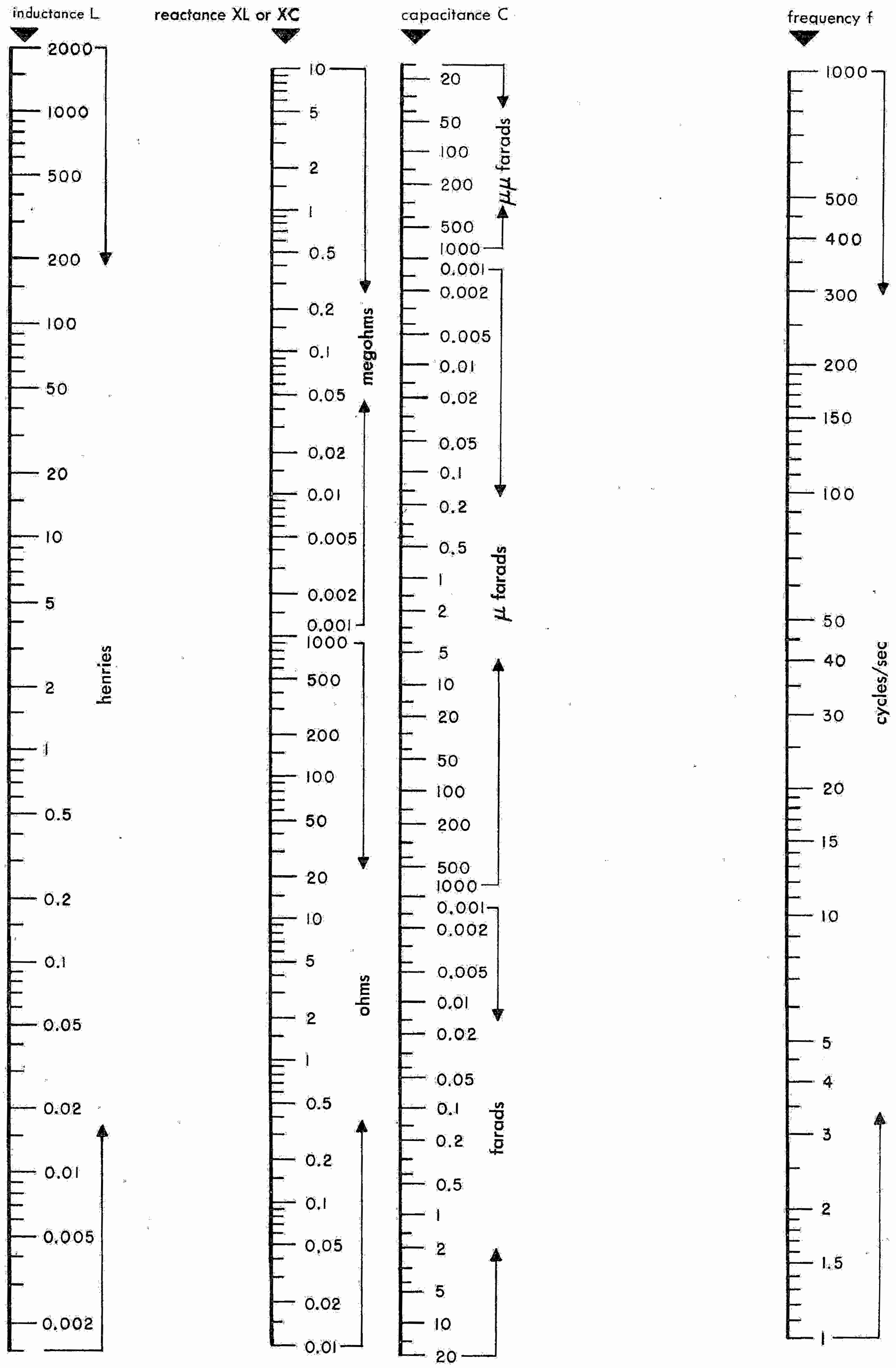
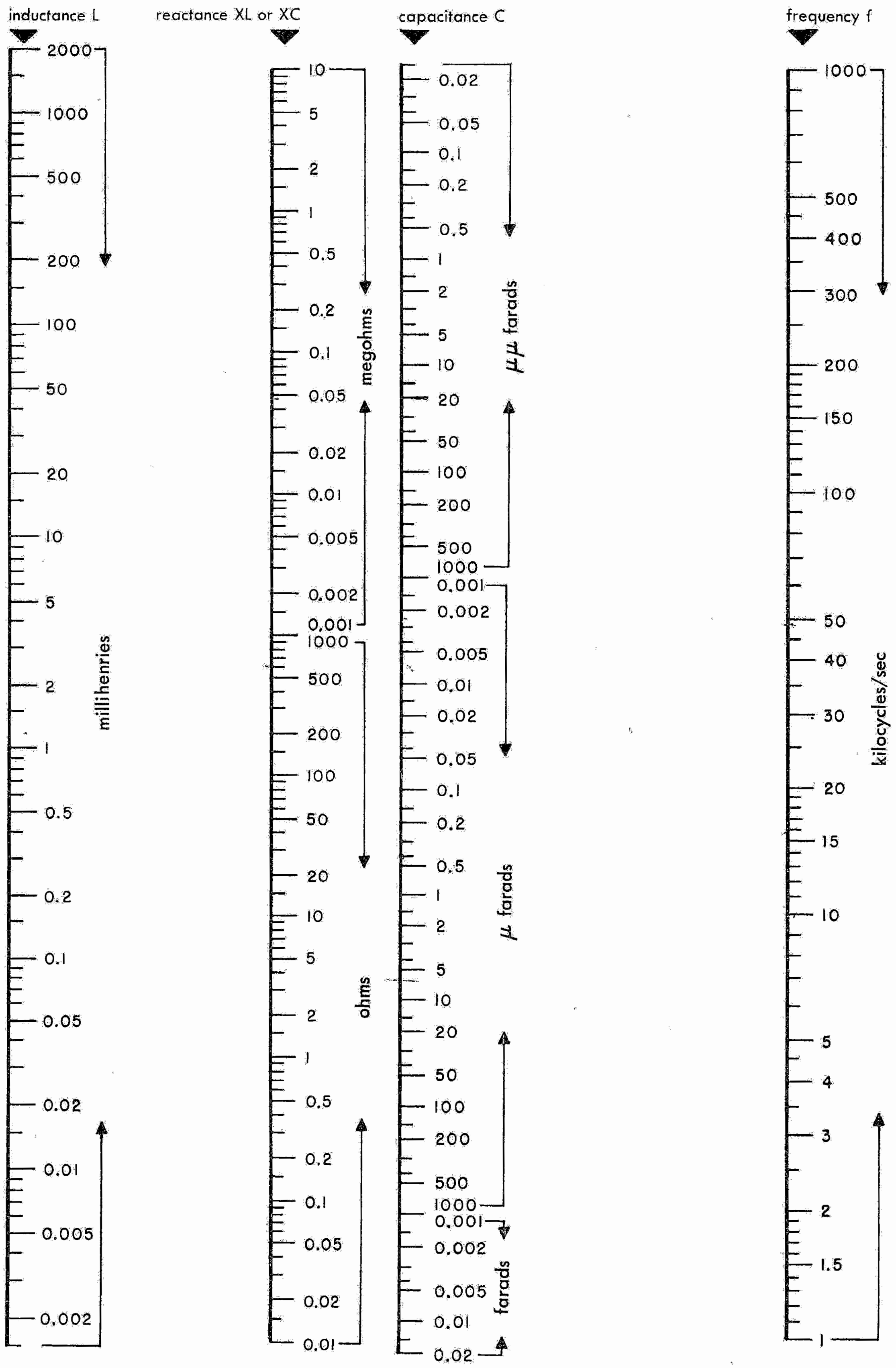
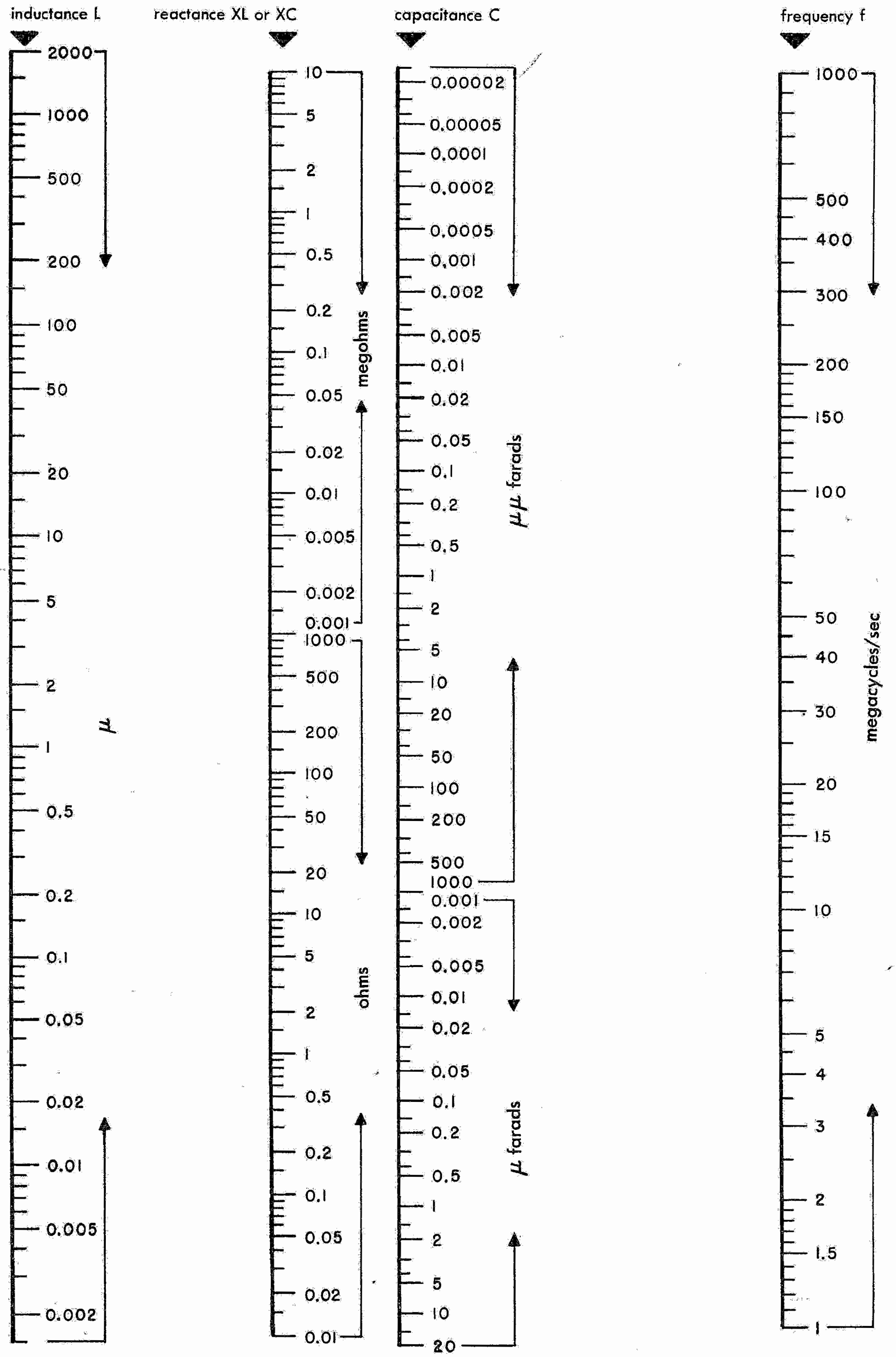


(Courtesy Hygrade Sylvania Corp.)



(Courtesy Hygrade Sylvania Corp.)



(Courtesy Hygrade Sylvania Corp.)

SILICON AND GERMANIUM RECTIFIERS

(Reprinted Through Courtesy of Electronics)

A modern crystal rectifier consists of a small-area contact between a tungsten whisker and a suitable semiconductor. It should not be confused with copper oxide or selenium rectifiers.

Developed as imperative components for microwave radar systems, the electrical characteristics and mechanical stability of the new crystal rectifiers makes them attractive to designers of modern electronic equipment. Point-contact rectifiers offer many possibilities in addition to the present uses as microwave converters, second detectors, beacon detectors and low-frequency diodes. They can replace many diodes with a saving in volume, weight, and filament power consumption. The low capacitance of the contact makes their use in uhf and shf applications desirable. Special kinds, such as welded-point crystals and silicon high back voltage crystals, are capable of still further development and use.

Table I shows uses and major characteristics of most currently available crystals. Those registered with the RMA Data Bureau are designated by an asterisk. The radar band in which each was used has been indicated in column "λ". After selecting a crystal type according to gross characteristics, the design engineer can find its exact characteristics in table II.

An analysis of physical composition; theory, and test procedures is given in an article, Crystal Rectifiers, by W. E. Stephens, Electronics, p 112, July 1946.

TABLE I

Uses and Major Characteristics

FUNCTIONS AND CHARACTERISTICS	Converter	Video	Diode	Instrument Rectifier	2nd Detector	Least Sensitive	Moderate Sensitivity	High Sensitivity	Most Sensitive	High Burn-out	Medium High Burn-out	High Back Voltage	D-C Restorer	λ (cm)
TYPE NUMBERS														
1N21 (obs)	●					●								10
1N21A	●						●							10
1N21B*	●							●						10
1N21C	●								●					10
1N22				●										
1N23	●					●								3
1N23A	●						●							3
1N23B*	●							●						3
1N24 (obs)	●					●								1
1N25*	●					●				●				30
1N26*	●						●							1
1N27*		●												10
1N28	●						●			●				10
1N29*		●												10
1N30*		●												3
1N31*		●												3
1N32*		●												10
1N33		●									●			10
1N34*			●									●		
1N35*			●●									●●		
WE D171561					●							●		
WE D171612												●	●	
WE D172925												●	●	

TABLE II

Converter Rectifiers

		1N21(obs)	1N21A	1N21B*	1N21C	1N23	1N23A	1N23B*	1N24(obs)	1N25*	1N26*	1N28
Center frequency	(mc)	3060	3060	3060±5	3060	9375	9375	9375±30	24000	1000±10	24000±60	3060
Max. i-f impedance	(ohms)	....	....	800	....	....	....	600	.....	400	600	....
Min. i-f impedance	(ohms)	....	....	200	....	....	....	150	.....	100	300	....
Max. conversion loss	(db)	8.5	7.5	6.5	....	10.0	8.0	6.5	8.5	8.5	8.5	7.0
R-f signal input	(milliwatts)	0.5	0.5	0.5	0.5	....	....	1.0	.....	1.25	1.0	....
Mod. freq. load imp.	(ohms)	....	....	400	....	....	....	400	.....	200	500	....
D-c load resistance	(ohms)	....	....	100±10	....	....	....	100±10	.....	100±5	100±10	....
Max. output noise ratio		4.0	3.0	2.0	1.5	3.0	2.7	2.7	2.5	2.5	2.5	2.0
R-f signal input	(milliwatts)	....	....	0.5	....	....	....	1.0	.....	0.9	1.0	....
Reference resistance	(ohms)	....	....	400	....	....	....	300	.....	200	300	....
D-c load resistance	(ohms)	....	....	100±10	....	....	....	100±10	.....	20±2	100±10	....
Approx. rect. crystal current	(ma)	....	....	0.6	....	....	....	1.2	.....	1.2	......	0.4

Video Rectifiers

		1N27*	1N29*	1N30*	1N31*	1N32*	1N33
Center frequency	(mc)	3295±40	3060±5	9375±30	9375±10	3000	2880
Max. video freq.	(mc)	5.0	.....	5.0	5.0	5.0	....
Min. video freq.	(cps)	500	.....	500	500	500	....
Max. video impedance	(ohms)	4000	.....	21000	24000	20000	10000
Max. forward voltage	(millivolts)	1	.....	.....	.....	.....	.....
Min. video impedance	(ohms)	....	6500	7000	6000	5000	2000
Max. forward voltage	(millivolts)	....	40	5.0	5.0	5.0	.....
Min. figure of merit		60	.....	55	55	100	40
Max. r-f power input	(microwatts)	5	.....	5	5	5	.....
Crystal circuit constant	(ohms)	1200	.....	1200	1200	1200	.....
Max. Conversion loss	(db)	....	8.0	.....	.....	.....	.....
R-f signal input power	(milliwatts)	....	0.5	.....	.....	.....	.....
Reference resistance	(ohms)	....	400	.....	.....	.....	.....
D-c load resistance	(ohms)	....	100±10	.....	.....	.....	.....
Rectified crystal current	(ma)	....	0.6	.....	.....	.....	.....

Diode Rectifiers

		1N34*	1N35*
Max. peak inverse voltage	(v)	50	50
Max. peak anode current	(ma)	60	60
Max. average anode current	(ma)	22.5	22.5
Max. surge current	(ma)	200	200
Max. reverse current (Eb = — 50 v d-c)		2.0	2.0
Operating range	(mc)	0-100	0-100
Units matched in pass direction	(%)	.....	10
Units matched in blocking direction	(%)	.....	20
Typical anode voltage	(v, a-c)	30	30
Typical load resistance	(ohms)	500	500
Typical minimum load voltage	(v, d-c)	10	10

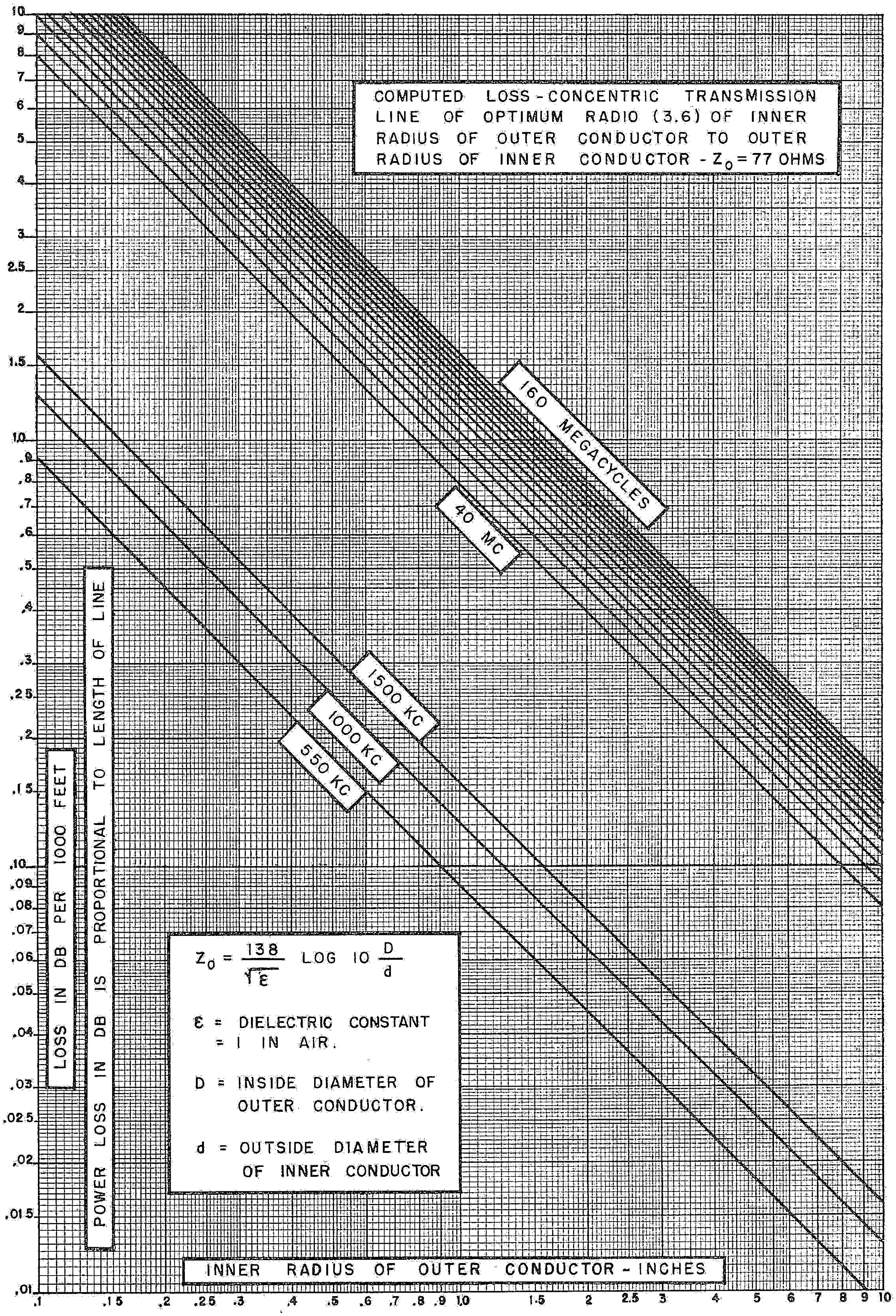
Note: The 1N35 consists of two 1N34's mounted together

S

Voltage or Current Ratio	Power Ratio	Power Ratio	Voltage or Current Ratio	—db+	Voltage or Current Ratio	Power Ratio
2.00	3.98	.0501	.224	13.0	4.47	19.95
2.02	4.07	.0490	.221	13.1	4.52	20.42
2.04	4.17	.0479	.219	13.2	4.57	20.89
2.07	4.27	.0468	.216	13.3	4.62	21.38
2.09	4.37	.0457	.214	13.4	4.68	21.88
2.11	4.47	.0447	.211	13.5	4.73	22.39
2.14	4.57	.0437	.209	13.6	4.79	22.91
2.16	4.68	.0427	.207	13.7	4.84	23.44
2.19	4.79	.0417	.204	13.8	4.90	23.99
2.21	4.90	.0407	.202	13.9	4.96	24.55
2.24	5.01	.0398	.200	14.0	5.01	25.12
2.27	5.13	.0389	.197	14.1	5.07	25.70
2.29	5.25	.0380	.195	14.2	5.13	26.30
2.32	5.37	.0372	.193	14.3	5.19	26.92
2.34	5.50	.0363	.191	14.4	5.25	27.54
2.37	5.62	.0355	.188	14.5	5.31	28.18
2.40	5.75	.0347	.186	14.6	5.37	28.84
2.43	5.89	.0339	.184	14.7	5.43	29.51
2.46	6.03	.0331	.182	14.8	5.50	30.20
2.48	6.17	.0324	.180	14.9	5.56	30.90
2.51	6.31	.0316	.178	15.0	5.62	31.62
2.54	6.46	.0309	.176	15.1	5.69	32.36
2.57	6.61	.0302	.174	15.2	5.75	33.11
2.60	6.76	.0295	.172	15.3	5.82	33.88
2.63	6.92	.0288	.170	15.4	5.89	34.67
2.66	7.08	.0282	.168	15.5	5.96	35.48
2.69	7.24	.0275	.166	15.6	6.03	36.31
2.72	7.41	.0269	.164	15.7	6.10	37.15
2.75	7.59	.0263	.162	15.8	6.17	38.02
2.79	7.76	.0257	.160	15.9	6.24	38.90
2.82	7.94	.0251	.159	16.0	6.31	39.81
2.85	8.13	.0246	.157	16.1	6.38	40.74
2.88	8.32	.0240	.155	16.2	6.46	41.69
2.92	8.51	.0234	.153	16.3	6.53	42.66
2.95	8.71	.0229	.151	16.4	6.61	43.65
2.99	8.91	.0224	.150	16.5	6.68	44.67
3.02	9.12	.0219	.148	16.6	6.76	45.71
3.06	9.33	.0214	.146	16.7	6.84	46.77
3.09	9.55	.0209	.145	16.8	6.92	47.86
3.13	9.77	.0204	.143	16.9	7.00	48.98
3.16	10.00	.0200	.141	17.0	7.08	50.12
3.20	10.23	.0195	.140	17.1	7.16	51.29
3.24	10.47	.0191	.138	17.2	7.24	52.48
3.27	10.72	.0186	.137	17.3	7.33	53.70
3.31	10.96	.0182	.135	17.4	7.41	54.95
3.35	11.22	.0178	.133	17.5	7.50	56.23
3.39	11.48	.0174	.132	17.6	7.59	57.54
3.43	11.75	.0170	.130	17.7	7.67	58.88
3.47	12.02	.0166	.129	17.8	7.76	60.26
3.51	12.30	.0162	.127	17.9	7.85	61.66
3.55	12.59	.0159	.126	18.0	7.94	63.10
3.59	12.88	.0155	.125	18.1	8.04	64.57
3.63	13.18	.0151	.123	18.2	8.13	66.07
3.67	13.49	.0148	.122	18.3	8.22	67.61
3.72	13.80	.0145	.120	18.4	8.32	69.18
3.76	14.13	.0141	.119	18.5	8.41	70.79
3.80	14.45	.0138	.118	18.6	8.51	72.44
3.85	14.79	.0135	.116	18.7	8.61	74.13
3.89	15.14	.0132	.115	18.8	8.71	75.86
3.94	15.49	.0129	.114	18.9	8.81	77.62
3.98	15.85	.0126	.112	19.0	8.91	79.43
4.03	16.22	.0123	.111	19.1	9.02	81.28
4.07	16.60	.0120	.110	19.2	9.12	83.18
4.12	16.98	.0118	.108	19.3	9.23	85.11
4.17	17.38	.0115	.107	19.4	9.33	87.10
4.22	17.78	.0112	.106	19.5	9.44	89.13
4.27	18.20	.0110	.105	19.6	9.55	91.20
4.32	18.62	.0107	.104	19.7	9.66	93.33
4.37	19.05	.0105	.102	19.8	9.77	95.50
4.42	19.50	.0102	.101	19.9	9.89	97.72
		.0100	.100	20.0	10.00	100.00

.309	.556	5.1	1.80	3.24
.302	.550	5.2	1.82	3.31
.295	.543	5.3	1.84	3.39
.288	.537	5.4	1.86	3.47
.282	.530	5.5	1.88	3.55
.275	.525	5.6	1.91	3.63
.269	.519	5.7	1.93	3.72
.263	.513	5.8	1.95	3.80
.257	.507	5.9	1.97	3.89

.0617	.248	[illegible]
.0603	.246	12.2
.0589	.243	12.3
.0575	.240	12.4
.0562	.237	12.5
.0550	.234	12.6
.0537	.232	12.7
.0525	.229	12.8
.0513	.227	12.9


COMPUTED LOSS - CONCENTRIC TRANSMISSION LINE OF OPTIMUM RADIO (3.6) OF INNER RADIUS OF OUTER CONDUCTOR TO OUTER RADIUS OF INNER CONDUCTOR - Z_0 = 77 OHMS
160 MEGACYCLES
40 MC
1500 KC
1000 KC
550 KC
$Z_0 = \frac{138}{\sqrt{\varepsilon}} \text{ LOG } 10 \frac{D}{d}$
ε = DIELECTRIC CONSTANT = 1 IN AIR.
D = INSIDE DIAMETER OF OUTER CONDUCTOR.
d = OUTSIDE DIAMETER OF INNER CONDUCTOR
LOSS IN DB PER 1000 FEET
POWER LOSS IN DB IS PROPORTIONAL TO LENGTH OF LINE
INNER RADIUS OF OUTER CONDUCTOR - INCHES
10
9
8
7
6
5
4
3
2.5
2
1.5
1.0
.9
.8
.7
.6
.5
.4
.3
.25
.2
.15
.10
.09
.08
.07
.06
.05
.04
.03
.025
.02
.015
.01
.1
.15
.2
.25
.3
.4
.5
.6
.7
.8
.9
1.0
1.5
2
2.5
3
4
5
6
7
8
9
10

COMPARISON OF OPEN WIRE, SOLID DIELECTRIC LINES AND WAVEGUIDES

Reprinted from Electronics Buyers Guide

Characteristics	Parallel open wires	Bead supported	Stub supported	Solid dielectric (Polyethylene)	Coaxial rubber	Waveguide	Pulse cables
Insulation resistance	O.k. in dry air--drops in rain	O.k. in dry air or nitrogen	O.k. dry or slightly wet	O.k. dry or wet	O.k. dry--drops when wet. Varies with temperature	O.k.	Same as rubber
Corona voltage and Dielectric strength	Depends on dry air and spacing--low	Depends on dry air--depends on size--low	Depends on size--low	Depends on size--high	Depends on dry air--size--med high	Depends on size--dry air--pressure--low	Depends on size--dry air--high
Dielectric constant	Low--air(1)	Low--air plus beads (1 +)	Low--air (1)	Medium (2.3)	Medium high 3-4	....	High (5-6)
Power factor	Low in dry air, goes up in wet	Low in dry air, goes up in wet	O.k. dry or slightly wet	O.k. dry or wet	High dry--higher wet. N.G. for H.F.	....	Same as rubber
D-C conductor resistance	Low--goes down with size	Same	Same	Higher than concentrics; goes down with size	High--goes down with size	Low--goes down with size	High--goes down with size
Ease of installation	Easy	More difficult	Difficult	Easier than concentric	Same as solid dielectric	Same as bead-supported	Same as rubber
Ease of maintenance	Easy	Very difficult	Not very	Easy	do	Easy	
Flexible	Somewhat--depends on size	Some--depends on size	No	Yes, flexibility goes down with size	Yes, more than solid dielectric	No	Same as rubber
Mechanically strong	Yes, but separators are weak points	Yes, beads are weak points	Yes, but stubs are fragile	Yes, but can be mistreated	Yes	Yes, but can be crushed	Yes
Can be sealed	Yes	Yes, but you have to do the right job	Yes	Yes	Yes	Yes	Yes
Self-shielding (electrical)	No	Yes	Yes	Yes, depends on the braid construction	Same as solid dielectric	Yes	Same as solid dielectric
Fire resistive	Yes	Yes	Yes	Yes, except largest size	Not completely	Yes	Same as rubber
High temperature resistant	Yes, depends on material of separators	Yes, depends on rubber gaskets or solder	Yes, same as bead supported	180°F--200°F for short time	220°F--250°F for short time	Yes, depends on rubber gasket or solder	Same as rubber
Transmission at high frequency	Limited by spacing	Good at low-med freq losses high at microwave	Good at high freq not at low--need spec for each	Good--at low and med not so good at microwave	Poor--loss too high	Best--but each freq needs spec guide--	Poor--loss too high
Stand shock-vibration	Good	Fair--beads are weak points	Good--stubs are weak points	Very good	Very good	Very good	Very good
Low temperatures	Yes	Yes, but allow for expansion	Same as beaded	Yes	Yes	Yes, but allow for expansion	Yes

RESISTANCE VALUES OF SYMMETRICAL ATTENUATION NETWORKS

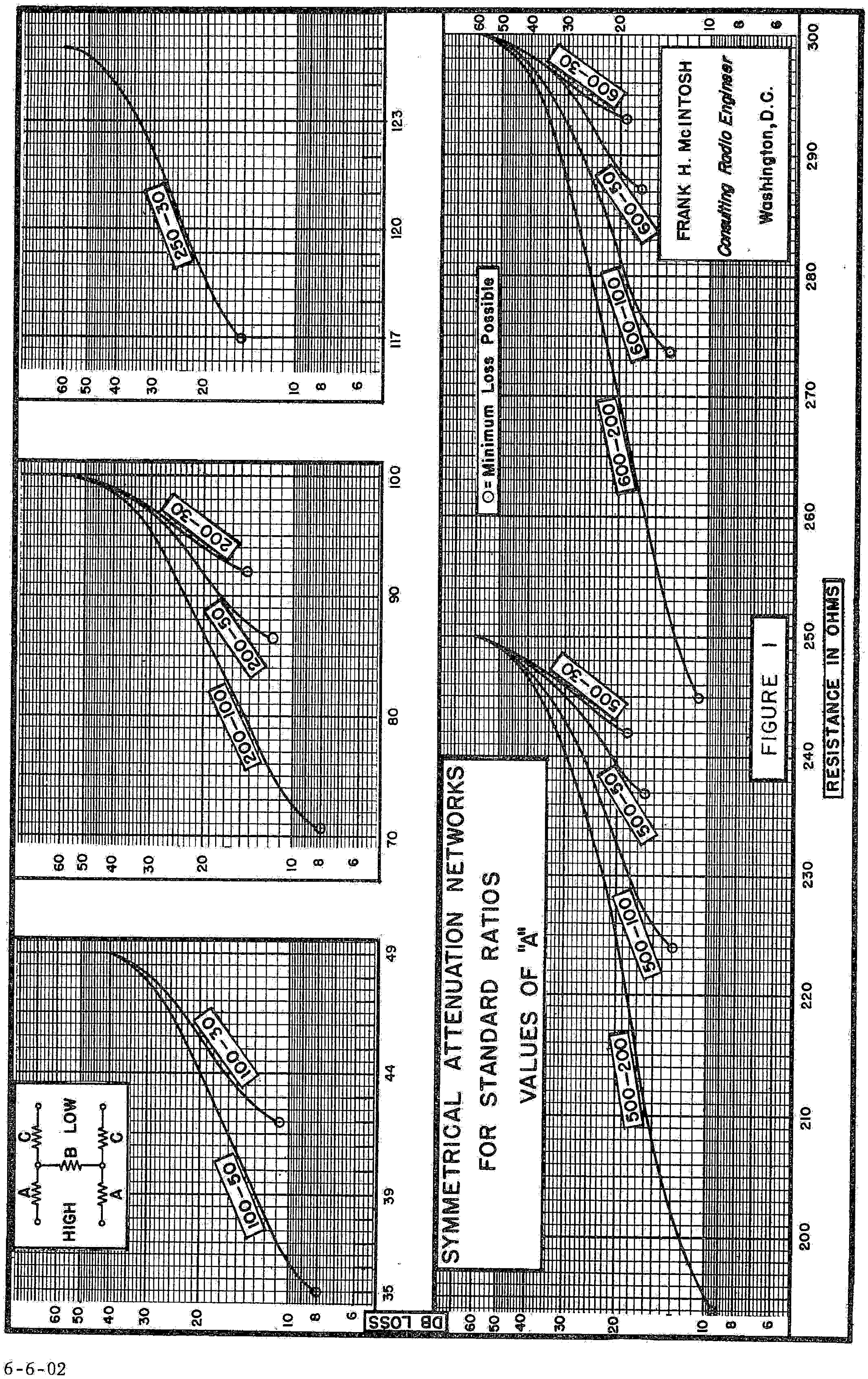
Frank H. McIntosh, Consulting Radio Engineer, Washington, D.C.

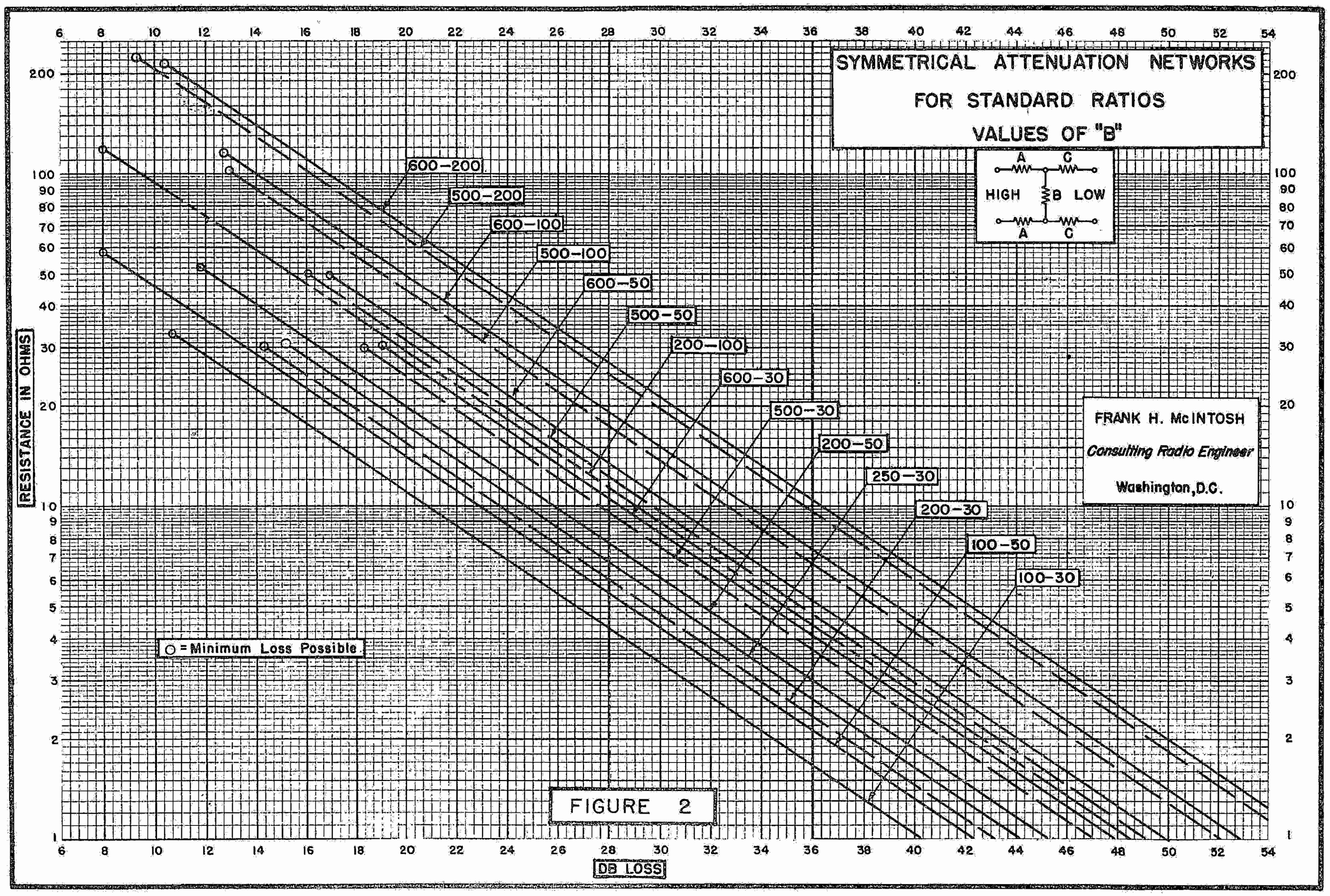
For ready reference and to satisfy most of the practical needs of the various artificial line pads, the following charts have been prepared:

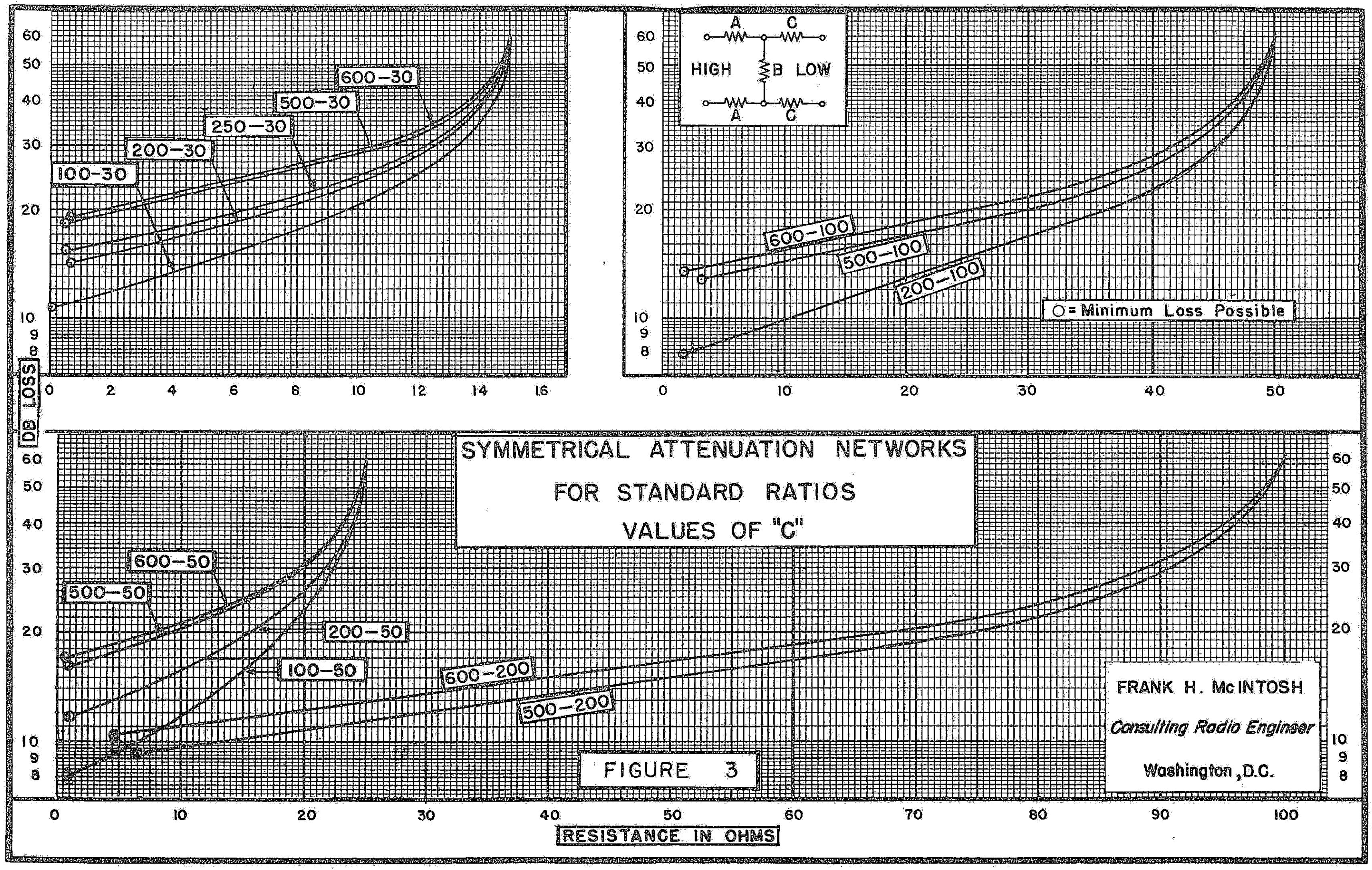
Figures 1 to 3, inclusive, are curves for determining the three components of pads which are symmetrical but have different input and output impedances. The curves are marked to indicate pad ratios for which it was calculated, and the values of "A" are for the higher pad series leg resistances shown on Figure 1, while "C" values for the lower pad series leg resistances are shown on Figure 3. "B" is for the shunt or transverse resistor shown on Figure 2.

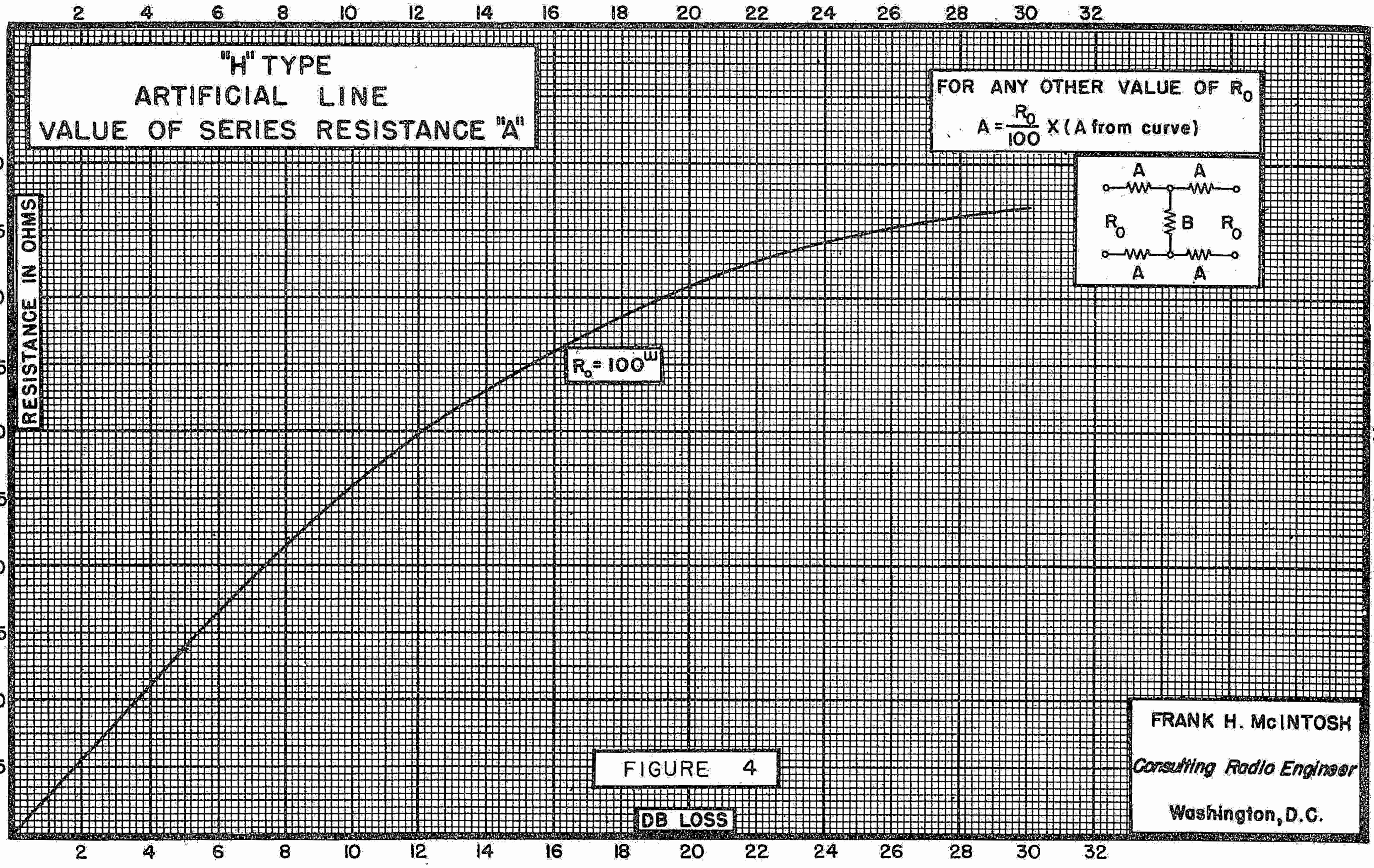
There is a minimum loss for each impedance ratio for which a pad can be designed and for convenience each curve on the figures is terminated by a circle at the lower value of resistance which corresponds to this minimum pad loss. For "L" networks double the values of "A" and "C".

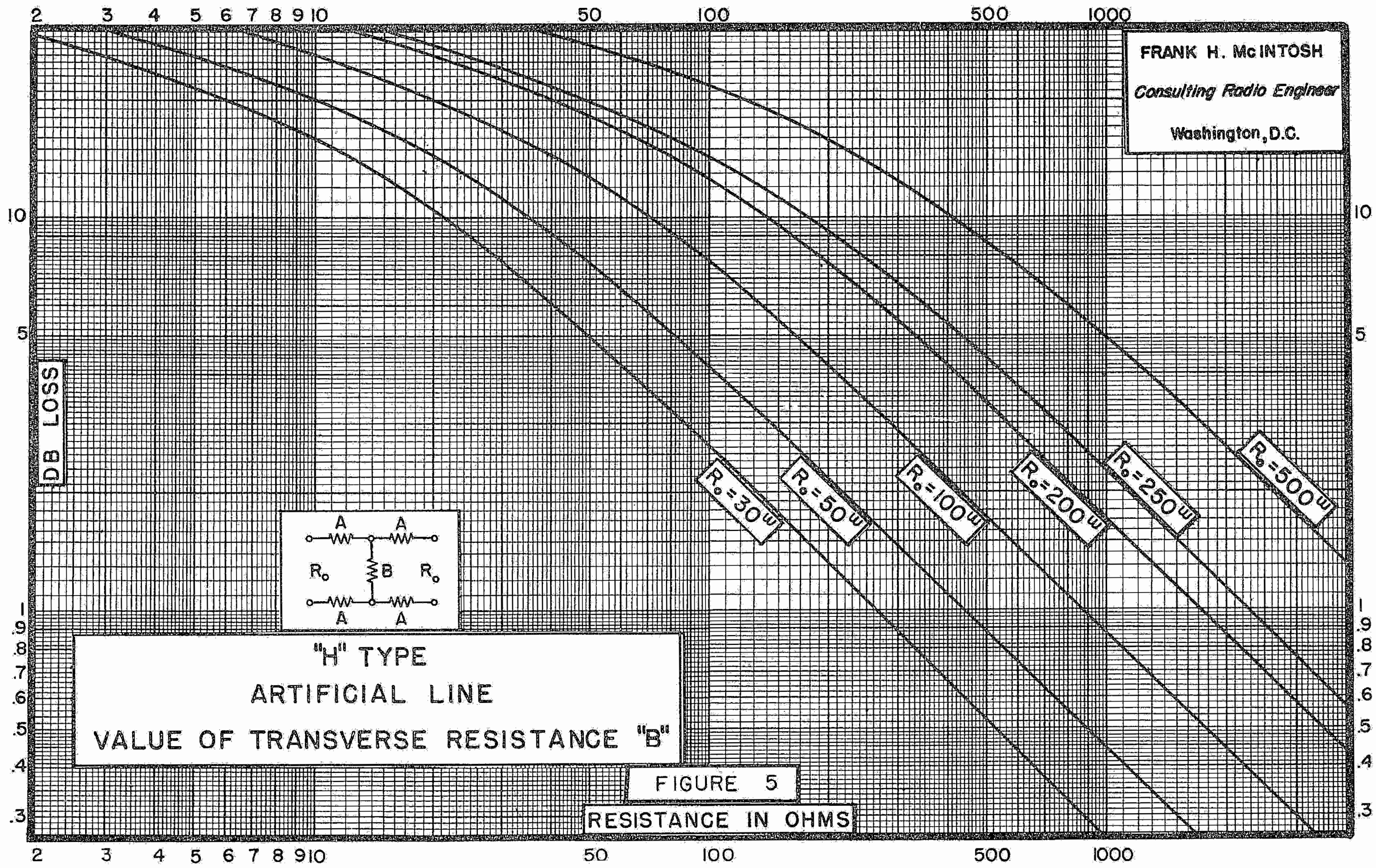
Figure 4 gives the resistance values for the series legs "A" of symmetrical pads having 1 to 1 impedance ratios. Figure 5 gives the transverse resistance values for these pads. For values not shown multiply the value shown for 100 ohms by the ratio of the desired value to 100. Double the series leg values for "L" network.


SYMMETRICAL ATTENUATION NETWORKS
FOR STANDARD RATIOS
VALUES OF "A"
FIGURE I
RESISTANCE IN OHMS
DB LOSS
○ = Minimum Loss Possible
FRANK H. McINTOSH
Consulting Radio Engineer
Washington, D.C.
HIGH
LOW
A
B
C
100-50
100-30
200-100
200-50
200-30
250-30
500-200
500-100
500-50
500-30
600-200
600-100
600-50
600-30


SYMMETRICAL ATTENUATION NETWORKS
FOR STANDARD RATIOS
VALUES OF "B"
A C
HIGH B LOW
A C
FRANK H. McINTOSH
Consulting Radio Engineer
Washington, D.C.
600-200
500-200
600-100
500-100
600-50
500-50
200-100
600-30
500-30
200-50
250-30
200-30
100-50
100-30
○ = Minimum Loss Possible
RESISTANCE IN OHMS
DB LOSS
FIGURE 2


SYMMETRICAL ATTENUATION NETWORKS
FOR STANDARD RATIOS
VALUES OF "C"
FIGURE 3
DB LOSS
RESISTANCE IN OHMS
○ = Minimum Loss Possible
HIGH
LOW
A
B
C
600-30
500-30
250-30
200-30
100-30
600-100
500-100
200-100
600-50
500-50
200-50
100-50
600-200
500-200
FRANK H. McINTOSH
Consulting Radio Engineer
Washington, D.C.


"H" TYPE
ARTIFICIAL LINE
VALUE OF SERIES RESISTANCE "A"
FOR ANY OTHER VALUE OF R_0
$A = \frac{R_0}{100} \times$ (A from curve)
A
A
B
R_0
R_0
A
A
RESISTANCE IN OHMS
$R_o = 100^{\omega}$
DB LOSS
FRANK H. McINTOSH
Consulting Radio Engineer
Washington, D.C.
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32
5 10 15 20 25 30 35 40 45 50
FIGURE 4


FRANK H. McINTOSH
Consulting Radio Engineer
Washington, D.C.
DB LOSS
RESISTANCE IN OHMS
R_o = 30ω
R_o = 50ω
R_o = 100ω
R_o = 200ω
R_o = 250ω
R_o = 500ω
A
A
R_o
B
R_o
A
A
"H" TYPE
ARTIFICIAL LINE
VALUE OF TRANSVERSE RESISTANCE "B"
FIGURE 5

6-6-06

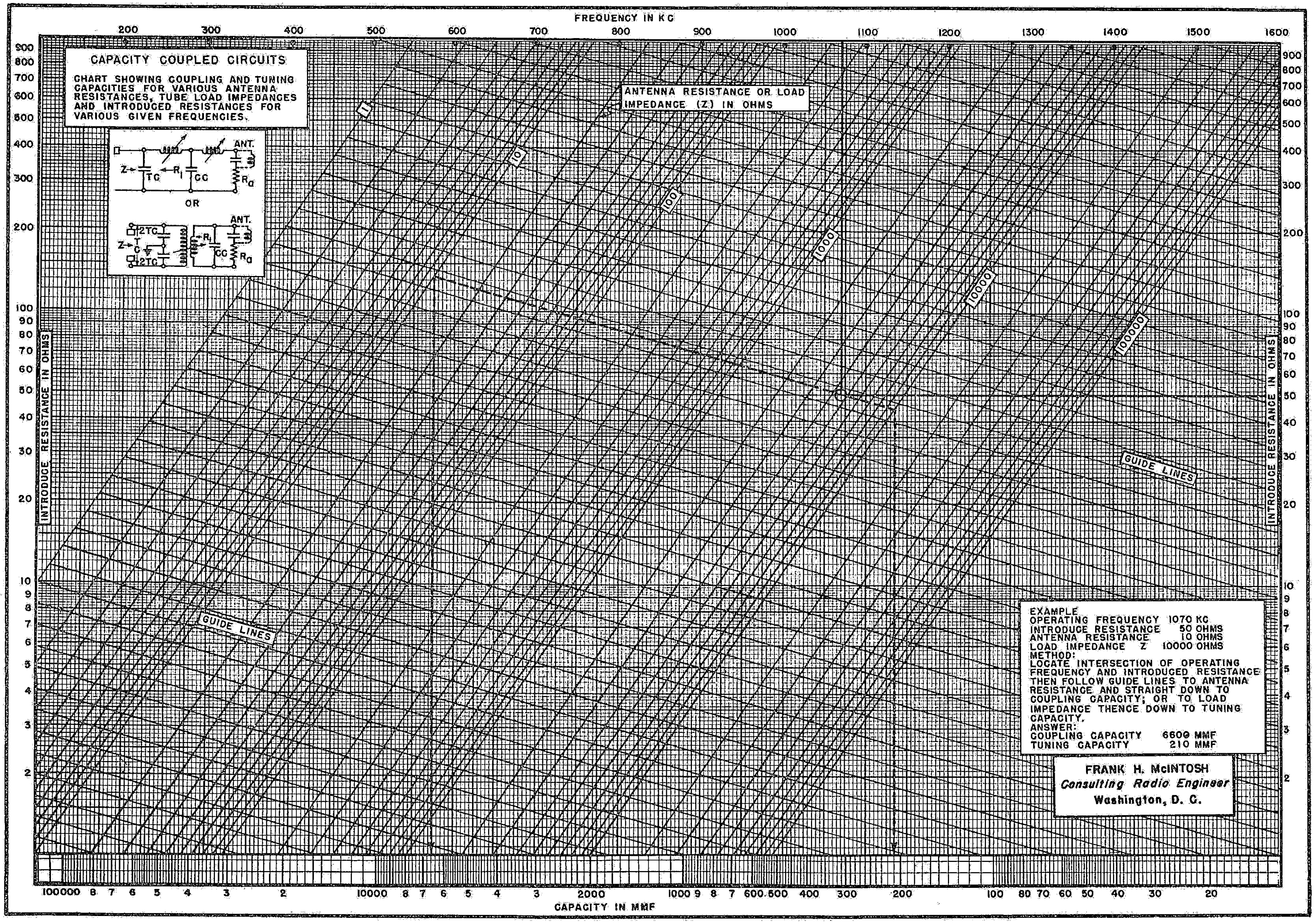
COUPLING AND TUNING CAPACITOR FOR VARIOUS ANTENNAS

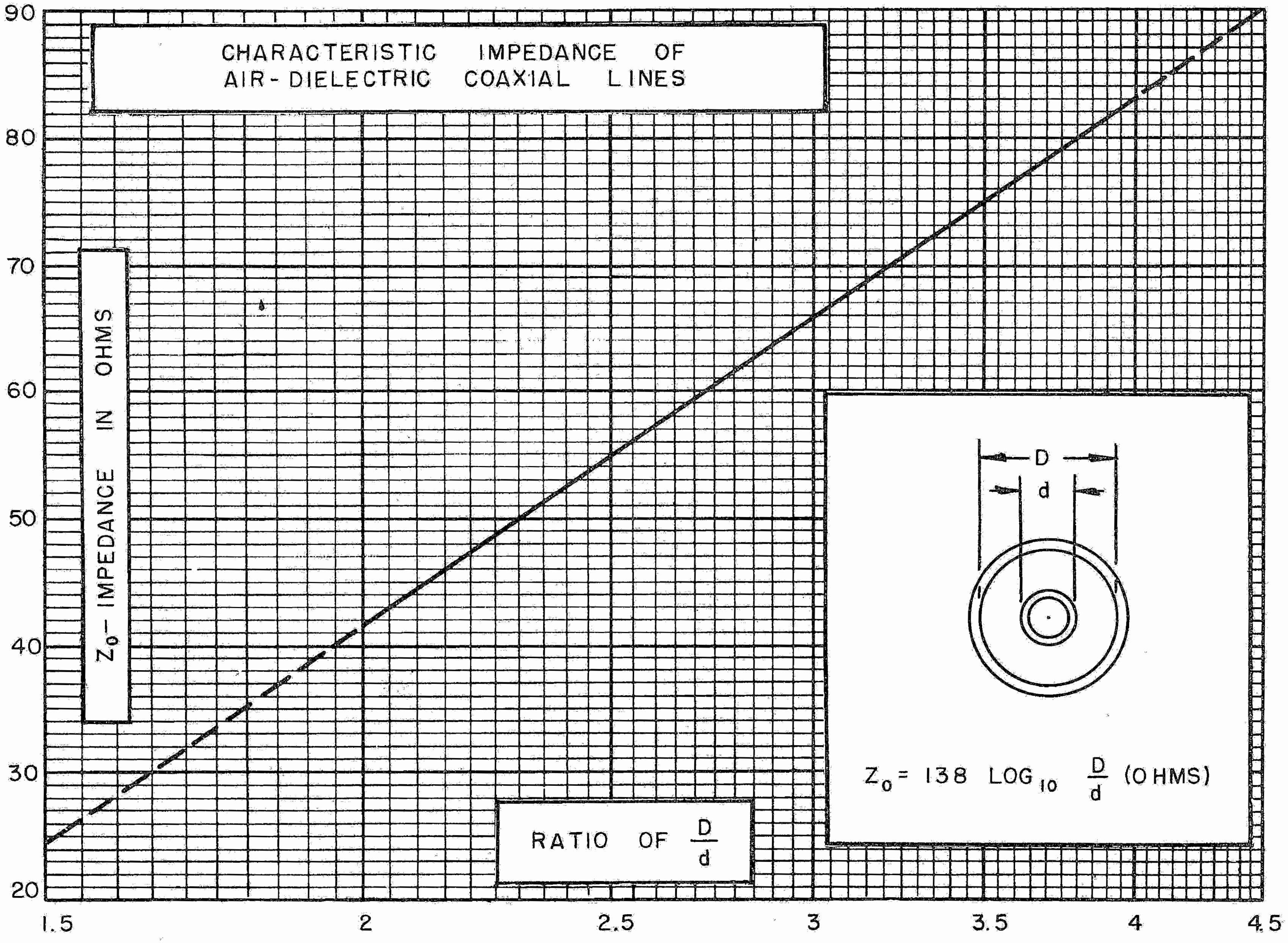
The attached chart has been found to be a useful tool for adjusting the transmitter output circuit using capacity coupling to the antenna or transmission line. The values of capacity shown are approximate but sufficiently close for practical purposes, since stray capacity of leads and components has not been taken into account. The capacity shown is the total capacity required for both the first and second sections of the low pass filters.

The introduced resistance is the net resistance component when section is adjusted resulting from the effect of the R_a (antenna or line resistance) and the coupling capacity C.C.

The Z is the load impedance for the tubes determined by dynamic characteristic for the particular tube and its operating voltages.

The value of introduced resistance used generally now lie between 50 and 100 ohms with the upper limit determined by the stray capacity. Formerly with high "C" ratios, introduced resistances were from 7 to 20 ohms which resulted generally in higher circuit losses.


CAPACITY COUPLED CIRCUITS
CHART SHOWING COUPLING AND TUNING CAPACITIES FOR VARIOUS ANTENNA RESISTANCES, TUBE LOAD IMPEDANCES AND INTRODUCED RESISTANCES FOR VARIOUS GIVEN FREQUENCIES.
FREQUENCY IN KC
CAPACITY IN MMF
INTRODUCE RESISTANCE IN OHMS
ANTENNA RESISTANCE OR LOAD IMPEDANCE (Z) IN OHMS
GUIDE LINES
ANT.
OR
EXAMPLE
OPERATING FREQUENCY 1070 KC
INTRODUCE RESISTANCE 50 OHMS
ANTENNA RESISTANCE 10 OHMS
LOAD IMPEDANCE Z 10000 OHMS
METHOD:
LOCATE INTERSECTION OF OPERATING FREQUENCY AND INTRODUCED RESISTANCE THEN FOLLOW GUIDE LINES TO ANTENNA RESISTANCE AND STRAIGHT DOWN TO COUPLING CAPACITY; OR TO LOAD IMPEDANCE THENCE DOWN TO TUNING CAPACITY.
ANSWER:
COUPLING CAPACITY 6600 MMF
TUNING CAPACITY 210 MMF
FRANK H. McINTOSH
Consulting Radio Engineer
Washington, D. C.


CHARACTERISTIC IMPEDANCE OF AIR-DIELECTRIC COAXIAL LINES
Z_0 – IMPEDANCE IN OHMS
RATIO OF $\frac{D}{d}$
$Z_0 = 138 \log_{10} \frac{D}{d}$ (OHMS)
D
d
90
80
70
60
50
40
30
20
1.5
2
2.5
3
3.5
4
4.5

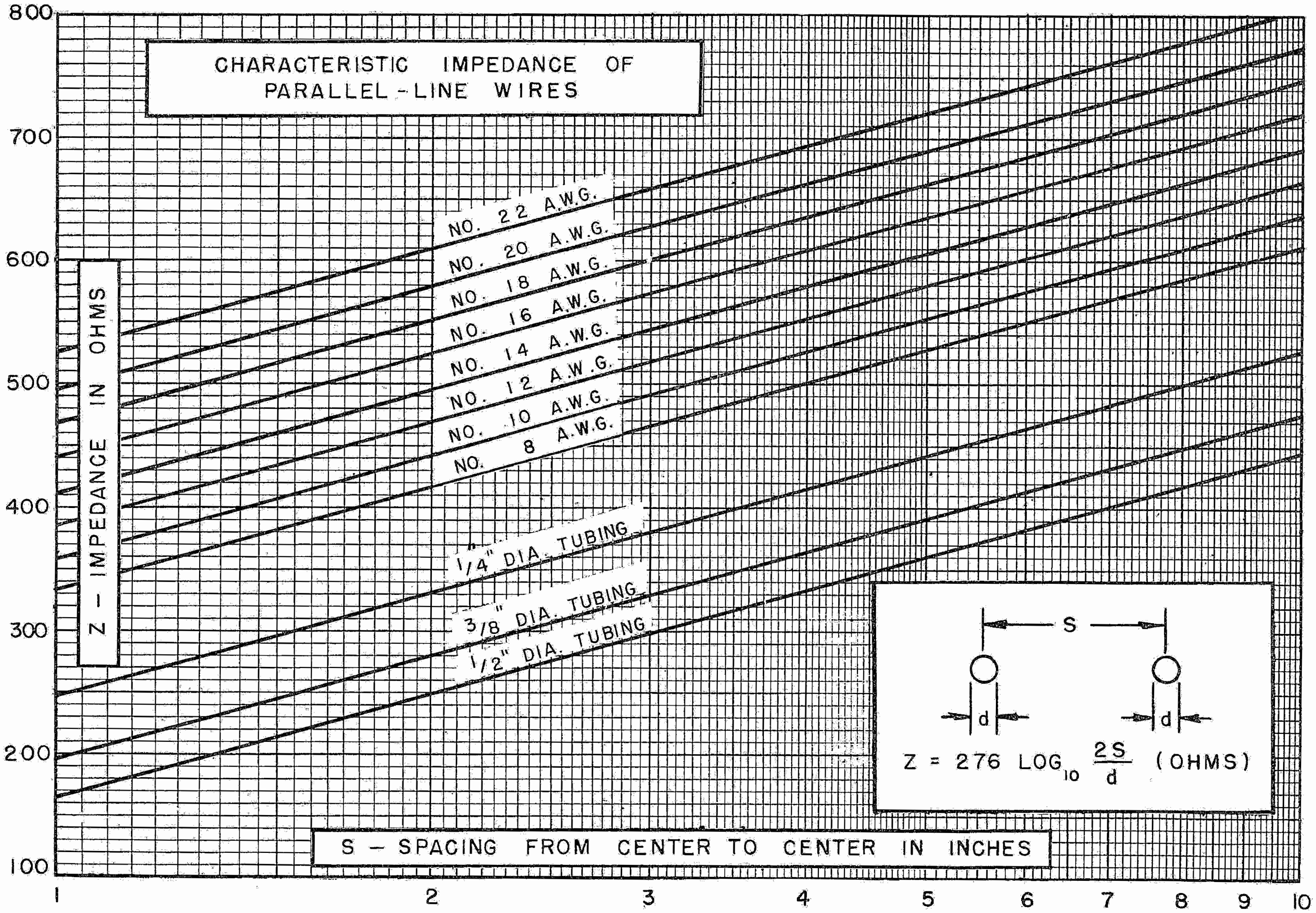

CHARACTERISTIC IMPEDANCE OF PARALLEL-LINE WIRES
Z – IMPEDANCE IN OHMS
S – SPACING FROM CENTER TO CENTER IN INCHES
800
700
600
500
400
300
200
100
1
2
3
4
5
6
7
8
9
10
NO. 22 A.W.G.
NO. 20 A.W.G.
NO. 18 A.W.G.
NO. 16 A.W.G.
NO. 14 A.W.G.
NO. 12 A.W.G.
NO. 10 A.W.G.
NO. 8 A.W.G.
1/4" DIA. TUBING
3/8" DIA. TUBING
1/2" DIA. TUBING
S
d
d
Z = 276 LOG10 2S/d (OHMS)

PHOTO-EFFECTIVENESS OF IMAGE ORTHICON WITH EQUAL WATTS OF TUNGSTEN FILAMENT AND FLUORESCENT LAMPS

Receptor	Lamp Type	Camera Lens Filters	Relative Conversion Efficiency*	Relative Signal Strength***	Color Balance: Blue 3000-5300Å	Color Balance: Green 5300-5900Å	Color Balance: Red 5900-8000Å
Eye					.42	1.00	.43
	(4500 white	none	8.5**	0.427	3.5	1.00	.43
	(Fluorescent	Wratten #7		0.166	.73	1.00	.77
Image Orthicon	(3500 white	none	6.9**	0.368	2.74	1.00	.86
#5769	(Fluorescent	Wratten #7		0.151	.42	1.00	.99
	(Tungsten	none	6	0.104	2.5	1.00	1.9
	(3000° K	Wratten #7		0.062	.7	1.00	1.8
		#7 + 9788		0.038	.8	1.00	.97
	(4500 white	none	43**	1.8	1.7	1.00	.57
	(Fluorescent	Wratten #6		1.13	.95	1.00	.64
Image Orthicon	(3500 white	none	38**	1.6	1.11	1.00	.59
#5820	(Fluorescent	Wratten #6		1.28	.56	1.00	.63
	(Tungsten	none	40	.62	1.36	1.00	1.23
	(3000° K	Wratten #6		.46	.83	1.00	1.21

*Camera tube microamperes per lamp lumen on photo cathode.
**64T6 slimline lamps at 300 ma. operating current.
***Camera tube milliamperes per lamp watt.
Å = Angstrom Units

(Courtesy General Electric Company - Nela Park, Ohio)

DERIVATION OF PHOTO-EFFECTIVENESS CURVES

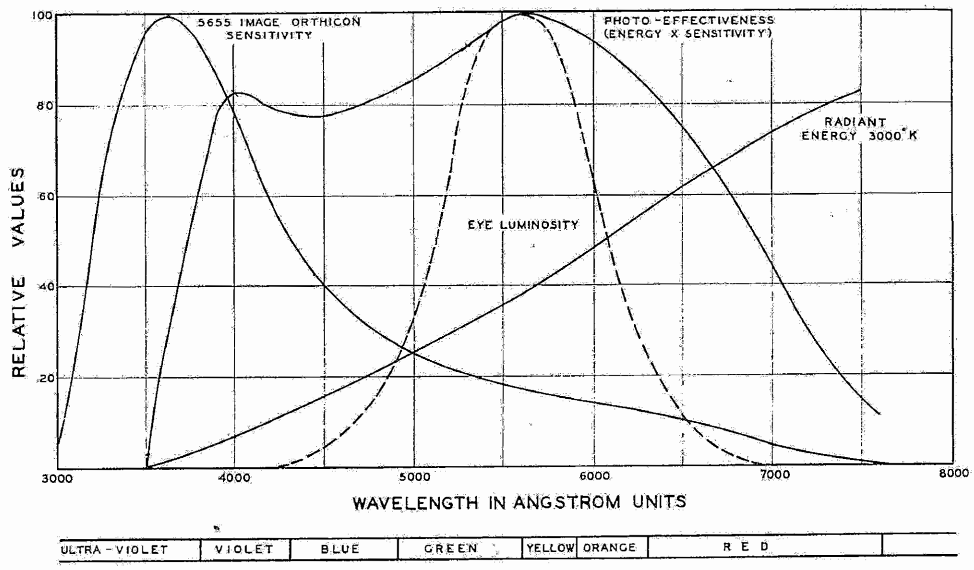


Fig. 1 - These derivation curves demonstrate the reason why blue and red objects frequently appear unnaturally bright in the receiver screen. The accompanying curves show how the proper use of filters corrects such distortion.

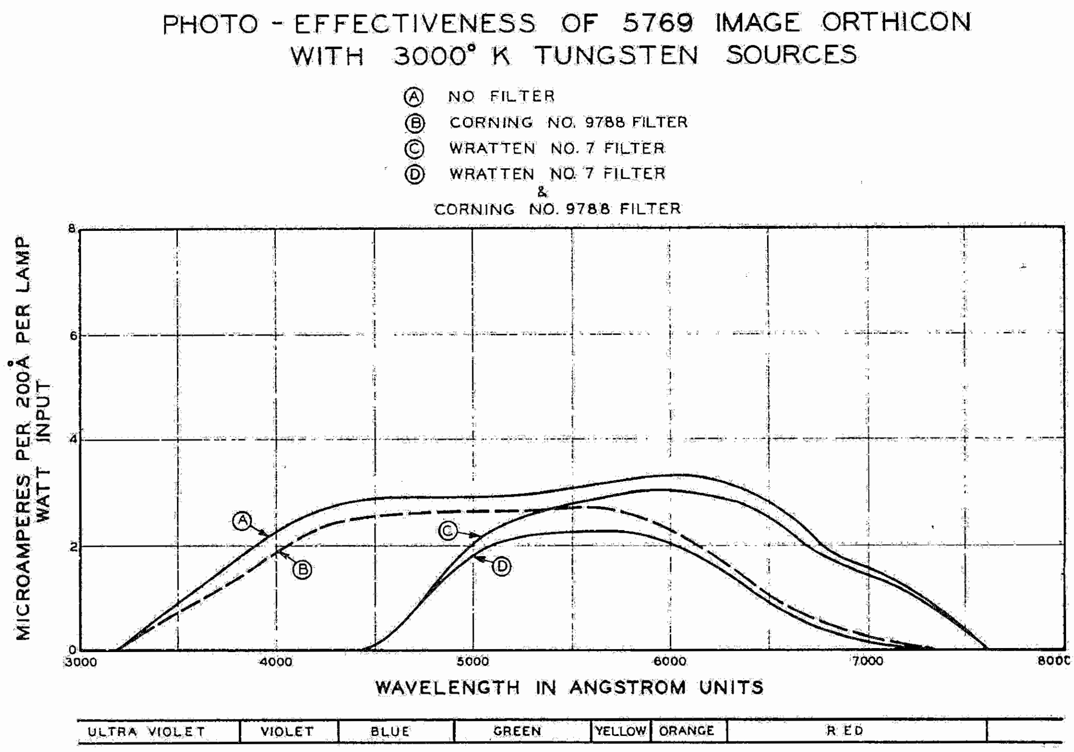


Fig. 2 - Unnatural brightness of blues and violets are reduced by camera lens filters such as the #7. Reds and oranges are improved by a filter similar to the 9788. The use of both filters results in the natural appearance of people and scenes.

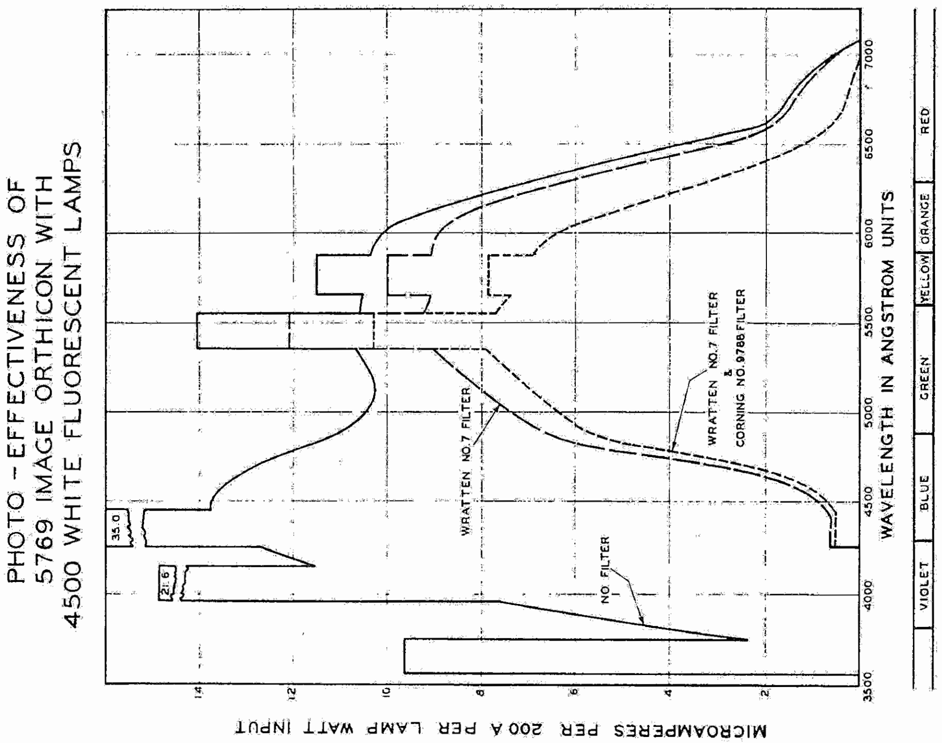


Fig. 3 - The appearance of blues and violets in scenes illuminated by 4500 white fluorescent lamps is greatly improved by the use of a #7 filter. The influence of the 9788 filter is also shown because it has so important an effect on the tungsten lighting usually used in combination with fluorescent lighting.

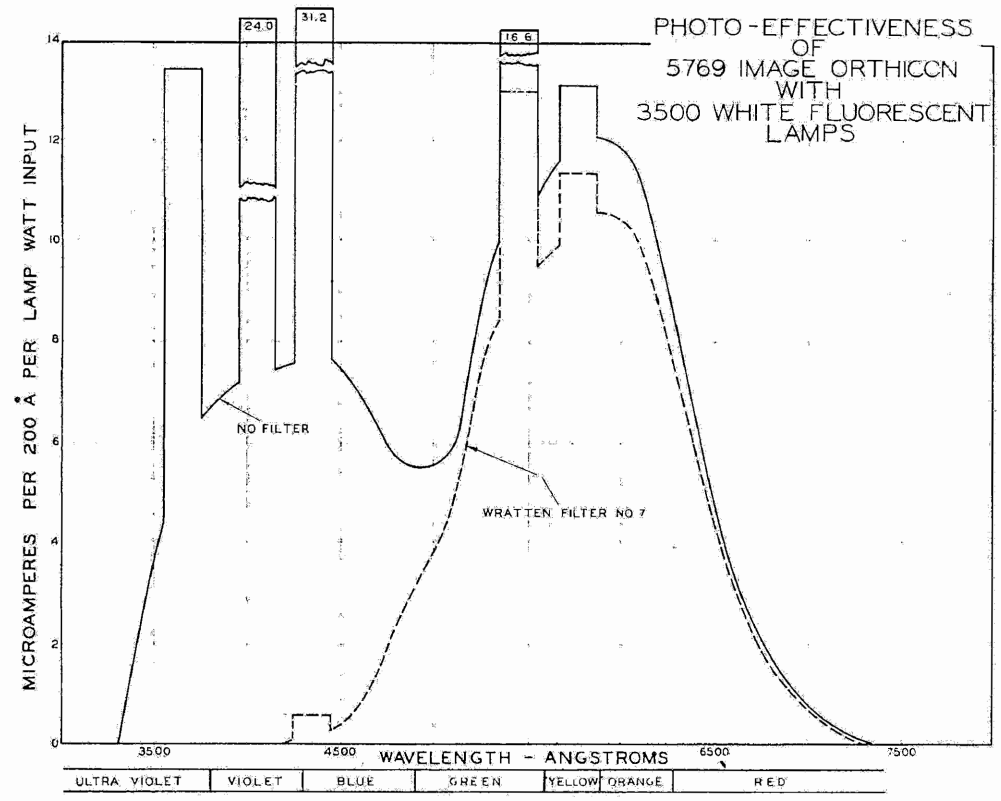


Fig. 4 - Excessive blue-violet response of the camera tube to 3500 white fluorescent lamps is effectively corrected by the #7 filter.

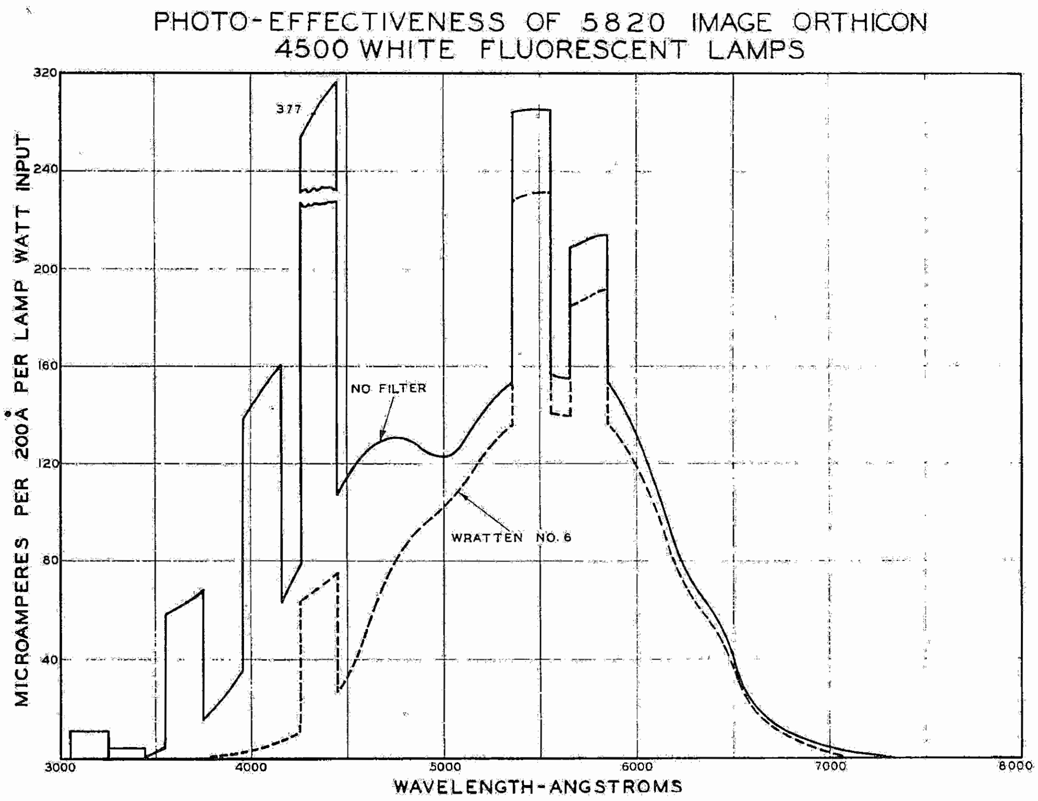


Fig. 5 - Reds and greens in scenes illuminated by 3500 white fluorescent and viewed by the 5820 image orthicon are naturally rendered. Blues which appear unnatural are improved by the use of a #6 filter.

PHOTO-EFFECTIVENESS OF 5820 IMAGE ORTHICON
3500 WHITE FLUORESCENT LAMPS

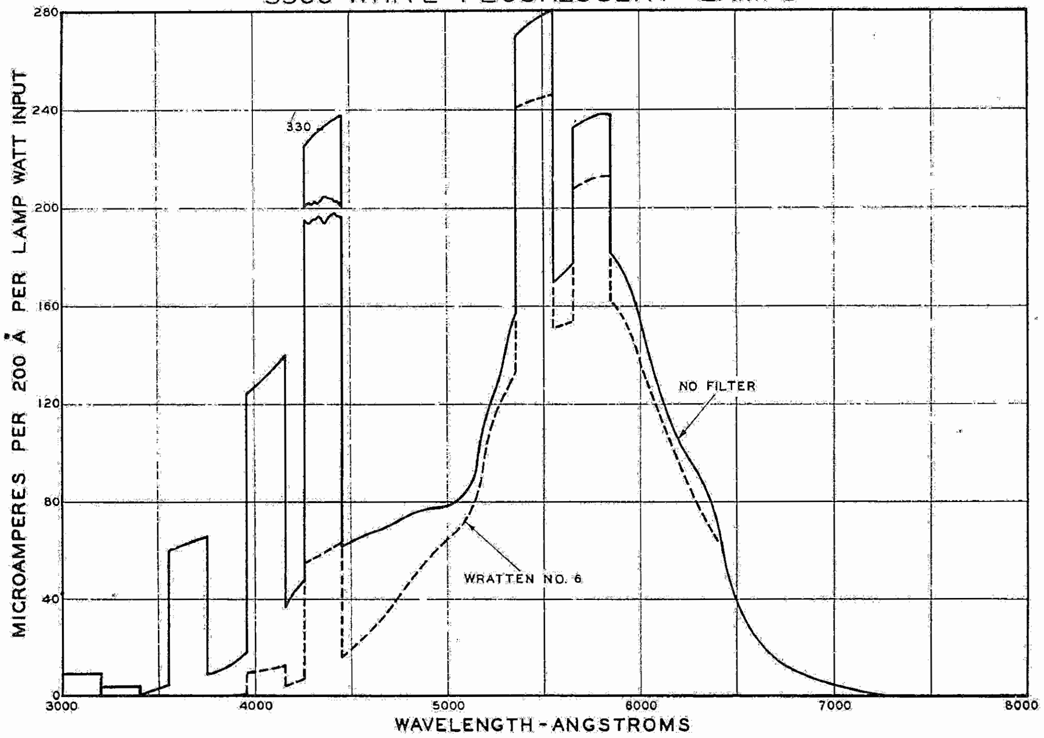


Fig. 6 - As with 4500 white fluorescent lamps, scenes illuminated with 3500 white lamps need the blue correction that the #6 filter provides.

PHOTO-EFFECTIVENESS OF 5820 IMAGE ORTHICON
3000° K TUNGSTEN FILAMENT LAMP

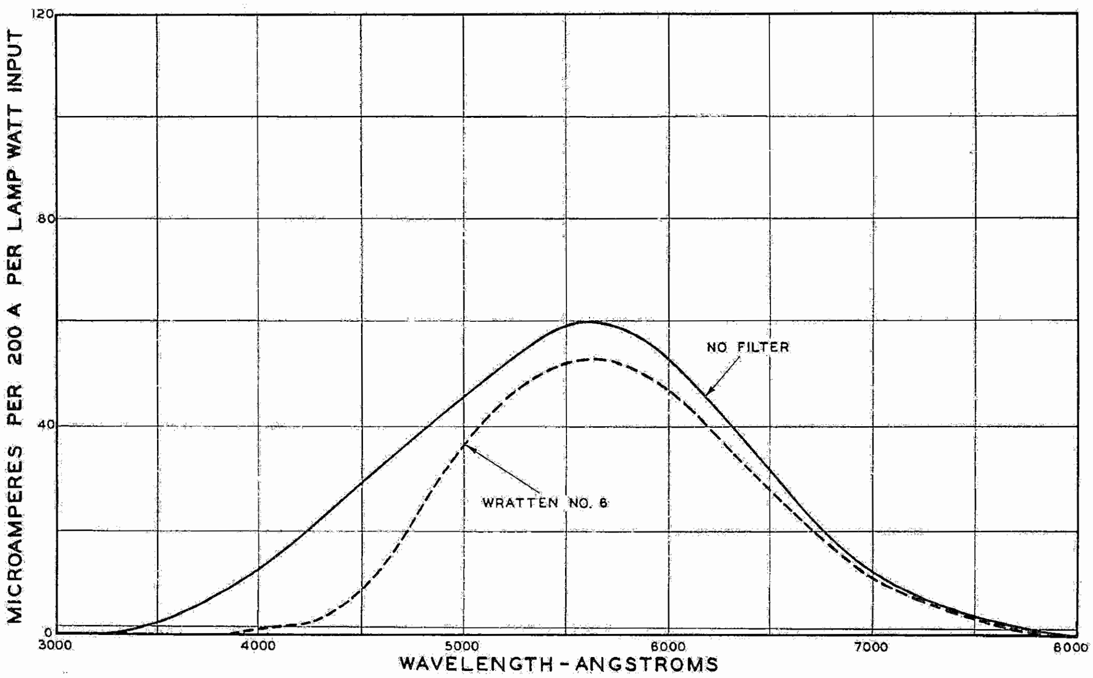
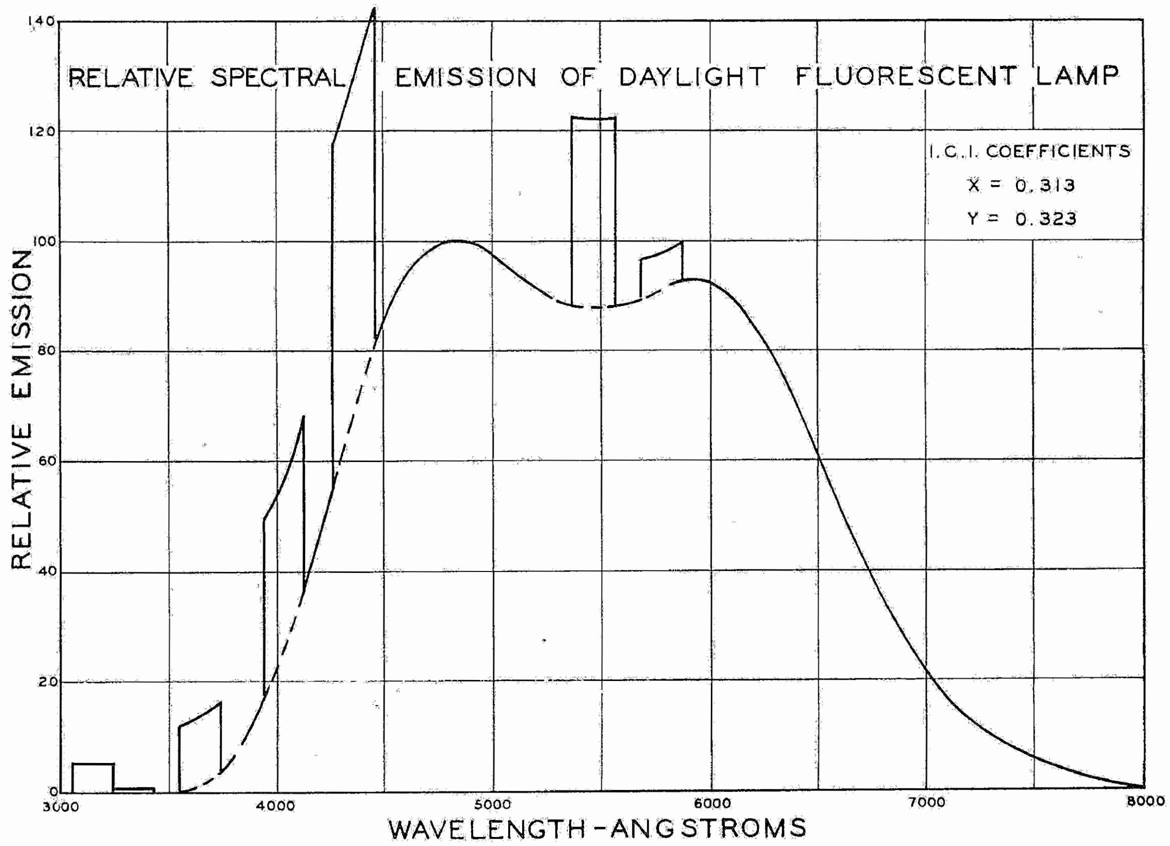
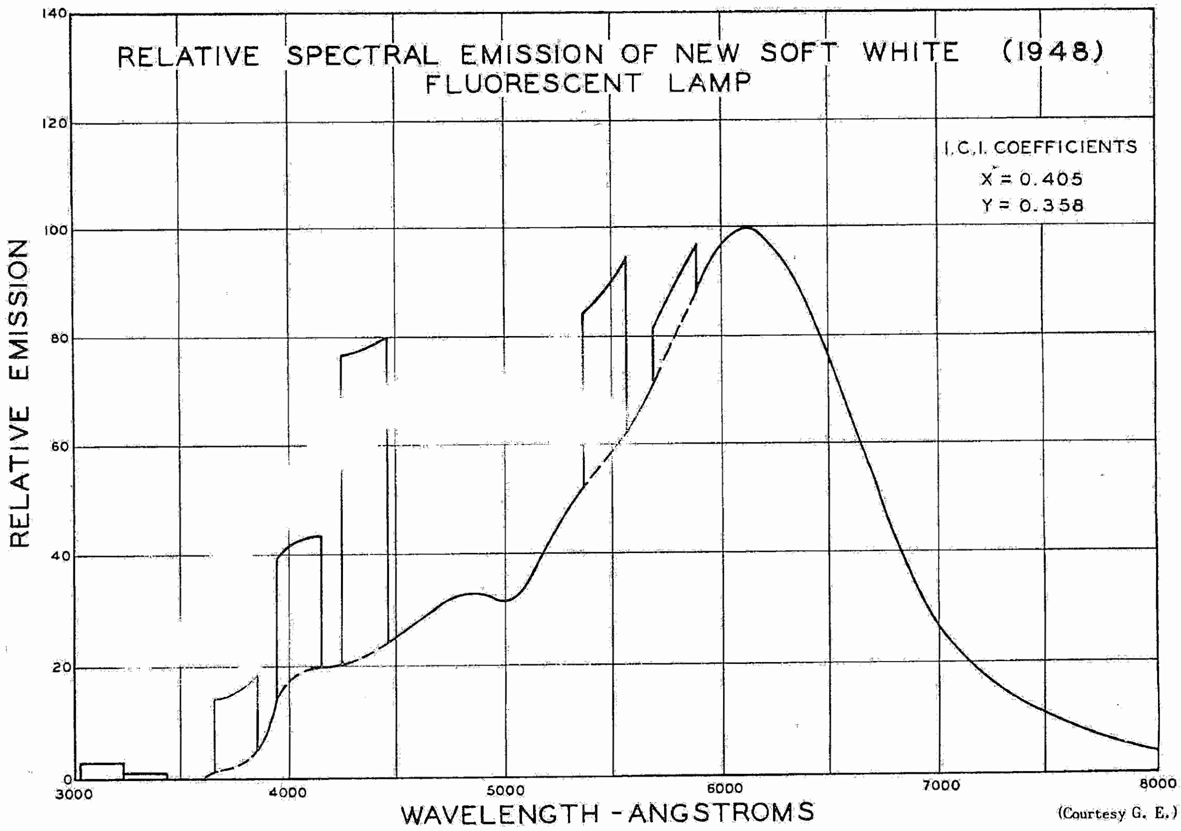
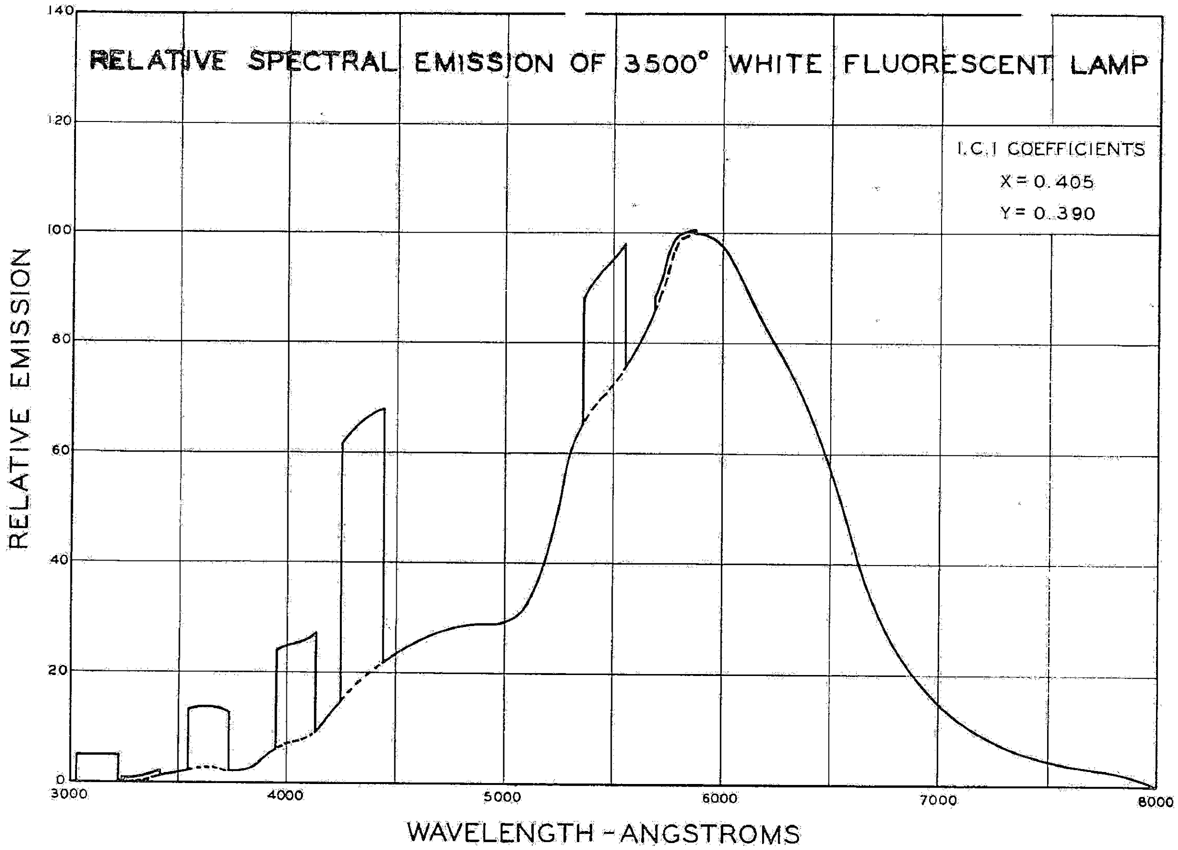


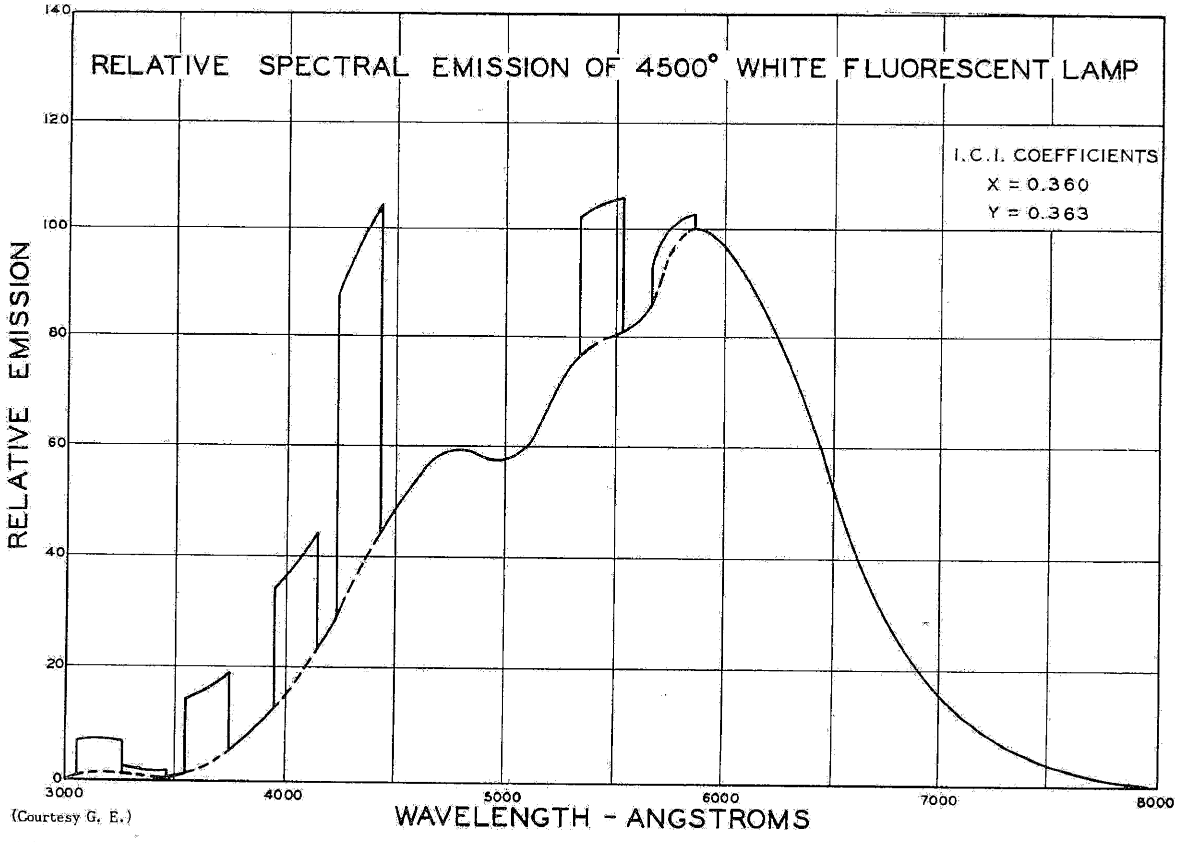
Fig. 7 - Colors in scenes illuminated by tungsten filament lamps appear very natural. Since filament and fluorescent sources may be used together, the effect of the #6 filter is shown.


RELATIVE SPECTRAL EMISSION OF DAYLIGHT FLUORESCENT LAMP
I.C.I. COEFFICIENTS
X = 0.313
Y = 0.323
RELATIVE EMISSION
WAVELENGTH-ANGSTROMS
0
20
40
60
80
100
120
140
3000
4000
5000
6000
7000
8000


RELATIVE SPECTRAL EMISSION OF NEW SOFT WHITE (1948)
FLUORESCENT LAMP
I.C.I. COEFFICIENTS
X = 0.405
Y = 0.358
RELATIVE EMISSION
WAVELENGTH - ANGSTROMS
0
20
40
60
80
100
120
140
3000
4000
5000
6000
7000
8000

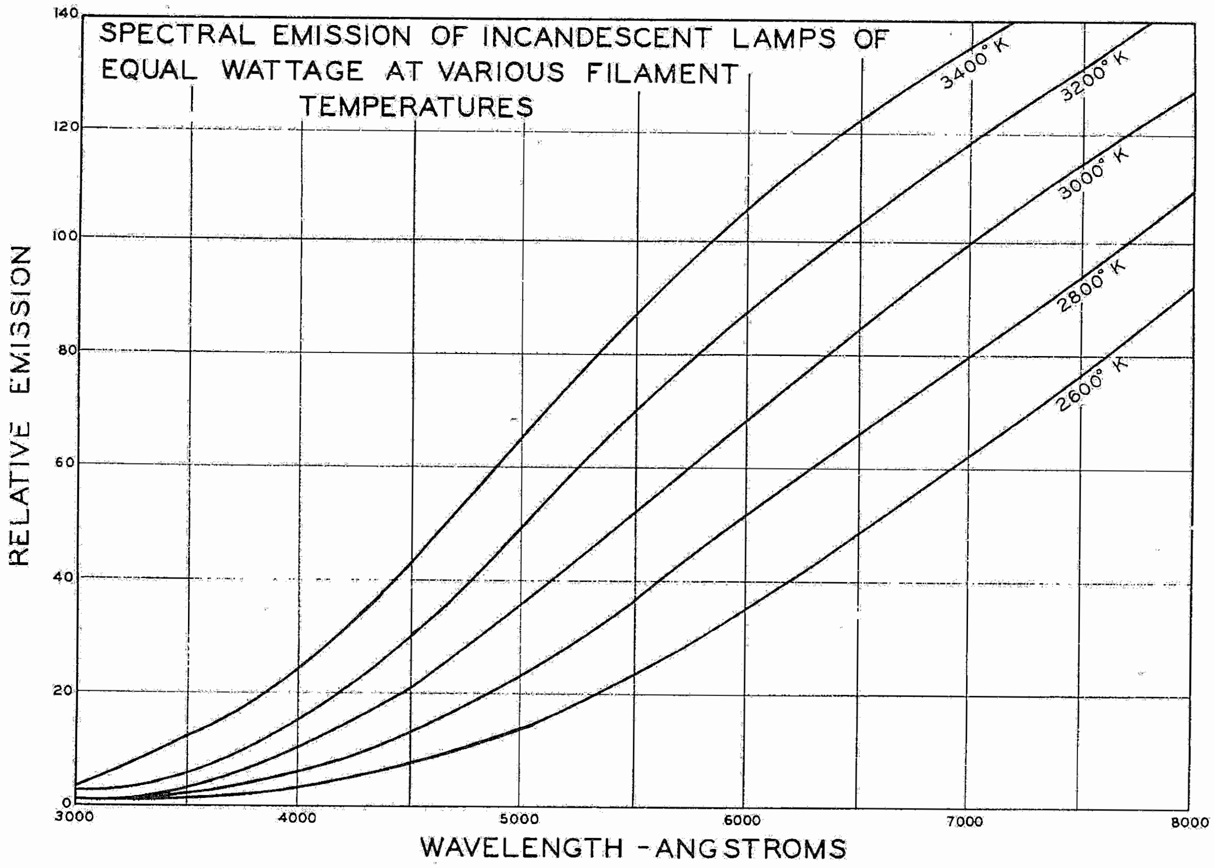
(Courtesy G. E.)

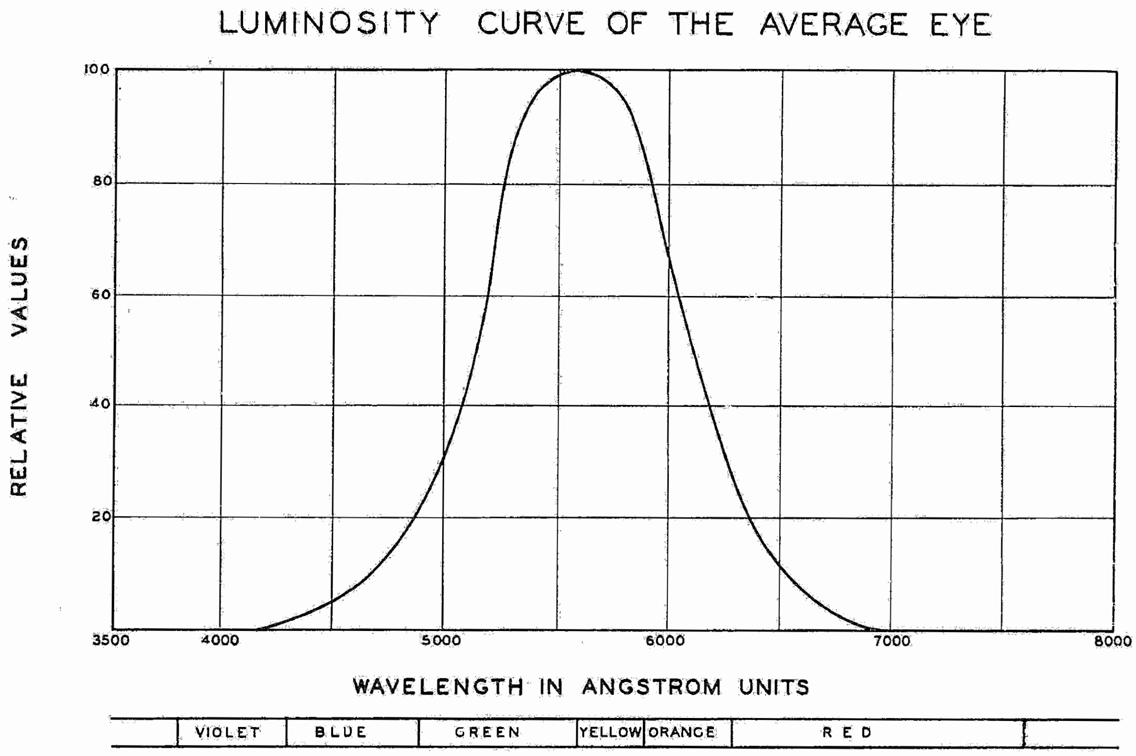




(Courtesy G. E.)

6-11-02





(Courtesy G. E.)

6-11-03

COMPARISON OF RADIANT ENERGY FROM TYPICAL FLUORESCENT AND TUNGSTEN SOURCES

FLUORESCENT LAMP

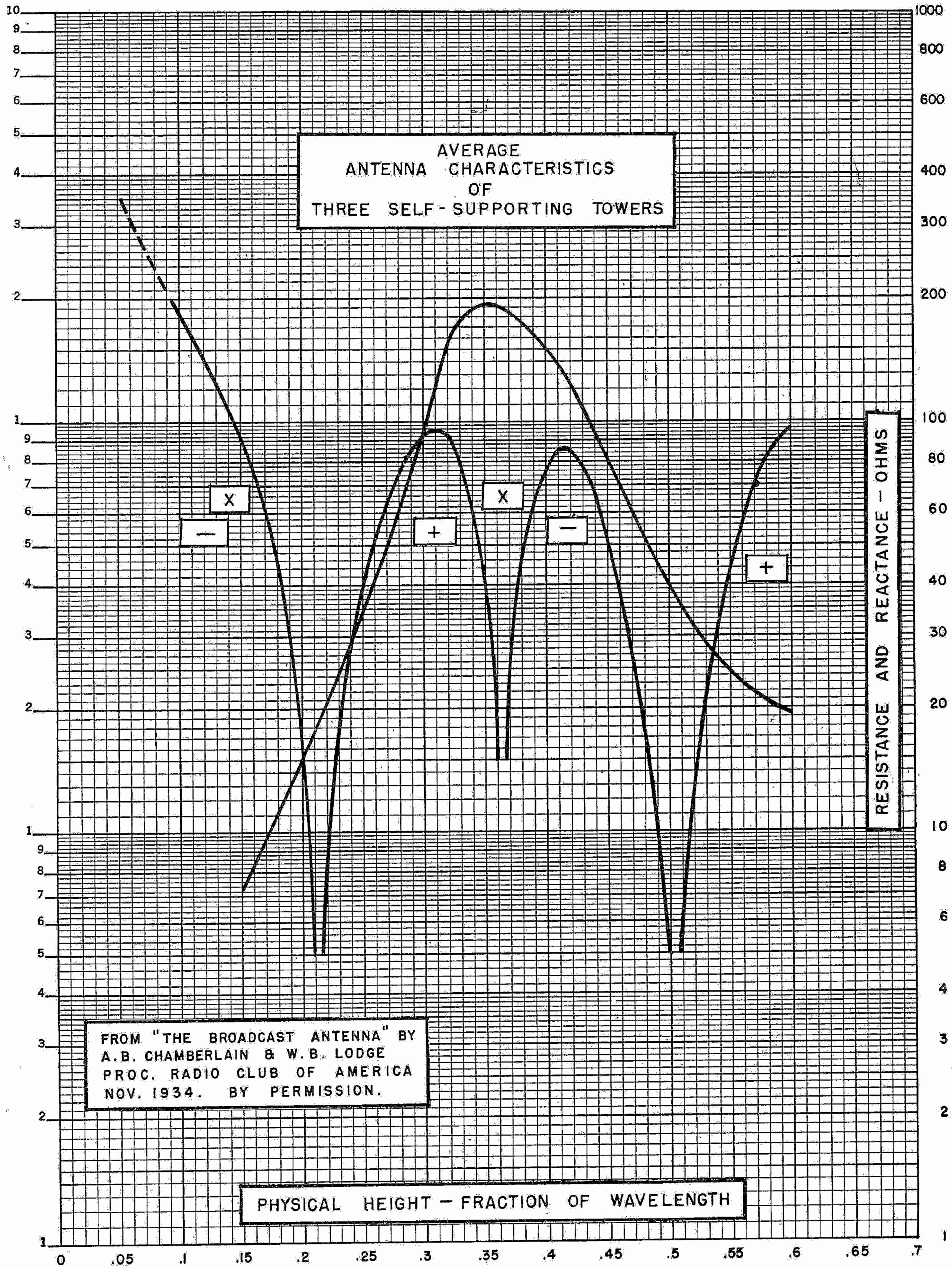
VISIBLE LIGHT	SHORT WAVE I-R	LONG WAVE INFRA-RED
20.5 %	26.5 %	53 %

TUNGSTEN LAMP AT 3000° K

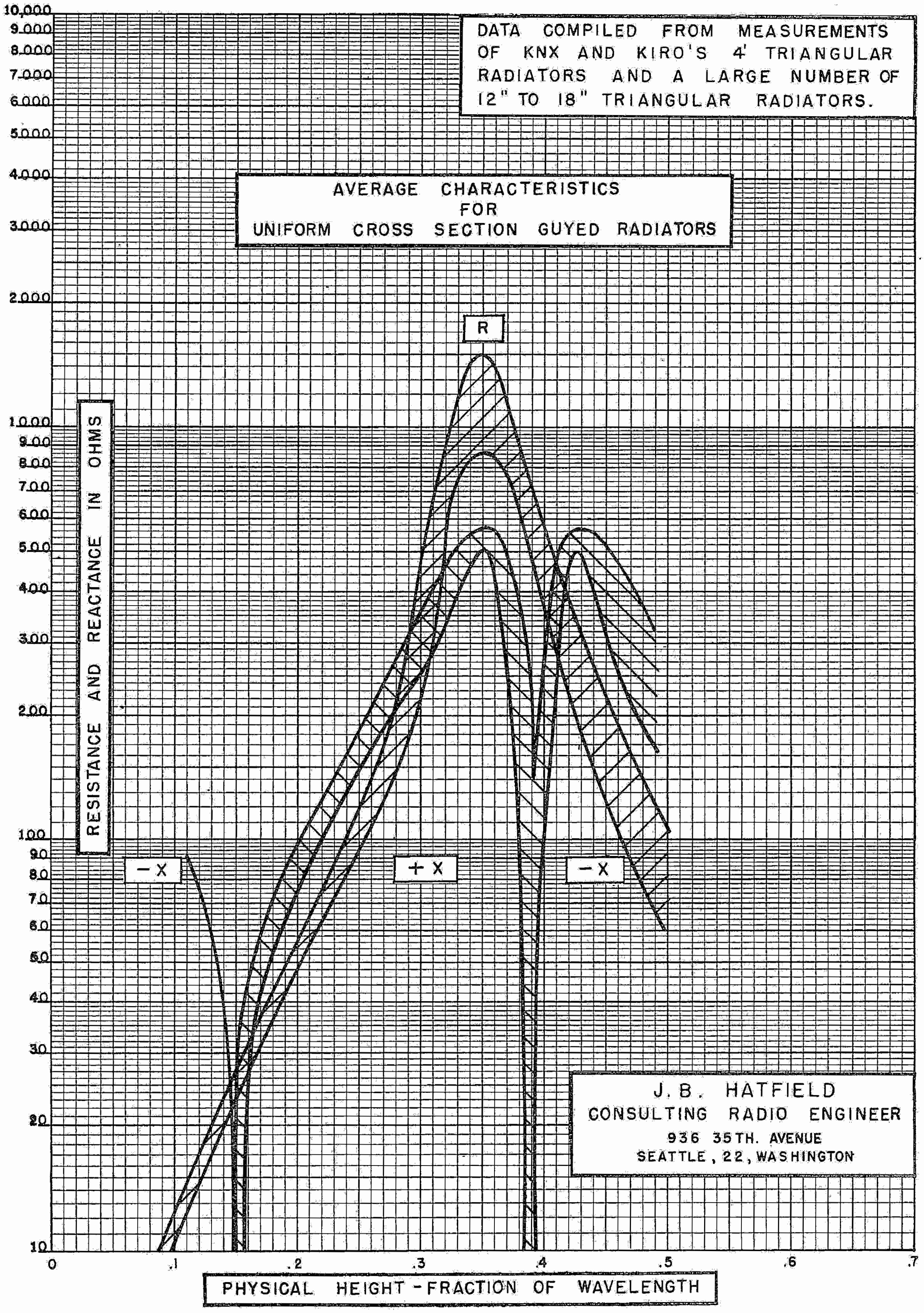
VISIBLE LIGHT	SHORT WAVE INFRA-RED	LONG WAVE I-R
12 %	70 %	18 %

← TOTAL LAMP WATTS →

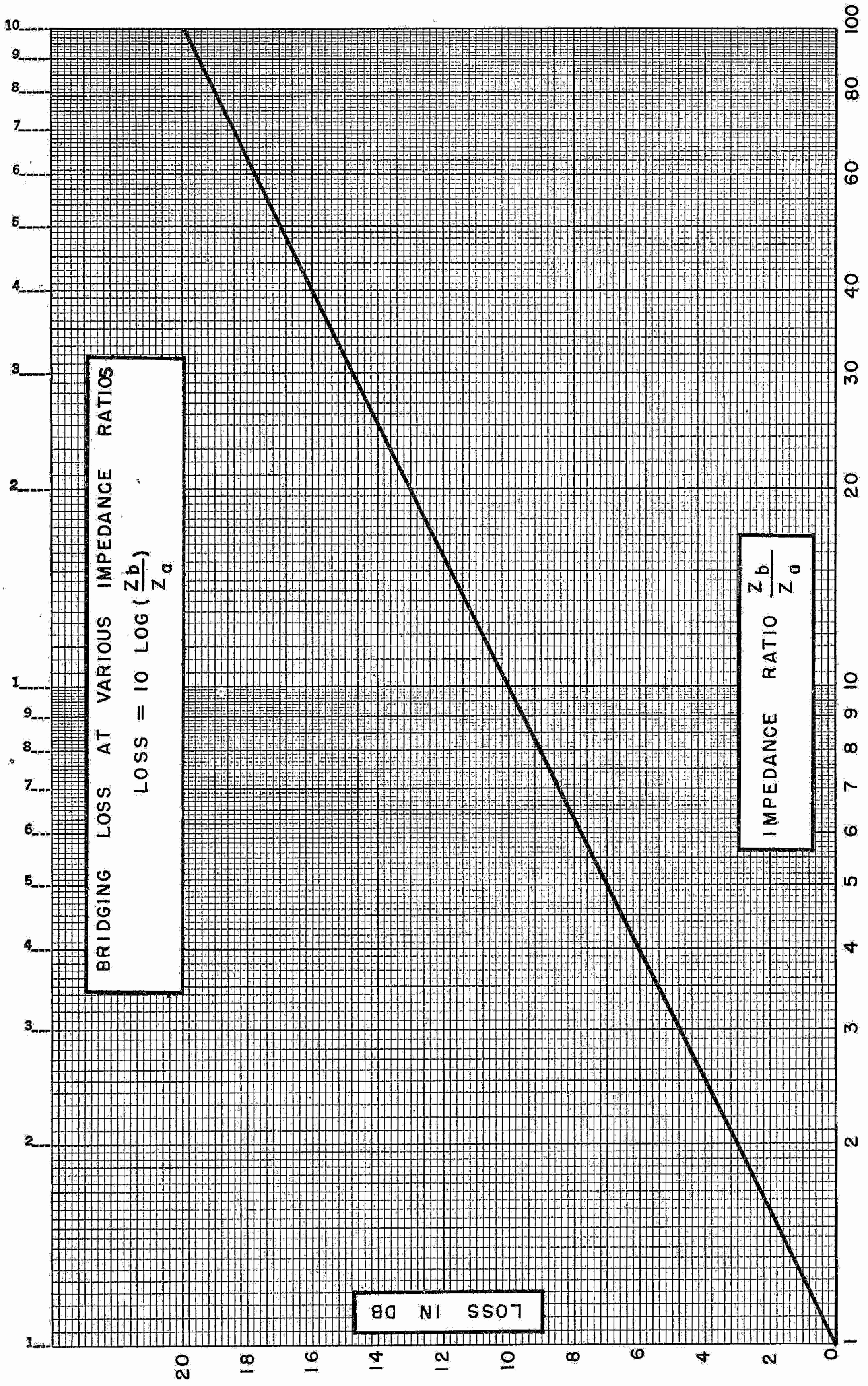
Courtesy G-E



AVERAGE
ANTENNA CHARACTERISTICS
OF
THREE SELF-SUPPORTING TOWERS
X
—
+
X
—
+
RESISTANCE AND REACTANCE - OHMS
FROM "THE BROADCAST ANTENNA" BY
A.B. CHAMBERLAIN & W.B. LODGE
PROC. RADIO CLUB OF AMERICA
NOV. 1934. BY PERMISSION.
PHYSICAL HEIGHT — FRACTION OF WAVELENGTH
0 .05 .1 .15 .2 .25 .3 .35 .4 .45 .5 .55 .6 .65 .7
1000 800 600 400 300 200 100 80 60 40 30 20 10 8 6 4 3 2 1


DATA COMPILED FROM MEASUREMENTS OF KNX AND KIRO'S 4' TRIANGULAR RADIATORS AND A LARGE NUMBER OF 12" TO 18" TRIANGULAR RADIATORS.
AVERAGE CHARACTERISTICS FOR UNIFORM CROSS SECTION GUYED RADIATORS
R
RESISTANCE AND REACTANCE IN OHMS
−X
+X
−X
J. B. HATFIELD
CONSULTING RADIO ENGINEER
936 35TH. AVENUE
SEATTLE, 22, WASHINGTON
PHYSICAL HEIGHT - FRACTION OF WAVELENGTH
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
900
800
700
600
500
400
300
200
100
90
80
70
60
50
40
30
20
10
0
.1
.2
.3
.4
.5
.6
.7

6-13-01


BRIDGING LOSS AT VARIOUS IMPEDANCE RATIOS
LOSS = 10 LOG (Zb / Za)
IMPEDANCE RATIO Zb / Za
LOSS IN DB
0 2 4 6 8 10 12 14 16 18 20
1 2 3 4 5 6 7 8 9 10 20 30 40 60 80 100

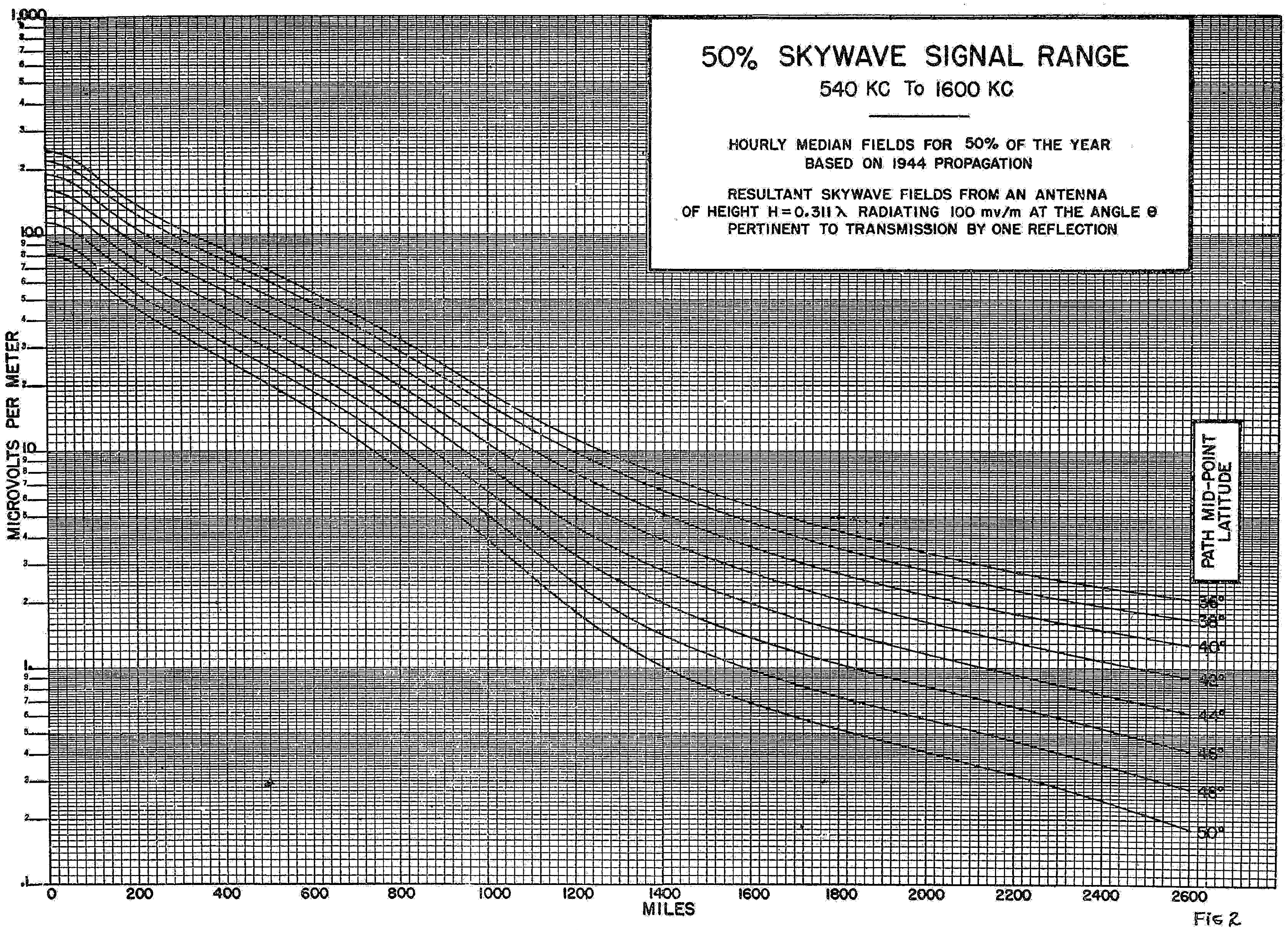

50% SKYWAVE SIGNAL RANGE
540 KC To 1600 KC
HOURLY MEDIAN FIELDS FOR 50% OF THE YEAR
BASED ON 1944 PROPAGATION
RESULTANT SKYWAVE FIELDS FROM AN ANTENNA
OF HEIGHT H=0.311 λ RADIATING 100 mv/m AT THE ANGLE θ
PERTINENT TO TRANSMISSION BY ONE REFLECTION
PATH MID-POINT
LATITUDE
36°
38°
40°
42°
44°
46°
48°
50°
MICROVOLTS PER METER
1,000
100
10
1
.1
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
MILES

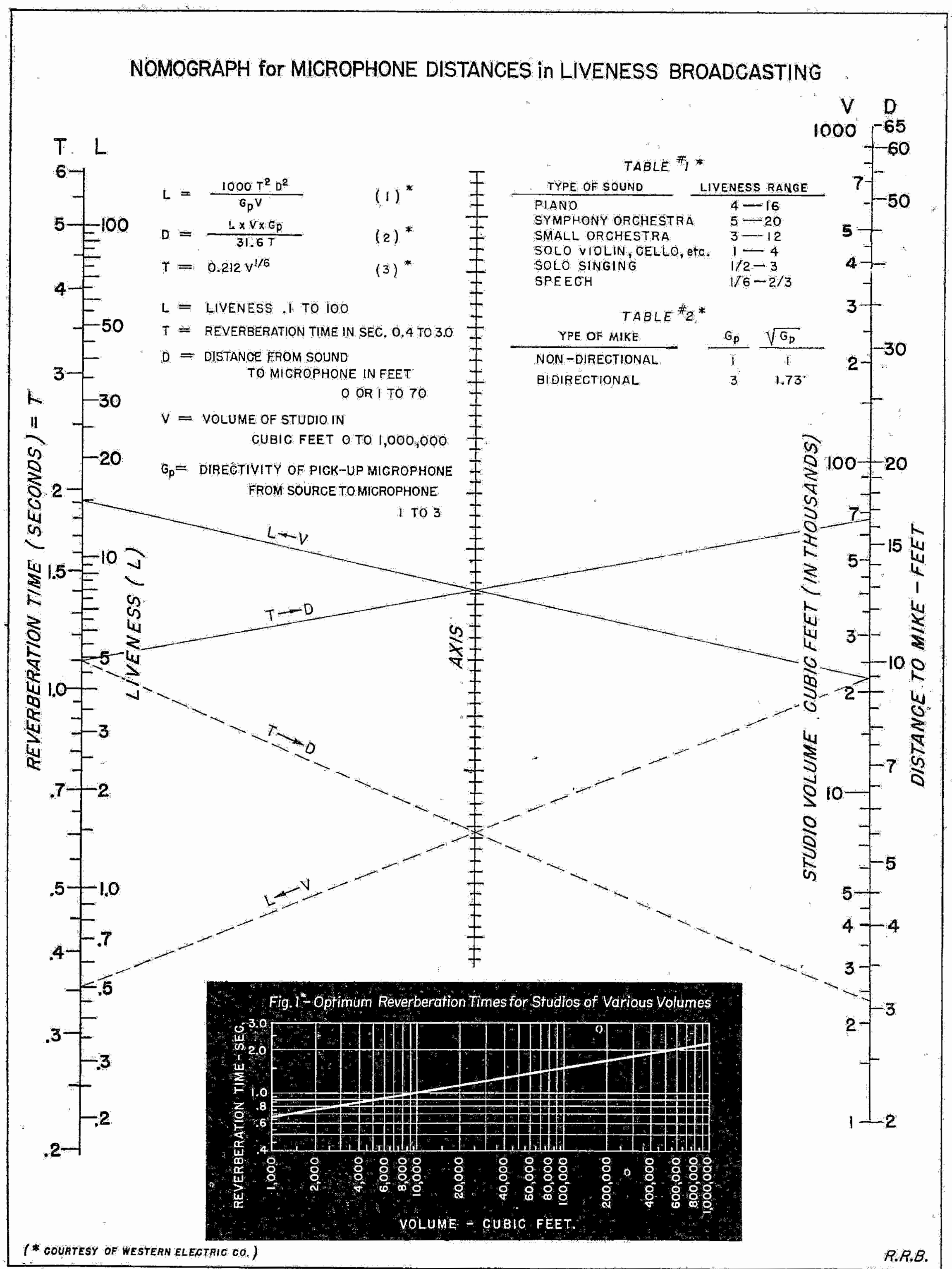
Fig 2

CONVERSION TABLE FOR UNITS OF LENGTH

MULTIPLY NUMBER OF → BY ↘ TO OBTAIN NUMBER OF ↓	ANGSTROMS	MICRONS	MILS	INCHES	FEET	MILES	MILLIMETERS	CENTIMETERS	KILOMETERS
ANGSTROMS	1	10^{4}	2.540×10^{5}	2.540×10^{8}	3.048×10^{9}	1.609×10^{13}	10^{7}	10^{8}	10^{13}
MICRONS	10^{-4}	1	2.540×10	2.540×10^{4}	3.048×10^{5}	1.609×10^{9}	10^{3}	10^{4}	10^{9}
MILS	3.937×10^{-6}	3.937×10^{-2}	1	10^{3}	1.2×10^{4}	6.336×10^{7}	3.937×10	3.937×10^{2}	3.937×10^{7}
INCHES	3.937×10^{-9}	3.937×10^{-5}	10^{-3}	1	12	6.336×10^{4}	3.937×10^{-2}	3.937×10^{-1}	3.937×10^{4}
FEET	3.281×10^{-10}	3.281×10^{-6}	8.333×10^{-5}	8.333×10^{-2}	1	5.280×10^{3}	3.281×10^{-3}	3.281×10^{-2}	3.281×10^{3}
MILES	6.214×10^{-14}	6.214×10^{-10}	1.578×10^{-8}	1.578×10^{-5}	1.894×10^{-4}	1	6.214×10^{-7}	6.214×10^{-6}	6.214×10^{-1}
MILLIMETERS	10^{-7}	10^{-3}	2.540×10^{-2}	2.540×10	3.048×10^{2}	1.609×10^{6}	1	10	10^{6}
CENTIMETERS	10^{-8}	10^{-4}	2.540×10^{-3}	2.540	3.048×10	1.609×10^{5}	0.1	1	10^{5}
KILOMETERS	10^{-13}	10^{-9}	2.540×10^{-8}	2.540×10^{-5}	3.048×10^{-4}	1.609	10^{-6}	10^{-5}	1

(FROM THE IES LIGHTING HANDBOOK -- SEE NAB RECOMMENDED LIBRARY.)

NOMOGRAPH for MICROPHONE DISTANCES in LIVENESS BROADCASTING



$$L = \frac{1000\, T^2 D^2}{G_p V} \qquad (1)^*$$

$$D = \frac{L \times V \times G_p}{31.6\, T} \qquad (2)^*$$

$$T = 0.212\, V^{1/6} \qquad (3)^*$$

L = LIVENESS .1 TO 100

T = REVERBERATION TIME IN SEC. 0.4 TO 3.0

D = DISTANCE FROM SOUND TO MICROPHONE IN FEET 0 OR 1 TO 70

V = VOLUME OF STUDIO IN CUBIC FEET 0 TO 1,000,000

G_p = DIRECTIVITY OF PICK-UP MICROPHONE FROM SOURCE TO MICROPHONE 1 TO 3

TABLE #1 *

TYPE OF SOUND	LIVENESS RANGE
PIANO	4 — 16
SYMPHONY ORCHESTRA	5 — 20
SMALL ORCHESTRA	3 — 12
SOLO VIOLIN, CELLO, etc.	1 — 4
SOLO SINGING	1/2 — 3
SPEECH	1/6 — 2/3

TABLE #2 *

YPE OF MIKE	G_p	$\sqrt{G_p}$
NON-DIRECTIONAL	1	1
BIDIRECTIONAL	3	1.73

Fig. 1 - Optimum Reverberation Times for Studios of Various Volumes

(* COURTESY OF WESTERN ELECTRIC CO.)

R.R.B.

Constants V = 22,000 cu. ft.; T = 1.1 sec.

EXAMPLE 1: (solid lines) Placement of general microphone. From Table 1 use liveness of 15. Connect 22000 on V and 15 on L. Mark reference on the axis. Then extend a line from 1.1 on T through reference on axis to 16.5 ft. on D. Answer: 16½ ft. from mike to sound source.

EXAMPLE 2: (dash lines) Placement of solo vocal microphone. From Table 1 use liveness of ½. Connect 22000 on V and ½ on L. Mark reference on the axis. Then extend line from 1.1 on T through this reference to 3 ft. on D. For bidirectional mike multiply 3 ft. by $\sqrt{3}$ or 1.73. This yields 5 to 6 ft. for actual distance.

(Reprinted from TELE-TECH)

CLEANING RELAY CONTACTS

(From the Engineering Notices of The National Broadcasting Company)

There are three general methods of cleaning relay contacts. The choice between these methods depends upon the character and amount of deposit encountered. The interval between cleanings depends upon the same elements plus atmospheric conditions, and is best determined by experience.

In general, relay equipment is installed in spaces that are relatively clean and free from dust, and cleaning of contacts is rarely necessary. Such dust as may lodge on contact surfaces will be removed during the regularly scheduled routining. However, in the event that observation indicates that cleaning is necessary, the following methods are recommended. They have been developed in cooperation with the Automatic Electric Company which manufactures most of the relays used by NBC.

Method No. 1

Used when ordinary dust is present.

(a) Remove loose dust from relay contacts with a brush suitable for the purpose as, for example, a clean, dry, tooth brush. This is all that is necessary in the majority of cases.

Method No. 2

Used only when the contacts have become covered with a gummy or greasy substance which is not readily removable by dry brushing.

(a) Dip clean tooth brush in chemically pure carbon tetrachloride, shake off excess, and brush contacts vigorously.

(b) Allow spring assembly to dry for approximately five minutes.

(c) Brush contacts with a clean dry tooth brush which has not been immersed in carbon tetrachloride.

Method No. 3

Used only when contacts have become pitted in normal use.

(a) Apply standard contact cleaning tool (Automatic Electric Company's type H-42962-1) as required to dress up the contact. This tool consists of a piece of sandblasted clock spring steel.

(b) Brush contacts with a clean dry tooth brush.

(c) Burnish contacts with a piece of smooth clock spring steel such as Automatic Electric's H-47386-1.

Notes:

1. It is not advisable to use a file when cleaning contacts, as the rough contact surface left by the file will readily collect dirt.
2. Strips of wood, paper, or fibre should not be used for cleaning contacts, as they generally leave minute particles of foreign material on the surface of the contact.

* IN THE COURSE OF SPOT WELDING COATED MATERIALS, THE COATINGS FREQUENTLY DISSOLVE IN THE OTHER METALS PRESENT OR BURN AWAY

	IRON	STAINLESS IRON	ALLEGHENY METAL	COBALT STEEL	NICKEL	NICHROME	MONEL METAL	NICKEL SILVER	BRASS	BRONZE	MANGANIN	EVERDUR	COPPER	ALUMINUM	MAGNESIUM	MOLYBDENUM	LEAD	TIN	CADMIUM	ZINC	GALVANIZED IRON *	TIN PLATE *	CHROMIUM PLATED STEEL *	NICKEL PLATED BRASS *
IRON	●																							
STAINLESS IRON	●	●																						
ALLEGHENY METAL	●	●	●																					
COBALT STEEL	●	●	●	●																				
NICKEL	●	●	●	●	●																			
NICHROME	●	●	●	●	●	●																		
MONEL METAL	●	●	●	●	●	●	●																	
NICKEL SILVER	●	●	●	●	●	●	●	●																
BRASS	●	●	●	●	●	●	●	●	●															
BRONZE	●	●	●	●	●	●	●	●	●	●														
MANGANIN	●	●	●	●	●	●	●	●	●	●	●													
EVERDUR	●	●	●	●	●	●	●	●	●	●	●	●												
COPPER	●	●	●	●	●	●	●	●	●	●	●	●	●											
ALUMINUM	●	●	●	⊕	○	•	⊕	⊕	•	⊕	•	•	•	●										
MAGNESIUM										⊕				●	●									
MOLYBDENUM	●	●	●	●	●	●	●	●	○	○	●		○	⊕		●								
LEAD							⊕	●	○	○	●	●					●							
TIN	○	○			⊕	○	●	●	●	●	●	●	●	○			●	●						
CADMIUM	●				⊕	○	●	●	●	●	●	●	●	○			●	●	●					
ZINC	⊕				⊕	⊕	•	•	•	•	•	•	•	●			⊕	⊕	⊕	•				
* GALVANIZED IRON	●	●	●	●	●	●	●	●	●	●	●	●	●	⊕			⊕	●	●	⊕	●			
* TIN PLATE	●	●	●	●	●	●	●	●	●	●	●	●	●	●			●	●	●	⊕	●	●		
* CHROMIUM PLATED STEEL	●	●	●	●	●	●	●	●	⊕	⊕	●		●	○							●	●	●	
* NICKEL PLATED BRASS	●	●	●	●	●	●	●	●	●	●	●	●	●	⊕		●	○	●	●	⊕	●	●	⊕	●

● GOOD WELD
• COMPLETELY MISCIBLE, BUT BRITTLE WELD
⊕ POOR WELD
○ NO WELD
BLANK SPACE — COMBINATION NOT TRIED

The welding characteristics of some 250 combinations of metals

(Reprinted from the Bell Laboratories Record)

STANDARD TELEPHONE CABLE COLOR CODE

Pair No.	*Color*	*Mate*	*Pair No.*	*Color*	*Mate*
1	Blue	White	26	Blue White	Red
2	Orange	White	27	Blue Orange	Red
3	Green	White	28	Blue Green	Red
4	Brown	White	29	Blue Brown	Red
5	Slate	White	30	Blue Slate	Red
6	Blue White	White	31	Orange White	Red
7	Blue Orange	White	32	Orange Green	Red
8	Blue Green	White	33	Orange Brown	Red
9	Blue Brown	White	34	Orange Slate	Red
10	Blue Slate	White	35	Green White	Red
11	Orange White	White	36	Green Brown	Red
12	Orange Green	White	37	Green Slate	Red
13	Orange Brown	White	38	Brown White	Red
14	Orange Slate	White	39	Brown Slate	Red
15	Green White	White	40	Slate White	Red
16	Green Brown	White	41	Blue	Black
17	Green Slate	White	42	Orange	Black
18	Brown White	White	43	Green	Black
19	Brown Slate	White	44	Brown	Black
20	Slate White	White	45	Slate	Black
21	Blue	Red	46	Blue White	Black
22	Orange	Red	47	Blue Orange	Black
23	Green	Red	48	Blue Green	Black
24	Brown	Red	49	Blue Brown	Black
25	Slate	Red	50	Blue Slate	Black

NOTE—The last pair in all cables is a Red with White mate, viz.

6-pair cable	6th pair	Red	White
11-pair cable	11th pair	Red	White
16-pair cable	16th pair	Red	White
26-pair cable	26th pair	Red	White
51-pair cable	51st pair	Red	White

6-20-01

A. COMPUTATION OF VERTICAL RADIATION CHARACTERISTICS

Two charts useful in the plotting of vertical radiation characteristics of a thin vertical wire appear in Section 2, Article 1, of this Handbook. However, for those who wish to compute the relative vertical radiation characteristics, the table below is suggested as a convenient means, using the following equation and table:

$$f_{(\theta)} = \frac{\cos(h \sin\theta) - \cos h}{\cos\theta\,(1-\cos h)}$$

* * * * * * * * * * *

h = ________ cos h = ________ sin h = ________ 1 - cos h = ________

(h = height in electrical degrees)

1. θ	2. $\sin\theta$	3. $h\sin\theta$	4. $\cos(h\sin\theta)$	5. $\cos(h\sin\theta) - \cos h$	6. $\cos\theta$	7. $\cos\theta\,(1-\cos h)$	8. $f\theta = \frac{5}{7}$
0°	(Relative value is always 1.0) (Horizon)						1.000
5°	.08716				.99619		
10°	.17365				.98481		
15°	.25882				.96593		
20°	.34202				.93969		
25°	.42262				.90631		
30°	.50000				.86603		
35°	.57358				.81915		
40°	.64279				.76604		
45°	.70711				.70711		
50°	.76604				.64279		
55°	.81915				.57358		
60°	.86603				.50000		
65°	.90631				.42262		
70°	.93969				.34202		
75°	.96593				.25882		
80°	.98481				.17365		
85°	.99619				.08716		
90°	(Relative value is always 0)						0.000

B. A CONVENIENT SLIDE RULE SHORT-CUT TO CONVERT ELECTRICAL DEGREES TO FEET, OR VICE-VERSA - WHEN FREQUENCY AND EITHER FEET OR DEGREES IS KNOWN

From the expression, Feet $= \frac{\text{Degrees}}{360^\circ} \times \frac{300}{f(\text{mc})} \times 3.281 = \text{Degrees} \times \frac{2.734}{f(\text{mc})}$, the following ratio may be set up on the slide rule using C and D scales: $\frac{2.734}{f(\text{mc})} = \frac{\text{Feet}}{\text{Degrees}}$. Set 2.734 on scale C over frequency in megacycles on Scale D, read feet and degrees on scales C and D respectively. In some instances it may be convenient to use the folded scales CF and DF.

GREAT CIRCLE DISTANCE AND BEARING CALCULATIONS

The need often arises in allocations problems for a simple and reliable method of computing the position of one radio station or area with respect to another expressed in degrees clockwise from true north. It is often equally important that the distance between these two points be known.

Bearings and distance may be computed in many ways. The method set forth here utilizes a table developed by Lieutenant Arthur A. Ageton, USN, which permits the simple solution of navigational problems. If the table is properly read and interpolations carefully made, the bearings and distances derived through use of the calculation sheet will be found to be in very close agreement with lengthy mathematical computations.

To use this method one must first obtain Hydrographic Office Publication No. 211, entitled "Dead Reckoning Altitude and Azimuth Table". The cost is 90¢ and the table may be ordered from the Hydrographic Office, Washington, D. C., or the Superintendent of Documents, Government Printing Office, Washington, D. C. Remittance must be made with the order; no postage is required.

The calculation sheet may be shortened in some respects if used only for determining bearings and distances between points within a limited area such as the United States or North America. As shown on page 6-22-02, bearings and distances may be calculated between any two points on the surface of the earth, if the latitude and longitude of the two positions are known.

If a considerable number of calculations are to be made, it is suggested that the calculation sheet be duplicated in quantity. Further, it is suggested that until one becomes thoroughly acquainted with the method the various STEPS be check-marked as they are completed.

GREAT CIRCLE DISTANCE AND BEARING CALCULATION SHEET

(Based on H.O. No. 211 Tables - Ageton)

FROM:
Location ______________________ (La) ___° ___' ___" (Lo) ___° ___' ___"

TO:
Location ______________________ (La') ___° ___' ___" (Lo') ___° ___' ___"

SYMBOLS USED

A Numbers in the "A" columns of the H.O. 211 tables.

B Numbers in the "B" columns of the H.O. 211 tables.

t (Lo∿Lo') The smaller angle between the two meridians, Lo and Lo'.

C Bearing East or West of 0° true.

D Great Circle Distance when converted to minutes of arc.

K An arc used in the calculations.

Dn The Great Circle Distance in Nautical Miles.

Ds The Great Circle Distance in Statute Miles.

(K∿La) The magnitude of the difference between arc K and La.

RULES

IF La AND La' ARE IN THE SAME HEMISPHERE (N or S)

K: Take K from bottom of columns in H.O. No. 211 tables if t is greater than 90°.

D: Take D from bottom of columns in H.O. No. 211 when t and (K∿La) are each greater than 90°.

C: Take C from bottom of columns in H.O. No. 211 when K is less than La.

(K∿La): Subtract K and La to find difference.

IF La AND La' ARE IN DIFFERENT HEMISPHERES (N & S)

K: Take K from bottom of columns in H.O. No. 211 tables if t is greater than 90°.

D: If t and (K∿La) are each less than 90°, take D from top of table, otherwise, from bottom.

C: Take C from bottom of tables in H.O. No. 211 tables unless (K∿La) is greater than 180°.

(K La): Add K and La to find magnitude. If (K∿La) exceeds 180°, subtract 180° before entering H.O. No. 211 table to find B3.

CALCULATIONS

(Follow rules closely for K, D, C, and B3) -also (K∿La).

	ADD--	SUBTRACT--	ADD--	SUBTRACT--
Lo' ______				
Lo ______	A1 ______	A3 ______	B2 ______	A2 ______
t= ______	B1+ ______	B2- ______	B3+ ______	A5- ______
La' ______	A2= ______	A4= ______	B4= ______	A6= ______
K= ______				
La ______				
(K∿La)= ______				

D= ______° ______' ______"

D: ______° x 60 = ______ + ______ ' = Dn ______ Miles

Dn ______ Miles x 1.152 = Ds ______ Miles

C* = ______° ______' ______" E/W of 0° true.

*NOTE: When Lo' is WEST of Lo, C will indicate bearings in degrees WEST of 0° true.
When Lo' is EAST of Lo, C will indicate bearings in degrees EAST of 0° true.

STEPS

1. List coordinates for Locations.
2. Subtract Lo and Lo' to find arc t.
3. Enter H.O. No. 211 with t to find A1.
4. Enter table with La' to find B1 and A3.
5. Add A1 and B1 for A2.
6. Enter table with A2 to find B2.
7. Subtract B2 from A3 for A4.
8. Enter table with A4 for arc K.
9. Determine arc for (K∿La).
10. Enter table with (K∿La) for B3.
11. Add B2 and B3 for B4.
12. Enter table with B4 to find A5 and arc D.
13. Subtract A5 from A2 for A6.
14. Enter table with A6 for bearing C.
15. Follow steps shown to find Ds & Dn.