	-80.9	-54.1	-24.9	-5.26	1.29	.0
.0	-36.7	-73.5	-90.0	-81.5	-54.4	-24.8	-4.57	2.13	.0
.0	-37.8	-73.8	-89.0	-80.2	-53.3	-24.2	-3.46	3.42	.0
.0	-37.8	-71.5	-84.6	-76.3	-51.0	-23.2	-2.09	5.07	.0
.0	-35.0	-63.2	-73.4	-67.7	-46.5	-21.8	-.841	6.63	.0

Table 4

Values for profiles represented on Figure 8
(Floated density)

ELECTRON TEMPERATURE (DEG-K)	ELECTRON CURRENT Z-COMP. (A/CM**2)	ELECTRON MOBILITY (CGS)	ION MOBILITY (CGS)
.263E+04	.112	.326E+00	.333E+05
.268E+04	.102	.326E+00	.347E+05
.273E+04	.905E-01	.325E+00	.362E+05
.278E+04	.754E-01	.325E+00	.373E+05
.283E+04	.552E-01	.336E+00	.386E+05
.287E+04	.260E-01	.353E+00	.399E+05
.292E+04	-.682E-02	.384E+00	.411E+05
.297E+04	-.479E-01	.425E+00	.421E+05
.302E+04	-.850E-01	.480E+00	.433E+05
.307E+04	-.122	.546E+00	.444E+05
ELECTRON DENSITY (1/CM**3)	TOTAL CURRENT Z-COMP. (A/CM**2)	ELECTRON THERMAL DIFFUSION (CGS)	ION THERMAL DIFFUSION (CGS)
.417E+14	.402E-01	.310	-.180
.588E+14	.200E-01	.367	-.180
.762E+14	.104E-01	.405	-.180
.898E+14	.135E-01	.420	-.180
.955E+14	.212E-01	.439	-.180
.947E+14	.404E-01	.441	-.180
.860E+14	.450E-01	.431	-.180
.720E+14	.339E-01	.400	-.180
.558E+14	.505E-01	.377	-.180
.431E+14	-.328E-01	.337	-.180
VOLTAGE (V)	PARTICLE SOURCE (1/(CM**3*S))	ELECTRON CONDUCTION (CGS)	R: T=0.23/0.62 03:11:30
-.560E-02	.322E+20	271.	
-.532E-02	.542E+20	399.	
-.510E-02	.829E+20	507.	
-.495E-02	.117E+21	595.	
-.488E-02	.147E+21	657.	
-.487E-02	.164E+21	691.	
-.493E-02	.175E+21	691.	
-.506E-02	.173E+21	654.	
-.526E-02	.156E+21	587.	
-.553E-02	.129E+21	490.	

(Floated voltage)

ELECTRON TEMPERATURE (DEG-K)	ELECTRON CURRENT Z-COMP. (A/CM**2)	ELECTRON MOBILITY (CGS)	ION MOBILITY (CGS)
.263E+04	76.9	.335E+00	.333E+05
.268E+04	72.8	.329E+00	.347E+05
.273E+04	70.7	.330E+00	.362E+05
.278E+04	72.6	.333E+00	.373E+05
.283E+04	78.5	.344E+00	.386E+05
.287E+04	86.6	.360E+00	.399E+05
.292E+04	97.6	.384E+00	.411E+05
.297E+04	109.	.417E+00	.421E+05
.302E+04	122.	.465E+00	.433E+05
.307E+04	126.	.537E+00	.444E+05
ELECTRON DENSITY (1/CM**3)	TOTAL CURRENT Z-COMP. (A/CM**2)	ELECTRON THERMAL DIFFUSION (CGS)	ION THERMAL DIFFUSION (CGS)
.360E+14	76.9	.302	-.180
.567E+14	72.8	.360	-.180
.725E+14	70.7	.390	-.180
.832E+14	72.6	.418	-.180
.890E+14	78.5	.436	-.180
.898E+14	86.6	.435	-.180
.856E+14	97.6	.430	-.180
.764E+14	110.	.415	-.180
.622E+14	122.	.390	-.180
.430E+14	126.	.345	-.180
VOLTAGE (V)	PARTICLE SOURCE (1/(CM**3*S))	ELECTRON CONDUCTION (CGS)	
-.481E-02	.279E+20	262.	
-.488E-02	.523E+20	389.	
-.497E-02	.791E+20	491.	
-.508E-02	.109E+21	569.	
-.523E-02	.137E+21	630.	
-.543E-02	.156E+21	670.	
-.570E-02	.174E+21	687.	
-.606E-02	.183E+21	676.	
-.655E-02	.173E+21	631.	
-.728E-02	.139E+21	523.	