

AD610066

RADC-TDR-64-465



MULTIMEGAWATT BROADBAND MICROWAVE TUBES

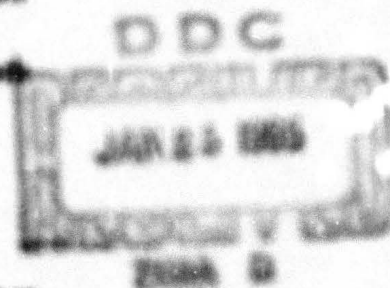
COPY	2	OF	3	R
HARD COPY	\$. 2.00			
MICROFICHE	\$. 0.50			

36P

TECHNICAL DOCUMENTARY REPORT NO., RADC-TDR-64-465

December 1964

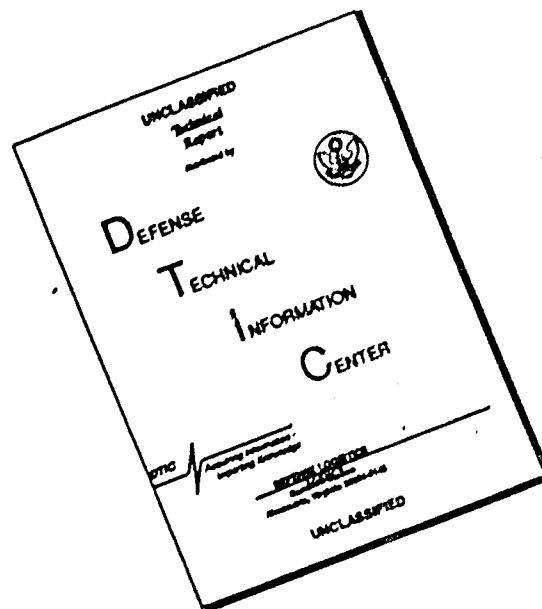
Techniques Branch
 Rome Air Development Center
 Research and Technology Division
 Air Force Systems Command
 Griffis Air Force Base, New York



Project No. 1573, Task No. 157303

(Prepared under Contract AF 33(602)-2573 by Microwave Laboratory,
 P. M. Harman Laboratories of Physics, Stanford University, Stanford,
 California.)

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

When US Government drawings, specifications, or other data are used for any purpose other than a definitely related government procurement operation, the government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the government may have formulated, furnished, or in any way supplied, the said drawings, specifications, or other data is not to be regarded by implication or otherwise, as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Qualified requesters may obtain copies from Defense Documentation Center.

Defense Documentation Center release as Office of Technical Services is authorized.

ABSTRACTS

1. CENTIPEDE TWT

The centipede circuit has been adapted for use on the electron stick in such a manner that the amplitude and phase of the growing wave along the beam-circuit interaction length can be measured. The results of this study will be of utmost value in optimizing the many parameters affecting the beam-circuit interaction. Current results of theory and experiment are presented.

2. EXTENDED-INTERACTION KLYSTRONS

Tests on the electron stick for the suppression of parasitic oscillations have been conducted. By covering the entire stick with a thin sheet of directionally resistive nylon, oscillations were removed, up to 30 dB. Two other sources of instability have been found and removed: feedback oscillations and anode-cathode oscillations. Work on calibration of external load and saturated-beam measurements is described.

3. TRANSDUCER-CURVE STUDIES

Studies on space-charge waves in an accelerated parallel-flow electron beam in a constant magnetic field have continued. The major emphasis this period has been on the analysis of the second-order differential system; a discussion of the solutions for various conditions is presented.

4. BEAM-PLASMA STUDIES

Preliminary work on this new project, which continues on aspects of earlier plasma research under this contract, is described.

5. ACOUSTIC WAVE DEVICES

The objective of this new project is to investigate the properties of microwave acoustic wave transducers in order to improve their conversion efficiency and bandwidth; the status of this work is described.

PUBLICATION REVIEW

This report has been reviewed and is approved. For further technical information on this project, contact SA Wilson, INSC, Attention 22224.

William E. Wilson

Approved: WILLIAM E. WILSON, 8/14, 1967
Project Officer
Electronic Devices Section

John D. Bube

Approved: JOHN D. BUBE
Chief, Techniques Branch
Development & Control Division

TABLE OF CONTENTS

	Page
INTRODUCTION	1
SUMMARY AND ANALYSIS OF THE WORK	2
1. Centipede TVT	2
2. Extended-Interaction Klystrons	15
3. Transverse-Wave Studies	19
4. Beam-Plasma Studies	23
5. Acoustic Wave Devices	25

INTRODUCTION

This is Quarterly Status Report No. 11, for the period of 1 May through 31 July 1964. This report describes projects active in the third year of this contract.

At the present time there are five projects, as follows:

1. Centipede TWT
2. Extended-Interaction Klystrons
3. Transverse-wave Studies
4. Near-plasma Studies
5. Acoustic Wave Devices.

The projects titled "Oscillation Suppression in TWT's" and "Non-periodic Dielectric-lined TWT" have been completed. No work has been done on the "Periodic Circuit Studies" project during this quarter. A description of the work done on these projects during this contract year will be presented in the forthcoming Annual Report.

A technical report, "Space-charge Waves in an Accelerated Parallel-flow Electron Beam in a Constant Magnetic Field," by Ras Horke, has been written, which describes the work on the "Transverse-wave Studies" project. It has been submitted to NAC for preparation as a Technical Documentary Report.

A plasma project on this contract has been continued, although the project formerly reported (titled "Electron Beam Interaction with a Cesium Plasma") was completed and a Technical Documentary Report on the whole project has been published. The new plasma project is presently in its initial stages, and this study, which is in essence a continuation of some aspects of the earlier work, is described herein under the title of "Near-plasma Studies."

A project titled "Acoustic Wave Devices" has been added in this film research and is concerned with the applications of such films to microwave acoustic transducers. An objective of this project is to explore the development of device configurations which may be useful for variable microwave phase shifters and delay lines.

The responsible investigator for this contract is Professor Marvin Chodorow.

SUMMARY AND ANALYSIS OF THE WORK

1. CENTIPEDE TWT

(D. K. Winslow,* T. Reeder)

A. INTRODUCTION

The objective of this project is to study the electron beam - slow wave circuit interaction in a high-power traveling-wave tube. The centipede slow wave circuit, a coupled cavity structure, is used in this study. In particular, the centipede has been chosen because it has proven to be one of the most satisfactory slow wave structures for a high-power TWT. The method of investigation will be to measure the amplitude and phase of the fields in each centipede cavity while the centipede is mounted on the electron stick and is being operated as a TWT. Measurements over a particular region are possible, such as at a sever and in the output section of the tube. The results of this study will be of utmost value in optimizing the many parameters affecting the beam-circuit interaction.

B. DISCUSSION

The fields inside each centipede cavity are sampled by a small, movable loop probe which is coupled to the fields by small slots located between the feet of adjacent centipede loops, as shown in Fig. 1. The probe can be moved over the entire length of the centipede structure, and it can be precisely positioned over a particular cavity slot. The size of the slots was adjusted to provide about one-tenth of a milliwatt of probe output when one kilovolt is applied at the centipede input coupler. The amplitude

*Project supervisor.

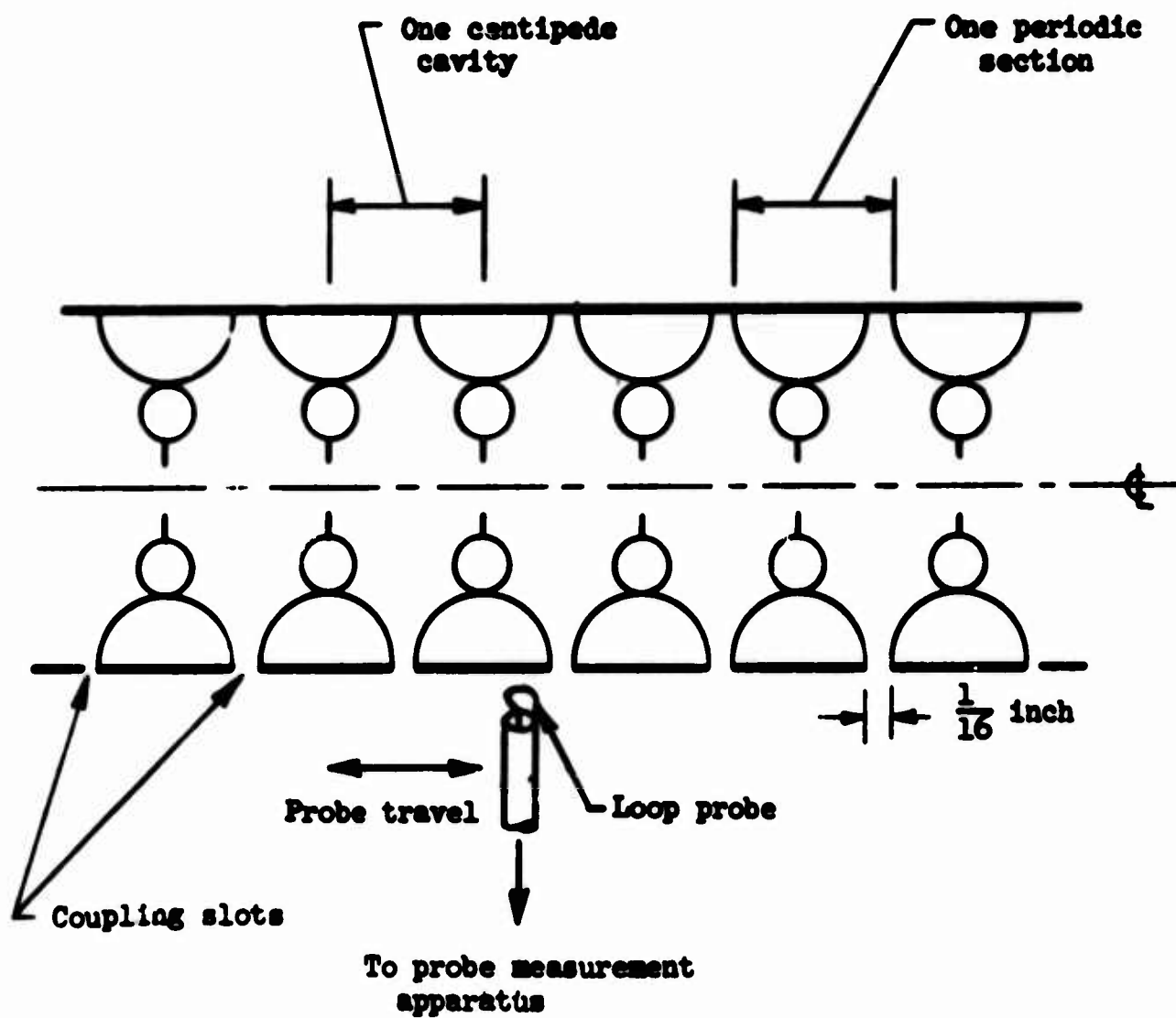


FIG. 1--Cross-sectional view of the centipede structure showing field probe and coupling slot location.

The $\mathcal{O}_K$ -module $\mathcal{O}_K/\mathfrak{p}^n$ is a free $\mathcal{O}_K/\mathfrak{p}$ -module of rank n . Suppose $\mathfrak{p} \nmid \Delta_K$. Then $\mathcal{O}_K/\mathfrak{p}^n$ is a free $\mathcal{O}_K/\mathfrak{p}$ -module of rank n . Suppose $\mathfrak{p} \mid \Delta_K$. Then $\mathcal{O}_K/\mathfrak{p}^n$ is a free $\mathcal{O}_K/\mathfrak{p}$ -module of rank n .

Approved for Release by NSA on 08-25-2013 pursuant to E.O. 13526

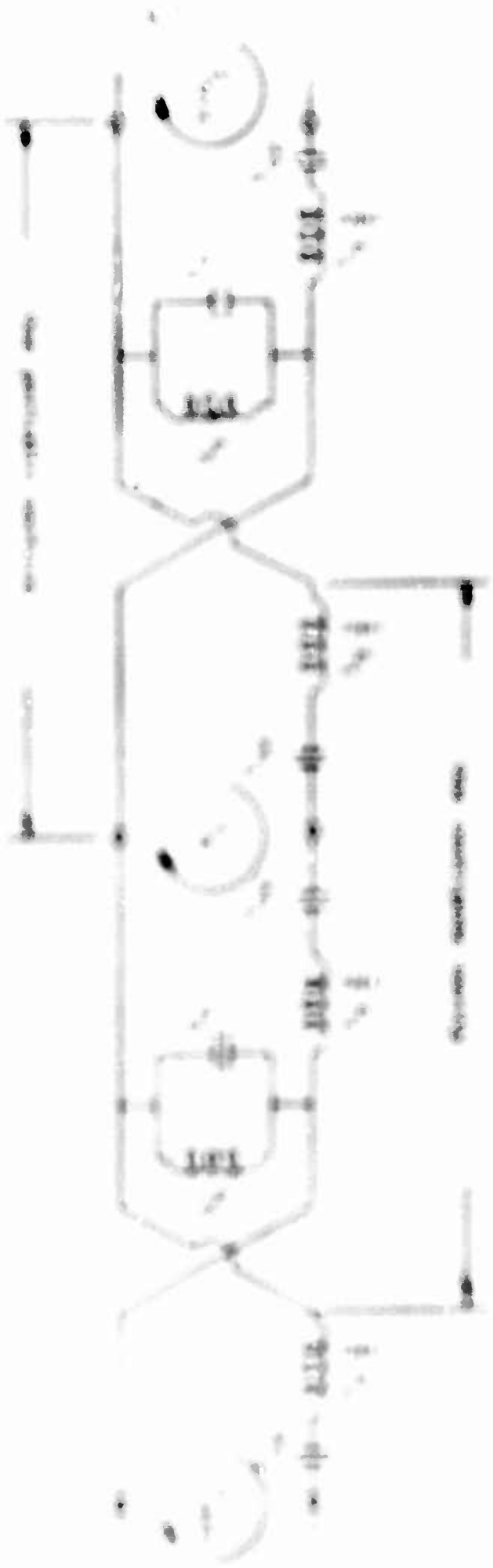


Figure 1: Differential amplifier circuit diagram showing input and output stages with variable capacitors and resistors.

and



During the 1st and 2nd years, a small number of the students who were
enrolled in the



The first year of the program is designed to provide the student with a
solid foundation in the basic principles of the subject. The second year
is devoted to the study of the more advanced topics.



The program is designed to provide the student with a solid foundation
in the basic principles of the subject.

1961

Page 25

- 1. The following are the results of the experiments (1)
- 2. The following are the results of the experiments (2)
- 3. The following are the results of the experiments (3)

The following are the results of the experiments of the following nature:

$$x = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

The following are the results of the experiments of the following nature:

$$x = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

The following are the results of the experiments of the following nature:

$$x = \begin{pmatrix} 1 \\ 2 \end{pmatrix}$$

Page 2 of 2. Discontinue this page information if it does not contain
the name and identification of (1) all the organizations, firms, and other persons
with whom you have any relationship.

Figure 1. Schematic representation of the experimental design. The subjects were divided into two groups: the control group and the experimental group. The control group was divided into two subgroups: the control group and the control group. The experimental group was divided into two subgroups: the experimental group and the experimental group. The control group was divided into two subgroups: the control group and the control group. The experimental group was divided into two subgroups: the experimental group and the experimental group.

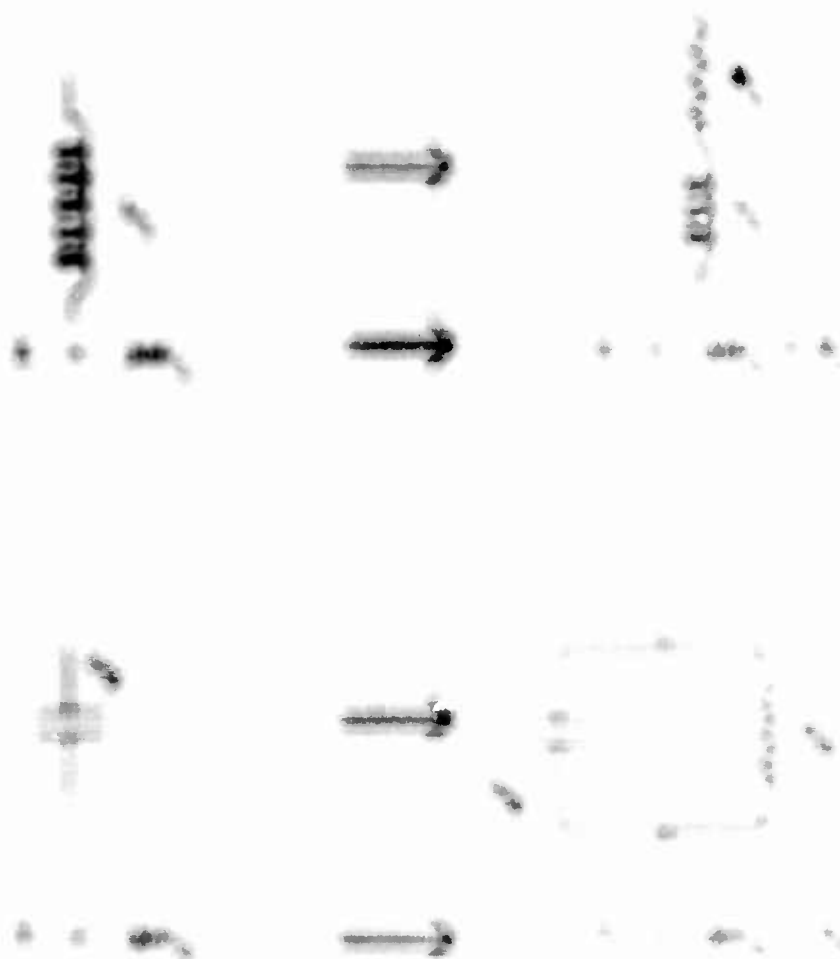


Figure 1



Figure 1

$$f_1 = \frac{1}{2} \quad f_2 = \frac{1}{2} \quad (1)$$

Figure 1 shows the two functions f_1 and f_2 which are defined on the interval $[0, 1]$ of the x -axis. The function f_1 is defined by $f_1(x) = 1 - x$ and the function f_2 is defined by $f_2(x) = x$. The functions f_1 and f_2 are both continuous on the interval $[0, 1]$ and both functions are also differentiable on the interval $(0, 1)$. The functions f_1 and f_2 are both increasing on the interval $[0, 1]$ and both functions are also concave down on the interval $[0, 1]$. The functions f_1 and f_2 are both symmetric about the line $x = 0.5$.

$$f_1 = 1 - x \quad f_2 = x \quad (2)$$

Figure 2 shows the two functions f_1 and f_2 which are defined on the interval $[0, 1]$ of the x -axis. The function f_1 is defined by $f_1(x) = 1 - x^2$ and the function f_2 is defined by $f_2(x) = x^2$. The functions f_1 and f_2 are both continuous on the interval $[0, 1]$ and both functions are also differentiable on the interval $(0, 1)$. The functions f_1 and f_2 are both symmetric about the line $x = 0.5$.

$$f_1 = 1 - x^2 \quad f_2 = x^2 \quad (3)$$

$$f_1 = 1 - x^3 \quad f_2 = x^3 \quad (4)$$

Figure 3 shows the two functions f_1 and f_2 which are defined on the interval $[0, 1]$ of the x -axis. The function f_1 is defined by $f_1(x) = 1 - x^4$ and the function f_2 is defined by $f_2(x) = x^4$. The functions f_1 and f_2 are both continuous on the interval $[0, 1]$ and both functions are also differentiable on the interval $(0, 1)$. The functions f_1 and f_2 are both symmetric about the line $x = 0.5$.

$$f_1 = 1 - x^5 \quad f_2 = x^5 \quad (5)$$

Figure 4 shows the two functions f_1 and f_2 which are defined on the interval $[0, 1]$ of the x -axis. The function f_1 is defined by $f_1(x) = 1 - x^6$ and the function f_2 is defined by $f_2(x) = x^6$. The functions f_1 and f_2 are both continuous on the interval $[0, 1]$ and both functions are also differentiable on the interval $(0, 1)$. The functions f_1 and f_2 are both symmetric about the line $x = 0.5$.

[Faint, illegible text from bleed-through]

[illegible]

1. Introduction
 2. Background
 3. Methodology
 4. Results
 5. Conclusion
 6. References
 7. Appendix
 8. Index
 9. Table of Contents
 10. Figure
 11. Table
 12. Figure
 13. Table
 14. Figure
 15. Table
 16. Figure
 17. Table
 18. Figure
 19. Table
 20. Figure
 21. Table
 22. Figure
 23. Table
 24. Figure
 25. Table
 26. Figure
 27. Table
 28. Figure
 29. Table
 30. Figure
 31. Table
 32. Figure
 33. Table
 34. Figure
 35. Table
 36. Figure
 37. Table
 38. Figure
 39. Table
 40. Figure
 41. Table
 42. Figure
 43. Table
 44. Figure
 45. Table
 46. Figure
 47. Table
 48. Figure
 49. Table
 50. Figure
 51. Table
 52. Figure
 53. Table
 54. Figure
 55. Table
 56. Figure
 57. Table
 58. Figure
 59. Table
 60. Figure
 61. Table
 62. Figure
 63. Table
 64. Figure
 65. Table
 66. Figure
 67. Table
 68. Figure
 69. Table
 70. Figure
 71. Table
 72. Figure
 73. Table
 74. Figure
 75. Table
 76. Figure
 77. Table
 78. Figure
 79. Table
 80. Figure
 81. Table
 82. Figure
 83. Table
 84. Figure
 85. Table
 86. Figure
 87. Table
 88. Figure
 89. Table
 90. Figure
 91. Table
 92. Figure
 93. Table
 94. Figure
 95. Table
 96. Figure
 97. Table
 98. Figure
 99. Table
 100. Figure
 101. Table
 102. Figure
 103. Table
 104. Figure
 105. Table
 106. Figure
 107. Table
 108. Figure
 109. Table
 110. Figure
 111. Table
 112. Figure
 113. Table
 114. Figure
 115. Table
 116. Figure
 117. Table
 118. Figure
 119. Table
 120. Figure
 121. Table
 122. Figure
 123. Table
 124. Figure
 125. Table
 126. Figure
 127. Table
 128. Figure
 129. Table
 130. Figure
 131. Table
 132. Figure
 133. Table
 134. Figure
 135. Table
 136. Figure
 137. Table
 138. Figure
 139. Table
 140. Figure
 141. Table
 142. Figure
 143. Table
 144. Figure
 145. Table
 146. Figure
 147. Table
 148. Figure
 149. Table
 150. Figure
 151. Table
 152. Figure
 153. Table
 154. Figure
 155. Table
 156. Figure
 157. Table
 158. Figure
 159. Table
 160. Figure
 161. Table
 162. Figure
 163. Table
 164. Figure
 165. Table
 166. Figure
 167. Table
 168. Figure
 169. Table
 170. Figure
 171. Table
 172. Figure
 173. Table
 174. Figure
 175. Table
 176. Figure
 177. Table
 178. Figure
 179. Table
 180. Figure
 181. Table
 182. Figure
 183. Table
 184. Figure
 185. Table
 186. Figure
 187. Table
 188. Figure
 189. Table
 190. Figure
 191. Table
 192. Figure
 193. Table
 194. Figure
 195. Table
 196. Figure
 197. Table
 198. Figure
 199. Table
 200. Figure
 201. Table
 202. Figure
 203. Table
 204. Figure
 205. Table
 206. Figure
 207. Table
 208. Figure
 209. Table
 210. Figure
 211. Table
 212. Figure
 213. Table
 214. Figure
 215. Table
 216. Figure
 217. Table
 218. Figure
 219. Table
 220. Figure
 221. Table
 222. Figure
 223. Table
 224. Figure
 225. Table
 226. Figure
 227. Table
 228. Figure
 229. Table
 230. Figure
 231. Table
 232. Figure
 233. Table
 234. Figure
 235. Table
 236. Figure
 237. Table
 238. Figure
 239. Table
 240. Figure
 241. Table
 242. Figure
 243. Table
 244. Figure
 245. Table
 246. Figure
 247. Table
 248. Figure
 249. Table
 250. Figure
 251. Table
 252. Figure
 253. Table
 254. Figure
 255. Table
 256. Figure
 257. Table
 258. Figure
 259. Table
 260. Figure
 261. Table
 262. Figure
 263



The first step in the construction of the n -th order approximation is to find the n -th order approximation to the function $f(x)$. This is done by finding the n -th order Taylor polynomial of $f(x)$ at the point a . The n -th order Taylor polynomial of $f(x)$ at the point a is given by

$$T_n(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \dots + \frac{f^{(n)}(a)}{n!}(x-a)^n$$

The second step in the construction of the n -th order approximation is to find the n -th order approximation to the function $f(x)$. This is done by finding the n -th order Taylor polynomial of $f(x)$ at the point a . The n -th order Taylor polynomial of $f(x)$ at the point a is given by

$$T_n(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \dots + \frac{f^{(n)}(a)}{n!}(x-a)^n$$

The third step in the construction of the n -th order approximation is to find the n -th order approximation to the function $f(x)$. This is done by finding the n -th order Taylor polynomial of $f(x)$ at the point a . The n -th order Taylor polynomial of $f(x)$ at the point a is given by

$$T_n(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \dots + \frac{f^{(n)}(a)}{n!}(x-a)^n$$

The fourth step in the construction of the n -th order approximation is to find the n -th order approximation to the function $f(x)$. This is done by finding the n -th order Taylor polynomial of $f(x)$ at the point a . The n -th order Taylor polynomial of $f(x)$ at the point a is given by

$$T_n(x) = f(a) + f'(a)(x-a) + \frac{f''(a)}{2!}(x-a)^2 + \dots + \frac{f^{(n)}(a)}{n!}(x-a)^n$$

(10)

The fifth step in the construction of the n -th order approximation is to find the n -th order approximation to the function $f(x)$. This is done by finding the n -th order Taylor polynomial of $f(x)$ at the point a . The n -th order Taylor polynomial of $f(x)$ at the point a is given by

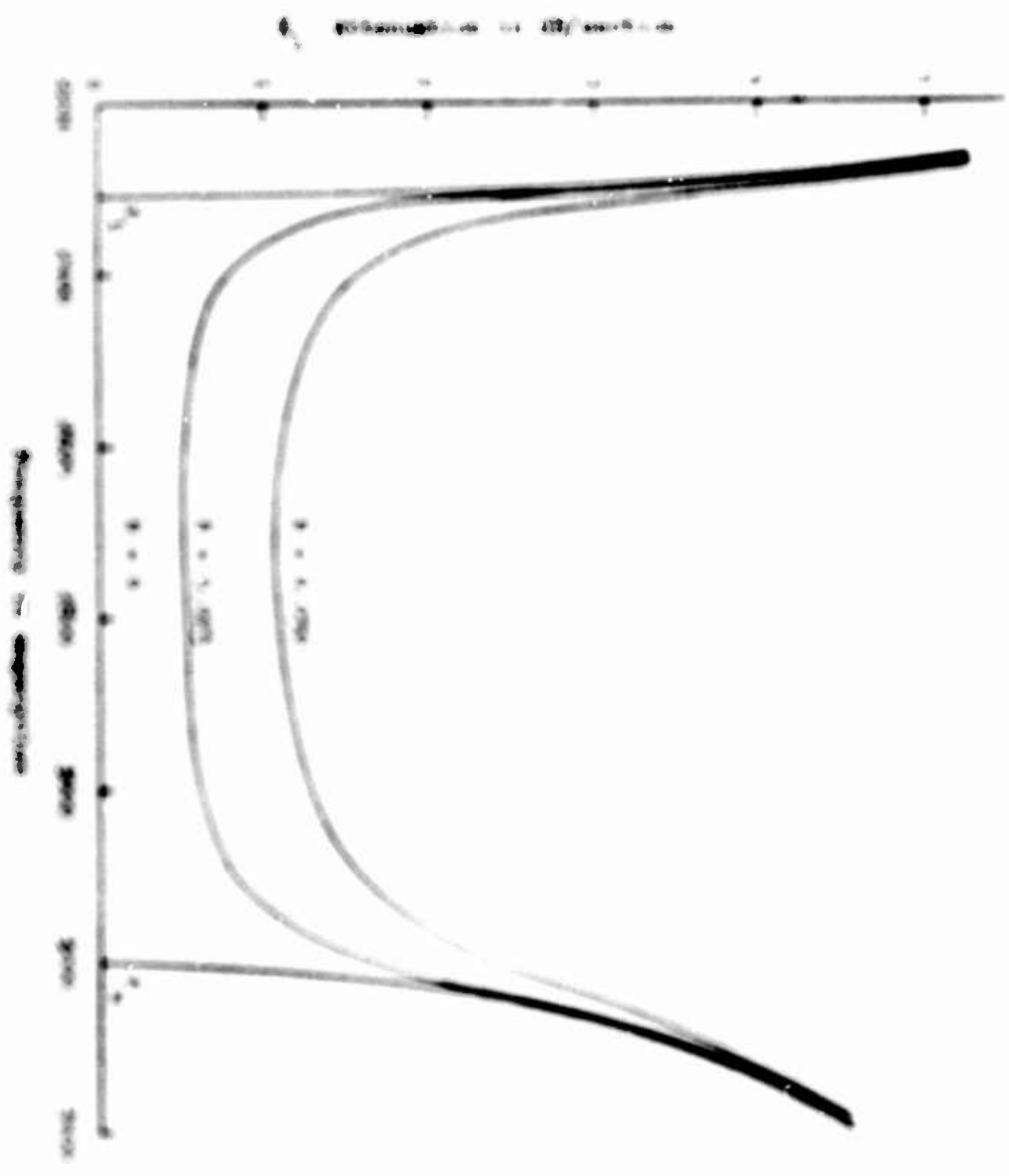


Fig. 2. Dependence of the equilibrium constant K on the parameter α for different values of β .

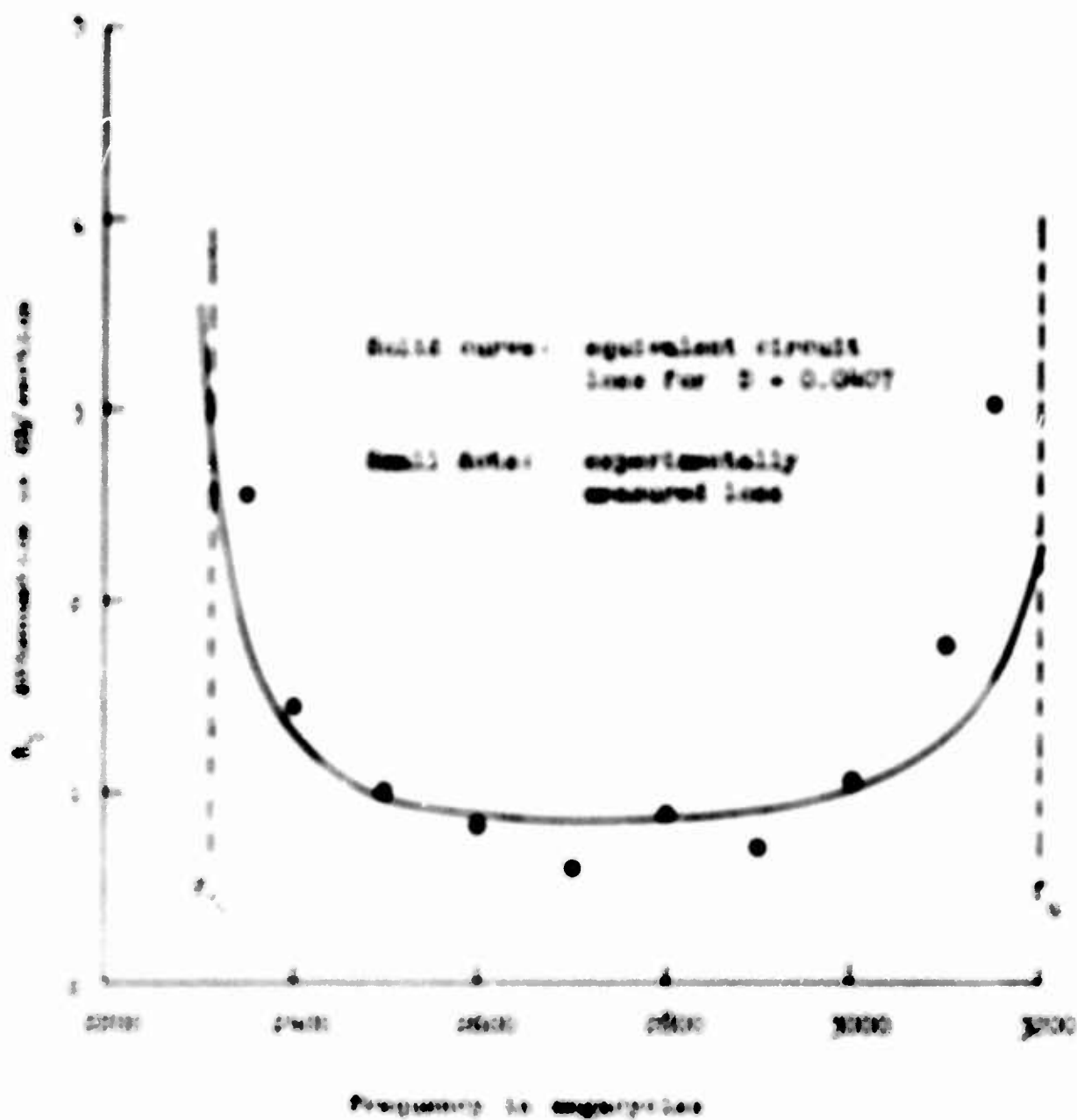


FIG. 1. Comparison of equivalent circuit loss with experimental data.

define

$$X = 20 \log_{10} e^{\frac{1}{2}} \quad \text{dB/section} \quad . \quad (28)$$

The approximate equations yield good accuracy for $X \leq 2.5$ dB/section

The above equations have been used to calculate circuit loss for several values of D . The constants have been chosen to match the fundamental and loop band dispersion of the centipede structure which has been studied experimentally. These constants are

$$\begin{aligned} f_a &= 3.200 \text{ Gc} \\ f_b &= 4.461 \text{ Gc} \\ k &= 0.3266 \end{aligned}$$

The frequency cutoffs of the fundamental passband are

$$\begin{aligned} f_L &= 2.310 \text{ Gc} \\ f_u &= 3.200 \text{ Gc} \end{aligned}$$

Figure 3 shows the results of the loss calculations for $D = 0$, 0.025 and 0.040. It has been possible to show that if $D = 0.0407$, the calculated loss of the equivalent circuit is in good agreement with the experimentally measured loss of the centipede. Figure 4 compares this calculation with the experimental data.

Work is continuing on a small-signal theory for the centipede which includes the effect of two circuit waves and two beam waves. Circuit loss is included in this theory in the manner described in this report. Thus far, a computer program has been written to calculate the propagation

constants of the four waves produced by the beam-circuit coupling. Another program is being devised to calculate amplitude and phase in each centipede cavity. A complete report on both the experimental and the theoretical work of this project is being written and will be available later.

2. EXTENDED-INTERACTION KLYSTRONS

(M. Chodorow,* B. Kulke)

A. INTRODUCTION

The primary purpose of this project is to investigate the maximum gain-bandwidth product and conversion efficiency which can be achieved in an extended-interaction klystron, with cavities consisting of resonated sections of a slow-wave structure. The current phase of this work is the evaluation, by means of the electron stick, of a three-cavity L-band tube. In this device, broadband modulation of the electron beam is simulated with input and intermediate cavities containing tunable resonated sections of a ring-bar structure. The length of the output cavity can be changed, in half-wavelength increments, from one to five resonant half-wavelengths of its component ring-bar structure, and the loading can be adjusted by changing the terminal conditions on the couplers attached to both ends of the output resonator.

The tube is better suited for beam-testing on the electron stick than the earlier S-band model, because the L-band device has higher interaction impedance on the beam axis and can operate at lower beam voltages, thus facilitating the suppression of parasitic oscillations on the electron stick. Beam tests of the L-band tube are in progress.

B. STABILITY CONSIDERATIONS

In Quarterly Report No. 9 (M. L. Report No. 1143), a new method was described by which one would suppress parasitic oscillations on the electron stick by covering the entire stick with a thin sheet of directionally resistive mylar. This approach has been quite satisfactory in that no stick oscillations were observed up to 30 kV, the highest beam voltage of interest. Tests at higher beam voltages will not be done until after completion of the main experiment, since, in case of breakdown, the resistive film is liable to destruction due to arcing from the glass tube. During trial

* Project supervisor.

Table

of the various measurements made on the various samples

Sample	Sample 1		Sample 2	
	Mean	Std. Dev.	Mean	Std. Dev.
Sample 1	1.0	0.1	1.0	0.1
Sample 2	1.0	0.1	1.0	0.1

The data were obtained from the various samples and the results are given in the table. The data show that the mean values for the two samples are 1.0 and 1.0, and the standard deviations are 0.1 and 0.1. The data are given in the table.

1. Description of the samples

The data were obtained from the various samples and the results are given in the table. The data show that the mean values for the two samples are 1.0 and 1.0, and the standard deviations are 0.1 and 0.1. The data are given in the table.

Figure 1

Figure 1

[illegible][illegible]

100

$\left[\begin{array}{ccc} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array} \right] \cdot \left[\begin{array}{ccc} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array} \right] = \left[\begin{array}{ccc} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{array} \right]$

10/10/10

1. The first part of the problem is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
2. The second part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
3. The third part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
4. The fourth part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
5. The fifth part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
6. The sixth part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
7. The seventh part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
8. The eighth part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
9. The ninth part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.
10. The tenth part is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.

The first part of the problem is to find the value of α such that the function $f(x) = \alpha x^2 + (1-\alpha)x + 1$ is a probability density function. This means that $f(x) \geq 0$ for all x and $\int_{-\infty}^{\infty} f(x) dx = 1$.

$$\int_{-\infty}^{\infty} f(x) dx = \int_{-\infty}^{\infty} (\alpha x^2 + (1-\alpha)x + 1) dx = 1$$

and for $\alpha = 1$

$$f(x) = x^2 + 1$$

Source: <http://www.irs.gov/efile/efiletrans.htm>. © 2009 by The McGraw-Hill Companies, Inc.

2004

Downloaded from <http://www.jstor.org/stable/2346127> on Tue, 20 Jun 2017 12:02:06 UTC

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

© 2011 Blackwell Publishing Ltd *Journal of Internal Medicine* 270: 391–400 395

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

3. 1)

1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 2453 2454 2455 2456 2457 2458 2459 2460 2461 2462 2463 2464 2465 2466 2467 2468 2469 2470 2471 2472 2473 2474 2475 2476 2477 2478 2479 2480 2481 2482 2483 2484 2485 2486 2487 2488 2489 2490 2491 2492 2493 2494 2495 2496 2497 2498 2499 2500 2501 2502 2503 2504 2505 2506 2507 2508 2509 2510 2511 2512 2513 2514 2515 2516 2517 2518 2519 2520 2521 2522 2523 2524 2525 2526 2527 2528 2529 2530 2531 2532 2533 2534 2535 2536 2537 2538 2539 2540 2541 2542 2543 2544 2545 2546 2547 2548 2549 2550 2551 2552 2553 2554 2555 2556 2557 2558 2559 2560 2561 2562 2563 2564 2565 2566 2567 2568 2569 2570 2571 2572 2573 2574 2575 2576 2577 2578 2579 2580 2581 2582 2583 2584 2585 2586 2587 2588 2589 2590 2591 2592 2593 2594 2595 2596 2597 2598 2599 2600 2601 2602 2603 2604 2605 2606 2607 2608 2609 2610 2611 2612 2613 2614 2615 2616 2617 2618 2619 2620 2621 2622 2623 2624 2625 2626 2627 2628 2629 2630 2631 2632 2633 2634 2635 2636 2637 2638 2639 2640 2641 2642 2643 2644 2645 2646 2647 2648 2649 2650 2651 2652 2653 2654 2655 2656 2657 2658 2659 2660 2661 2662 2663 2664 2665 2666 2667 2668 2669 2670 2671 2672 2673 2674 2675 2676 2677 2678 2679 2680 2681 2682 2683 2684 2685 2686 2687 2688 2689 2690 2691 2692 2693 2694 2695 2696 2697 2698 2699 2700 2701 2702 2703 2704 2705 2706 2707 2708 2709 2710 2711 2712 2713 2714 2715 2716 2717 2718 2719 2720 2721 2722 2723 2724 2725 2726 2727 2728 2729 2730 2731 2732 2733 2734 2735 2736 2737 2738 2739 2740 2741 2742 2743 2744 2745 2746 2747 2748 2749 2750 2751 2752 2753 2754 2755 2756 2757 2758 2759 2760 2761 2762 2763 2764 2765 2766 2767 2768 2769 2770 2771 2772 2773 2774 2775 2776 2777 2778 2779 2780 2781 2782 2783 2784 2785 2786 2787 2788 2789 2790 2791 2792 2793 2794 2795 2796 2797 2798 2799 2800 2801 2802 2803 2804 2805 2806 2807 2808

10

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains. The concentration of the *Agrobacterium* suspension was 10⁶ cells/ml (a), 10⁷ cells/ml (b), 10⁸ cells/ml (c), and 10⁹ cells/ml (d). The concentration of the *Agrobacterium* suspension was 10⁶ cells/ml (a), 10⁷ cells/ml (b), 10⁸ cells/ml (c), and 10⁹ cells/ml (d). The concentration of the *Agrobacterium* suspension was 10⁶ cells/ml (a), 10⁷ cells/ml (b), 10⁸ cells/ml (c), and 10⁹ cells/ml (d).

1. *Chlorophyll a* (Chl *a*) 2. *Chlorophyll b* (Chl *b*) 3. *Carotenoids* (Car) 4. *Phaeophytin a* (Phe *a*) 5. *Phaeophytin b* (Phe *b*) 6. *Phaeo-pigments* (Phe)

[illegible][illegible]

— — — — —

Abstract

1000

[Illegible text]

— — — — —

1. SUMMARY OF WORK DONE

2. / Date: 1 8 October 1964

3. INTRODUCTION

The objective of this project is to investigate the properties of an acoustic surface wave transducer in order to improve their conversion efficiency and bandwidth. The efficient conversion of RF energy to acoustic energy is necessary to enhance the usefulness of acoustic delay lines, surface wave devices and related devices using elastic waves in solids. The immediate objective is to improve the transducers by evaluating both the piezoelectric and magnetostrictive types, and to improve the coupling from the transducer to the operational solid transmission line by using appropriate acoustic impedance matching techniques. To accomplish the above objectives, thin evaporated films of oxide and dielectric are required for both the impedance transformers and transducers.

4. THEORY

A number of thin films have been evaporated in this laboratory in the past for a variety of purposes and, in fact, on this occasion, equipment has been modified and equipped to evaporate films for our purposes here and to measure the coupling efficiency of these transducers. A typical single film transducer with a resonator and delay line for operation at 240 MHz is shown in Fig. 1. The immediate objective is to improve this type of transducer by the use of multilayer films between the stack and the delay line to afford the proper acoustic impedance matching. The method is similar to that used for optical impedance matching using films of quarter-wave thickness of alternating high and low refractive indices.

The equipment for the evaporation of single layer oxide films is in operation, and several oxide films have been evaporated. An electron gun is used in this equipment. Procedures for use with dielectric materials are being designed. The facility for evaluating the completed transducer,

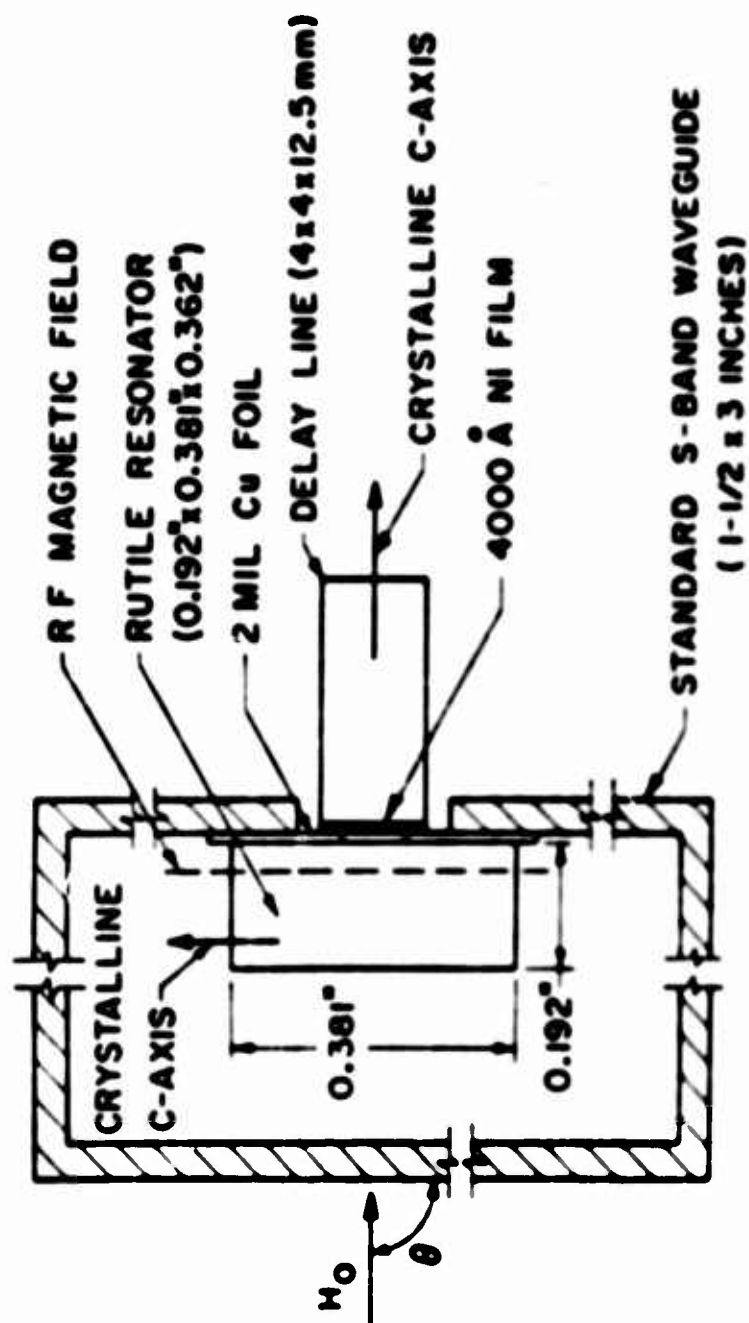


FIG. 1—Resonator and delay line (not to scale).

similar to that in Fig. 1, including the rf equipment, is also operational. This is the first report on this project and no definitive results have yet been obtained. Subsequent reports will give more detailed results of analysis and experiment.

1-61 101-2

1. ORIGINATING ACTIVITY: Enter the name and address of the organization, government, private, Department of the Army, Navy, Air Force, etc., responsible for the report.

2. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Declassified Here" is included. Marking is to be in accord with appropriate security regulations.

3. GROUP: Assignments designating is specified in (a) DoD Directive 1,234,56 and Armed Forces Industrial Manual. Enter the group number. Also, enter applicable other that regional markings have been used for Group 1 and Group 2 as authorized.

4. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be collected without classification, then title classification in all capitals to parentheses immediately following the title.

5. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

6. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

7. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

8. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

9. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

10. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

11. a, b, & c. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, outproject number, system number, code number, etc.

12. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

13. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by the sponsor), also enter this number(s).

14. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those

imposed by security classification, using standard statements such as:

- (1) "Qualified requesters may obtain copies of this report from DDC."
- (2) "Foreign dissemination and dissemination of this report by DDC is not authorized."
- (3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through..."
- (4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through..."
- (5) "All distributors of this report to controlled. Qualified DDC users shall request through..."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

15. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

16. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

17. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as (PS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

18. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical content. The assignment of links, rules, and weights is optional.

General description of the work of the laboratory during the period covered by this report, including a brief statement of the objectives of the work and a summary of the results obtained.

At National Laboratories of Physics

Research Laboratory

Chandigarh, India

Report No. 100

INTERDISCIPLINARY RESEARCH PROGRAM

1. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

2. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

3. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

4. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

5. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

6. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

7. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

8. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

9. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

10. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

11. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

12. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

13. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

14. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

Qualified requesters may obtain copies of this report from DR.

Release to DTIC is authorized.

15. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

16. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

17. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

18. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

19. **RESEARCH WORK** - A summary of the work done during the period covered by this report.

1. CENTRIFUGALITY

The centrifuge circuit has been adapted for use on the electron stick in such a manner that the amplitude and phase of the growing wave along the beam-circuit interaction length can be measured. The results of this study will be of utmost value in optimizing the many parameters affecting the beam-circuit interaction. Current results of theory and experiment are presented.

2. EXTENDED-INTERACTION KLYSTRONS

Tests on the electron stick for the suppression of parasitic oscillations have been conducted. By covering the entire stick with a thin sheet of directionally resistive mylar, oscillations were removed, up to 30 kW. Two other sources of instability have been found and removed: feedback oscillations and monotron oscillations. Work on calibration of external load and saturated-beam measurements is described.

3. TRANSVERSE-WAVE STUDIES

Studies on space-charge in an accelerated parallel-flow electron beam in a constant magnetic field have continued. The major emphasis this period has been on the analysis of the second-order differential system; a discussion of the solutions for certain conditions is presented.

4. BEAM-PLASMA STUDIES

Particulars of work on this are given, which includes an account of various
experiments conducted under the microscope, to determine

1. GENERAL PRINCIPLES

The object of this work is to investigate the properties of various
materials and to determine the effect of temperature, pressure and
other factors on the rate of reaction.