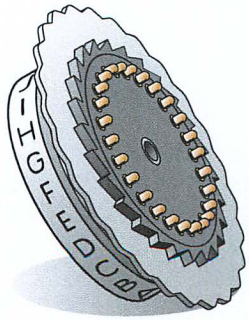
EC Mark III

Easy Chair Extended Range
Progress Report No. 2

1 July 1957

Project Easy Chair



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Project Easy Chair Extended Range. 1st July 1957

Progress Report No. 2 Typed in twofold

Ex.No. 2 Page 1

Summary. This report contains a description of the test bench set up for the comparison of various systems and/or components and the evaluation os system parameters involved in the research for Extended Range Systems.
Some results are given.
The construction of a variable frequency system has been started; the characteristics of a few components for this system are mentioned.

1. In view of the desirability to compare with a high order of repeatability the performance of various systems (including those of the cavity type), to test components and to evaluate the influence of change of system parameters, a laboratory test bench set up has been arranged. The lay-out of the arrangement is clearly shown in Fig. 1. The duplexer and high power attenuator simulate the effect of the antenna arrangement and of the propagation. As can be seen from a vector diagram the process of synchronous mixing is unchanged. The values in brackets in Fig. 1 are the reference values at the initial adjustment of the test bench.
Relative measurements were taken on the crystal modulator with associated transistorized amplifier of the level of the modulated component of the reflected power as a function of the power fed into the device. This relationship is given in Fig. 2.
These measurements were taken with two transistorized amplifiers labeled Nrs. 4 and 5. In the diagram the origin denotes the conditions if the test bench is adjusted to its reference values. These compare with an actual set up using the same Easy Chair components and two 12dB antennas for a range of 100 meters. From this diagram the following conclusions were drawn:

1.1. Improvement of the receiver sensitivity of the Easy Chair equipment EC-01 will only lead to a slight increase in range. Only when the transmitter power is increased several orders of magnitude, an increase of receiver sensitivity becomes a sensible proposition in view of the extension of the range. It will be understood that apart from this an increase of signal to noise ratio will result in an improvement of the intelligibility. In this respect it may be mentioned that the first experiments with the proposed relaxation oscillator (see 3.1 of Progress Report No. 1) have given reassuring results. Measurements have been made under static conditions however, and therefore it was difficult to gather sufficient coherent information.

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Before further work along this line can proceed effectively an instantaneous frequency meter will have to be available to indicate at once and simultaneously mean frequency, frequency sweep width, sweep linearity and amplitude modulation.
Ultimate precision is not required for this sort of instrument, of more importance being its usability as a fast data-gathering tool. A design for such an instrument has been worked out and construction of a laboratory model is starting soon.

1.2. Increase of transmitter power will generally result in extension of range. However no appreciable further increase in range can be expected for transmitter powers exceeding 3kW, when use is made of two 12dB antennas. The range to be expected at this power level is 300 meters, whereby a reasonable intelligibility is still guaranteed.

1.3. Due to the steep slope of the curve for power levels below 1mW an increase of approx. 7dB in signal level can be expected keeping the range constant if the two-antenna system is exchanged for a duplexer with proper coupling between the antenna and the receiving branch and a single antenna of the same size as the two original antennas together.

1.4. For an arrangement with a 15dB antenna connected to the transmitter and a 12dB antenna connected to the receiver the range can be increased to 150 meters using ECO1 equipment.

1.5. When using a battery energized transistorised amplifier a reduction of the transmitter power of 12dB (resulting in an actual transmitter power of 1W) can be allowed for the same range.

Further investigations, using the test bench set up, are under consideration, the main items being the performance of the cavity type system, of a crystal modulator with associated transistorised amplifier using more stages of amplification and of the frequency shift system mentioned in Progress Report No. 1 under 3.1.

2. One of the conclusions of Progress Report No. 1 was that no spectacular increase in range can be achieved by choice of another frequency, except when the number of barriers is very small and their dimensions, nature and condition are known exactly. An important increase in range however can be expected if the reflections from objects in or near the transmission path are used in an efficient way. Full advantage of this effect can only be established if the frequency can be adjusted continuously. Preliminary trials at low power have indicated large variations of signal level at the receiving end if the transmitter frequency is varied. It will be understood that the chance to hit the right frequency by sheer luck is very remote.

For this "Interference Transmission System" the following components are needed:

2.1. A variable frequency CW-transmitter with single knob tuning,
2.2. A broad band high gain antenna,
2.3. A broad band receiver detector,
2.4. A broad band duplexer.

In view of these requirements research and development has been started of appropriate broad band components. In this respect a receiver detector and a duplexer, consisting of a high directivity coaxial directional coupler, a non-microphonic coaxial tuner without sliding contacts and a 4-Watt load have been developed. The characteristics of these items are given respectively in Figs. 3, 4, 5 and 6.
Although these components are designed for a centre frequency of 375 Mc/s, the same technique can be applied for other frequencies as well.
However, as far as the transmitter and antenna are concerned, the ultimate choice of frequency is of decisive influence on their general design and construction.
Therefore the necessity arises to agree upon the ultimate choice of frequency band. Before selecting this frequency band it seems necessary to have the reaction of the contracting group on the general lines of the research as outlined in Progress Report No. 1. With special reference to par.2.4. of the latter report the laboratory would like to know at the earliest possible convenience whether the proposed new system will have to be designed for the penetration of a small or a large number of barriers and - if possible - some information on the nature of the barriers.

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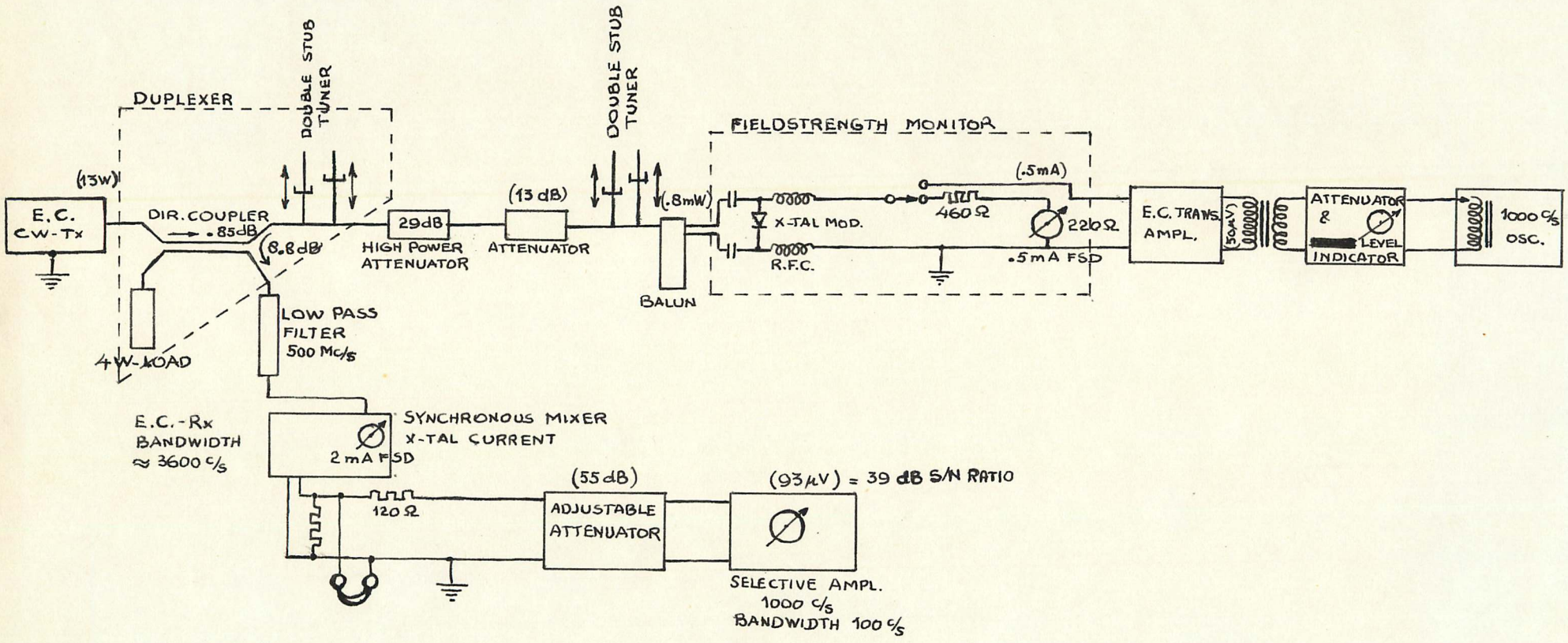

FIG.1 TEST BENCH SET UP

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RELATIVE LEVEL OF THE MODULATED COMPONENT OF THE REFLECTED POWER

+10 dB
+8
+6
+4
+2
-2
-4
-6
-8
-10
-12
-20
-30
-40
-50
-60

-20 -18 -16 -14 -12 -10 -8 -6 -4 -2 +2 +4 +6 +8 +10 +12 +14 +16 +18 +20

RELATIVE POWER LEVEL AT P.E. IN DB

SLOPE FOR BATTERY DRIVEN AND CAVITY-TYPE P.E.'S.

CRYSTAL MODULATOR WITH TRANSISTORIZED AMPL. Nº 4
" " " " " " Nº 5

0.84 mW

0.22 0.30 0.39 0.50 0.55 0.66

POWER LEVEL AT P.E. AS INDICATED ON FIELD STRENGTH MONITOR (mA)

NOISE LEVEL FOR NORMAL SET UP

≈ 500 μV DIRECTLY ON CRYSTAL MODULATOR

NOISE LEVEL FOR "LOW NOISE LEVEL" SET UP

FIG. 2

NAME	TITLE	DWG. NO.
SMITH CHART Form 756-N	CRYSTAL HOLDER GENERAL RADIO COMPANY, CAMBRIDGE, MASSACHUSETTS	FIG. 3. DATE

IMPEDANCE OR ADMITTANCE COORDINATES

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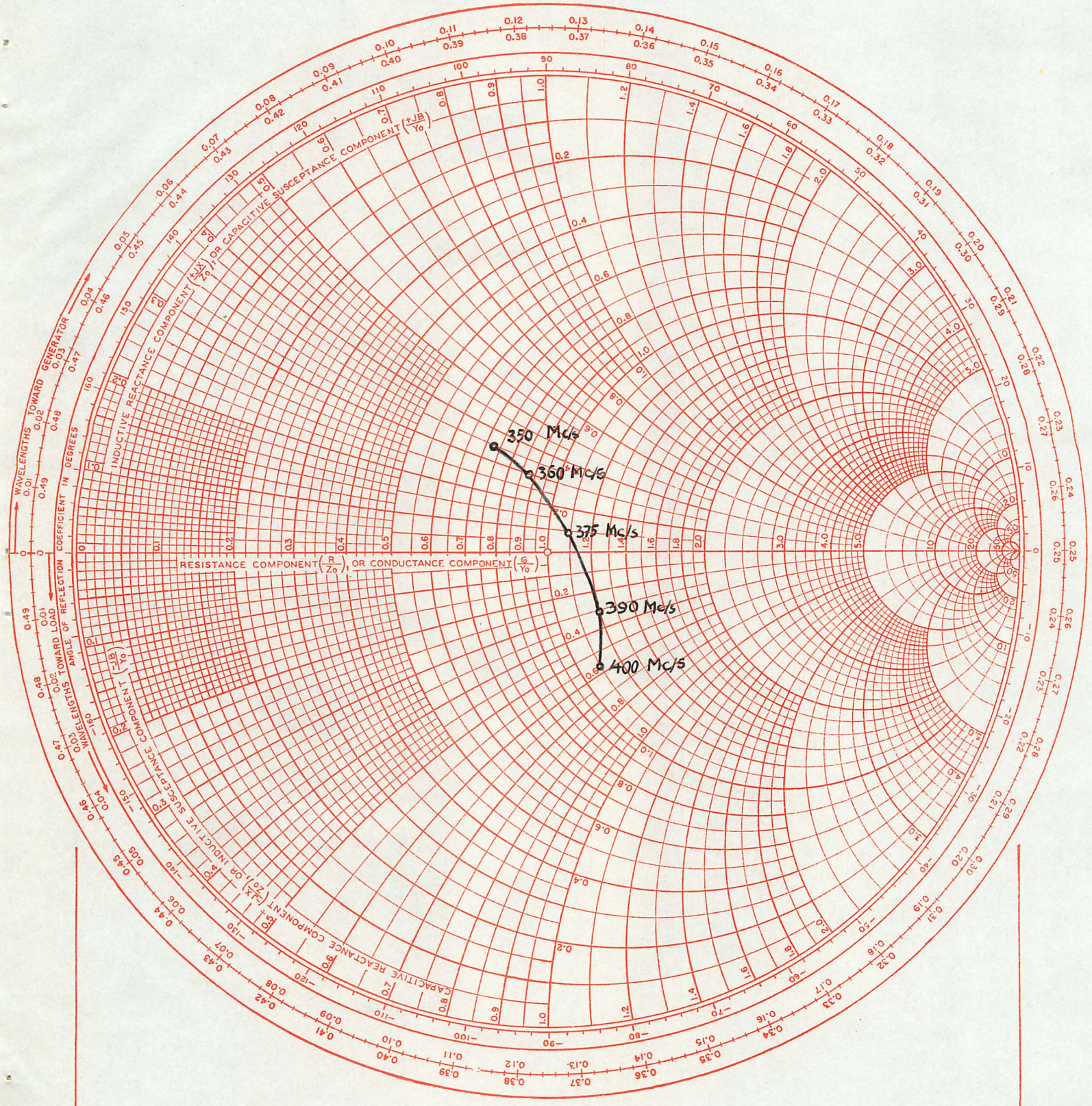
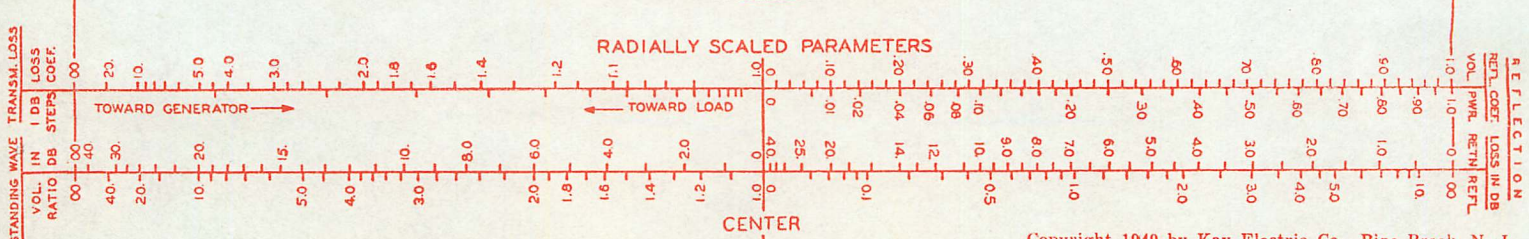


RADIALLY SCALED PARAMETERS



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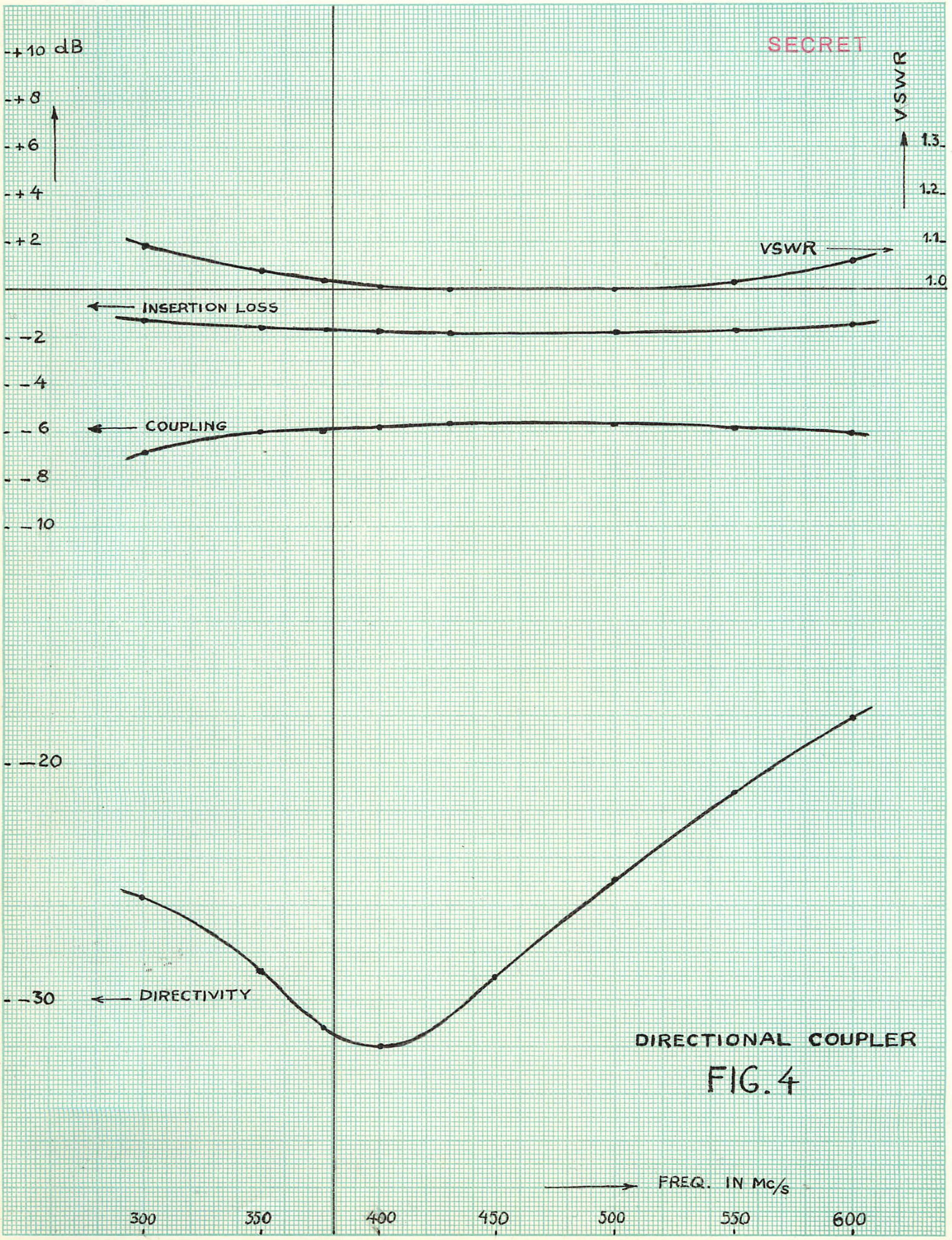

DIRECTIONAL COUPLER

FIG. 4

D B & M

NAME	TITLE	DWG. NO. FIG. 5
SMITH CHART Form 756-N	TUNER GENERAL RADIO COMPANY, CAMBRIDGE, MASSACHUSETTS	DATE

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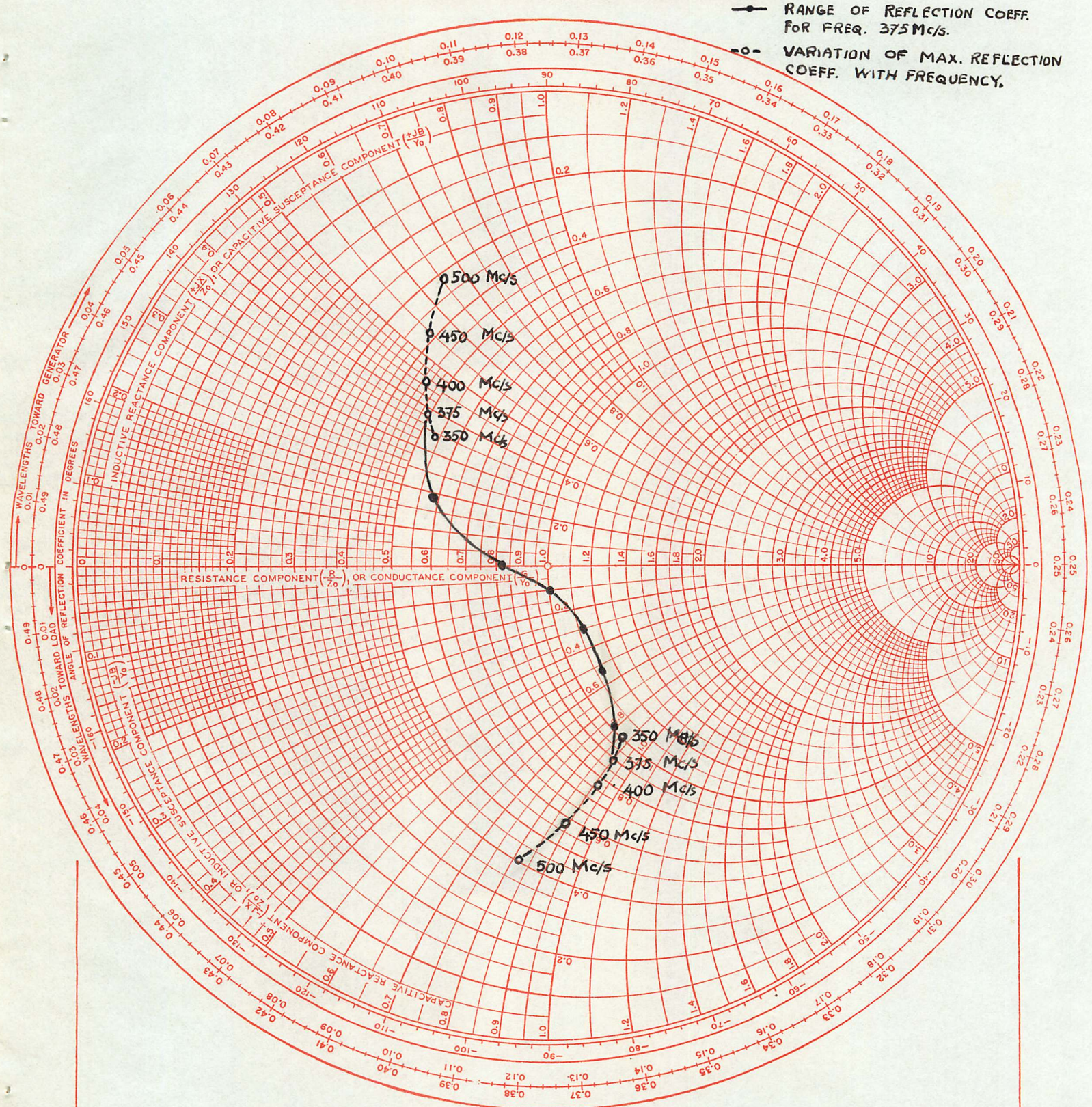
IMPEDANCE OR ADMITTANCE COORDINATES

RANGE OF REFLECTION COEFF. FOR FREQ. 375 Mc/s.

VARIATION OF MAX. REFLECTION COEFF. WITH FREQUENCY.



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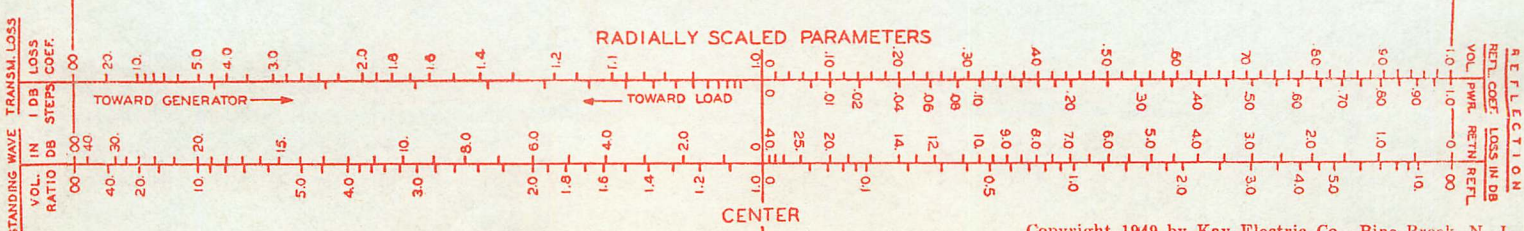

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NAME	TITLE	DWG. NO. FIG. 6
SMITH CHART Form 756-NE	4-WATT LOAD GENERAL RADIO COMPANY, CAMBRIDGE, MASSACHUSETTS	DATE

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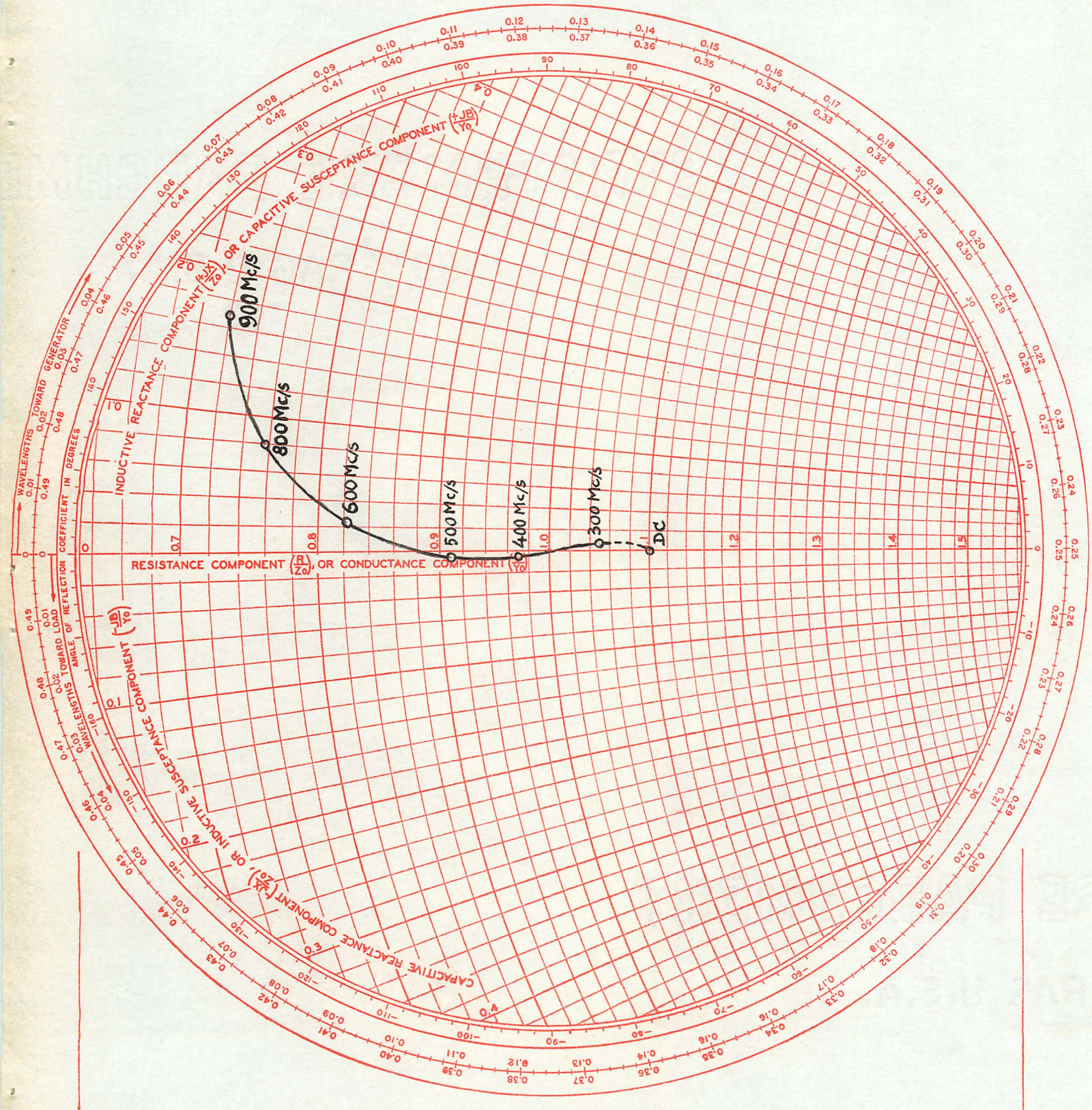
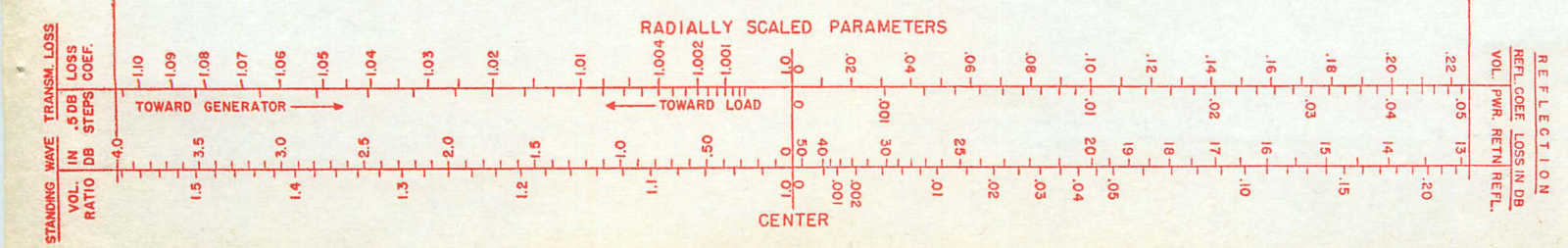
IMPEDANCE OR ADMITTANCE COORDINATES





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A MEGA-CHART