EXCHANGE LINE BALANCING NETWORK DATA

1. GENERAL

1.01 This addendum to Section 332-851-103 covers the following information:

(1) Replacement of the 113-type balancing networks by the 115-type networks and a brief description of the physical differences (Part 2).

(2) Strapping of the 115F (or 113F) network when used to balance an F1A-AST or equivalent station set (Part 2).

(3) Use of the 115S (or 113S) network on 22-gauge B-135 cable (Part 3).

(4) Data on the strapping and performance of the universal balancing network developed for packaged V1 repeaters (Army-type) when used with typical exchange area cable facilities (Part 4).

(5) ♦115AL network for 24 DSM and CSM H-88 loaded cable (Part 5).♦

2. 115-TYPE NETWORKS

2.01 115-type networks now replace corresponding types of the 113-type balancing networks for use on exchange facilities. Electrically, the 115-type networks are the same as the 113-type networks; however, there is a difference in the size and the location of the terminal areas. In the 115-type, the terminals are located near one end of the mounting face instead of at the center. This arrangement permits the installation of mounting bars across the center of the 7-inch mounting dimension to accommodate an assembly of miscellaneous apparatus.

2.02 Where a 115-type network is used to replace a 113-type network that is supported on a mounting plate, it will be necessary to replace the plate with one having the proper drilling for the new network.

2.03 When used to balance F1A-AST or equivalent station sets, the 115F (or 113F) network should be strapped as follows: 3-4, 6-8, 9-10, 10-12-16, 14-15. A balance of 10 dB or better may be expected with this combination.

3. 115S NETWORK

3.01 The 115S (or 113S) network is now available specifically for use with 22-gauge BSA B-135 loaded cable circuits. It is described in Section 332-851-101. It should be applied in exchange plant wherever 22-gauge B-135 facilities are involved instead of the 115J or 113J network suggested in Table F of Section 332-851-103. The J-type network was designed for 19-gauge CNB B-135 facilities and its use for the 22-gauge facility was, as noted in Table F, the best choice of the then available networks.

4. UNIVERSAL BALANCING NETWORKS OF ARMY-TYPE V1 REPEATERS

4.01 A substantial number of the Army-type packaged V1 repeaters have been procured by the Telephone Companies for use in the toll and exchange plant. These units include, as standard equipment, universal balancing networks which must be adjusted for each type of facility with which they are associated. The following data should be helpful in reducing the initial testing and installation work required when this equipment is used with the more common types of exchange area cables and loading.

4.02 Figure 1 shows a schematic arrangement of the universal balancing network and Fig. 2 shows the details and unit values of each of the network elements.

4.03 Listed below are the gauges and loading combinations of the circuits for which network data are covered in this section.

GAUGE	TYPE OF LOADING				
	NL	H-88	B-88	H-135	B-135
19 DNB	X	X	X	X	X
19 CNB	X	X	X		X
22 CSA	X	X	X		X
24 CSM	X	X	X		
24 DSM	X	X			

4.04 The nominal strapping of the universal balancing network for midsection impedances for the above facility combinations are given in Table A of this addendum.

4.05 The nominal values of network elements corresponding to strappings shown in Table A are given in Table B of this addendum.

4.06 Computed return losses for the specified strappings against theoretical midsection impedances of the corresponding facilities are given in Table C of this addendum.

4.07 Approximate network strappings for loaded exchange facilities not listed above may be determined from the following rules applied in conjunction with the general pattern of values shown on Table B of this addendum.

R1 — Use resistance value approximately equal to magnitude of 1000-Hz impedance of facility. (1000-Hz impedances of various loading systems are given in Section AB42.075.)

R2 — Follow gauge pattern in Table B.

C1S — Shorted for all loaded facilities.

C1P — Approximated from patterns of values for gauges and weights of loading in Table B.

L — Adjusted to a value about one-third the nominal coil inductance of the loading system involved.

C2 — Adjusted for reasonance with L at a frequency about 25 percent higher than nominal cutoff frequency of the facility to be balanced. (Nominal cutoff frequencies of various loading systems are given in Section AB42.075.)

C3 — Adjusted to approximately one-third the value of the loading section capacitance of the facility to be balanced.

5. 115AL NETWORK

5.01 ➧The 115AL network is for 24 DSM and CSM H-88 loaded cable. Its circuit, impedance, and performance, together with strapping information, are shown in Fig. 3. As indicated in the figure, provision is made in this network for building-out resistance adjustments in case the actual cable capacitance runs higher or lower than nominal. This has been a standard feature of toll circuit networks for some time as described in Section 332-851-101.➧

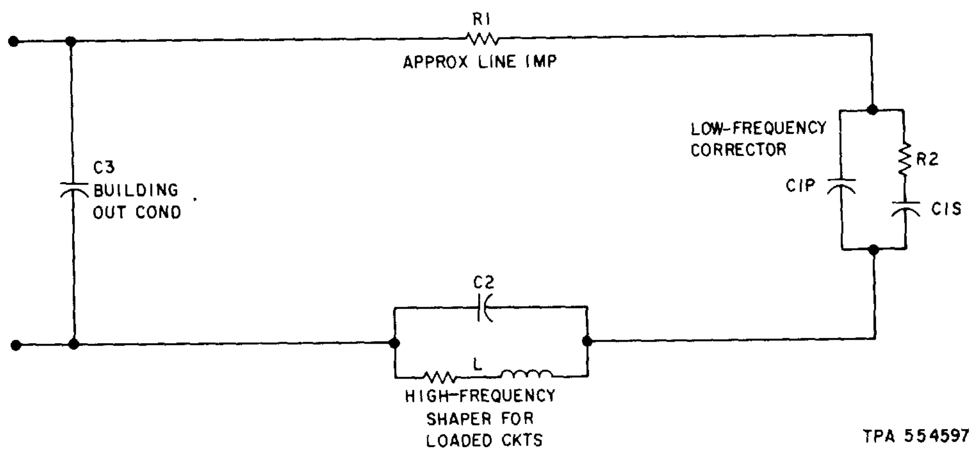


Fig. 1—Universal Balancing Network, Block Diagram

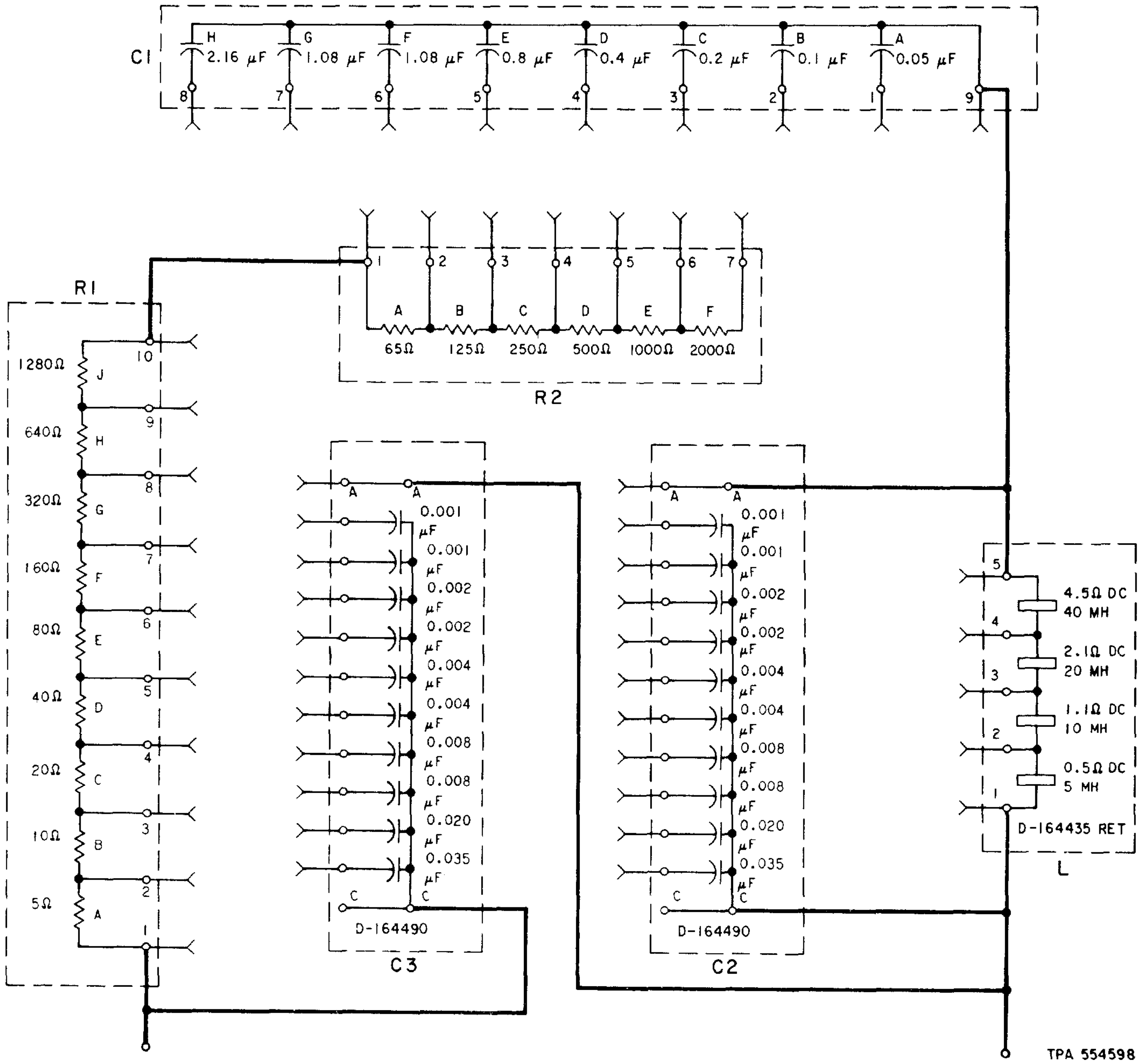
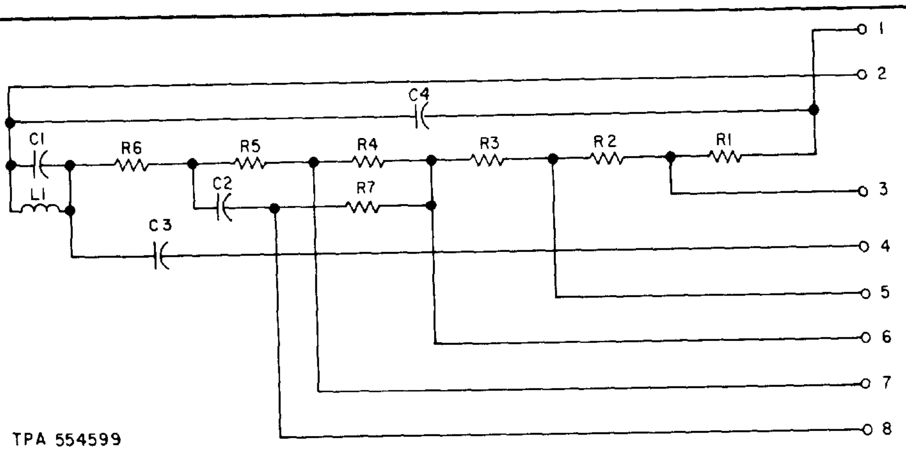


Fig. 2—Universal Balancing Network

24 CSM AND DSM H-88



TPA 554599

Component	Value
R1	10 ohms
R2	20
R3	199
R4	390
R5	3710
R6	971
R7	71
L1	30 mH
C1	0.03415 UF
C2	0.6695
C3	0.9075
C4	BO Cond

Basic End Section	DSM 0.1915	CSM 0.2083
Midsection BOC	DSM 0.02945	CSM 0.02387
Nominal Cable Cap./mi	DSM 0.084	CSM 0.072

Freq Range (Hz)	Return Loss * (dB)	Gauge
200 to 3000	35	24 DSM
200 to 2500	35	24 CSM
2500 to 3000	32	

* Return loss of network including manufacturing tolerances, against theoretical line.

	Cable Capacity (UF/Loading Sect.)	Strap Terminals
24 DSM	Below 0.0927	2-4;5-6
	0.0927 to 0.0945	2-4;1-3;5-6
	0.0945 to 0.0964	2-4;3-6
	Above 0.0964	2-4;1-6
24 CSM	Below 0.0798	6-8
	0.0798 to 0.0811	6-8;1-3
	0.0811 to 0.0825	6-8;3-5
	Above 0.0825	6-8;1-5

Nominal Midsection Impedance of Network (Between Terminals 1 and 2)

	24 DSM - Strap 3-5-6, 2-4		24 CSM - Strap 3-5, 6-8	
		Basic Net.		Basic Net.
BOR - Ohms	10	10	10	10
BOC - UF	0.02945	None	0.02387	None
Freq (Hz)				
200	1330 - j991	1430 - j956	1460 - j1053	1860 - j1215
500	1041 - j443	1121 - j349	1169 - j468	1246 - j372
1000	1021 - j229	1071 - j28	1145 - j246	1197 - j41
1500	1067 - j154	1058 + j166	1183 - j169	1187 + j152
2000	1183 - j116	1061 + j361	1266 - j131	1184 + j331
2500	1403 - j117	1063 + j602	1423 - j116	1181 + J535
2800			1583 - j129	
3000	1895 - j333	1070 + j972	1735 - j166	1180 + j809

Fig. 3—115AL Network—Engineering Information

TABLE A

NOMINAL STRAPPING OF UNIVERSAL BALANCING NETWORK FOR MIDSECTION IMPEDANCE

Type of Circuit	Strapping of R1	Strapping of R2	Strapping of C1	Strapping of L	Strapping of C2	Strapping of C3	C1: Connect Term. No. 1 of R2 to Following Term. on C1P*	C1: Connect Term. No. 7 of R2 to Following Term. on C1S*
19-Ga DNB NL	1-3,4-6,7-10	1-3,5-7	1-2-3	1-5	None	None	3	5
19-Ga CNB NL	6-10	1-2,3-4,5-7	None	1-5	None	None	4	5
22-Ga CSA NL	1-4,5-6,7-10	5-7	1-3	1-5	None	None	3	5
24-Ga CSM NL	1-2,3-4,7-10	1-3,4-5,6-7	None	1-5	None	None	3	4
24-Ga DSM NL	1-2,3-5,7-10	3-5,6-7	2-4	1-5	None	None	3	4
19-Ga DNB H-88	1-3,6-7,9-10	1-4,6-7	2-4-6	1-2,4-5	A-.020-.008-.002-.001	A-.020-.004	6	9
19-Ga DNB H-135	1-2,4-5,6-9	1-4,6-7	None	2-4	A-.035-.004-.002-.001	A-.020-.004-.001	8	9
19-Ga DNB B-88	1-2,4-5,7-9	1-4,6-7	2-3-4-6	1-2,4-5	A-.008-.004-.002-.001	A-.008-.004-.001	6	9
19-Ga DNB B-135	1-8	1-4,6-7	2-4-8	2-4	A-.008-.004-.002-.001	A-.008-.004	8	9
19-Ga CNB H-88	1-2,4-7,9-10	1-4,6-7	2-3-4-6	1-2,4-5	A-.035-.004	A-.020-.008-.002	6	9
19-Ga CNB B-88	3-5,6-9	1-4,6-7	None	1-2,4-5	A-.008-.008	A-.008-.008	8	9
19-Ga CNB B-135	1-2,4-5,6-7,8-9	1-4,6-7	2-4-8	2-4	A-.020-.002	A-.008-.008	8	9
22-Ga CSA H-88	1-2,3-5,6-7,9-10	1-6	None	1-2,4-5	A-.035-.004	A-.020-.008-.001	6	9
22-Ga CSA B-88	1-2,3-4,6-9	1-6	4-5	1-2,4-5	A-.008-.004-.002-.001	A-.008-.004-.002-.001	5	9
22-Ga CSA B-135	1-2,3-4,6-7,8-9	1-6	2-4-6	2-4	A-.008-.008-.002-.001	A-.008-.004-.002-.001	6	9
24-Ga CSM H-88	1-6,9-10	1-4	3-4	1-2,4-5	A-.035-.004	A-.020-.004-.002	4	9
24-Ga CSM B-88	1-5,7-9	1-4	None	1-2,4-5	A-.008-.004-.002-.001	A-.008-.004-.001	5	9
24-Ga DSM H-88	1-5,6-7,9-10	1-5	None	1-2,4-5	A-.020-.008-.002-.001	A-.020-.008-.002-.001	5	9

* C1P and C1S are obtained from C1 as indicated in Fig. 1.

TABLE B

NOMINAL VALUE OF UNIVERSAL BALANCING NETWORK ELEMENTS - MIDSECTION IMPEDANCE

Type of Circuit	Loading	R1 - Ohms	R2 - Ohms	C1S - UF	C1P - UF	L - UF	C2 - UF	C3 - UF
19-Ga DNB	None	180	750	0.8	0.35	Short	Open	Open
19-Ga CNB	None	155	625	0.8	0.40	Short	Open	Open
22-Ga CSA	None	200	940	0.8	0.25	Short	Open	Open
24-Ga CSM	None	290	1250	0.4	0.20	Short	Open	Open
24-Ga DSM	None	250	1190	0.5	0.20	Short	Open	Open
19-Ga DNB	H-88	1100	1500	Short	1.58	30	0.031	0.024
19-Ga DNB	H-135	1390	1500	Short	2.16	45	0.042	0.025
19-Ga DNB	B-88	1550	1500	Short	1.78	30	0.015	0.013
19-Ga DNB	B-135	1920	1500	Short	2.66	45	0.015	0.012
19-Ga CNB	H-88	990	1500	Short	1.78	30	0.039	0.030
19-Ga CNB	B-88	1375	1500	Short	2.16	30	0.016	0.016
19-Ga CNB	B-135	1710	1500	Short	2.66	45	0.022	0.016
22-Ga CSA	H-88	1050	2000	Short	1.08	30	0.039	0.029
22-Ga CSA	B-88	1410	2000	Short	1.20	30	0.015	0.015
22-Ga CSA	B-135	1730	2000	Short	1.58	45	0.019	0.015
24-Ga CSM	H-88	1120	3500	Short	0.6	30	0.039	0.026
24-Ga CSM	B-88	1520	3500	Short	0.8	30	0.015	0.013
24-Ga DSM	H-88	1040	3000	Short	0.8	30	0.031	0.031

	Nominal Capacitance UF per Mile
19-Ga DNB	0.066
19-Ga CNB	0.084
22-Ga CSA	0.082
24-Ga CSM	0.072
24-Ga DSM	0.084

Note: All network values are for midsection impedances. For other terminations C3 should be changed in accordance with nominal capacitance. For explanation of R1, R2, C1S, C1P, L, C2, and C3, see Fig. 1.

TABLE C

RETURN LOSSES OF UNIVERSAL BALANCING NETWORK

AGAINST THEORETICAL MIDSECTION IMPEDANCES

Freq (Hz)	Return Loss of Nonloaded Circuits (dB)				
	19DNB	19CNB	22CSA	24CSM	24DSM
200	16	17	23	17	20
500	44	29	31	33	38
1000	48	48	35	45	31
1500	45	38	35	52	36
2000	39	32	46	33	53
2500	32	28	32	27	32
3000	28	26	28	24	28
4000	24	22	23	20	23

Freq (Hz)	Return Loss of Nonloaded Circuits (dB)						
	19DNB H-88	19DNB H-135	19DNB B-88	19DNB B-135	19CNB H-88	19CNB B-88	19CNB B-135
200	40	39	33	42	39	39	38
500	51	41	40	47	57	46	41
1000	42	52	43	53	49	53	47
1500	41	42	45	56	40	55	45
2000	40	44	44	47	43	48	56
2400	42	47	44	46	53	45	42
2800	47	-	43	50	37	43	43

Freq (Hz)	Return Loss of Loaded Circuits (dB)					
	22CSA H-88	22CSA B-88	22CSA B-135	24CSM H-88	24CSM B-88	24DSM H-88
200	36	35	40	32	62	27
500	36	49	51	35	42	38
1000	39	48	58	38	44	40
1500	40	59	48	38	45	43
2000	42	51	45	37	46	41
2400	44	49	45	38	44	40
2800	40	45	40	37	44	40