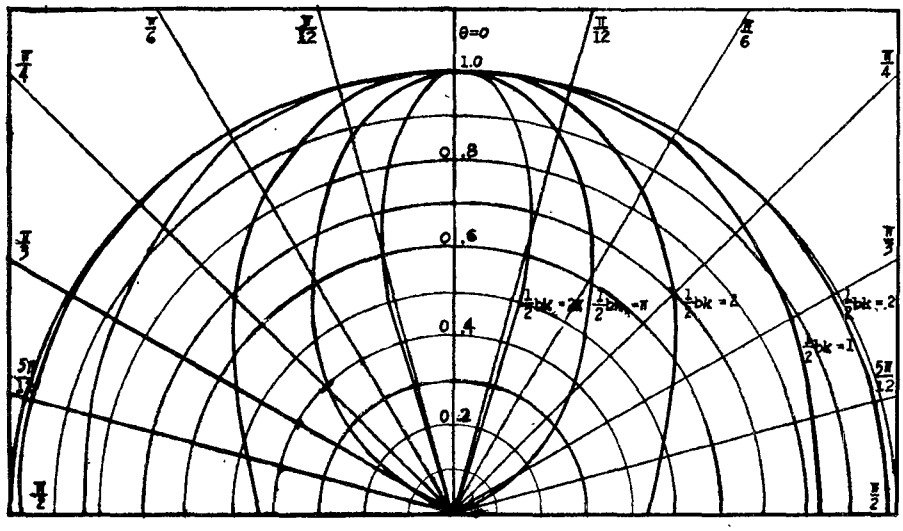

Fig. 2. Electric field pattern E_θ in the E plane ($\phi=\pi/2$) for $\alpha/\beta=1$.

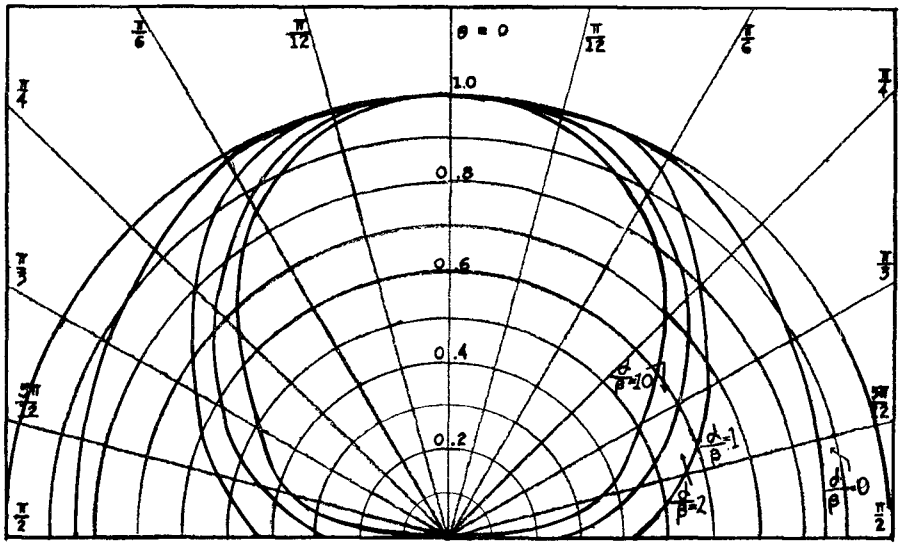

Fig. 3. Electric field pattern E_θ in the E plane ($\phi=\pi/2$) for $(\frac{1}{2})bk=1$.

scribed. The result for region III has the same general form as shown in (9) for the radiation pattern [9].

The total radiation pattern of E_θ in the E plane ($\phi=\pi/2$) from the three regions is of the general form

$$F(\theta)=\frac{\sin(\frac{1}{2}bk\sin\theta)}{\sin\theta}(\alpha\cos\theta+\beta) \quad (10)$$

Figure 2 shows the corresponding radiation patterns for various values of $(1/2)bk$ for the case $\alpha/\beta=1$. Figure 3 shows the corresponding radiation patterns for various values of α/β for the case $(1/2)bk=1$. The radiation patterns are normalized in all cases. The values of α/β depend on the waveguide configuration and the applied static magnetic fields in magnitude and direction.

It has been shown experimentally by Angelakos and Korman [10], and theoretically by Tyras and Held [1], that by changing the static magnetic field in a waveguide filled with ferrite, a scanning of the radiation pattern is obtained in the H plane. A similar scanning should be obtained if one calculates the radiation pattern from (8) for two or more modes of propagation. However, under the present system, more control is given on the radiation pattern from the design point of view (δ_1 *and* δ_2) and from the possibilities of changing the static magnetic fields (H_1 *and* H_2). Additional study of the present system is under way.

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Microwave and High-Frequency Calibration Services of the National Bureau of Standards—Part IV

Introduction

This is the fourth of a series of presentations on microwave and high-frequency calibration services of the National Bureau of Standards which began in the July 1964 issue of these Transactions. (See the July issue for a more complete introduction.) Included in this issue are the services for voltage, frequency stability, and cavity wavemeter calibrations. This completes the listing of presently available microwave and high-frequency calibration services of NBS. It is expected that the announcement of additional calibration services will be published in a similar manner in the Transactions as they become available. As in previous installments, following the listing of calibration services is a series of charts (Figs. 1 and 2) indicating the magnitudes of quantities, the frequency range, and the overall estimated accuracy of the calibrations performed.

Microwave Region

201.930 *Frequency measurements on cavity wavemeters*

Frequency measurements are made on fixed or variable cavity wavemeters of either the reaction (one-port) type or the transmission (two-port) type. Frequency measurements are made on cavity wavemeters

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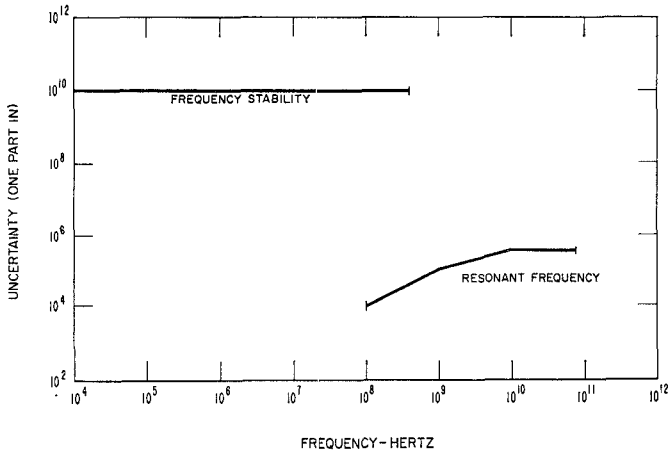

Fig. 1. Microwave and high-frequency calibrations (rectangulra waveguide and coaxial).

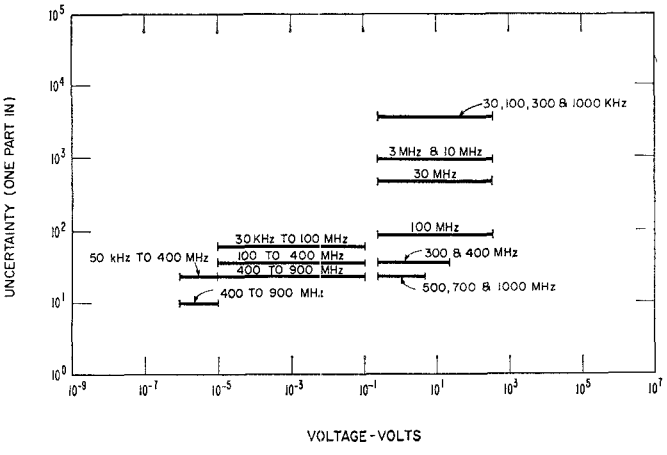

Fig. 2. High-frequency voltage calibrations (coaxial).

having coaxial terminals with Type *N* connectors (male or female) in the frequency range 100 MHz to 10 GHz, and on cavity wavemeters having standard rectangular waveguide terminals in the frequency range 2.6 to 75 GHz.

Item	Description
201.930a	Measurement of resonant frequency of fixed cavity wavemeter.
201.930b	Setting of adjustable cavity wavemeter at prescribed resonant frequency.
201.930c-1	Calibration of dial setting vs resonant frequency of variable cavity wavemeter at initial prescribed frequency.
201.930c-2	Calibration of dial setting vs resonant frequency of variable cavity wavemeter at each prescribed frequency additional to the initial frequency and on the same wavemeter as 201.930c-1.
201.930z	Special calibrations not covered by the above schedule.

High-Frequency Region

201.860 *Frequency stability calibration of signal sources*

Frequency stability calibrations are made on signal sources in the frequency range 30 kHz to 500 MHz. The signal source should have a power output of at least 10 mW (into a matched load). The frequency stability of the signal source should be better than approximately one part in 10^7.

Item	Description
201.860	Measurement of frequency stability of signal sources from 30 kHz to 500 MHz.

201.810 *Thermal converters, RF-dc voltmeters and RF voltmeters*

Ordinarily, instruments which are equally suitable for dc and RF use are calibrated only for RF-dc difference by the procedure of item 201.810a since periodic calibrations can be made by the user with a calibrated dc instrument. Such dc calibrations will be made at NBS only under unusual circumstances and by advance arrangement. Instruments suitable for RF use only are given RF calibrations by the procedures of items 201.810a and 201.810b. Instruments which respond to average or peak values, or which are not in *ASA accuracy class* $\frac{1}{4}$ *per cent* or better, usually are not accepted for calibration below 30 MHz.

Item	Description
201.810a	Determination of voltage at 30, 100, 300 kHz; 1, 3, 10, 30, and 100 MHz from 0.2 to 300 V.
201.810b	Determination of voltage at 300 and 400 MHz from 0.2 to 20 V, and at 500, 700, and 1000 MHz from 0.2 to 7 V.
201.810z	Special calibrations not covered by the above schedule.

201.811 *Radio-frequency voltmeters and signal sources*

Normally, NBS accepts for calibration only high-quality voltmeters suitable for use as interlaboratory standards. These instruments should have a stability of one per cent or better, and an accuracy of three per cent or better. Voltmeters are calibrated by the procedures of item 201.811a and 201.811b. NBS usually accepts only signal sources (signal generators) of sufficiently high quality to be considered as interlaboratory standards. If these instruments are equally suitable for dc and RF use, they are calibrated for RF-dc difference by the procedures of item 201.811a, 201.811b, and 201.811c. Signal sources suitable for RF use only are calibrated by the procedures of items 201.811a and 201.811c.

Item	Description
201.811a	Determination of voltage for voltmeters and of RF micropotentiometers and signal sources from 30 kHz to 400 MHz, from 1 μV to 0.1 V.
201.811b	Determination of voltage for voltmeters from 400 to 1000 MHz, from 100 μV to 0.1 V.
201.811c	Determination of voltage of RF micropotentiometers and signal sources from 30 kHz to 900 MHz, from 1 μV to 0.1 V.
201.811z	Special calibrations not covered by the above schedule.

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Comment on "Wave Propagation in Sinusoidally Stratified Dielectric Media"

Great interest has been evidenced in a recent paper by Tamir and his associates[1] with regard to the problems involved in solving the equations which govern wave propagation in a waveguide containing an inhomogeneous dielectric media with a sinusoidal variation of the permittivity in the logitudinal direction. In this communication, an alternative approach to the solution of the equations is presented in which the vector wave equation method, as described by Hansen [1] and Stratton [2], is followed. In conjunction with this approach, the Hertzian vector technique is employed in a particularly appealing and satisfying manner. The usefulness of the methodology described is more than adequately demonstrated.

Manuscript received July 30, 1964.

[1] Tamir, T., et al., *IEEE Trans. Microwave Theory and Techniques*, vol MTT-12, May 1964, pp 323–335.