GENERAL DESIGN PROCEDURE FOR HIGH-EFFICIENCY TRAVELING-WAVE AMPLIFIERS

Technical Report No. 24
Part II

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Department of Electrical Engineering

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EXPLANATORY NOTES

1. Theoretical Development of Design Procedure. In Part I of this report a general design procedure is developed for the design of high-efficiency traveling-wave amplifiers. The procedure is first developed for helix-type tubes and is then extended to cover traveling-wave amplifiers with other types of r-f structures. The same design curves are used for these dispersive structures with appropriate correction factors.

2. Design Curves. In Part II all of the available design curves useful in the actual design of high-efficiency amplifiers are compiled. Immediately preceding each section of curves there is a list of parameters for which the particular curves have been calculated.
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SECTION A

EFFICIENCY

The efficiency curves are presented for selected values of the parameters $C$, $B$, and $Q_C$ in the indicated ranges.

<table>
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<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
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<tbody>
<tr>
<td>$C$</td>
<td>0.05 to 0.20</td>
</tr>
<tr>
<td>$B$</td>
<td>0.5 to 1.5</td>
</tr>
<tr>
<td>$Q_C$</td>
<td>0 to 0.75</td>
</tr>
</tbody>
</table>
FIG. A.1  SATURATION EFFICIENCY VS. SPACE CHARGE.

B - ADJUSTED FOR MAXIMUM $\eta_s$. (C = 0.1, d = 0)
FIG. A.2 SATURATION EFFICIENCY VS. SPACE CHARGE AND BEAM DIAMETER. b - ADJUSTED FOR MAXIMUM $\eta_s$.
(C = 0.1, d = 0)
FIG. A.3 SATURATION EFFICIENCY VS. SPACE-CHARGE PARAMETER. b - ADJUSTED FOR MAXIMUM $\eta_s$.

($B = 0.5$, $d = 0$)
FIG. A.4 SATURATION EFFICIENCY VS. SPACE-CHARGE PARAMETER. b - ADJUSTED FOR MAXIMUM $\eta_s$.
($B = 1$, $d = 0$)
FIG. A.5  SATURATION EFFICIENCY VS. GAIN PARAMETER.

b - ADJUSTED FOR MAXIMUM $X_1$.  ($B = 1.0$, $d = 0$)
FIG. A.6  MAXIMUM SATURATION EFFICIENCY VS. GAIN PARAMETER.  
* b – ADJUSTED FOR MAXIMUM $\eta_s$.  (B = 1.0, d = 0)
SECTION B

IMPEDANCE REDUCTION FACTOR

The impedance reduction factor curves are arranged according to ascending values of the dielectric loading factor.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLF</td>
<td>70 to 100</td>
</tr>
</tbody>
</table>
FIG. B.1  IMPEDANCE REDUCTION FACTOR $F = F_1 F_2$ FOR A TAPE HELIX. (EXTENSION OF TIEN’S CALCULATIONS.)
FIG. B.2 (a.) IMPEDANCE REDUCTION FACTOR $F_1$ FOR DIFFERENT CURRENT DISTRIBUTIONS.

(b.) FACTOR $F_1$ COMPUTED USING CURRENT DISTRIBUTION —a— FOR $\eta_0^i = 1, 1.5, 4$.

(COURTESY OF P.K. TIEN)
FIG. B.3 IMPEDANCE REDUCTION FACTOR $F_2$ FOR A TAPE HELIX.

(COURTESY OF P.K. TIEN)
FIG. B.4 HELIX IMPEDANCE REDUCTION FACTOR FOR VARIOUS VALUES OF BEAM VOLTAGE. (DLF = 70 %)
FIG. B.8  HELIX IMPEDANCE REDUCTION FACTOR F FOR VARIOUS VALUES OF BEAM VOLTAGE. (DLF = 95%)
SECTION C

SPACE CHARGE vs. STREAM DIAMETER

The curves of the space-charge parameter vs. the stream diameter are arranged according to increasing values of the parameters $V_{o}$, $a'/b'$ and DLF successively.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{o}$</td>
<td>1 to 14 kv</td>
</tr>
<tr>
<td>$a'/b'$</td>
<td>1.2 to 2.0</td>
</tr>
<tr>
<td>DLF</td>
<td>70 to 100</td>
</tr>
</tbody>
</table>
FIG. C.1  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.2, V_0 = \text{1 KV}, \text{DLF} = 70\%$)
FIG. C.2  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( (a'/b' = 1.2, V_0 = 2\,\text{kV}, \text{DLF} = 70\%) \)
FIG. C.3
SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a/b = 1.2, V₀ = 3 kV, DLF = 70%)

SPACE CHARGE, QC/(1 + QD)

BEAM DIAMETER, B

C = 0.20
C = 0.15
C = 0.10
C = 0.08
C = 0.05
FIG. C.5  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(\alpha'/b' = 1.2\), \(V_0 = 5\) KV, DLF = 70 %
FIG. C.6  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a'/b' = 1.2, V_0 = 6\text{KV}, \text{DLF} = 70\%)\)
FIG. C.7  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b'=1.2$, $V_0 = 7$ kV, DLF = 70%)
Fig. C.8
Space charge vs. beam diameter for various values of the gain parameter.
(d/b = 1.2, V_0 = 8 kV, DLF = 70%)
FIG. C.10  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a'/b' = 1.2 \), \( V_0 = 10 \text{KV} \), DLF = 70\%
FIG. C.21 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a'/b' = 1.2, V_0 = 12\, \text{kV}, \text{DLF} = 70\%)\)
Fig. C.12  Space Charge VS. Beam Diameter for Various Values of the Gain Parameter.
($a'/b' = 1.2$, $V_0 = 14$ KV, DLF = 70%)
FIG. C.13  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.4, V_0 = 1\ \text{KV}, \ DLF = 70\% \)
FIG. C.14  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 1.4, V_0 = 2 \text{ KV}, \text{ DLF} = 70\%\)
FIG. C.16 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER. 
(a'/b' = 1.4, V₀ = 4 KV, DLF = 70%)
**FIG. C.17**  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a^i/b^i = 1.4\), \(V_0 = 5\) KV, DLF = 70%
FIG. C.19
SPACE CHARGE V.S. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a}{b'} = 1.4, V_0 = 7 \text{ KV}, \text{ DLF} = 70\% \)
FIG. C.21 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER. 
\(a'/b' = 1.4, V_0 = 9 \text{ KV}, \text{ DLF} = 70\%\)
FIG. C.22 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b'} = 1.4 \), \( V_0 = 10 \text{ KV} \), DLF = 70%
FIG. C.23 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(\frac{a'}{b'} = 1.4, V_0 = 12 \text{ KV}, \text{ DLF} = 70\%\)
FIG. C.24  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a' / b' = 1.4, V_o = 14 \text{ KV}, \text{ DLF} = 70\%\)
FIG. C.25  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a'/b' = 1.6\ , V_0 = 1\ \text{KV},\ \text{DLF} = 70\%\)
FIG. C.26  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a'/b'=1.6, V_0 = 2 \text{ KV}, \text{DLF} = 70\%)\)
FIG. C.27  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a/b = 1.6, V₀ = 3KV, DLF = 70%)

Space Charge, q₀/(1 + q₀)
FIG. C.28  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b'$ = 1.6 , $V_0$ = 4 KV, DLF = 70 %)
FIG. C.29  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a'/b' = 1.6, V_0 = 5 \text{ KV}, \text{ DLF} = 70\%)\)
FIG. C.30 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 1.6, V_0 = 6\, \text{kV}, \text{DLF} = 70\%\)
FIG. C.31  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.6 , V_0 = 7 \text{ KV}, \text{ DLF} = 70\% \)
FIG. C.32  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a/b^1 = 1.6, \ V_0 = 8 \text{ KV}, \ DLF = 70 \%)\)
FIG. C.33
SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($d/b' = 16, V_0 = 9$ KV, DLF = 70%)

SPACE CHARGE, $\frac{Q}{\pi c^2}$

BEAM DIAMETER, $B$
FIG. C.34  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(\(a/b = 1.6\), \(V_0 = 10\) KV, DLF = 70\%)
FIG. C.35  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( a/b' = 1.6 \), \( V_0 = 12 \text{ KV} \), \( \text{DLF} = 70\% \)
FIG. C.36  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
\( \frac{a'/b'}{1.6}, V_0 = 14 \text{ KV}, \text{ DLF} = 70\% \)
FIG. C.37  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a/b'}{1.8}, V_0 = 1 \text{ KV, DLF = 70\%} \)
FIG. C.38 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 1.8\), \(V_0 = 2\) KV, DLF = 70%
FIG. C.39 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \delta_{b}/b = 1.8, \sqrt{v_0} = 3 \text{ KV}, \text{ DLF} = 70\% \)
FIG. C.40  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

$(a'/b' = 1.8, V_0 = 4 \text{ KV}, \text{DLF} = 70\%)$
FIG. C.41  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(\(a'/b' = 1.8\), \(V_0 = 5\, \text{KV}\), DLF = 70%)
FIG. C.42  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.8, V₀ = 6 KV, DLF = 70%)
FIG. C.44  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER

(\(\delta/b' = 1.8\), \(V_o = 8\) kV, DLF = 70%)
FIG. C.45  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( (a'/b' = 1.8 \), \( V_o = 9 \) KV, \( DLF = 70\% \) )
FIG. C.47  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a' / b' = 1.8, \quad V_0 = 12 \text{ KV}, \quad \text{DLF} = 70\% \)
FIG. C.48 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.8, V₀ = 14 KV, DLF = 70%)

SPACE CHARGE, QC/(1 + Cb)

BEAM DIAMETER, B
FIG. C.49  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 2.0$, $V_0 = 1$ KV, DLF = 70%)
FIG. C.50 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b'=2.0, V_0 = 2 \text{ KV}, \text{DLF} = 70\%)
FIG. C.51  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a' b'}{2.0}, V_0 = 3 \text{ KV}, \text{ DLF} = 70 \% \)
Fig. C.53: Space charge vs. beam diameter for various values of the gain parameter.

\( \Phi / \Phi_0 = 2.0, V_0 = 5 \text{ KV, DLF = 70%} \)
FIG. C.54  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a'/b'=2.0, V_0 = 6 \text{ kV}, \text{DLF} = 70\%\)
FIG. C.55  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(\alpha/b'=2.0, V_0 = 7\) KV, DLF = 70%
FIG. C.56  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 2.0, V_0 = 8 \text{ KV}, \text{DLF} = 70\% \)
FIG. C.57  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 2.0\), \(V_0 = 9\, \text{KV}\), DLF = 70\%
FIG. C.58 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a/b = 2.0, V_o = 10 \text{KV}, \text{DLF} = 70 \% \)
FIG. C.59  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(\frac{a'}{b'} = 2.0\), \(V_0 = 12\) KV, DLF = 70%
FIG. C.61  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.2, V₀ = 1 KV, DLF = 80 %)
FIG. C.62  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
$(a'/b') = 1.2, V_0 = 2$ KV, DLF = 80%
Figure C.63 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \alpha' / \beta' = 1.2, V_0 = 3 \text{ kV}, \text{ DLF} = 80\% \)
FIG. C.65  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.2, V_0 = 5$ KV, DLF = 80 %)
FIG. C 66  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a'/b' = 1.2, V_0 = 6 \text{ KV}, \text{ DLF} = 80\%)\)
FIG. C.67  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[ \frac{a'}{b'} = 1.2, \quad V_0 = 7 \text{ KV}, \quad \text{DLF} = 80\% \]
FIG. C.70 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a'}{b'} = 1.2 \), \( V_0 = 10 \text{ KV} \), DLF = 80%
FIG. C.71  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.2, V₀ = 12 KV, DLF = 80%)
FIG. C.73  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.4 \), \( V_0 = 1 \text{ KV} \), DLF = 80%
FIG. C.74  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.4, V₀ = 2 KV, DLF = 80 %)
FIG. C.75 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.4$, $V_0 = 3$ KV, DLF = 80%)
FIG. C.76  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER
($a'/b' = 1.4$, $V_\infty = 4$ KV, DLF = 80 %)
FIG. C.77  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.4$, $V_0 = 5$ KV, $DLF = 80\%$)
FIG. C.78  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a' b'}{1 + C} \), \( V_p = 6 \text{ KV} \), DLF = 80%
FIG. C.79  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER  
(a'/b' = 1.4, V0 = 7 KV, DLF = 80 %)
FIG. C.80  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a'//b' = 1.4, \ V_0 = 8 \text{ KV}, \ DLF = 80\%\)
FIG. C.81  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
\( \alpha'/b' = 1.4, \quad V_0 = 9\,\text{KV}, \quad \text{DLF} = 80\,\% \)
FIG. C.82  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[ a'/b' = 1.4, \ V_0 = 10 \text{ KV,} \ \text{DLF} = 80 \% \]
FIG. C.83
SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a/b' = 1.4, V_0 = 12$ kV, DLF = 80%)
FIG. C.84  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.4, V_o = 14 KV, DLF = 80%)
FIG. C.85 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.6, V₀ = 1 KV, DLF = 80 %)
FIG. C.86 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER

\( \frac{a' b'}{1.6}, V_0 = 2 \text{ KV}, \text{ DLF} = 80\% \)
FIG. C.87  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
\(a' / b' = 1.6, \ V_0 = 3 \ \text{kV}, \ \text{DLF} = 80 \ %\)
FIG. C.88  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.6, V₀ = 4 KV, DLF = 80%)
FIG. C.89 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.6, V₀ = 5 KV, DLF = 80 %)
FIG. C.90  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( (a'/b' = 1.6, \ V_0 = 6 \text{ KV, DLF } = 80\%) \)
FIG. C.91 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a'}{b'} = 1.6, \ V_0 = 7 \text{ KV}, \ \text{DLF} = 80\% \)
FIG. C.92  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.6, V_0 = 8$ KV, DLF = 80%)
FIG. C.93  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($a'/b' = 1.6$, $V_0 = 9$ kV, DLF = 80 %)
FIG. C.94 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER
(a/b' = 1.6, V₀ = 10 KV, DLF = 80 %)
FIG. C.96  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($a'/b' = 1.6, \ V_0 = 14 \text{ kV}, \ DLF = 80\%$)
FIG. C.97
SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{d_0}{b_0} = 1.8, \ V_0 = 1 \text{KV}, \ DLF = 80 \% \)
FIG. C.98  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER
($a'/b' = 1.8, \text{ } V_o = 2 \text{ kV, DLF = 80\%}$)
FIG. C.99  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a'/b' = 1.8, V_0 = 3 \text{ kV}, \text{ DLF} = 80\% \)
FIG. C.100  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF GAIN PARAMETER. 
\( \left( a'/b' = 1.8, V_n = 4 \text{ KV}, \text{ DLF} = 80 \% \right) \)
FIG. C.101 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.8, V₀ = 5 KV, DLF = 80%)
FIG. C.103  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.8, V_0 = 7$ KV, DLF = 80%)
FIG. C.104  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.8$, $V_o = 8$ KV, DLF = 80 %)
FIG. C.105  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.8, V_0 = 9$ KV, DLF = 80%)

SPACE CHARGE, QC/(1 + CB)

BEAM DIAMETER, B

0 0.5 1.0 1.5 2.0

C = 0.20
C = 0.15
C = 0.10
C = 0.08
C = 0.05
FIG. C.108 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a' b'}{l \cdot V_c} = 1.8 \cdot V_c = 14 \text{ kV} \), D.I.F. = 80%
FIG. C.109 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER. 
\((a'/b' = 2.0, V_0 = 1 \text{ KV}, \text{ DLF} = 80 \% )\)
FIG. C.110  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 2.0, V_0 = 2 \text{ KV}, \text{ DLF} = 80 \% \)
FIG. C.111
SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($\alpha/b^* = 2.0$, $V_0 = 3$ kV, DLF = 80%)
FIG. C.112  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 2.0, V_0 = 4 \text{ KV}, \text{ DLF} = 80\%$)
FIG. C.114 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 2.0, \ V_0 = 6 \text{ KV}, \ \text{DLF} = 80\% \)
FIG. C.115  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a'/b' = 2.0, V_0 = 7 \text{ KV, DLF} = 80\%\)
FIG. C.117  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 2.0, V_o = 9 KV, DLF = 80 %)
FIG. C.119  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 2.0, V₀ = 12 KV, DLF = 80%)
FIG. C.120  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((d'/b' = 2.0, V_n = 14 \text{ KV}, \text{ DLF } = 80\%)\)
FIG. C.121 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(\frac{a'}{b'} = 1.2, V_0 = 1 \text{ KV, DLF} = 85\%\)
FIG. C.122  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.2, V_0 = 2$ KV, DLF = 85 %)
FIG. C.126  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.2, V₀ = 6 kV, DLF = 85 %)
FIG. C.127 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a}{b} = 1.2, V_0 = 7 \, \text{KV}, \, \text{DLF} = 85\% \)
FIG. C.128  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.2$, $V_0 = 8$ KV, DLF = 85 %)
FIG. C.130 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.2, $V_a = 10$ KV, DLF = 85 %)
FIG. C.131  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\[(a'/b') = 1.2, V_0 = 12 \text{ KV}, \text{ DLF} = 85\%\]
FIG. C.132 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a'/b' = 1.2\), \(V_0 = 14\) KV, \(DLF = 85\%\)
FIG. C.134 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.4, V₀ = 2 KV, DLF = 85 %)
FIG. C.135 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(\alpha/b' = 1.4, \ V_0 = 3 \text{ kV}, \ \text{DLF} = 85 \%\)
FIG. C.137  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\((a' / b' = 1.4, \ V_0 = 5 \ \text{KV}, \ \text{DLF} = 85 \ %)\)
FIG. C.138 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[ \frac{a'}{b'} = 1.4, \ V_0 = 6 \text{ KV}, \ \text{DLF} = 85\% \]
FIG. C.140 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a'}{b'} = 1.4 \), \( V_a = 8 \text{ KV} \), DLF = 85%
FIG. C.141 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a/b' = 1.4, V_0 = 9 \text{ KV}, \text{ DLF} = 85 \%)\)
FIG. C.142  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.4, V_0 = 10$ KV, DLF = 85 %)
Fig. C.143  Space charge vs. beam diameter for various values of the gain parameter.

(\(\frac{d}{D} = 1.4, V_o = 12\,\text{kV}, DLF = 85\%\))
FIG. C.144  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a'}{b'} = 1.4, V_0 = 14 \text{ KV}, \text{ DLF} = 85\% \)
FIG. C.145  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{d'b^1}{b^1} = 1.6, \ V_0 = 1 \text{ KV}, \ DLF = 85 \% \)
FIG. C.147 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 1.6, V_0 = 3 \text{ KV}, \text{ DLF} = 85\%\)
FIG. C.148  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.6$, $V_o = 4$ kV, DLF = 85%)
FIG. C.149 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{d}{b} = 1.6, V_0 = 5 \text{ KV}, \text{ DLF} = 85\% \)
FIG. C.150  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a'}{b'} = 1.6, \ V_n = 6 \text{ KV}, \ \text{DLF} = 85 \% \)
FIG. C.151  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.6, V₀ = 7 KV, DLF = 85 %)
FIG. C.152 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{d}{b'} = 1.6, \ V_n = 8 \text{ KV}, \ \text{DLF} = 85\% \)
FIG. C.155 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{C}{b'} = 1.6, V_o = 12 \text{ KV, DLF = 85\%} \)
FIG. C.156  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b'} = 1.6, V_0 = 14 \text{ KV, DLF} = 85\% \)
FIG. C.157  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.8, V₀ = 1 KV, DLF = 85 %)
FIG. C.158
SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a/b = 1.8, V₀ = 2 kV, DLF = 85 %)

SPACE CHARGE, qC/(1 + qC)

BEAM DIAMETER, B
FIG. C.160  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(\frac{a'}{b'} = 1.8, \ V_0 = 4 \text{ KV}, \ \text{DLF} = 85\%\)
FIG. C.161 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\[(a'/b'=1.8, \ V_0=5 \ \text{KV}, \ \text{DLF}=85 \ \%)\]
FIG. C.163  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.8, V_0 = 7 \text{ KV}, \text{ DLF} = 85 \text{ %} \)
FIG. C.164 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \left( \frac{n}{b'} = 1 \quad R = 8 \text{ KV} \quad \text{DI E = 85 %} \right) \)
Fig. C.165: Space Charge vs. Beam Diameter for Various Values of the Gain Parameter.

(d/b = 1.8, V_0 = 9 KV, DLF = 85%)
FIG. C.166  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a_i}{b_i} = 1.8, \ V_n = 10 \text{ KV, DLF} = 85\% \)
FIG. C.169  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( a'/b' = 2.0, V_0 = 1 \text{ KV}, \text{ DLF} = 85 \% \)
FIG. C.170 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( (a'/b' = 2.0 \ V_0 = 2 \text{ KV}, \ DLF = 85\%) \)
FIG. C.171
SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a/b) = 2.0, Y_o = 3 KV, DLF = 85%
FIG. C.173  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
(a'/b' = 2.0, V₀ = 5 kV, DLF = 85%)
FIG. C.174  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{d}{b} = 2.0, V_0 = 6 \text{ KV, DLI = 85\%} \)
FIG. C.175 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($a'/b' = 2.0$, $V_0 = 7$ KV, DLF = 85%)
FIG. C.176  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
\( \alpha' / \beta' = 2.0, V_0 = 8 \text{ KV, DLF} = 85 \% \)
FIG. C.177  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a'/b' = 2.0, V_0 = 9 \text{ KV}, \text{ DLF} = 85\% \)
FIG. C.178  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 2.0, V_o = 10KV, DLF = 85%)
FIG. C.179 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 2.0$, $V_0 = 12$ kV, DLF = 85%)
FIG. C.180 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b} = 2.0, \ V_n = 14 \text{ KV, DLF} = 85\% \)
FIG. C.181  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 1.2\), \(V_0 = 1\) KV, DLF = 90%
FIG. C.182  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.2, \ V_n = 2 \text{ KV}, \ \text{DLF} = 90\% \)
FIG. C.183 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(\frac{\alpha/\beta'}{1, V_0 = 3 \text{ KV}, DLF = 90\%}\)
FIG. C.166 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($d/b' = 1.2$, $V_0 = 6$ kV, DLF = 90%)
FIG. C.187 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.2, V_0 = 7 KV, DLF = 90%)
FIG. C.188 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.2, \ V_a = 8 \ \text{KV}, \ \text{DLF} = 90\% \)
FIG. C.189  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a'/b' = 1.2, V_0 = 9 \text{ KV}, \text{ DLF} = 90\%)\)
FIG. C.191  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.2, V_0 = 12 \text{ KV, DLF} = 90\%$)
FIG. C.193  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.4$, $V_0 = 1$ KV, DLF = 90 %)
FIG. C.195  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
\( (a'/b' = 1.4, V_0 = 3 \text{ KV, DLF} = 90\% ) \)
FIG. C.196 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.4$, $V_0 = 4$ KV, DLF = 90 %)
FIG. C.197  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

$\frac{d/b'}{1.4}$, $V_b = 5$ KV, DLF = 90%
FIG. C.200 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b} = 1.4, V_a = 8 \text{ KV, DLF = 90 \%} \)
FIG. C.201  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{Q_{0}}{V_{0}} = 1.4 \), \( V_{0} = 9 \text{ KV}, \text{DLF} = 90\% \)
FIG. C.202 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[ \frac{g}{b} = 1.4, \quad V_e = 10 \text{ KV}, \quad \text{DLF} = 90\% \]
FIG. C.203 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(\frac{\alpha_b}{b} = 1.4, \phi_0 = 12 \text{ KV}, \text{ DLF} = 90 \%)
FIG. C.204 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.4, V_a = 14 \text{ KV}, \text{ DLF} = 90\% \)
FIG. C.205 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a^2}{b^2} = 1.6, V_0 = 1 \text{ KV}, \text{ DLF} = 90\% \)
FIG. C.206 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a' \div b' = 1.6 \), \(V_n = 2\) KV. DLF = 90\%
FIG. C.207  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a/b}{1.6} = 3 \text{ KV}, \text{ DLF} = 90\% \)
FIG. C.208  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a' \cdot b'}{1.6}, V_0 = 4 \text{ KV}, \text{ DLF} = 90\% \)
FIG. C.209 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($a'/b' = 1.6$, $V_0 = 5$ KV, DLF = 90%)
FIG. C.211  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
$(a'/b' = 1.6, V_0 = 7 \text{ KV}, \text{DLF} = 90\%)$
FIG. C.212  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( (a'/b' = 1.6, V_0 = 8 \text{ KV}, \text{ DLF} = 90\%) \)
FIG. C.213  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[ \frac{\alpha}{\beta} = 1.6, \ V_0 = 9 \text{ KV, DLF} = 90\% \]
FIG. C.214  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
$(a'/b' = 1.6, V_a = 10 \text{ KV}, \text{ DLF} = 90\%)$
FIG. C.215 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a' / b' = 1.6\), \(V_0 = 12\) kV, DLF = 90%
FIG. C.216  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a' / b' = 1.6 \), \( V_n = 14 \) KV, DLF = 90 %
FIG. C.217 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a/b' = 1.8, V₀ = 1 KV, DLF = 90 %)
FIG. C.219  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a'}{b'} = 1.8 \), \( V_0 = 3 \) kV, DLF = 90%
FIG. C.220  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[ (a'/b' = 1.8 , V_n = 4 \text{ KV, DLF = 90\%} \)
FIG. C.221  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b'=1.8$, $V_0 = 5$ KV, DLF = 90%)
FIG. C.222 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a/b = 1.8, V_n = 6 KV, DLF = 90%)
FIG. C.223  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \alpha' / b' = 1.8 \), \( V_0 = 7 \text{ KV} \), DLF = 90%
FIG. C.224  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($a'/b' = 1.8$, $V_n = 8$ KV, DLF = 90%)
FIG. C.225 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b'} = 1.8 \), \( V_0 = 9 \text{ kV} \), DLF = 90%
FIG. C.226 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\[(a/b') = 1.8, \ V_o = 10 \text{ KV}, \ DLF = 90\%\]
FIG. C.227  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.8 \), \( V_0 = 12 \text{ KV} \), DLF = 90\%
FIG. C.22B SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(d/b = 1.8, V₀ = 14 KV, DLF = 90%)
FIG. C.229 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a' / b' = 2.0, V_0 = 1 \text{ KV}, \text{ DLF} = 90\% \)
FIG. C.231 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(d/b' = 2.0, V_0 = 3 K V, DLF = 90%)
FIG. C.232 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 2.0, V_n = 4 KV, DLF = 90%)
FIG. C.233 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\[a'/b' = 2.0, V_0 = 5 \text{ KV, DLF} = 90\%\]
FIG. C.234 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a/b' = 2.0, V_n = 6$ kV, $DLF = 90\%$)
FIG. C.235  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b'} = 2.0, V_0 = 7 \text{ KV}, \text{ DLF} = 90\% \)
FIG. C.236 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(d/a)^2 = 2.0, V_r = 8 kV, DLF = 90%
FIG. C.237  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \alpha' / b' = 2.0, V_0 = 9 \text{ KV}, \text{ DLF} = 90\% \)
FIG. C.24O SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 2.0, V_n = 14 \text{ KV}, \text{ DLF} = 90\% \)
FIG. C.241  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.2 \), \( V_0 = 1 \text{ KV} \), DLF = 95%
FIG. C.242  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a'/b' = 1.2, V_0 = 2\, \text{KV}, \, \text{DLF} = 95\%\)
FIG. C.243  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a'}{b'} = 1.2, V_0 = 3 \text{ kV}, \text{DLF} = 95\% \)
FIG. C.244 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a/b = 1.2, V_e = 4 KV, DLF = 95%)
FIG. C.245 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a/b' = 1.2, V₀ = 5 KV, DLF = 95%)
FIG. C.246  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a/b^1 = 1.2, \, V_n = 6 \, KV, \, DLF = 95\%)\)
FIG. C.247 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( (a'/b' = 1.2, V_0 = 7 \text{ KV}, \text{ DLF} = 95\%) \)
FIG. C.248 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(n'/h' = 1.2\), \(V_\gamma = 8\,\text{KV}\), \(D/L = F = 95\%\)
FIG. C.249 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( a'/b' = 1.2 \), \( V_0 = 9 \text{ KV} \), DLF = 95%
FIG. C.250  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($a'/b'=1.2, V_n = 10kV, DI F = 95\%$)
FIG. C.251  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.2 \), \( V_0 = 12 \text{KV} \), DLF = 95\%
FIG. C.253 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( a'/b' = 1.4 \), \( V_0 = 1 \) KV, DLF = 95%
FIG. C.254 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.4, Vn = 2 kV, DLF = 95%)
FIG. C.255 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 1.4, V_0 = 3 \text{ KV}, \text{ DLF} = 95\%\)
FIG. C.256 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
$(\alpha/\beta' = 1.4, V_0 = 4 \text{ KV, DLF = 95\%})$
FIG. C.260  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a'/b' = 1.4 \), \(V_n = 8 \text{ KV} \), DLF = 95%
FIG. C.263 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

$\left(\frac{a}{b} = 1.4, V_o = 12 \text{ KV}, DLF = 95\%\right)$
FIG. C.266 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( a' / b' = 1.6 \), \( V_0 = 2 \text{ KV} \), \( \text{DLF} = 95\% \)
**FIG. C.269** SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[(a/b' = 1.6, V_0 = 5 \text{ KV, DLF = 95\%})\]
FIG. C.271  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a'/b' =1.6 , V₀ = 7 KV, DLF = 95 %)
FIG. C.272  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
\( \frac{a}{b} = 1.6 \), \( V_0 = 8 \text{ KV} \), DLF = 95 \%
FIG. C.273  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a'/b' = 1.6, V_0 = 9 \text{KV}, \text{DLF} = 95\%\)
FIG. C.274  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[ \frac{d}{b} = 1.6 \, , \, V_0 = 10 \text{ KV}, \, \text{DLF} = 95\% \]
FIG. C.276 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( (a/b^4 = 1.6, \quad V_{\alpha} = \text{14 kV}, \quad \text{DLF} = 95\%) \)
FIG. C.277 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \alpha^*/b^* = 1.8, V_0 = 1 \text{KV, DLF = 95\%} \)
FIG. C.278 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($a/b = 1.8$, $V_0 = 2$ KV, DLF = 95%)
FIG. C.279 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.8 \), \( V_0 = 3 \text{ KV} \), DLF = 95%
FIG. C.282 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[(a/b') = 1.8, \ V_o = 6 \text{ KV, DLF = 95\%}\]
FIG. C.283  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( (a'/b' = 1.8, V_0 = 7 \text{ KV, DLF = 95\%}) \)
FIG. C.284 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a/b' = 1.8 \quad V_0 = 8 \text{ kV} \quad \text{DIE} = 95\%)\)
FIG. C.285 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a/b^2 = 1.8, V_0 = 9 \text{ KV}, \text{ DLF} = 95\%)\)
FIG. C.286  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{d}{b} = 1.8 \), \( V_A = 10 \text{ kV} \), \( \text{DLF} = 95\% \)
FIG. C.289  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{d}{b} = 2.0, V_e = 1 \text{ KV, DLF = 95\%} \)
FIG. C.290  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
\( \alpha/\beta = 2.0, V_0 = 2 \text{ KV, DLF = 95\%} \)
Fig. C.291  Space charge vs. beam diameter for various values of the gain parameter.

\( \frac{d}{b} = 20 \), \( V_0 = 3 \text{ kV} \), DLF = 95%
FIG. C.293 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a/b^{'=}2.0, V_0 = 5\text{ kV}, \text{ DLF} = 95\%\)
FIG. C.294  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a/b' = 2.0, V_n = 6 KV, DLF = 95%)
FIG. C.295 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 2.0, V_0 = 7 \text{ KV}, \text{ DLF} = 95\% \)
FIG. C.296  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[ \frac{a/b'}{2.0} \cdot V_n = 8 \text{ KV}, \ DLF = 95\% \]
FIG. C.297 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b'=2.0$, $V_0 = 9$ kV, DLF = 95%)
FIG. C.298  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 2.0, V = 10 kV, DLF = 95%)
FIG. C.299 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a/b'=2.0$, $V_0 = 12$ KV, DLF = 95%)
FIG. C.300 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( (a/b^* = 2.0, V_0 = 14\text{KV}, \text{DLF} = 95\%) \)
FIG. C.301 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{q}{Q} = \frac{1}{(1 + C b)} \)

\( (a/b' = 1.2, V_o = 1 \text{KV}, \text{DLF} = 100\%) \)
FIG. C.303 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a^2}{b^2} = 1.2 \), \( V_0 = 3 \text{kV} \), DLF = 100%
FIG. C.305 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(\frac{q}{b}\) = 1.2, \(V_0 = 5\) kV, DLF = 100%

Space Charge, \(qC/(1 + Cb)\)
FIG. C.306 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a/b') = 1.2, V₀ = 6 KV, DLF = 100%
FIG. C.307  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.2, V₀ = 7 KV, DLF = 100%)
FIG. C.308 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($\alpha'\beta'=1.2$, $V_c = 8$ kV, DLE = 100%)
FIG. C.309 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\((a'/b'=1.2, V_0 = 9 \text{ KV}, \text{DLF}=100\%)\)
FIG. C.310 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b} = 1.2 \), \( V_o = 10 \text{ KV} \), DLF = 100%
FIG. C.311  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\(a' / b' = 1.2\), \(V_0 = 12\) KV, DLF = 100\%
FIG. C.312  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{\alpha}{\beta} = 1.2, V_n = 14 \text{ KV}, \text{ DLF} = 100\% \)
FIG. C.313 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{d}{b} = 1.4, V_0 = 1 \text{ KV, DLF = 100\%} \)
FIG. C.315  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.4, V₀ = 3 KV, DLF = 100%)
FIG. C.316  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( n' / n = 1.4, V_0 = 4 \text{ KV, DLE = 100\%} \).
FIG. C.317 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( (a/b' = 1.4, V_0 = 5 \text{ KV}, \text{ DLF} = 100\%) \)
FIG. C.31B
SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\[
\frac{a/b^*}{V_0} = 6 \text{ KV, DLF} = 100 \%
\]
FIG. C.320 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(\frac{a'}{b'} = 1.4, V_0 = 8\text{ KV}, \text{ DLF} = 100\%\)
FIG. C.321  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.4$, $V_0 = 9$ KV, DLF = 100 %)
FIG. C.32 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(d/b = 1.4, V₀ = 10kV, DLF = 100%)
FIG. C.323 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 1.4, V_o = 12 \text{ KV}, \text{ DLF} = 100\%\)
FIG. C.324 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b} = 1.4, V_a = 14 \text{ KV}, \text{ DLF} = 100\% \)
Fig. C.325 Space charge vs. beam diameter for various values of the gain parameter.
\((a'/b' = 1.6, V_0 = 1 \text{ KV, DLF = 100\%})\)
FIG. C.327 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

$\frac{a}{b'} = 1.6, V_0 = 3$ kV, DLF = 100%

$\frac{\text{Space Charge}}{\text{Ac/(1 + Cb)}}$
FIG. C.328 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.6 \), \( V = 4 \text{ KV} \), DI E = 100%
FIG. C.329 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(a'/b' = 1.6, V_0 = 5 \text{ KV, DLF = 100\%}\)
FIG. C.330 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{b}{d} = 1.6, V_d = 6 \text{ KV}, \text{ DLF = 100\%} \)
FIG. C.331  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.6, V₀ = 7 KV, DLF = 100%)
FIG. C.332  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($d/b' = 1.6, V_n = 8$ KV, DLF = 100%)
FIG. C.333 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.6$ , $V_0 = 9$ KV, DLF = 100%)
FIG. C.334 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a'/b' = 1.6, \ V_0 = 10 \text{ KV}, \ DLF = 100\% \)
FIG. C.335 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a'/b' = 1.6 \), \( V_0 = 12 \text{ KV} \), DLF = 100%
FIG. C.336  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(a'/b' = 1.6, V₀ = 14 KV, DLF = 100%)
FIG. C.337  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\[ \frac{a'}{b'} = 1.8, \ V_0 = 1 \text{ KV}, \ DLF = 100\% \]
FIG. C.338  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a'/b' = 1.8, V_0 = 2 \text{ KV}, \text{ DLF} = 100\% \)
FIG. C.339  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 1.8 \), \( V_0 = 3 \text{KV} \), DLF = 100%
FIG. C.340 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a/b'=1.8, V_o = 4 kV, DI F = 100%)
FIG. C.341 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b'=1.8$, $V_o = 5$ KV, DLF = 100%)
FIG. C.343  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a_i^{i^1}}{b_i} = 1.8 \), \( V_0 = 7 \text{ KV} \), DLF = 100%
FIG. C.345  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \left( \frac{d}{b} = 1.8, V_0 = 9 \, \text{KV}, \text{DLF} = 100\% \right) \)
FIG. C.346 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a}{b^2} = 1.8 \), \( V_\alpha = 10 \text{ KV} \), \( \text{DLF} = 100\% \)
FIG. C.347 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(\frac{a}{b} = 1.8, V_0 = 12\, \text{KV}, \text{DLF} = 100\%\)
FIG. C.348 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($\alpha/k^3 B < 1$, $V = 14$ kV, DLE = 100%)
FIG. C.350 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{Q}{C(1 + Cb)} \)

\( a'/b' = 2.0, V = 2 \text{ kV}, \text{ DLE} = 100\% \)
FIG. C.351 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 2.0$, $V_0 = 3$ KV, DLF = 100%)
FIG. C.354 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 2.0, V_n = 6 KV, DLF = 100%)
FIG. C.355  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 2.0, V_0 = 7 \text{ KV}, \text{ DLF} = 100\% \)
FIG. C.356 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

(\frac{d}{b} = 2, V_0 = 8 \text{ kV}, \text{ DLF} = 100\%)
FIG. C.357 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b'=2.0, V_0 = 9$ KV, DLF = 100%)
FIG. C.358  SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( \frac{a'}{b'} = 2.0, V_n = 10 \text{ KV, DLF = 100\%} \)
FIG. C.360 SPACE CHARGE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a}{b^*} = 2.0 \), \( V_a = 14 \) KV. DLF = 100 %
SECTION D

SPACE CHARGE vs. VOLTAGE

The plots of the space-charge parameter vs. the stream voltage are arranged according to increasing values of the parameters B and DLF successively at a fixed value of $a'/b'$.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>0.5 to 1.5</td>
</tr>
<tr>
<td>DLF</td>
<td>70 to 100</td>
</tr>
<tr>
<td>$a'/b'$</td>
<td>1.4</td>
</tr>
</tbody>
</table>
FIG. D.2 SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( a'/b' = 1.4, B = 1.0, DLF = 70\% \)
FIG. D.4  SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b' = 1.4$, $B = 0.50$, DLF = 80%)
FIG. D.6 SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.

\( (a' / b' = 1.4, \ B = 1.50, \ \text{DLF} = 80\%) \)
FIG. D.7  SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.
(a'/b' = 1.4, B = 0.5, DLF = 85 %)
FIG. D.8  SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.  
\((a'/b' = 1.4, \ B = 1.0, \ \text{DLF} = 85\%)\)
FIG. D.9 SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\( \frac{a'}{b'} = 1.4, \ B = 1.50, \ \text{DLF} = 85 \% \)
FIG. D.10
SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER
($\alpha/\beta = 1.4$, $B = 0.50$, DLF = 90%)
FIG. D.12 SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a'/b = 1.4$, $B = 1.50$, DLF = 90%)
Fig. D.13 Space Charge vs. Helix Voltage for Various Values of the Gain Parameter.

\( \frac{a}{b} = 1.4, \ B = 0.50, \ DLF = 95\% \)
FIG. D.15 SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.
($a' / b' = 1.4$, $B = 1.50$, DLF = 95 %)
FIG. D.16  SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.

($a'/b' = 1.4, B = 0.50, DLF = 100\%$)
FIG. D.17 SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.
$(\gamma/b) = 1.4, B = 1.0, DLF = 100 \%$
FIG. D.18 SPACE CHARGE VS. HELIX VOLTAGE FOR VARIOUS VALUES OF THE GAIN PARAMETER.
\(\alpha' / \beta' = 1.4, \ B = 1.5, \ DLF = 100\%\)
SECTION E

SPACE-CHARGE CORRECTION FACTOR

The space-charge correction factor curves are arranged according to ascending values of the gain parameter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.05 to 0.20</td>
</tr>
</tbody>
</table>
FIG. E.1 SPACE-CHARGE CORRECTION. (C = 0.05, d = 0)
FIG. E.2 SPACE-CHARGE CORRECTION. (C = 0.10, d = 0)
FIG. E.3 SPACE-CHARGE CORRECTION. (C = 0.2, d = 0)
SECTION F

OPTIMUM ELECTRON INJECTION VELOCITY

The curves of the optimum electron injection velocity are arranged according to ascending values of the loss parameter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0 to 0.3</td>
</tr>
<tr>
<td>QC</td>
<td>0 to 1.0</td>
</tr>
<tr>
<td>d</td>
<td>0 to 1.0</td>
</tr>
</tbody>
</table>
FIG. F.1  b AT $X_1$ MAX. VS. $X_1$ MAX. WITH C AND QC AS PARAMETERS. (d = 0)
FIG. 2 b AT X₁ MAX. VS. X₁ MAX. WITH C AND QC AS PARAMETERS. (d = 0.0)
FIG. F.3  $b$ AT $X_1$ MAX. VS. $X_1$ MAX. WITH C AND QC AS PARAMETERS.  
($d = 0.125$)
FIG. F.4  \( b \) AT \( X_1 \) MAX. VS. \( X_1 \) MAX. WITH \( C \) AND \( QC \) AS PARAMETERS.  
\( (d = 0.5) \)
FIG. F.5  b AT X_1 MAX. VS. X_1 MAX. WITH C AND QC AS THE PARAMETERS.
(d = 1.0)
FIG. F.6 RELATIVE INJECTION VELOCITY VS. SPACE-CHARGE PARAMETER. (B = 1, d = 0)
SECTION G

PERVEANCE

The curves of the electron stream perveance vs. the stream diameter are arranged according to ascending values of the parameters $a'/b'$ and $C$ in succession.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a'/b'$</td>
<td>1.2 to 2.0</td>
</tr>
<tr>
<td>$C$</td>
<td>0.05 to 0.20</td>
</tr>
</tbody>
</table>
FIG. G.1 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. ($C = 0.05$, $a'/b' = 1.2$)
FIG. G.2 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. \((c = 0.05, a'/b' = 1.4)\)
FIG. G.3  MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.05, a'/b' = 1.6)
FIG. G.4 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. ($C = 0.05, a'/b' = 1.8$)
FIG. G.5  MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER.\( (C = 0.05, \alpha'/b' = 2.0) \)
FIG. G.6 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER (c = 0.08, a'/b' = 1.2)
FIG. G.7  MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.08, a'/b' = 1.4)
FIG. G.8  MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.08, a'/b' = 1.6)
FIG. G.9 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. \( C = 0.08, \ a'/b' = 1.8 \)
FIG. G.10  MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. ($C = 0.08, a'/b' = 2.0$)
FIG. G.11 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. ($C = 0.10$, $a'/b' = 1.2$)
FIG. G.12 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. ($c = 0.10$, $a'/b' = 1.4$)
FIG. G.13  MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.10, a'/b' = 1.6)
FIG. G.14 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.10, a'/b' = 1.8)
FIG. G.15 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. \((C=0.1, a'/b' = 2.0)\)
FIG. G.16 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.15, a'/b' = 1.2)
FIG. G.17 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. \( (c = 0.15, d'/b' = 1.4) \).
FIG. G.18  MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.15, a/b' = 1.6)
FIG. G.19 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. ($C = 0.15, a'/b' = 1.8$)
FIG. G.20 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. \((C = 0.15, a'/b' = 2.0)\)
FIG. G.21 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.20, a'/b' = 1.2)
FIG. G.22 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. \( C = 0.20, \frac{a'}{b'} = 1.4 \)
FIG. G.23 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. ($C=0.20$, $a'/b = 1.6$)
FIG. G.24 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. (C = 0.20, \(a'/b' = 1.8\))
FIG. G.25 MICROPERVEANCE VS. BEAM DIAMETER FOR VARIOUS VALUES OF THE SPACE-CHARGE PARAMETER. \( c = 0.20, a'/b' = 2.0 \)
SECTION H

PERVEANCE CORRECTION FACTOR

The curves of the perveance correction factor vs. the space-charge parameter are arranged according to ascending values of the gain parameter.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.05 to 0.20</td>
</tr>
</tbody>
</table>
FIG. H.1 PERVEANCE CORRECTION FACTOR. (C = 0.05, d = 0)
FIG. H.2 PERVEANCE CORRECTION FACTOR. (C=0.10, d = 0)
FIG. H.3  PERVEANCE CORRECTION FACTOR. (C = 0.2, d = 0)
SECTION I

ELECTRON STREAM CHARACTERISTICS

The following useful electron stream characteristic curves are included:

1. QC vs. B with $\omega_p/\omega$ as the Parameter.
   
   $C = 0.05; \ a'/b' = 1.4, 2.0.$
   
   $C = 0.10; \ a'/b' = 1.4, 2.0.$
   
   $C = 0.20; \ a'/b' = 1.4, 2.0.$

2. $R_n$ vs. B with $a'/b'$ as the Parameter.


5. Magnetic Field Required for Brillouin Flow.
FIG. I.1 SPACE CHARGE VS. STREAM DIAMETER WITH NORMALIZED PLASMA FREQUENCY AS THE PARAMETER. ($C = 0.05$, $a'/b' = 1.4$)
FIG. I.2 SPACE CHARGE VS. STREAM DIAMETER WITH NORMALIZED PLASMA FREQUENCY AS THE PARAMETER.
(C = 0.05, a'/b' = 2.0)
FIG. I.3  SPACE CHARGE VS. STREAM DIAMETER WITH
NORMALIZED PLASMA FREQUENCY AS THE PARAMETER.
(C = 0.1, \( a'/b' = 1.4 \))
FIG. I.4 SPACE CHARGE VS. STREAM DIAMETER WITH NORMALIZED PLASMA FREQUENCY AS THE PARAMETER.  
(C = 0.1, \(a'/b' = 2.0\))
FIG. 1.5 SPACE CHARGE VS. STREAM DIAMETER WITH NORMALIZED PLASMA FREQUENCY AS THE PARAMETER.
(C = 0.2, a'/b' = 1.4)
FIG. I.6 SPACE CHARGE VS. STREAM DIAMETER WITH NORMALIZED PLASMA FREQUENCY AS THE PARAMETER. (c = 0.2, a'/b' = 2.0)
\[ R_n = \left[ 1 - \frac{n \beta b'}{I_{Ona'}} \left( I_{Inb'}K_{Ona'} + I_{Ona'}K_{Inb'} \right) \right]^{\frac{1}{2}} \]

\( R_n \) = DRIFT TUBE RADIUS

\( b' \) = ELECTRON STREAM RADIUS

\( b' = \gamma b' \approx \beta e (1 + Cb) b' \)

FIG. 1.7 PLASMA FREQUENCY REDUCTION FACTOR
FIG. I.8 ELECTRON STREAM PERVEANCE AND POWER
FIG. I.9 NOMOGRAPh RELATING CURRENT, VOLTAGE, POWER AND PERVEANCE IN AN ELECTRON STREAM.
$B_0 d = 0.654 P \mu^\frac{1}{2} V_0^\frac{1}{2}$

- $P$ in $\mu$-PERVS
- $V_0$ in VOLTS
- $B_0$ in GAUSS
- $d$ - STREAM DIAMETER IN INCHES

**FIG. I.10** MAGNETIC FIELD REQUIRED FOR BRILLOUIN FLOW VS. STREAM VOLTAGE WITH PERVEANCE AS THE PARAMETER.
SECTION J

SPACE-CHARGE REDUCTION FACTOR
FOR DISPERSIVE STRUCTURES

The space-charge reduction factor curves for dispersive structures are arranged according to ascending values of the parameters $V_0$, $a'/b'$ and DLF successively.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_0$</td>
<td>5 kv and 10 kv</td>
</tr>
<tr>
<td>$a'/b'$</td>
<td>1.2 and 2.0</td>
</tr>
<tr>
<td>DLF</td>
<td>70 and 90</td>
</tr>
</tbody>
</table>
FIG. J.1 SPACE-CHARGE REDUCTION FACTOR VS. BEAM DIAMETER.
(C = 0.1—— , C = 0.2—— , a'/b' = 1.2, V₀ = 5 KV, DLF = 70 %)
FIG. J.2  SPACE-CCHARGE REDUCTION FACTOR VS. BEAM DIAMETER.

(C = 0.1 ————, C = 0.2 ————, a'/b' = 1.2, V_n = 10 kV, DLF = 70 %)
FIG. J.3 SPACE-CHARGE REDUCTION FACTOR VS. BEAM DIAMETER.
(C = 0.1 ———, C = 0.2 ———, $\alpha' / b' = 2.0$, $V_0 = 5$ kV, DLF = 70%)
FIG. J.4 SPACE-CHARGE REDUCTION FACTOR VS. BEAM DIAMETER.
(C = 0.1 --- , C = 0.2 ---- , a'/b' = 2.0, V_o = 10 KV, DLF = 70 %)
FIG. J.5 SPACE-CHARGE REDUCTION FACTOR VS. BEAM DIAMETER.
(C = 0.1 ———, C = 0.2 ———, a'/b' = 1.2, V₀ = 5 KV, DLF = 90 %)
FIG. J.6 SPACE-CHARGE REDUCTION FACTOR VS. BEAM DIAMETER.
(C = 0.1 ———, C = 0.2 ———, \(a'/b' = 1.2\), \(V_0 = 10\) KV. DLF = 90%.)
FIG. J.7  SPACE-CHARGE REDUCTION FACTOR VS. BEAM DIAMETER.
(C = 0.1 ———, C = 0.2 ———, d/b' = 2.0, V₀ = 5 KV, DLF = 90 %)
SECTION K

TUBE LENGTH AND CHANGE IN PHASE
SHIFT vs. INPUT-SIGNAL LEVEL

The optimum tube length and the change in phase shift through the
tube are given as functions of the input-signal level \( \psi \), relative to \( C \ell_0 V_0 \).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
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<tbody>
<tr>
<td>C</td>
<td>0.1</td>
</tr>
<tr>
<td>B</td>
<td>1.0</td>
</tr>
<tr>
<td>QC</td>
<td>0, 0.05, 0.125, 0.25, 0.5</td>
</tr>
</tbody>
</table>
FIG. K.1

$\psi$, input-signal level in db below $C I_0 V_0$, vs. tube length at saturation in undisturbed wavelengths. $b$ is adjusted for maximum saturation gain

$(C = 0.1, d = 0, B = 1, a/b' = 2)$
FIG. K.2

CHANGE IN PHASE SHIFT AT

$N_g = 5.5$ VS. $\psi$ FOR FIXED TUBE LENGTH WITH VARIABLE INPUT-SIGNAL LEVEL

($C = 0.1, d = 0, N_g = 5.5, B = 1, a'/b' = 2$)
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