COMMUNICATIONS DEPARTMENT, DATA SHEET 401

USEFUL VIDEO EQUALISER FORMULAE

Video Equalisers in General

$$\frac{L}{C'} = \frac{L'}{C} = 75^2 = 5625$$

Non-Resonant Equalisers

C.E.I.(S) No. 5 deals with use of the BBC precision equaliser mask outside the audio frequency spectrum, and at characteristic impedances other than 600Ω.

Briefly to use the mask at frequencies above the 100 Hz index line simply multiply the reactive component values given on the mask by the ratio 100/f. Where f is the new index line (usually 100 kHz or 1 MHz). To convert from the 600Ω characteristic impedance to 75Ω characteristic impedance divide the resistive, and inductive component values given on the mask by 8 and multiply the capacitive component values by 8 (i.e. impedance ratio = 600/75).

Resonant Equalisers

The BBC precision equaliser masks will yield the following information:

a) $\frac{L}{C}$ ratio, as on mask

b) f, the resonant frequency in Hz

c) Basic Loss - values given in tables 403/8 to 10

The following formulae give the capacity values for use in 75Ω resonant equalisers. The inductance values can be obtained from the table on Sheet 2.

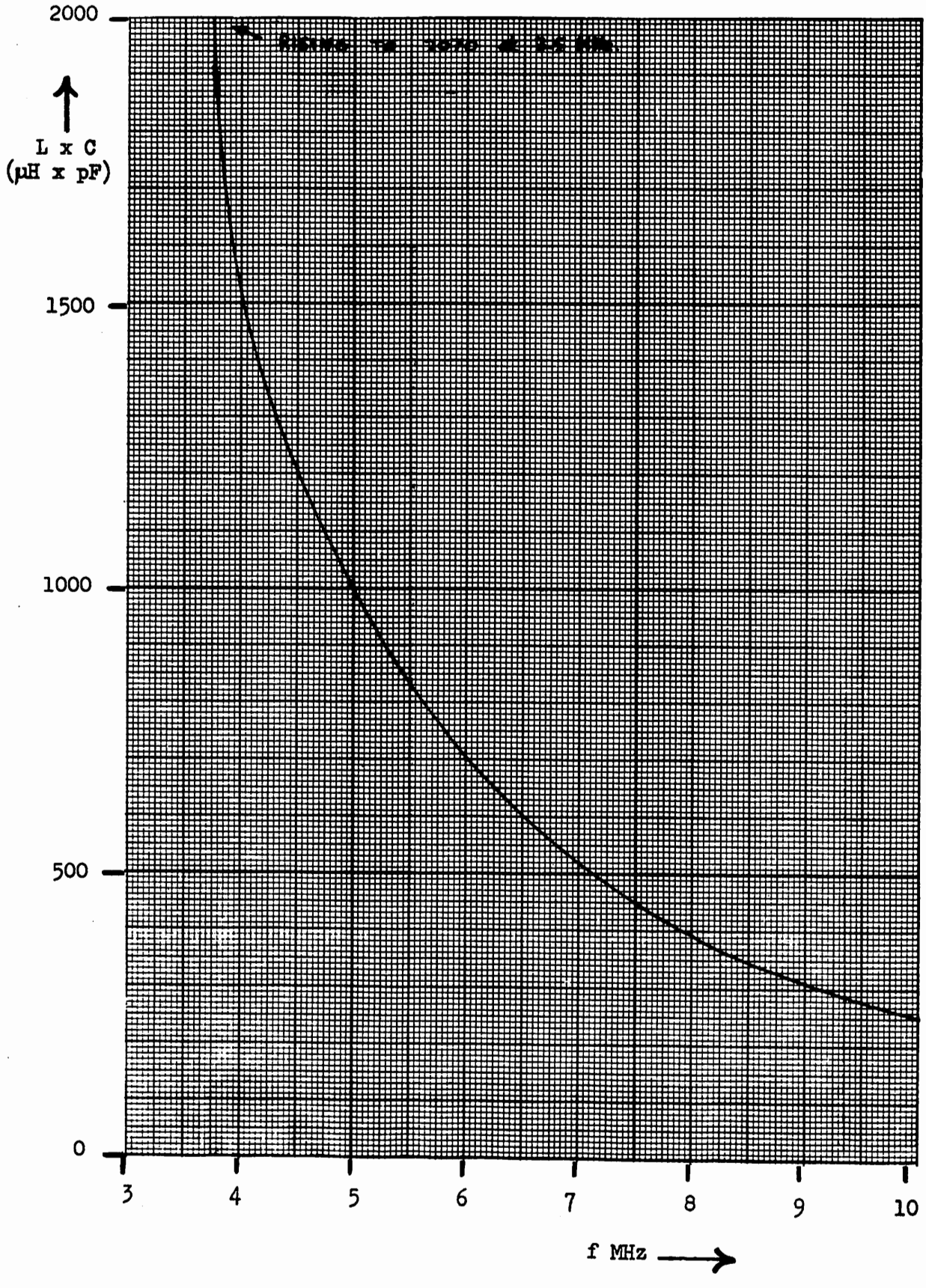
$$C = \frac{1270}{f\sqrt{\frac{L}{C}}}\ \mu F \qquad\qquad C' = \frac{3540\sqrt{\frac{L}{C}}}{f}\ \mu F$$

TABLE GIVING L & C VALUES FOR 75Ω VIDEO EQUALISERS

CpF and L'μH or C'pF and LμH		Turns	CpF and L'μH or C'pF and LμH		Turns	CpF and L'μH or C'pF and LμH		Turns	
10	.056	<3	100	.56	6	1000	5.6	28	
11	.062	<3	110	.62	7	1100	6.2	29	
12	.0675	<3	120	.675	7	1200	6.75	31	
13	.073	<3	130	.73	7	1300	7.3	33	
15	.084	<3	150	.84	8	1500	8.4	36	
16	.09	<3	160	.9	8	1600	9.0	37	
18	.101	<3	180	1.01	9	1800	10.1	41	
20	.112	<3	200	1.12	9	2000	11.2	44	
22	.124	<3	220	1.24	10	2200	12.4	47	
24	.135	<3	240	1.35	10	2400	13.5	50	
27	.152	<3	270	1.52	11	2700	15.2	55	
30	.169	<3	300	1.69	12	3000	16.9	60	
33	.186	<3	330	1.86	13	3300	18.6	65	
36	.202	<3	360	2.02	14	3600	20.2	70	
39	.22	3	390	2.2	14	3900	22.0	45	
43	.242	3	430	2.42	15	4300	24.2	47	
47	.265	3	470	2.65	16	4700	26.5	50	
51	.287	4	510	2.87	17	5100	28.7	54	
56	.315	4	560	3.15	18	5600	31.5	57	
62	.35	4	620	3.5	20	6200	35.0	62	38 SWG
68	.382	5	680	3.82	21	6800	38.2	65	
75	.423	5	750	4.23	23	7500	42.3	69	
82	.462	5	820	4.62	24	8200	46.2	74	
91	.512	6	910	5.12	26	9100	50.6	79	

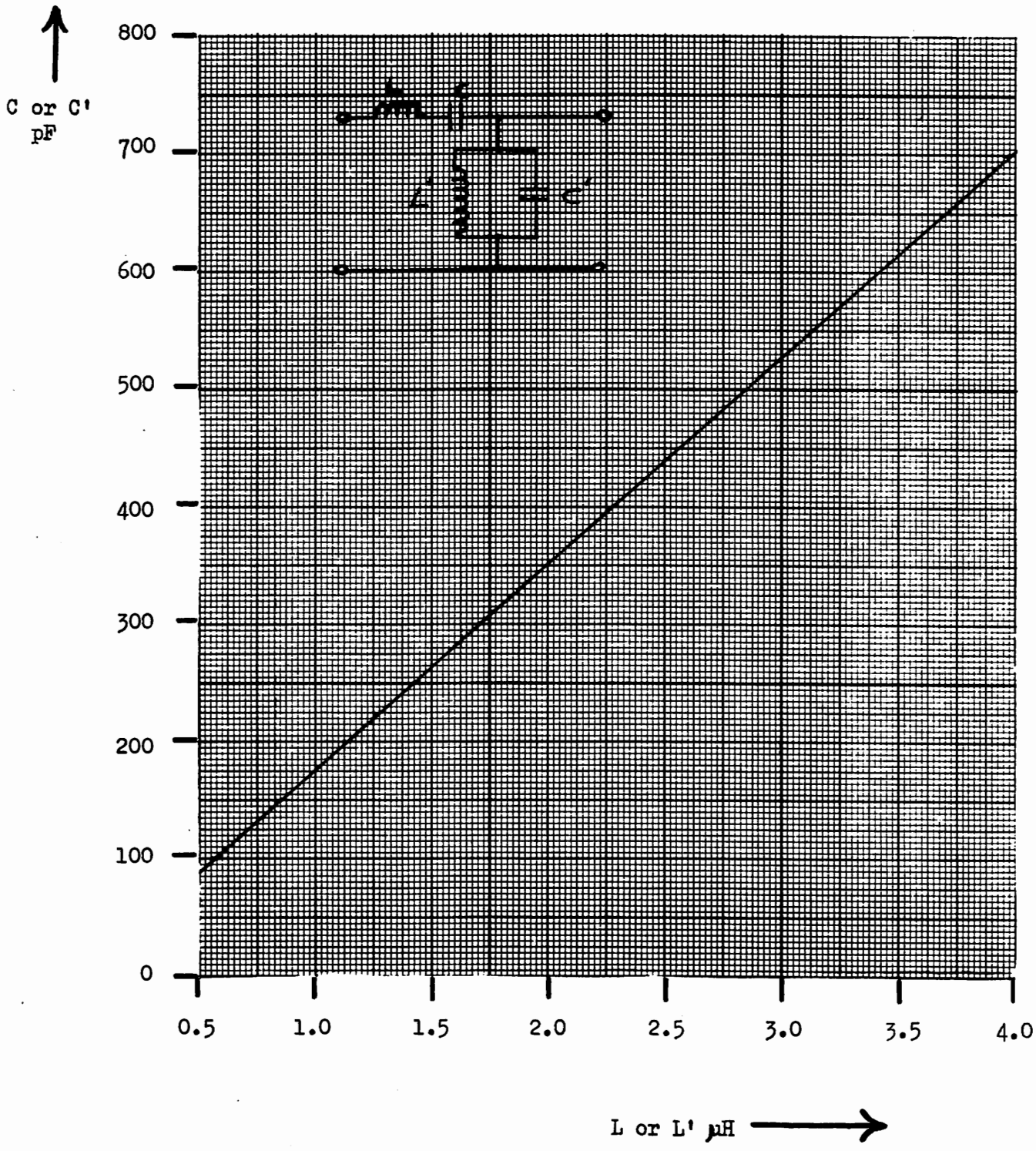
The number of turns shown above apply to the standard neosid coil former type DRG 666, and 30 SWG enamelled copper wire should be used (except where stated otherwise).

RESONANT CONSTANTS



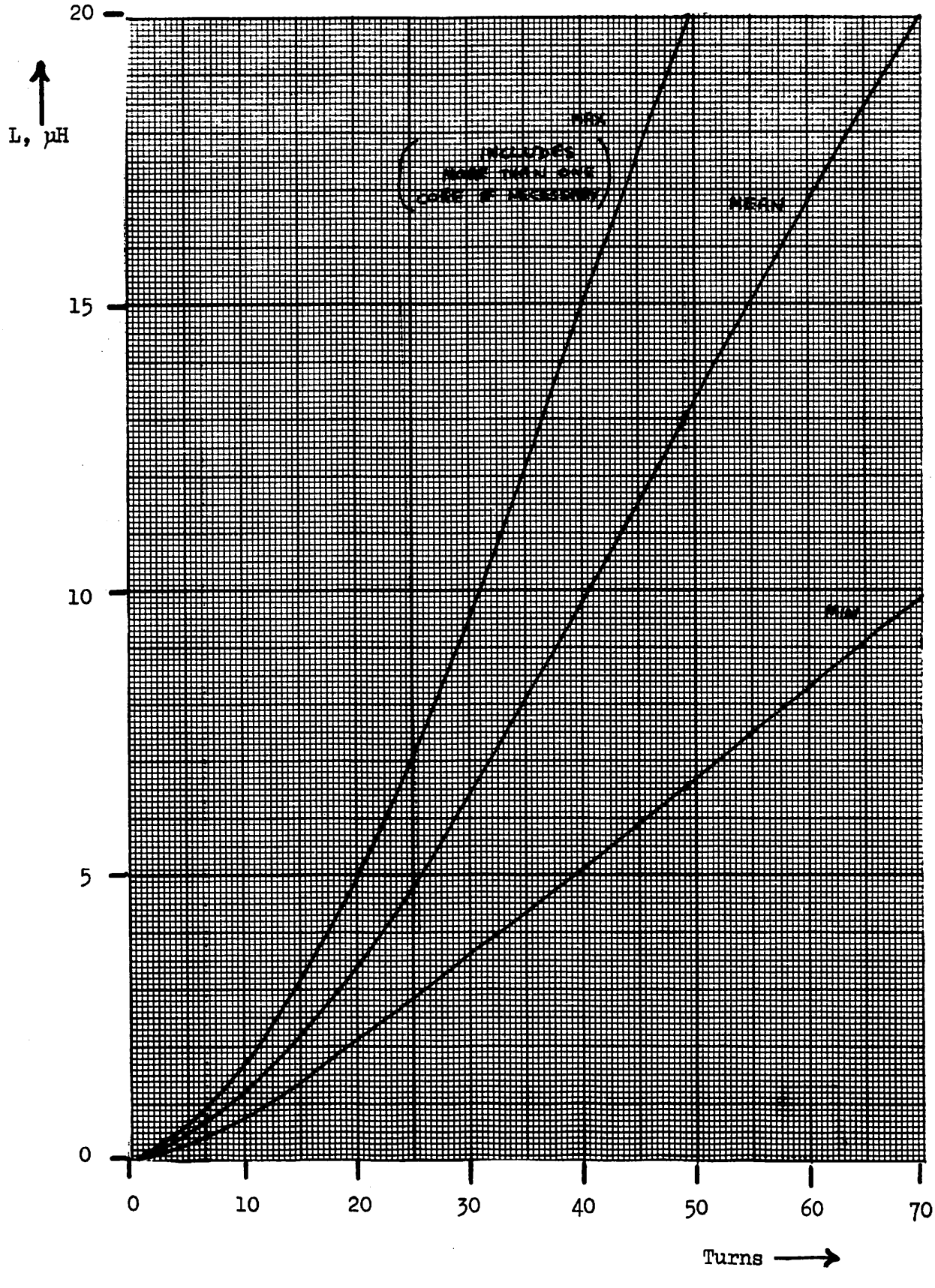
INVERSE COMPONENT VALUES FOR 75Ω VIDEO EQUALISER

The scales may be multiplied or divided by a factor of ten.



COIL WINDING DATA FOR NEOSID COIL FORMER 30 SWG

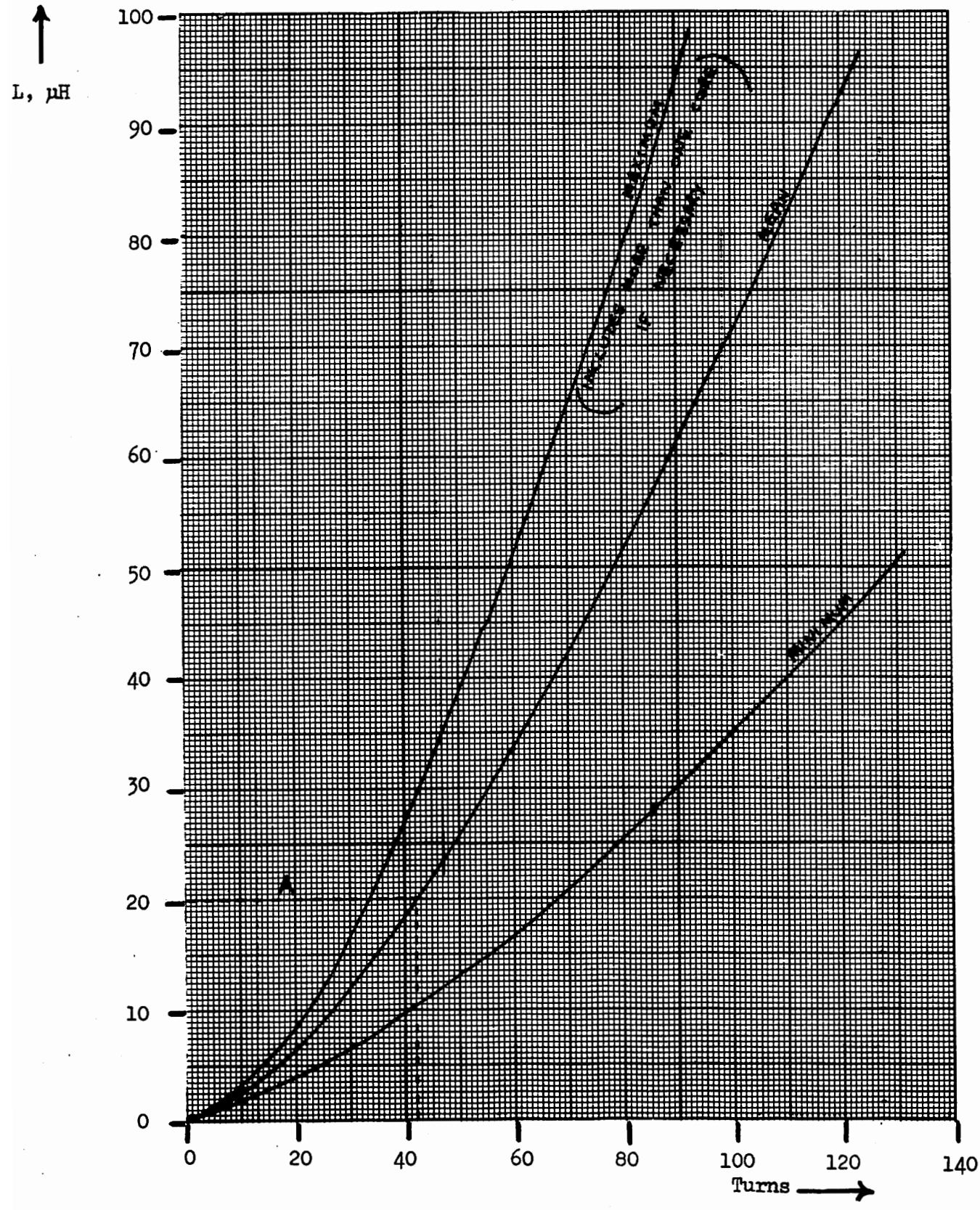
Former Diam. = 8.5 mm
Length = 2.54 cm (1")
Uses dust iron cores 6mm



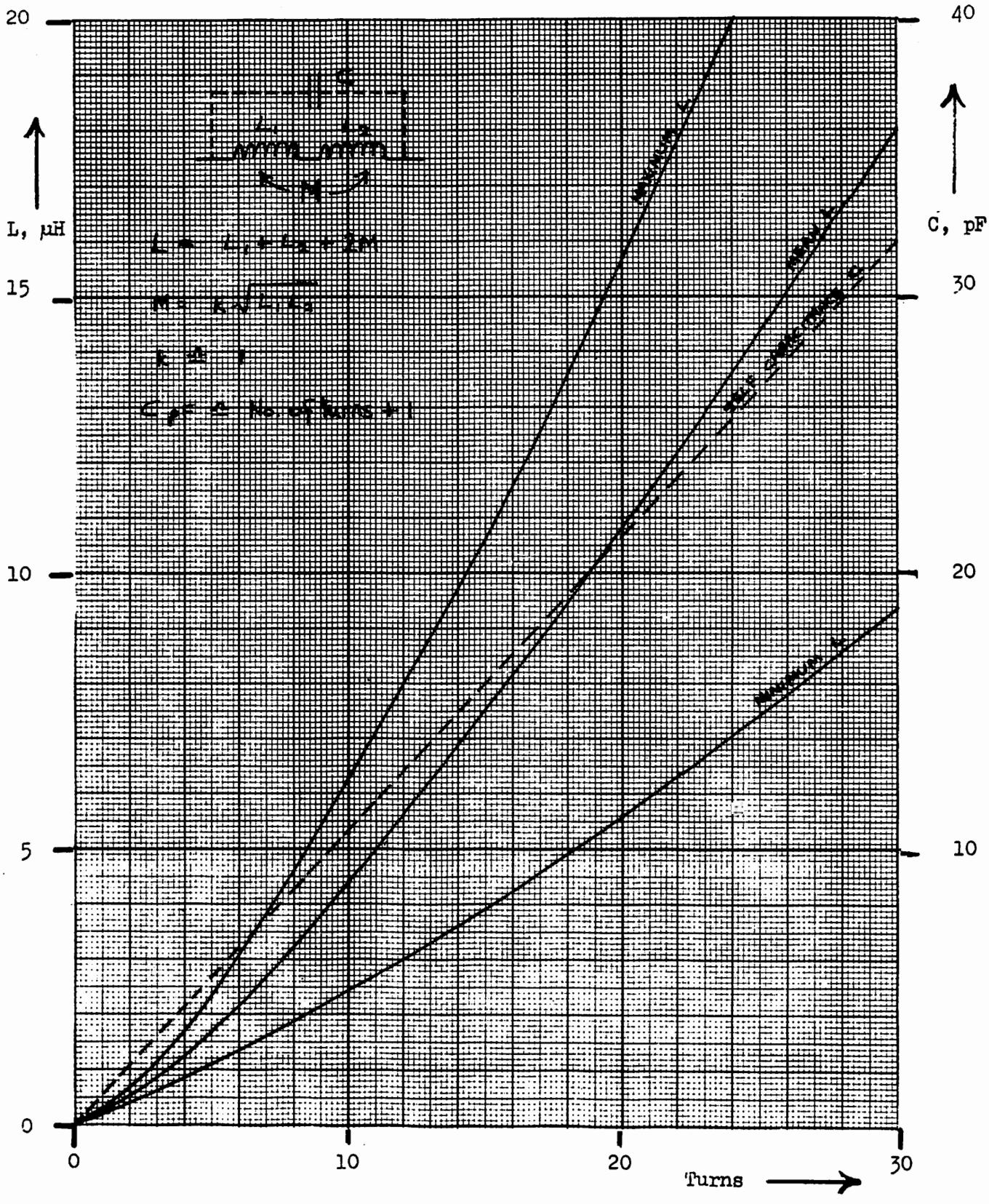
COIL WINDING DATA FOR NEOSID COIL FORMER 38 SWG

'A' : It is recommended that 30 SWG be used below 20 µH.

Former Diam. = 8.5 mm
Length = 2.54 cm (1")
Uses 6 mm dust iron cores



INDUCTANCE & SELF CAPACITY USING A SINGLE LAYER OF 30 SWG (BIFILAR WOUND) COPPER WIRE ON STANDARD NEOSID COIL FORMER



CAUER EQUALISERS

When setting up a temporary equaliser, the variable EQ1/505 can be set at any component values which give the correct results. If it is then required to build a permanent equaliser to duplicate the results obtained with the EQ1/505 there are two ways in which this can be done.

Method 1

Applying the multiplying factor K for the particular basic loss value in use, the component values can be calculated and then "built up" from a number of preferred value components by measuring the components on a bridge.

Method 2

The equaliser can be built using preferred value components only. This implies that certain settings of the variable EQ5/505 are barred from use as they do not transform into preferred value components. The settings which are permitted are listed in the following tables together with the transformed values (in preferred value components).

It is not possible to build a fixed equaliser which duplicates exactly the response of the EQ1/505. There is always an inherent error. In the case of Method 1 above, this error has a maximum value of about 0.5 dB. In the case of Method 2 above, this error is likely to be slightly worse. However, the error may be reduced by suitable adjustment of the inductor cores.

CAUER INFORMATION

Nominal Loss (dB)	1	2	3	4	5	8	11	14	17	20
Actual Loss (dB)	0.9	2.1	3.0	4.0	4.9	7.9	11.4	14.1	17.2	20.1
R1 (Ω)	8.2	20	30	43	56	110	200	300	470	680
Ra (Ω)	680	270	180	130	100	51	27	18	12	8.2
Scale K Factor	.0363	.0829	.118	.160	.198	.327	.487	.626	.791	1.0

To convert Cauer equaliser values R12-R15, C11-C15 and L11 to the corresponding values R2-R5, C1-C5 and L1 in the series arm of the full-section equaliser, the resistance and inductance values are multiplied by the Scale Factor, capacitance values are divided by the Scale Factor.

The shunt arm components of the full-section equaliser, Ra-Re, La-Le and Ca, are the reciprocal form of the series arm components R1-R5, C1-C5 and L1. Corresponding component values are related by the expression:

$$Z1ZA = Ro^2$$

RESISTOR VALUES

CAUER SETTING R12 R13 R14 R15	1 dB R2 R3 R4 R5	 Rb Rc Rd Re	2 dB R2 R3 R4 R5	 Rb Rc Rd Re	3 dB R2 R3 R4 R5	 Rb Rc Rd Re	4 dB R2 R3 R4 R5	 Rb Rc Rd Re
180	6.8	820	15	390	22	270	30	180
220	8.2	680	18	300	27	200	36	160
270	10.0	560	22	270	33	180	43	130
330	12	470	27	200	39	150	51	110
390	-	-	33	180	47	120	62	91
470	-	-	39	150	56	100	75	75
560	20	270	47	120	68	82	91	62
680	24	240	56	100	82	68	110	51
820	30	180	68	82	100	56	130	43
1.0 K	36	160	82	68	120	47	160	36
1.2 K	43	130	100	56	150	39	-	-
1.5 K	56	100	120	47	180	30	240	24
1.8 K	68	82	150	39	220	27	300	18
2.2 K	82	68	180	30	270	20	360	16
2.7 K	100	56	220	27	330	18	430	13
3.3 K	120	47	270	20	390	15	510	11
3.9 K	-	-	330	18	470	12	620	9.1
4.7 K	-	-	390	15	560	10	780	7.5
5.6 K	200	27	470	12	680	8.2	910	6.2
6.8 K	240	24	560	10	820	6.8	1.1 K	5.1
8.2 K	300	18	680	8.2	1.0 K	5.6	1.3 K	4.3
10 K	360	16	820	6.8	1.2 K	4.7	1.6 K	3.6
12 K	430	13	1.0 K	5.6	1.5 K	3.9	-	-
15 K	560	10	1.2 K	4.7	1.8 K	3.0	2.4 K	2.4
18 K	680	8.2	1.5 K	3.9	2.2 K	2.7	3.0 K	1.8
22 K	820	6.8	1.8 K	3.0	2.7 K	2.0	3.6 K	1.6

RESISTOR VALUES

CAUER SETTING R12 R13 R14 R15	5 dB R2 R3 R4 R5	 Rb Rc Rd Re	8 dB R2 R3 R4 R5	 Rb Rc Rd Re	11 dB R2 R3 R4 R5	 Rb Rc Rd Re	14 dB R2 R3 R4 R5	 Rb Rc Rd Re
180	36	160	56	100	91	62	110	51
220	43	130	75	75	110	51	-	-
270	51	110	91	62	130	43	160	36
330	68	82	110	51	160	36	200	27
390	75	75	130	43	-	-	240	24
470	91	62	150	39	220	27	300	18
560	110	51	180	30	270	20	360	16
680	130	43	220	27	330	18	430	13
820	160	36	270	20	390	15	510	11
1.0 K	200	27	330	18	470	12	620	9.1
1.2 K	240	24	390	15	560	10	750	7.5
1.5 K	300	18	-	-	750	7.5	910	6.2
1.8 K	360	16	560	10	910	6.2	1.1 K	5.1
2.2 K	430	13	750	7.5	1.1 K	5.1	-	-
2.7 K	510	11	910	6.2	1.3 K	4.3	1.6 K	3.6
3.3 K	680	8.2	1.1 K	5.1	1.6 K	3.6	2.0 K	2.7
3.9 K	750	7.5	1.3 K	4.3	-	-	2.4 K	2.4
4.7 K	910	6.2	1.5 K	3.9	2.2 K	2.7	3.0 K	1.8
5.6 K	1.1 K	5.1	1.8 K	3.0	2.7 K	2.0	3.6 K	1.6
6.8 K	1.3 K	4.3	2.2 K	2.7	3.3 K	1.8	4.3 K	1.3
8.2 K	1.6 K	3.6	2.7 K	2.0	3.9 K	1.5	5.1 K	1.1
10 K	2.0 K	2.7	3.3 K	1.8	4.7 K	1.2	6.2 K	.91
12 K	2.4 K	2.4	3.9 K	1.5	5.6 K	1.0	7.5 K	.75
15 K	3.0 K	1.8	-	-	7.5 K	.75	9.1 K	.62
18 K	3.6 K	1.6	5.6 K	1.0	9.1 K	.62	11.0 K	.51
22 K	4.3 K	1.3	7.5 K	.75	11.0 K	.51	-	-

RESISTOR VALUES

CAUER SETTING R12 R13 R14 R15	17 dB R2 R3 R4 R5	17 dB Rb Rc Rd Re	20 dB R2 R3 R4 R5	20 dB Rb Rc Rd Re
180	-	-	180	30
220	180	30	220	27
270	220	27	270	20
330	270	20	330	18
390	300	18	390	15
470	360	16	470	12
560	430	13	560	10
680	560	10	680	8.2
820	620	9.1	820	6.8
1.0 K	820	6.8	1.0 K	5.6
1.2 K	910	6.2	1.2 K	4.7
1.5 K	1.2 K	4.7	1.5 K	3.9
1.8 K	-	-	1.8 K	3.0
2.2 K	1.8 K	3.0	2.2 K	2.7
2.7 K	2.2 K	2.7	2.7 K	2.0
3.3 K	2.7 K	2.0	3.3 K	1.8
3.9 K	3.0 K	1.8	3.9 K	1.5
4.7 K	3.6 K	1.6	4.7 K	1.2
5.6 K	4.3 K	1.3	5.6 K	1.0
6.8 K	5.6 K	1.0	6.8 K	.82
8.2 K	6.2 K	.91	8,2 K	.68
10 K	8.2 K	.68	10 K	.56
12 K	9.1 K	.62	12 K	.47
15 K	12 K	.47	15 K	.39
18 K	-	-	18 K	.3
22 K	18 K	.3	22 K	.27

CAPACITOR VALUES (pF)

CAUER SETTING	1 dB	2 dB	3 dB	4 dB	5 dB	8 dB	11 dB	14 dB	17 dB	20 dB
C11	C1	C1	C1	C1	C1	C1	C1	C1	C1	C1
C12	C2	C2	C2	C2	C2	C2	C2	C2	C2	C2
C13	C3	C3	C3	C3	C3	C3	C3	C3	C3	C3
C14	C4	C4	C4	C4	C4	C4	C4	C4	C4	C4
C15	C5	C5	C5	C5	C5	C5	C5	C5	C5	C5
10	270	120	82	62	51	30	20	16	13	10
20	560	240	160	130	100	62	43	33	24	20
30	820	360	270	180	150	91	62	47	39	30
40	1100	470	330	240	200	120	82	62	51	39
50	1300	620	430	300	240	150	100	81	62	51
60	1600	750	510	390	300	180	120	100	75	62
70	2000	820	620	430	360	220	150	110	91	68
80	2200	1000	680	510	390	240	160	130	100	82
90	2400	1100	750	560	470	270	180	150	110	91
100	2700	1200	820	620	510	300	200	160	130	100
110	3000	1300	910	680	560	330	220	180	-	110
120	-	1500	1000	750	620	360	240	-	150	120
130	3600	1600	1100	820	680	390	-	200	160	130
140	3900	-	1200	-	-	430	300	220	180	-
150	-	1800	1300	910	750	470	330	240	-	150
160	4300	-	-	1000	820	-	-	-	200	160
170	4700	2000	-	-	-	510	360	270	220	-
180	5100	2200	1500	1100	910	560	390	-	-	180
190	-	-	1600	1200	-	-	-	300	240	-
200	5600	2400	-	-	1000	620	430	-	-	200
210	-	-	1800	1300	-	-	-	330	270	-
220	6200	2700	-	-	1100	680	470	-	-	220
230	-	-	-	-	-	-	-	360	-	-
240	-	-	2000	1500	1200	-	510	-	300	240
250	6800	3000	-	-	-	750	-	390	-	-

(Continued)

CAPACITOR VALUES (pF) (Contd.)

CAUER SETTING	1 dB	2 dB	3 dB	4 dB	5 dB	8 dB	11 dB	14 dB	17 dB	20 dB
C11	C1	C1	C1	C1	C1	C1	C1	C1	C1	C1
C12	C2	C2	C2	C2	C2	C2	C2	C2	C2	C2
C13	C3	C3	C3	C3	C3	C3	C3	C3	C3	C3
C14	C4	C4	C4	C4	C4	C4	C4	C4	C4	C4
C15	C5	C5	C5	C5	C5	C5	C5	C5	C5	C5
260	-	-	2200	1600	1300	-	560	-	330	-
270	7500	3300	-	-	-	820	-	430	-	270
280	-	-	-	-	-	-	-	-	-	-
290	-	-	2400	1800	-	-	620	470	360	-
300	8200	3600	-	-	1500	910	-	-	-	300
310	-	-	-	-	-	-	-	-	390	-
320	-	-	2700	2000	1600	-	680	510	-	-
330	9100	3900	-	-	-	1000	-	-	-	330
340	-	-	-	-	-	-	-	-	430	-
350	-	-	3000	2200	-	-	-	560	-	-
360	10 K	4300	-	-	1800	1100	750	-	-	360
370	-	-	-	-	-	-	-	-	470	-
380	-	-	-	2400	-	-	-	-	-	-
390	-	4700	3300	-	-	1200	820	620	-	390
400	-	-	-	-	2000	-	-	-	510	-
410	-	-	-	-	-	-	-	-	-	-
420	-	5100	3600	-	-	-	-	-	-	-
430	-	-	-	2700	-	1300	910	680	-	430
440	-	-	-	-	2200	-	-	-	560	-
450	-	-	-	-	-	-	-	-	-	-
460	-	-	3900	-	-	-	-	-	-	-
470	-	5600	-	-	-	-	-	750	-	470
480	-	-	-	3000	2400	-	1000	-	-	-
490	-	-	-	-	-	1500	-	-	620	-
500	-	-	-	-	-	-	-	-	-	-

(Continued)

CAPACITOR VALUES (pF) (Contd.)

CAUER SETTING	1 dB	2 dB	3 dB	4 dB	5 dB	8 dB	11 dB	14 dB	17 dB	20 dB
C11	C1	C1	C1	C1	C1	C1	C1	C1	C1	C1
C12	C2	C2	C2	C2	C2	C2	C2	C2	C2	C2
C13	C3	C3	C3	C3	C3	C3	C3	C3	C3	C3
C14	C4	C4	C4	C4	C4	C4	C4	C4	C4	C4
C15	C5	C5	C5	C5	C5	C5	C5	C5	C5	C5
510	-	6200	4300	-	-	-	-	820	-	510
520	-	-	-	-	-	1600	-	-	-	-
530	-	-	-	3300	2700	-	1100	-	-	-
540	-	-	-	-	-	-	-	-	680	-
550	-	-	4700	-	-	-	-	-	-	-
560	-	6800	-	-	-	-	-	-	-	560
570	-	-	-	-	-	-	-	910	-	-
580	-	-	-	3600	-	-	1200	-	-	-
590	-	-	-	-	3000	1800	-	-	-	-
600	-	-	5100	-	-	-	-	-	750	-
610	-	-	-	-	-	-	-	-	-	-
620	-	7500	-	3900	-	-	1300	-	-	620
630	-	-	-	-	-	-	-	1000	-	-
640	-	-	-	-	-	-	-	-	-	-
650	-	-	-	-	3300	2000	-	-	820	-
660	-	-	5600	-	-	-	-	-	-	-
670	-	-	-	-	-	-	-	-	-	-
680	-	8200	-	-	-	-	-	-	-	680
690	-	-	-	4300	-	-	-	1100	-	-

VALUES FOR L1 (μH) AND Ca (pF)

CAUER SETTING	1 dB			2 dB		
	L1	Turns	Ca	L1	Turns	Ca
0.84	.0315	< 3	5.6	.0675	< 3	12
1.24	.0462	< 3	8.2	.101	< 3	18
1.86	.0675	< 3	12	.152	< 3	27
2.62	.09	< 3	16	.22	3	39
3.82	.135	< 3	24	.315	4	56
5.62	.202	< 3	36	.462	5	82
8.45	.315	4	56	.675	7	120
12.4	.462	5	82	1.01	9	180
18.6	.675	7	120	1.52	11	270

CAUER SETTING	3 dB			4 dB		
	L1	Turns	Ca	L1	Turns	Ca
0.84	.101	< 3	18	.135	< 3	24
1.24	.152	< 3	27	.202	< 3	36
1.86	.22	3	39	.287	4	51
2.62	.315	4	56	.423	5	75
3.82	.462	5	82	.62	7	110
5.62	.675	7	120	.9	8	160
8.45	1.01	9	180	1.35	10	240
12.4	1.52	11	270	2.02	14	360
18.6	2.2	14	390	2.87	17	510

The number of turns given for L1 apply to the standard neosid coil former type DRG 666.

(Continued)

30 SWG enamelled copper wire should be used.

VALUES FOR L1 (μH) AND Ca (pF)

CAUER SETTING	5 dB			8 dB		
	L1	Turns	Ca	L1	Turns	Ca
0.84	.169	< 3	30	.287	4	51
1.24	.242	3	43	.423	5	75
1.86	.382	5	68	.62	7	110
2.26	.512	6	91	.84	8	150
3.82	.73	7	130	1.24	10	220
5.62	1.12	9	200	1.86	13	330
8.45	1.69	12	300	2.87	17	510
12.4	2.42	15	430	4.23	23	750
18.6	3.82	21	680	6.2	29	1100

CAUER SETTING	11 dB			14 dB		
	L1	Turns	Ca	L1	Turns	Ca
0.84	.423	5	75	.512	6	91
1.24	.62	7	110	.73	7	130
1.86	.9	8	160	1.12	9	200
2.26	1.24	10	220	1.69	12	300
3.82	1.86	13	330	2.42	15	430
5.62	2.64	16	470	3.5	20	620
8.45	4.23	23	750	5.12	26	910
12.4	6.2	29	1100	7.3	33	1300
18.6	9.0	37	1600	11.2	44	2000

The number of turns given for L1 apply to the standard neosid coil former type DRG 666.

30 SWG enamelled copper wire should be used.

(Continued)

VALUES FOR L1 (μH) AND Ca (pF) (Contd.)

CAUER SETTING	17 dB			20 dB		
	L1	Turns	Ca	L1	Turns	Ca
0.84	.675	7	120	.84	8	150
1.24	1.01	9	180	1.24	10	220
1.86	1.52	11	270	1.86	13	330
2.62	2.02	14	360	2.64	16	470
3.82	3.15	18	560	3.82	21	680
5.62	4.62	24	820	5.6	28	1000
8.45	6.75	31	1200	8.4	36	1500
12.4	10.1	41	1800	12.4	47	2200
18.6	15.2	55	2700	18.6	65	3300

The number of turns given for L1 apply to the standard neosid coil former type DRG 666.

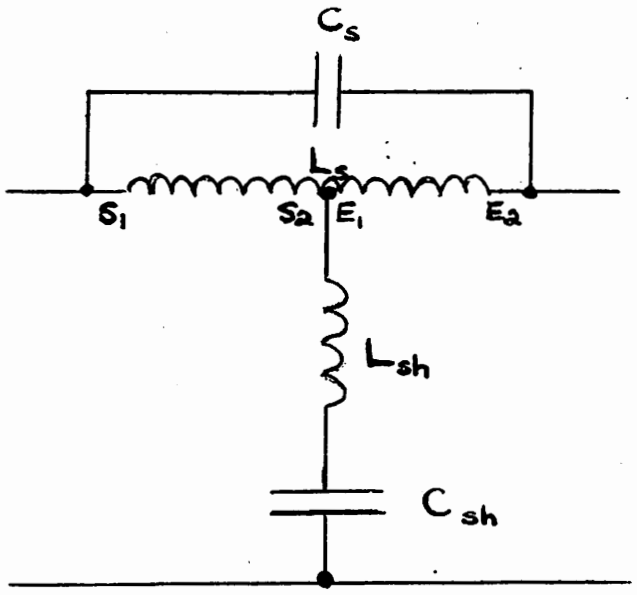
30 SWG enamelled copper wire should be used.

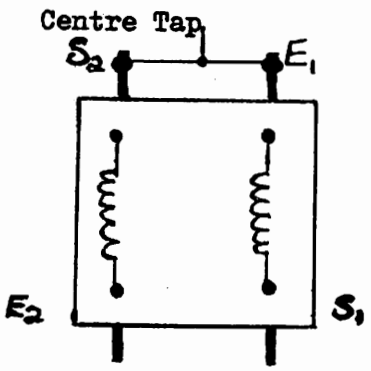
PHASE EQUALISER DESIGN INFORMATION

TABLE GIVING ACTUAL L & C VALUES OF PHASE EQUALISERS

f(MHz)	Csh	C_s	Lsh	Turns	Ls	Turns
3	2700 pF	160 pF	1.01 µH	9	15.2 µH	26
4	2000 pF	120 pF	.75 µH	7	11.2 µH	21
5	1600 pF	91 pF	.62 µH	7	9.0 µH	17
6	1300 pF	75 pF	.51 µH	6	7.3 µH	15
7	1200 pF	68 pF	.46 µH	5	6.75 µH	14
8	1000 pF	56 pF	.38 µH	5	5.63 µH	12
9	910 pF	51 pF	.35 µH	4	5.12 µH	11
10	820 pF	47 pF	.32 µH	4	4.62 µH	10

The number of turns given for Ls are bifilar turns of 30 SWG on a standard neosid coil former type DRG 666, e.g. 21 bifilar turns = 42 turns centre-tapped.





Insert into printed circuit board.

S means start
E means end

Table Giving the Figures Obtained

from the Expression

$A(dB) = K/\sqrt{f}$, f in MHz.

These figures are used to calculate the effect of the cauer equaliser, before designing the basic equaliser.

Two conditions are shown:-

(a) Loss of cauer equaliser assumed to be 12 dBs at 6 MHz

hence $A(dB) = 4.9/\sqrt{f}$, f in MHz.

(b) Loss of cauer equaliser assumed to be 8 dBs at 6 MHz

hence $A(dB) = 3.27/\sqrt{f}$, f in MHz.

The insertion loss for these two conditions is shown overleaf.

Frequency	CAUER LOSS	
	(a) 8 dB	(b) 12 dB
20 kHz	+ 0.462	+ 0.692
50 kHz	0.73	1.09
100 kHz	1.03	1.55
200 kHz	1.46	2.19
500 kHz	2.31	3.47
1.0 MHz	3.27	4.9
1.5 MHz	4.0	6.0
2.0 MHz	4.62	6.92
2.5 MHz	5.17	7.75
3.0 MHz	5.66	8.5
3.5 MHz	6.1	9.16
4.0 MHz	6.54	9.8
4.5 MHz	6.94	10.04
5.0 MHz	7.3	10.95
5.5 MHz	7.67	11.5
6.0 MHz	8.0	12.0
7.0 MHz	8.65	12.9
8.0 MHz	9.25	13.9