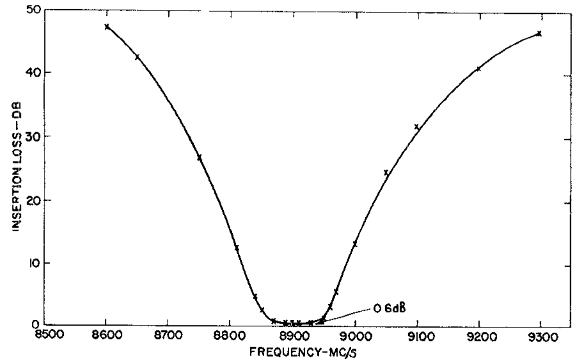

Fig. 4. Insertion loss vs. frequency response, conventional waveguide band-pass filter.

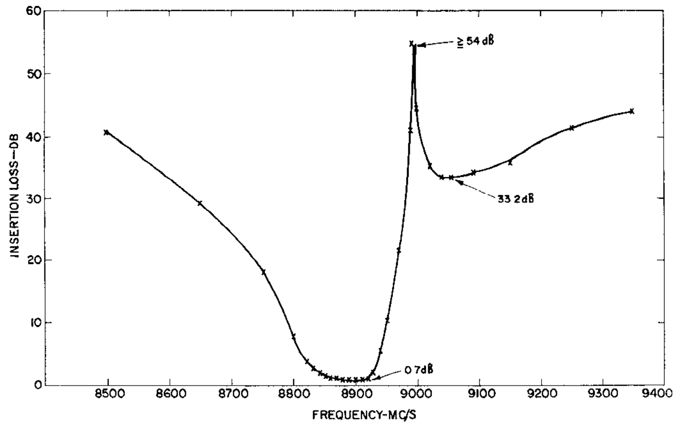

Fig. 5. Insertion loss vs. frequency response, general waveguide band-pass filter.

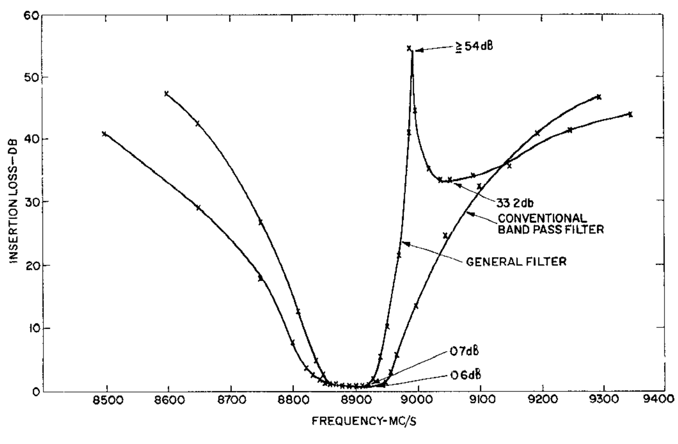

Fig. 6. Comparison of insertion loss vs. frequency responses.

$$f = f_0 + \left(\frac{\Delta f_{3\,\mathrm{dB}}}{2}\right)$$

$$X = 8900 + 1.72\left(\frac{100}{2}\right) = 8986\ \mathrm{Mc/s};$$

the measured frequency of peak rejection was 8995 Mc/s.

The theoretical insertion loss at the frequency of peak rejection is approximately equal to the sum of two components:

$$\mathrm{I.L.} = P + R, \tag{2}$$

$$P = 10 \log (1 + X^6), \tag{3}$$

$$R = 20 \log \left[\frac{1}{2K_{13}d_2}\right] \tag{4}$$

where

$$d_2 = \frac{Q_T}{Q_{UL}} = \text{normalized dissipation factor o}$$
second resonator.

Now

$$Q_T = \frac{f_0}{\Delta f_{3\,\mathrm{dB}}} = \frac{8900}{100} = 89.$$

Letting

$$Q_{UL} = \text{unloaded } Q \text{ of second resonator} = 4000,$$

$$d_2 = \frac{89}{4000} = 0.0222.$$

For $X = 1.72$, using (3), $P = 14.2$ dB. Letting $K_{13} = 0.291$, $d_2 = 0.0222$; using (4), $R = 37.8$ dB. Then $P+R = 52$ dB, which can be compared to a measured peak rejection of $\geqq 54$ dB.

The pass-band insertion loss of the general three-resonator waveguide filter can also be determined.

$$\mathrm{I.L.} \cong 10 \log [A_0^2 + A^2], \tag{5}$$

where

$$A_0 = d_1^2 d_2 + K_{13}^2 d_2 + 2K_{12}^2 d_1, \tag{6}$$

$$A = 2K_{12}^2 K_{13}. \tag{7}$$

Letting $d_1 = 1$, $d_2 = 0.0222$, $K_{12} = 0.707$, $K_{13} = 0.291$, $A_0^2 = 1.05$, and $A^2 = 0.085$. Then the pass-band insertion loss using (5) will be 0.6 dB, as compared to a measured pass-band insertion loss of 0.7 dB.

Reasonably good correlation between theory and experiment has been attained. The general three-resonator waveguide filter described herein is applicable to situations requiring asymmetrical selectivity. Possible areas of practical usage include diplexer filters and sideband selection filters.

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Peak-Pulse Power Calibrations Initiated

The Radio Standards Laboratory at Boulder, Colorado, has inaugurated a new service for the calibration of coaxial RF peak-pulse power meters. This service is available for a frequency band of 950 to 1200 MHz and a peak-power range of 1 mW to 3 kW. Calibrations are performed at pulse widths of 2 to 10 μs and repetition rates of 100 to 1600 pps, with a maximum duty cycle of 0.0033 due to generator limitations.

The calibration system shown in Fig. 1 makes use of a sampling-comparison method. This method[1] employs a specially-constructed diode switch to extract a sample of

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[1] P. A. Hudson, W. L. Ecklund, and R. A. Ondrejka, "Measurement of RF peak-pulse power by a sampling-comparison method," *IRE Trans. on Instrumentation*, vol. I–II, pp. 280–284, December, 1962.

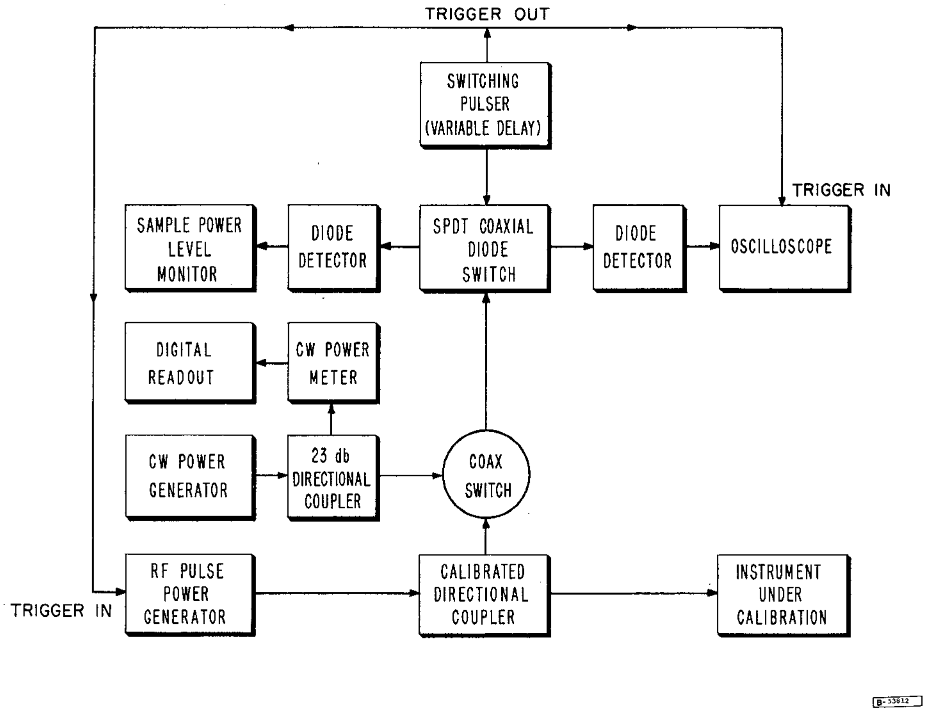

Fig. 1. Block diagram of sampling comparison method used in making RF peak-pulse power calibrations. Equal samples of pulsed RF power and CW power are intercompared and the peak pulse power computed by an accurate measurement of the CW signal.

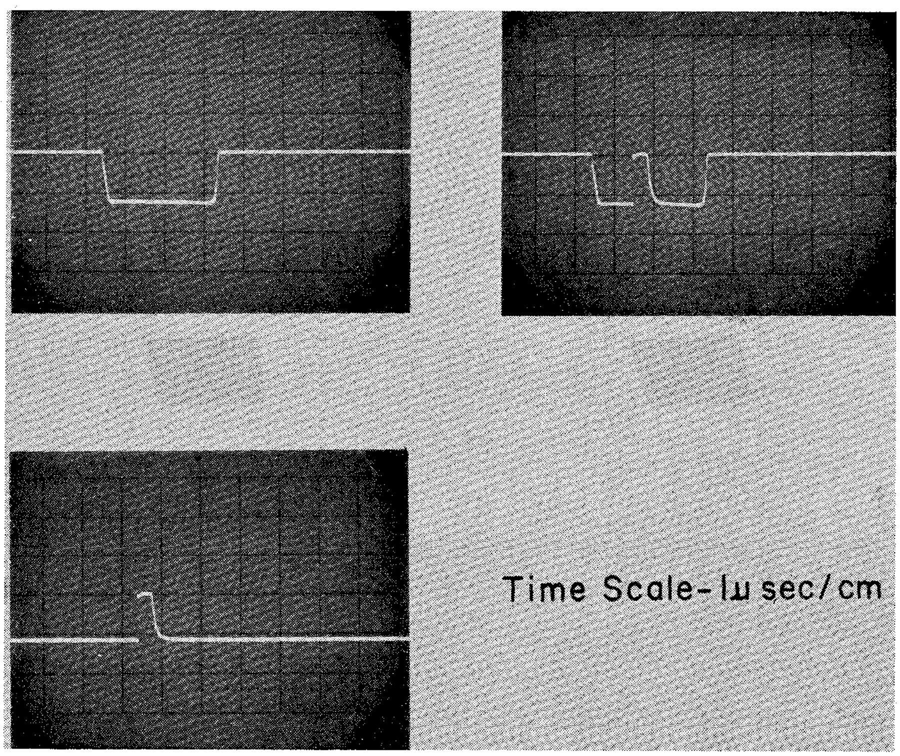

Fig. 2. Typical waveforms observed on oscilloscope when connected to normally closed arm of the coaxial diode switch. (a) Envelope of unsampled RF pulse. (b) Envelope of sampled RF pulse. (c) Envelope of sampled CW signal.

power from an RF pulse for measurement. The switch is also used to obtain a similar sample from a CW signal whose power can be accurately measured. By adjusting the CW level to obtain similar readings (as shown in Fig. 2) for the pulse and CW samples on a level monitor, the peak-pulse power can be determined.

While the range of the basic system is limited to 0.1 to 1.2 watts by the power handling capability of the diode switch, higher or lower powers can be measured by means of calibrated directional couplers.

The performance of the calibration console was checked by comparing it against the peak-pulse power standard maintained by the High Frequency Electrical Standards Section. Since the calibration of the directional couplers is a possible additional source of error, intercomparisons of the two systems were first made over the power range of 0.1 to 1.2 watts without these couplers, then at higher power levels with the couplers. The results show no significant difference between the two standards and both, therefore, have the same degree of uncertainty, ± 3 percent. This is based on an estimate of 2 percent for the basic system which includes the measurement of the CW power, and an additional 1 percent for the calibration of the directional couplers.

It is planned to expand this calibration service to include additional frequency bands and higher power levels. Also, new type diode switches, which promise to give improved accuracy to the basic system, are under development at the Radio Standards Laboratory. It is hoped the uncertainty of measurement can be reduced to 1 percent or better.

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On the Impedance of a Finite Slot

It is well known that in boundary value problems which involve slots or apertures the analysis becomes easier when the assumption of infinitesmally narrow slots can be made. Doing so however, will usually result in divergent expressions for slot impedance and current across the slot. One ordinarily gets around this by stating that, since in a real or physical problem the slot width must be finite, the impedance of such a slot can be obtained by summing the first few terms of the infinitesimal slot series and throwing away the divergent part. It is the purpose of this correspondence to show that the impedance of a finite, but narrow slot can be reasonably approximated by the first N terms of the infinitesimal slot series

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