LINE BALANCE NETWORK DATA

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1. GENERAL

1.01 This section gives tables of transmission data regarding balancing networks which are rated at the present time as "Standard" and lists networks which are rated as "Additions and Maintenance Only" and as "Manufacture Discontinued" and certain D-specifications networks which may be obtained on order. This section also includes impedance curves and associated data regarding these networks and curves for computing the correct capacitance to be associated with certain of the networks when used either to balance circuits or to terminate them. There is included also information regarding the mounting of these networks on relay racks or coil racks.

A. Transmission Considerations

DEFINITIONS

1.02 ***Characteristic Impedance*** as used in this section is the sending end impedance of an infinitely long circuit having uniform constants per unit length throughout. In the case of a periodically loaded circuit it is used here to apply to midsection impedance and for average temperature conditions. In the case of nonloaded circuits, it is used here to apply to circuits under conditions such that the leakage is slightly greater than dry weather leakage.

1.03 The ***Basic Network*** is a combination of resistance, capacitance, and inductance elements, designed to simulate the impedance of an infinite length of a particular line facility. In the case of a periodically loaded circuit, the basic network is designed to balance the circuit at some particular end section, usually in the neighborhood of 0.2 section. The basic network may be designed to match the impedance of the circuit on the assumption that the circuit contains no distributed resistance, in which case a low-frequency corrector must be associated with the network in order to obtain a precise balance, or it may be designed to contain resistance and capacitance elements correcting for the distributed resistance effect so that it simulates the impedance over the entire useful frequency range without the need of supplementary apparatus. In this latter case, the networks are called precision-type networks.

1.04 The ***Low-Frequency Corrector*** is a combination of resistance and capacitance elements connected in series with one terminal of the basic network and between the basic network and its building-out section, if any, to simulate the effect on the impedance of the circuit caused by the distributed resistance in the circuit.

1.05 The ***Building-Out Section*** is a capacitance, or a "T" section having series resistance arms and a shunt capacitance, designed to simulate all or a part of the entrance or office cable, or of both entrance cable and office cabling, at the repeater point. In the case of the nonloaded open-wire circuit entering the office through nonloaded cable, one or more building-out sections balance the entire cable. In the case of the periodically loaded circuit or a nonloaded open-wire circuit entering the repeater station through loaded cable, the building-out section balances only that part of the last loading section which is in excess of the end section balanced by the particular type of network employed.

1.06 ***Balancing Network*** may be taken as a general term applying to any network unit used for balancing a particular circuit or piece of

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equipment. Hence, in some cases it is synonymous with basic network. For coding purpose, the term was first used for the 100-series networks and will be used for all new networks whether for balancing lines or equipment.

1.07 ***Line Balancing Network*** has been used to define the entire combination of basic network, fractional-weight or full-weight terminal loading coil balancing coil, low-frequency corrector, and building-out sections, or such of these units as are needed to match the circuit impedance exclusive of office equipment and equipment cabling.

Building Out the Network End Section

1.08 The curves in Part 2C show the capacitance values to be added to the various balancing networks in order to build them out to simulate various cable end sections. In the case of the networks of the 100 series, with the exception of the 101-A, the 101-B, and the networks designed for nonloaded open wire, the network is designed to function with greatest precision when built out by means of capacitance only to balance or terminate the circuit at midsection; that is, they are designed for the characteristic impedance of the circuit. Accordingly, in the case of networks used for balancing purposes, when the end section of the cable facilities is less than half-section, the resistance component of the impedance of the balancing network and building-out section will be somewhat higher than for the cable. When the cable end section is greater than half-section, the resistance component of the impedance of the balancing network and building-out section will be somewhat deficient in resistance, unless the necessary resistance to care for this is included in the building-out section. When, on the other hand, these networks are used to terminate circuits, if the cable end section is less than half-section, resistance may be needed which is approximately equal to the difference between the resistance of half a loading section of the cable and that of the actual end section. If the cable end section is in excess of half section, there will be an excess of resistance provided by the network termination. The magnitude of this resistance effect is not large but becomes of importance with many combinations of such factors as small cable gauge, light-weight loading, and excessive departures from half-section.

B. Equipment Considerations

1.09 As shown in the attached tables, some of the networks are designed for relay rack mounting and some for coil rack mounting, the newer type networks in all cases being designed for relay rack mounting. Because of the limited demand, it has not been considered necessary to provide relay-rack-mounted networks for some of the older types. Assembly details and connection arrangements for the various parts of the line balancing network are covered in Fig. 31.

Mounting Relay-Rack Networks

1.10 The methods of mounting relay-rack networks on relay racks are given on standard drawings. When relay-rack networks are mounted on coil racks, it should be noted that a shelf spacing of at least six inches is required. Each network will require a wooden mounting plate per specification D-77985 in order to permit mounting on the coil rack.

Mounting Coil-Rack Networks

1.11 Coil-rack-mounted networks will be required in the future mainly as replacements or, in special cases, for facilities for which relay-rack-mounted networks are not available. They can be mounted on existing coil racks if space is available or they can be mounted on 19-1/2 inch relay racks by means of a relay-rack-type shelf as indicated on drawing 202-B-25.

2. DESCRIPTION OF DATA

A. General

2.01 There are two general types of line balancing network in existence at the present time: namely, the open-wire impedance type and the cable impedance type. The open-wire impedance type, as the name implies, is designed to match the characteristic impedance of a nonloaded open-wire circuit without entrance cable. The cable impedance type generally is designed to match an infinite length of a periodically loaded cable terminating at some particular end section. In the case of the networks of the 100 series, with the exception of the 101-A and 101-B, the networks when built out to midsection with capacitance only are designed to match the loaded circuit characteristic impedance. The networks listed in Part 2B are divided into these two general classes.

B. Tables

2.02 ***Table A:*** This table lists the standard balancing networks arranged for relay-rack mounting, which have been designed for nonloaded open-wire circuits. As indicated in the footnote of this table, the nonloaded open-wire networks may be used to balance various loaded entrance cables as well as the open wire beyond.

2.03 ***Table B:*** This table lists the standard balancing networks arranged for relay rack mounting, which have been designed for loaded cable circuits.

2.04 ***Table C:*** This table lists the standard basic networks and low-frequency correctors, arranged for coil-rack mounting, which have been made available for 19-gauge H-44-25 circuits. Since these networks have practically no demand for uses other than for testing purposes and since the demand for them is small, it has not been considered necessary or practicable to provide corresponding relay-rack-mounted networks.

2.05 ***Table D:*** This table lists certain networks to which D-specifications numbers have been assigned, which are obtainable on order. Standard code numbers have not been given to them, since the demand is very small.

2.06 ***Table E:*** This table lists coil-rack-mounted basic networks for nonloaded open-wire circuits, which have been rated "A and M Only." As indicated in the table, standard networks and D-77985 mounting plates in many cases may be used for additions and replacement purposes in place of the networks in this table.

2.07 ***Table F:*** This table lists networks and low-frequency correctors for cable circuits, which have been rated "A and M Only."

2.08 ***Table G:*** This table lists basic networks which have been rated as "Manufacture Discontinued." Either these networks have been replaced by other networks or the facilities they were designed to balance have been replaced by more recent standard types.

2.09 ***Table H:*** The return loss-frequency data given in the table are between the charactertistic impedance of the circuits for which the networks are designed and the impedance (midsection, if loaded) of networks having the largest number of combinations of resistance, inductance, and capacitance units possible with present manufacturing tolerances.

C. Drawings

2.10 Impedance curves are shown in Fig. 1 through 19 for all of the standard 100-series networks. For loaded circuits, these give the resistance and reactance component of the network impedance without building-out and also with building-out to half-section by means of capacitance only. For nonloaded circuit networks, the impedance curves are for the networks without building-out. Manufacturing tolerances may cause slight departures in the impedance of any particular network from that given in the curves.

2.11 The values of building-out capacitance to be added to certain of the cable impedance type networks for various conditions of balancing and terminating are shown in Fig. 20 through 22. When the networks are used to balance circuits which terminate at various end sections, curves "B" apply. These curves give for any particular end section the building-out capacitance to be added to the balancing networks to match properly the impedance of the line at the end section. When networks are used to terminate the circuits, in a similar manner the building-out capacitances are indicated by curves "T". The building-out capacitance in this latter case is equal to the capacitance effective in the basic network and the capacitance of the end section of the line.

2.12 In the absence of balance measurements to indicate the best capacitance to use for those types of networks not covered by the above drawings, the usual method is to determine the capacitance value from the average capacitance per mile of the cable and the length involved, taking into account the effective end section of the balancing network as given in Part 2B.

2.13 The nominal constants of the line balancing networks and low-frequency correctors at time of manufacture are given in Fig. 23 through 30. These figures do not give the manufacturing tolerances.

2.14 Figure 31 and SD-60963-021 give the dimensions of the standard relay-rack-mounted line balancing networks and show the schematic wiring arrangements of the various parts of the line network.

TABLE A

STANDARD, PRECISION-TYPE BALANCING NETWORKS — RELAY RACK MOUNTING
DESIGNED FOR NONLOADED, OPEN-WIRE IMPEDANCE

GAUGE	CIRCUIT	CORRESPONDING NONPOLE PAIR PIN SPACING	CODE NO.	REPLACING	
165	Nonpole Pair Physical	8 inches	108-C	—	
"	Nonpole Pair Side	12 "	102-E	12-A, 17-E, 26-A, 28-A	Two No. 102-E and
"	Pole Pair Side	" "	102-F	12-G, 17-F, 26-B	One No. 103-A Net-
"	Half-Pole Pair Side	" "	102-G	12-F, 17-G	works replace the
"	Phantom	" "	103-A	12-B, 18-A, 27-A, 29-A	No. 19-A Network.
128	Nonpole Pair Physical	8 "	108-B	—	
"	Nonpole Pair Side	12 "	102-H	12-H	
"	Pole Pair Side	" "	102-J	12-K	
"	Half-Pole Pair Side	" "	102-K	12-L	
"	Phantom	" "	102-L	12-J	
104	Nonpole Pair Physical	8 "	108-A	—	
"	Nonpole Pair Side	12 "	102-A	11-A, 11-E, 17-A, 25-A	
"	Pole Pair Side	" "	102-B	11-C, 17-B, 25-C	
"	Half-Pole Pair Side	" "	102-C	11-D, 17-C	
"	Phantom	" "	102-D	11-B, 17-D, 25-B	

Note: The Standard Open-Wire Networks may be used also to balance the cable and open wire of open wire circuits entering the repeater station through compensated terminated A-2.7-N, A-3.0-N, B-15-S, BH-15-15-S, BH-15-16-S, C-4.1-S, CE-4.1-12.8-S, CF-4.1-6.3-S, C-4.8-S, CE-4.8-12.8-S, CF-4.8-7.1-S, CF-4.1-6.3-P, or CF-4.8-7.1-P loaded cables, and through half-coil terminated 13- and 16-gauge BH-15-15-P, BH-15-16-P, 13- or 16-gauge CE-4.1-12.8-P or CE-4.8-12.8-P, and through half-section terminated 16- or 19-gauge CE-4.1-12.8-P or CE-4.8-12.8-P loaded cables,—when loading system and cable gauge are optimum for the open wire.

TABLE B

STANDARD, PRECISION TYPE BALANCING NETWORKS — RELAY RACK MOUNTING DESIGNED FOR CABLE IMPEDANCE

**(Designed for Cable having 0.062 μF per Mile Side Circuit Capacitance
0.10 μF per Mile Phantom Circuit Capacitance)**

GAUGE	LOADING	CIRCUIT	CODE NO.	NETWORK END SECTION	REPLACING
13 AWG	*H-31-S	Side	107-A	0.16	—
13 AWG	*H-18-P	Phantom	107-D	0.17	—
16 AWG	H-174-S	Side	104-A	0.18	39-A, 33-A, 13-R + 3.3 μF
16 AWG	H-63-P	Phantom	104-C	0.16	39-C
16 AWG	H-44-S	Side	104-E	0.16	—
16 AWG	H-25-P	Phantom	104-F	0.17	—
16 AWG	*H-31-S	Side	107-B	0.16	—
16 AWG	*H-18-P	Phantom	107-E	0.17	—
19 AWG	H-174-S	Side	104-B	0.18	39-B, 32-A, 13-R + 21-A
19 AWG	H-63-P	Phantom	104-D	0.16	39-D
19 AWG	*H-31-S	Side	107-C	0.16	—
19 AWG	*H-18-P	Phantom	107-F	0.17	—

* Also may be used for E-28-16 circuits of corresponding gauge. The 107-F balancing networks may be used to balance 19-gauge BH-15-15-P or BH-15-16-P circuits bringing in 104 open wire circuits.

TABLE C

STANDARD BASIC NETWORKS AND LOW FREQUENCY CORRECTORS — COIL RACK MOUNTING

(Basic Network End Section = 0.2)

**(Designed for Cables having 0.062 μF per Mile Side Circuit Capacitance
0.10 μF per Mile Phantom Circuit Capacitance)**

GAUGE	LOADING	CIRCUIT	TYPE NETWORK	CODE NO.	REMARKS
19 AWG	H-44-S	Side	Nonprecision Basic	13-P	
19 AWG	H-44-S	"	Low Frequency Corrector	17-H	Used with No. 13-P
19 AWG	H-25-P	Phantom	Nonprecision Basic	13-S	
19 AWG	H-25-P	"	Low Frequency Corrector	17-J	Used with No. 13-S

TABLE D

D-SPECIFICATIONS NETWORKS OBTAINABLE ON ORDER

FACILITY	GAUGE	LOADING	CIRCUIT	TYPE NETWORK	SPECIFICATIONS NUMBER	FORMER DESIGNATION
Open Wire	144 (9-NBS)	N.L.	Nonpole Pair Side*	Nonprecision, Basic, Coil Rack	D-12571	W-2059
" "	144 (9-NBS)	" "	Pole Pair Side*	" " " " "	D-12572	W-2061
" "	144 (9-NBS)	" "	Half-Pole Pair Side*	" " " " "	D-18015	W-2062
" "	144 (9-NBS)	" "	Phantom*	" " " " "	D-18014	W-2060
" "	134 (10-BWG)	" "	Pole Pair Side*	" " " " "	D-12218	W-2048
" "	134 (10-BWG)	" "	Half-Pole Pair Side*	" " " " "	D-12219	W-2049
" "	114 (9-AWG)	" "	Pole Pair Side*	" " " " "	D-14074	W-2053
" "	114 (9-AWG)	" "	Half-Pole Pair Side*	" " " " "	D-75850	W-2054
" "	80 (14-NBS)	" "	Pole Pair Side*	" " " " "	D-12748	W-2051
Cable	16	Special-44-25	Side	Precision, Balancing, Relay Rack	D-90140	—
"	16	Special-44-25	Phantom	" " " "	D-90142	—
"	19	Special-44-25	Side	" " " "	D-90141	—
"	19	Special-44-25	Phantom	" " " "	D-90143	—
"	22	S-44-25	Side	" " " "	D-88652	—
"	22	S-44-25	Phantom	" " " "	D-88653	—

* The spacing of the corresponding nonpole pair side circuits is 12 inches.

TABLE E

BASIC NETWORKS RATED A. AND M. ONLY — COIL RACK MOUNTING DESIGNED FOR NONLOADED OPEN WIRE CIRCUITS

GAUGE	CIRCUIT	TYPE NETWORK	CODE NO.	FORMER DESIG-NATION	STANDARD NETWORK RECOM-MENDED	REMARKS
165 (8-BWG)	Nonpole Pair Side	Precision Basic	17-E	—	102-E (X)	
165 (8-BWG)	Nonpole Pair Side	Nonprecision Basic	12-A	W-2001	102-E (X)	
165 (8-BWG)	Nonpole Pair Side	"Type A" Carrier	20-A	—		Replaced the 16A
165 (8-BWG)	Pole Pair Side	Precision Basic	17-F	—	102-F (X)	
165 (8-BWG)	Pole Pair Side	Nonprecision Basic	12-G	W-2029	102-F (X)	
165 (8-BWG)	Half-Pole Pair Side	Precision Basic	17-G	—	102-G (X)	
165 (8-BWG)	Half-Pole Pair Side	Nonprecision Basic	12-F	W-2027	102-G (X)	
165 (8-BWG)	Phantom	Precision Basic	18-A	—	103-A (X)	
165 (8-BWG)	Phantom	Nonprecision Basic	12-B	W-2002	103-A (X)	
134 (10-BWG)	Nonpole Pair Side	" " "	12-C	W-2003	—	
134 (10-BWG)	Phantom	" " "	12-M	W-2004	—	
128 (10-NBS)	Nonpole Pair Side	" " "	12-H	W-2040	102-H (X)	
128 (10-NBS)	Pole Pair Side	" " "	12-K	W-2042	102-J (X)	
128 (10-NBS)	Half-Pole Pair Side	" " "	12-L	W-2043	102-K (X)	
128 (10-NBS)	Phantom	" " "	12-J	W-2041	102-L (X)	
114 (9-AWG)	Nonpole Pair Side	" " "	12-D	W-2025	—	
114 (9-AWG)	Phantom	" " "	12-E	W-2026	—	
104 (12-NBS)	Nonpole Pair Side	Precision Basic	17-A	—	102-A (X)	
104 (12-NBS)	Nonpole Pair Side	Nonprecision Basic	11-A	W-2005	102-A (X)	
104 (12-NBS)	Pole Pair Side	Precision Basic	17-B	—	102-B (X)	
104 (12-NBS)	Pole Pair Side	Nonprecision Basic	11-C	W-2024	102-B (X)	
104 (12-NBS)	Half-Pole Pair Side	Precision Basic	17-C	—	102-C (X)	
104 (12-NBS)	Half-Pole Pair Side	Nonprecision Basic	11-D	W-2034	102-C (X)	
104 (12-NBS)	Phantom	Precision Basic	17-D	—	102-D (X)	
104 (12-NBS)	Phantom	Nonprecision Basic	11-B	W-2006	102-D (X)	
80 (14-NBS)	Nonpole Pair Side	" " "	11-G	W-2037	—	
80 (14-NBS)	Phantom	" " "	11-H	W-2038	—	

(X) The 100-series networks are designed for relay rack mounting but may be mounted on the coil rack by using D-77985 mounting plates. They are coded as balancing networks.

TABLE F

NETWORKS AND LOW FREQUENCY CORRECTORS RATED A. AND M. ONLY DESIGNED FOR CABLE CIRCUITS

GAUGE	LOADING	CIRCUIT	TYPE NETWORK	CODE NO.	FORMER DESIG-NATION	NET-WORK END SEC-TION	STANDARD NETWORK RECOM-MENDED	REMARKS
10 AWG	K-200-S	Side	Nonprecision Basic, Coil Rack	13-E	W-2011	0.2	—	Noncotton-bound cable
10 AWG	K-130-P	Phantom	“ “ “ “ “	13-F	W-2012	0.2	—	“ “ “ “
14 AWG	H-245-S	Side	“ “ “ “ “	13-G	W-2013	0.2	—	“ “ “ “
Small Gauge	H-245-S	Side	“ “ “ “ “	13-L	—	0.2	—	
16 or 19 AWG	H-245-S	“	Low Frequency Corrector, Coil Rack	23-A	—	—	—	Used with 13-L
Small Gauge	H-155-P	Phantom	Nonprecision Basic, Coil Rack	13-B	W-2008	0.2	—	
16 or 19 AWG	H-155-P	“	Low Frequency Corrector, Coil Rack	24-A	—	—	—	Used with No. 13-B
16 or 19 AWG	H-174-S	Side	Nonprecision Basic, Coil Rack	13-R*	—	0.2	104-A or 104-B**(X)	
19 AWG*	H-174-S	Side	Low Frequency Corrector, Coil Rack	21-A*	—	—	—**	
16 or 19 AWG	H-106-P	Phantom	Nonprecision Basic, Coil Rack	13-T***	—	0.2	—	
19 AWG***	H-106-P	“	Low Frequency Corrector, Coil Rack	22-A***	—	—	—	Used with No. 13-T
All Gauges	M-174-S	Side	Nonprecision Basic, Coil Rack	13-M	—	0.2	—	
All Gauges	M-106-P	Phantom	“ “ “ “ “	13-N	—	0.2	—	
19 AWG	M-174-S	Side	“ “ “ “ “	13-H	W-2014	0.2	—	Noncotton-bound cable
13 AWG	H-28-S	Side	Precision, (X)	106-A	—	0.16	—	
13 AWG	H-16-P	Phantom	“ “	106-D	—	0.17	—	
16 AWG	H-28-S	Side	“ “	106-B	—	0.16	—	
16 AWG	H-16-P	Phantom	“ “	106-E	—	0.17	—	
19 AWG	H-28-S	Side	“ “	106-C	—	0.16	—	
19 AWG	H-16-P	Phantom	“ “	106-F	—	0.17	—	

* The 13-R network with a $3.3 \pm 0.7\ \mu F$ condenser in series with it is used to balance 16-gauge circuits. The 13-R network with a 21-A low frequency corrector in series with it is used to balance 19-gauge circuits.

**The 104-A and 104-B networks require no corrector; the 13-R network requires either 21-A or $3.3\ \mu F$ corrector as above.

*** The 13-T network with a $7.7 \pm 0.2\ \mu F$ condenser in series with it is used to balance 16-gauge circuits. The 13-T with a 22-A corrector in series with it is used to balance 19-Gauge circuits only.

(X) The 100-series networks are designed for relay rack mounting but may be mounted on the coil rack by using D-77985 mounting plates. They are coded as balancing networks.

TABLE G

BASIC NETWORKS RATED MANUFACTURE DISCONTINUED — COIL AND RELAY RACK MOUNTING

(Network End Sections for Loaded Circuits = 0.2)

FACILITY	GAUGE	LOADING	CIRCUIT	TYPE NETWORK	CODE NO.	FORMER DESIGNATION	REPLACED BY	REMARKS
Open Wire	165 (8-BWG)	W-240-S	Side	Nonprecision, Coil Rack	13-A	W-2007	—	
" "	128 (10-NBS)	W-240-S	Side	" " " "	13-J	W-2019	—	
" "	128 (10-NBS)	W-150-P	Phantom	" " " "	13-K	W-2020	—	
" "	104 (12-NBS)	W-240-S	Side	" " Relay Rack	101-A*	—	—	
" "	104 (12-NBS)	W-240-S	Side	" " Coil Rack	13-C*	W-2009	—	
" "	104 (12-NBS)	W-150-P	Phantom	" " Relay Rack	101-B*	—	—	
" "	104 (12-NBS)	W-150-P	Phantom	" " Coil Rack	13-D*	W-2010	—	
" "	165 (8-BWG)	NL	Nonpole Pair Side	Precision, Relay Rack	28-A	—	102-E	
" "	165 (8-BWG)	"	Nonpole Pair Side	Nonprecision, Relay Rack	26-A	—	102-E	
" "	165 (8-BWG)	"	Pole Pair Side	" " " "	26-B	—	102-F	
" "	165 (8-BWG)	"	Phantom	Precision, Relay Rack	29-A	—	103-A	
" "	165 (8-BWG)	"	Phantom	Nonprecision, Relay Rack	27-A	—	103-A	
" "	165 (8-BWG)	"	Nonpole Pair Sides & Phantom	Precision, Relay Rack	19-A	—	2-No. 102-E & 1-No. 103-A	Combined network
" "	165 (8-BWG)	"	Side	Nonprecision, Coil Rack	16-A	—	20-A	Carrier "Type A" Systems
" "	134 (10-BWG)	"	Side	" " " "	11-F	W-2036	—	Iron Wire CKT
" "	134 (10-BWG)	"	Phantom	" " " "	11-J	W-2039	—	" " "
" "	104 (12-NBS)	"	Nonpole Pair Side	" " Relay Rack	25-A	—	102-A	
" "	104 (12-NBS)	"	Side	" " Coil Rack	11-E	W-2035	102-A	For short length circuit
" "	104 (12-NBS)	"	Pole Pair Side	" " Relay Rack	25-C	—	102-B	
" "	104 (12-NBS)	"	Phantom	" " " "	25-B	—	102-D	
Cable	16 or 19 AWG	H-245-S	Side	Precision, Relay Rack	31-A	—	—	
"	16 or 19 AWG	H-155-P	Phantom	" " "	34-A	—	—	
"	16 AWG	H-174-S	Side	" " "	33-A	—	104-A	
"	16 AWG	H-106-P	Phantom	" " "	36-A	—	13-T+7.7 MF	
"	16 AWG	M-174-S	Side	Nonprecision, Coil Rack	13-U	—	—	Special
"	16 AWG	M-106-P	Phantom	" " " "	13-W	—	—	"
"	19-AWG	H-174-S	Side	Precision, Relay Rack	32-A	—	104-B	
"	19-AWG	H-106-P	Phantom	" " "	35-A	—	13-T+22-A	
"	All Gauges	Special	Side	Nonprecision, Coil Rack	D-12316	W-2055	—	
"	" "	"	Phantom	" " " "	D-12317	W-2056	—	
"	" "	"	Side	" " " "	D-12465	W-2057	—	

* The 101-A is electrically the same as the 13-C and the 101-B is electrically the same as the 13-D.

TABLE G (Cont)

FACILITY	GAUGE	LOADING	CIRCUIT	TYPE NETWORK	CODE NO.	FORMER DESIG-NATION	REPLACED BY	REMARKS
Open Wire	165 (8-BWG)	NL	Side	Nonprecision, Coil Rack	—(x)	W-2066	—	Iron Wire
" "	109 (12-BWG)	"	Side	" " " "	—(x)	W-2065	—	" "
" "	8 (14-NBS)	"	Half-Pole Pair Side	" " " "	—(x)	W-2052	—	" "
Cable	All Gauges	H-200-S	Side	" " " "	—(x)	W-2050	—	For cotton-bound cable
"	" "	K-130-P	Phantom	" " " "	—(x)	W-2058	—	For cotton-bound cable
"	13 AWG	NL	Side	" " " "	—(x)	W-2032	—	Special
"	13 AWG	"	Side	" " " "	—(x)	W-2044	—	"
"	13 AWG	"	Side	" " " "	—(x)	W-2046	—	Nonduplex cable, special
"	13 AWG	"	Phantom	" " " "	—(x)	W-2033	—	Special
"	13 AWG	"	Phantom	" " " "	—(x)	W-2045	—	Duplex cable special
"	13 AWG	"	Phantom	" " " "	—(x)	W-2047	—	Nonduplex cable, special

(x) Types not coded in present standard system.

TABLE H

MINIMUM RETURN LOSSES

FREQUENCY RANGE (Hz)

NETWORK CODE NUMBER	100 to 200	200 to 300	300 to 2000	2000 to 2300	2000 to 2500	2500 to 2800	2500 to 3000	3000 to 3500
104–A	–	35	40	36	–	–	–	–
104–B	–	35	40	36	–	–	–	–
104–C	–	35	40	–	32	28	–	–
104–D	–	35	40	–	32	28	–	–
104–E	–	35	40	–	40	–	36	–
104–F	–	35	40	–	40	–	36	–
106–A–B–C–D–E–F	24	34	40	–	40	–	40	34
107–A–B–C–D–E–F	24	34	40	–	40	–	40	34
102–E–F–G–103–A	36	38	40	–	40	–	40	–
102–H–J–K–L	34	38	40	–	40	–	40	–
102–A–B–C–D	32	34	38	–	38	–	38	–
108–A	36	40	40		40		40	40
108–B	40	44	44		44		44	44
108–C	40	44	44		44		44	44

Note: The figures given above are the minimum return losses of the various networks against the characteristic impedance of the particular line facility for which the networks are designed. The return loss figures include allowance for manufacturing deviation of the network elements as well as allowance for the variation of the network impedance due to current strength effects.

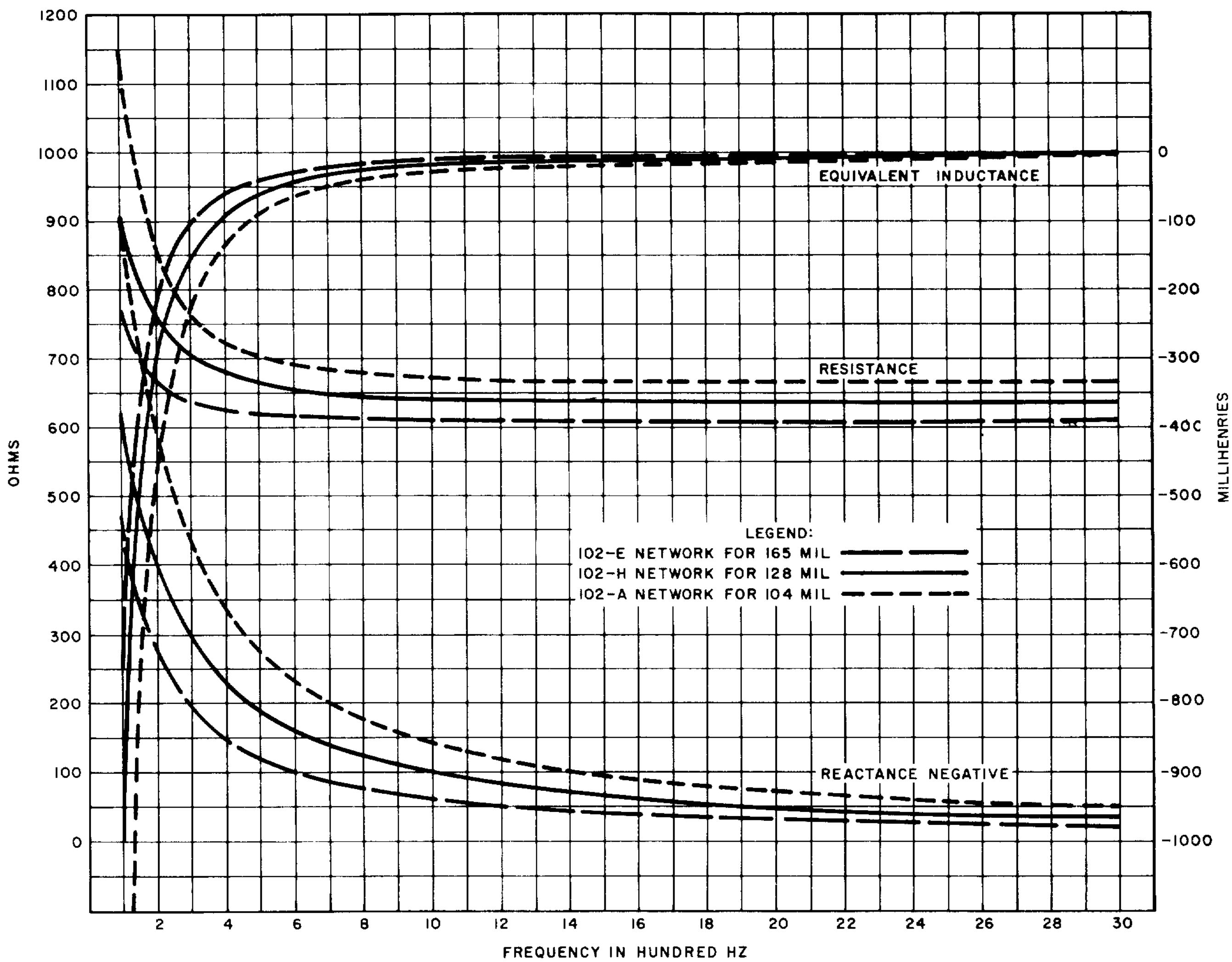


Fig. 1—Impedance of Networks for Nonloaded Open-Wire Circuits—102-Type Networks for 12-Inch Spaced Side Circuits

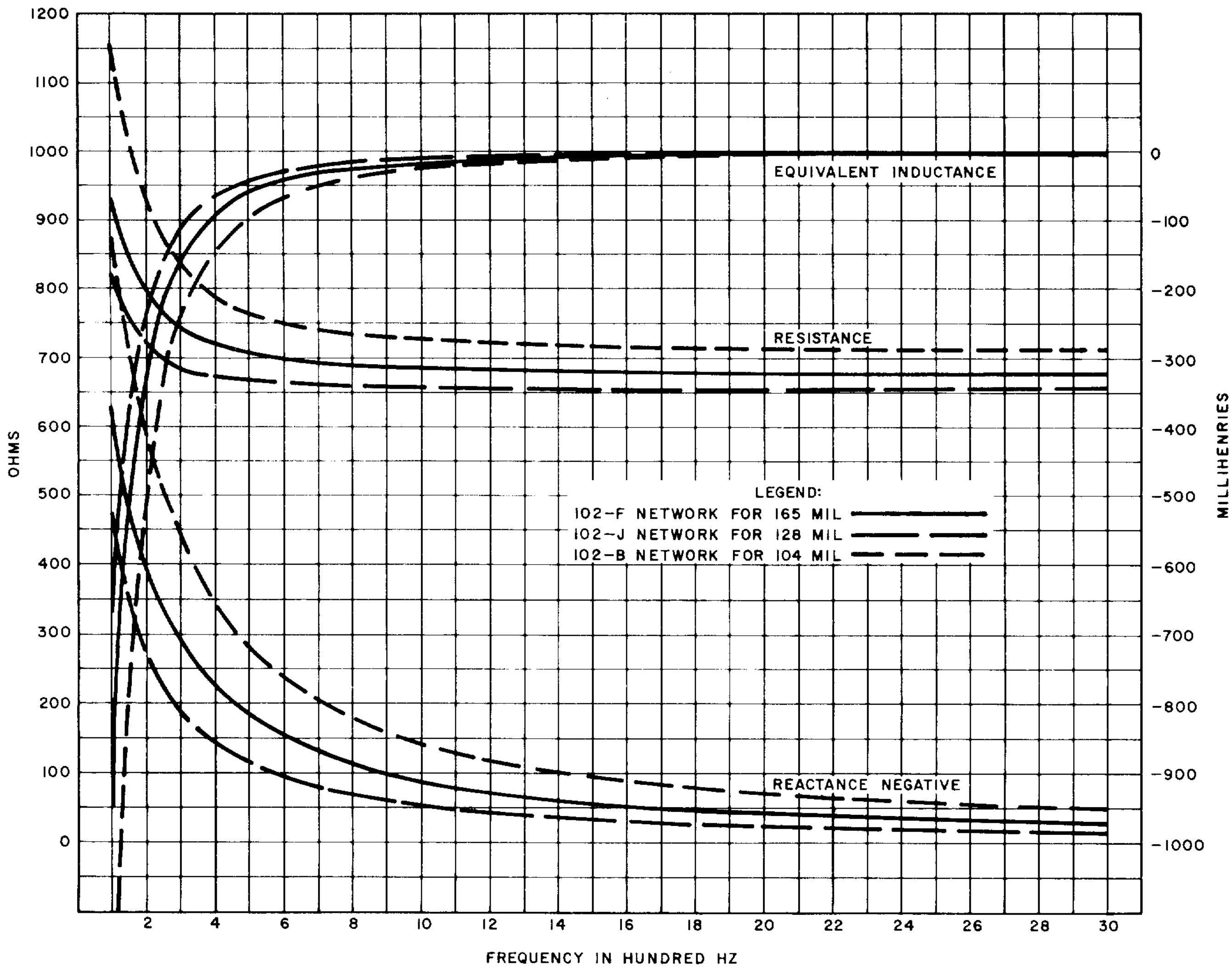


Fig. 2—Impedance of Networks for Nonloaded Open-Wire Circuits—102-Type Networks for Pole Pair Side Circuits

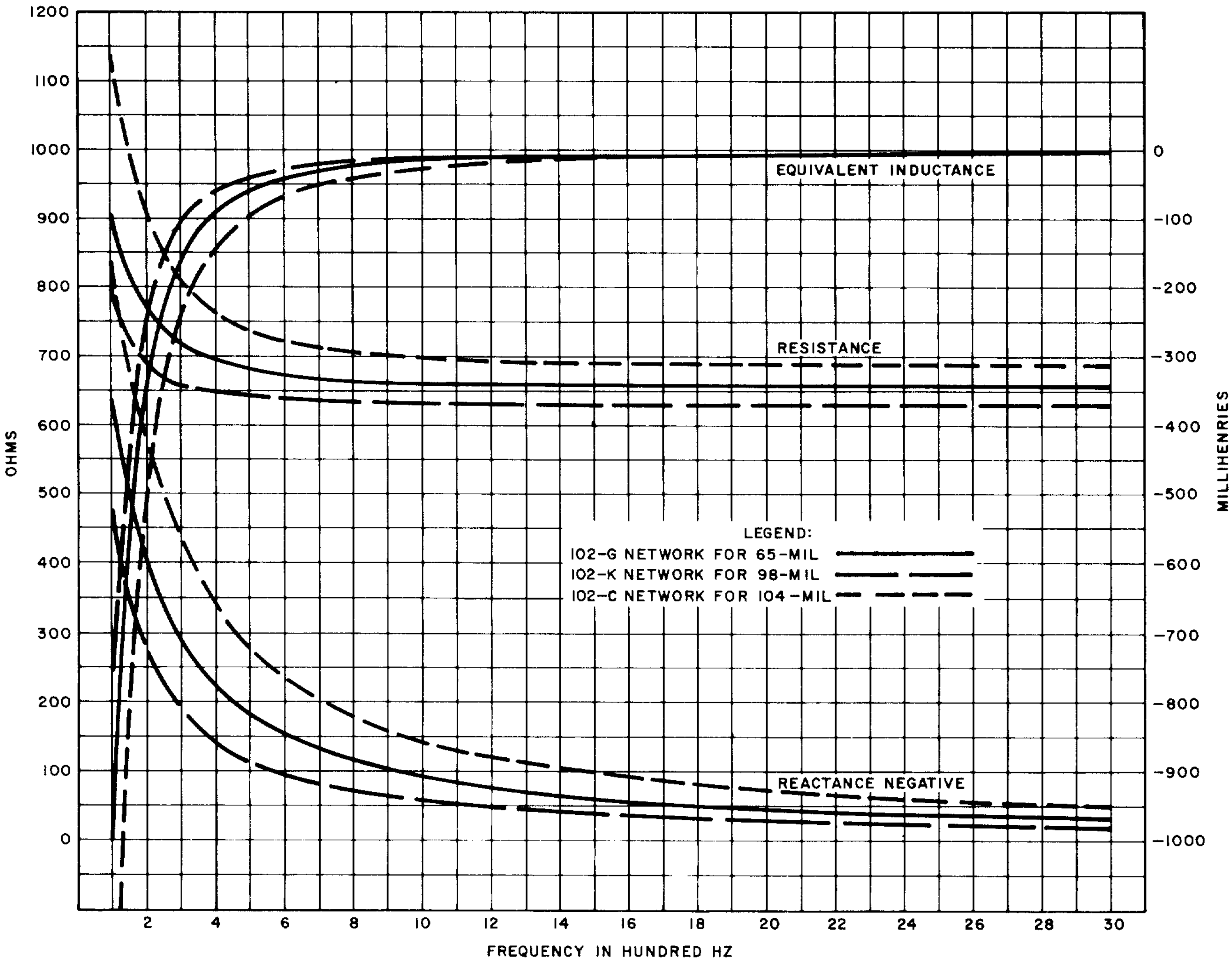


Fig. 3—Impedance of Networks for Nonloaded Open-Wire Circuits—102-Type Networks for Half-Pole Pair Side Circuits

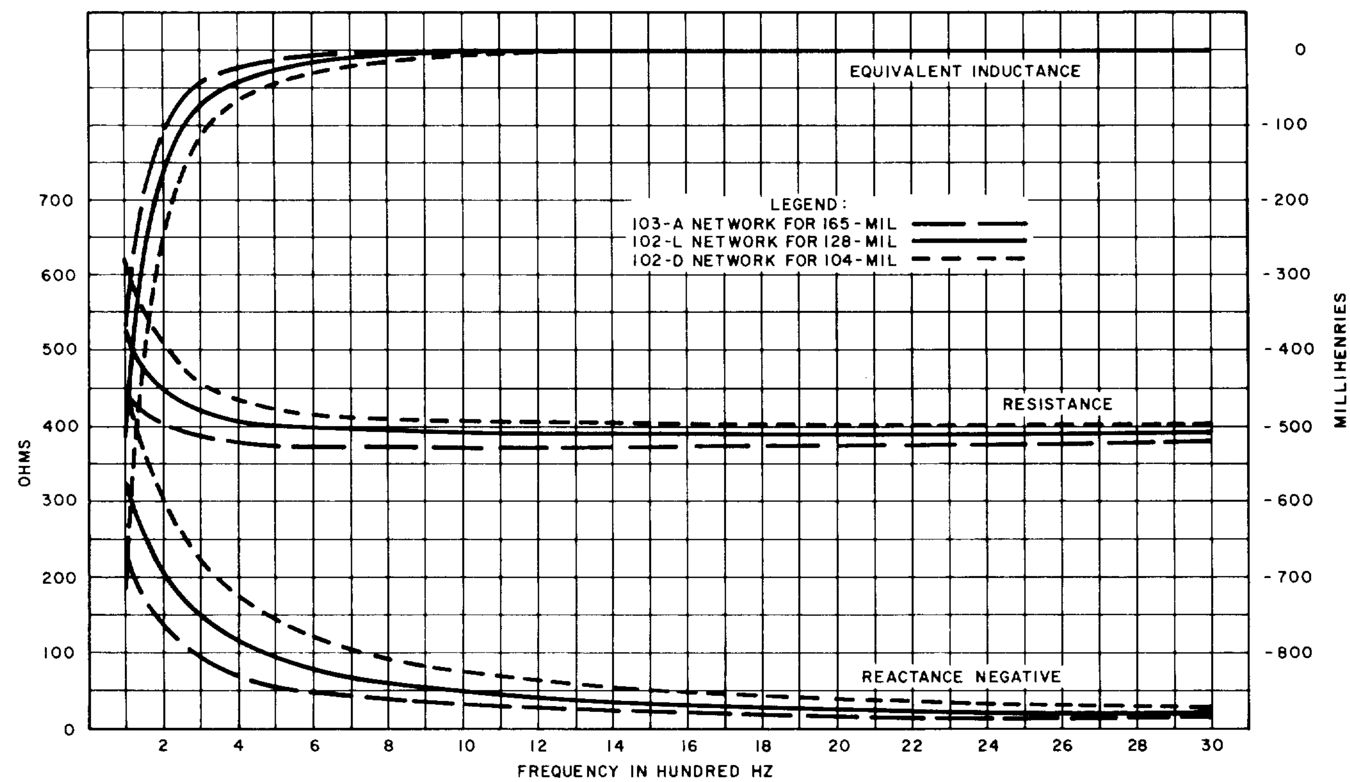


Fig. 4—Impedance of Networks for Nonloaded Open-Wire Circuits—102- and 103-Type Networks for 12-Inch Spaced Phantom Circuits

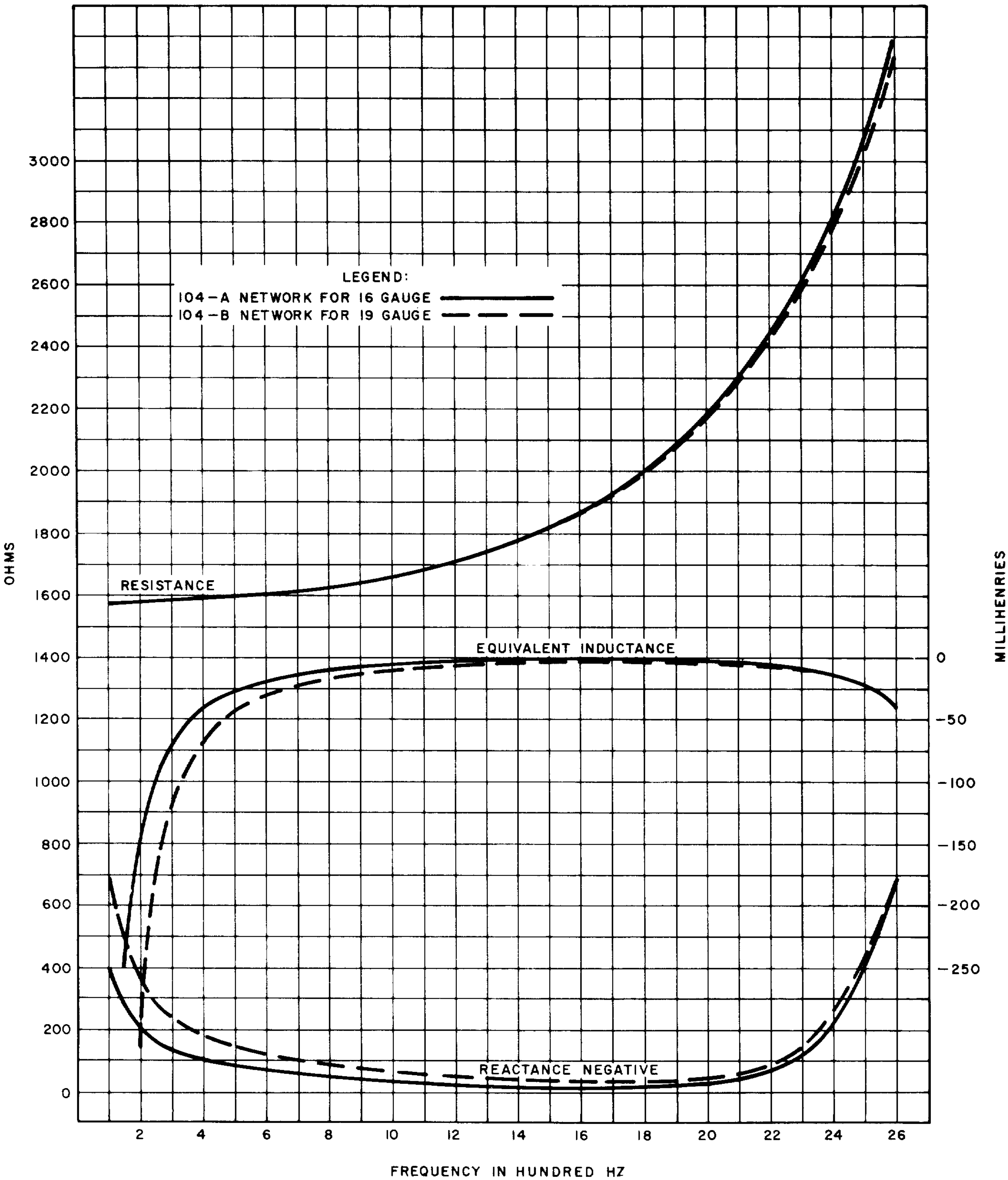


Fig. 5—Mid-Section Impedance of Networks for H172-174 Side Circuits

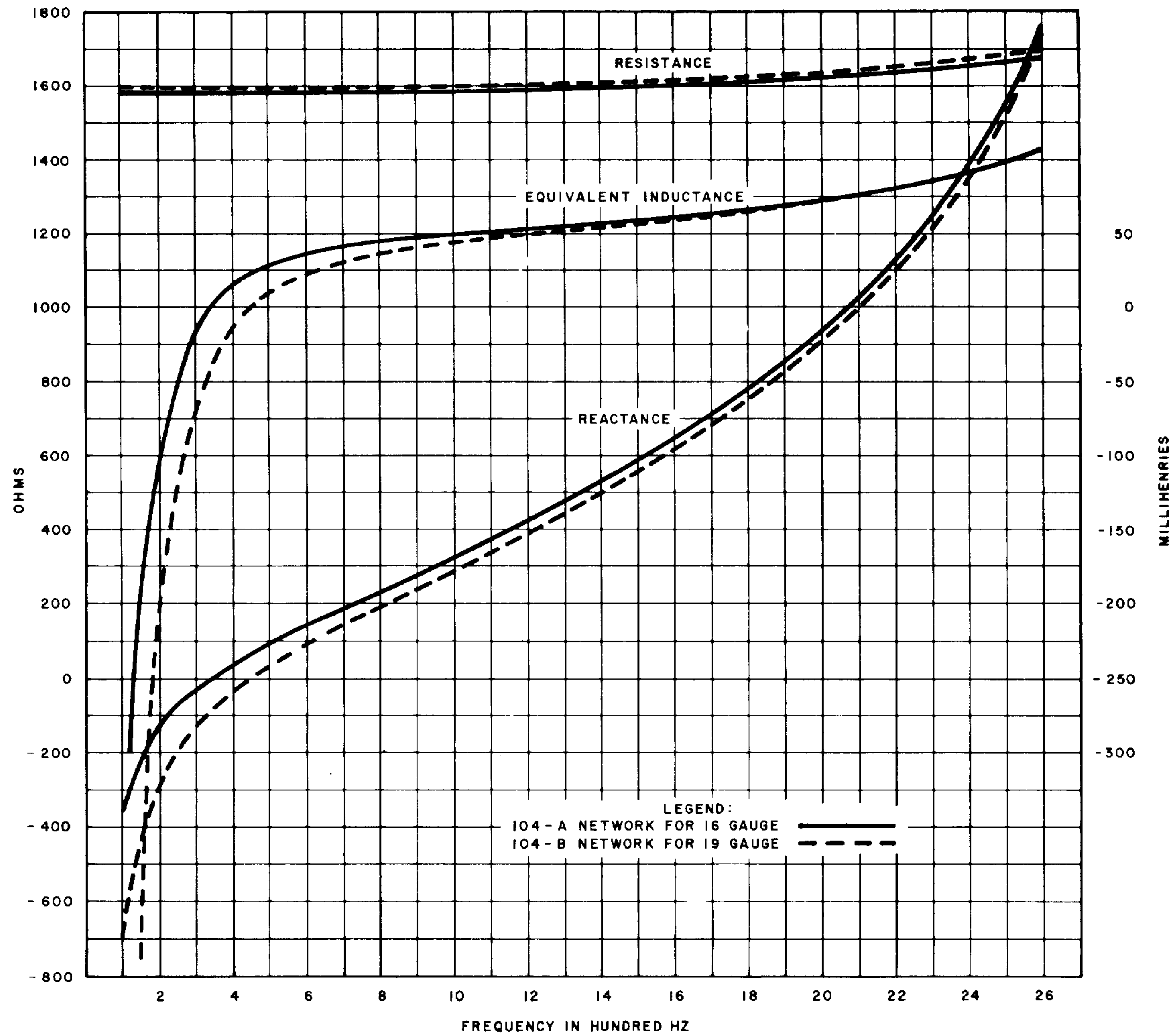


Fig. 6—Impedance of Networks for Nonloaded Open-Wire Circuits—102- and 103-Type Networks for 12-Inch Spaced Phantom Circuits

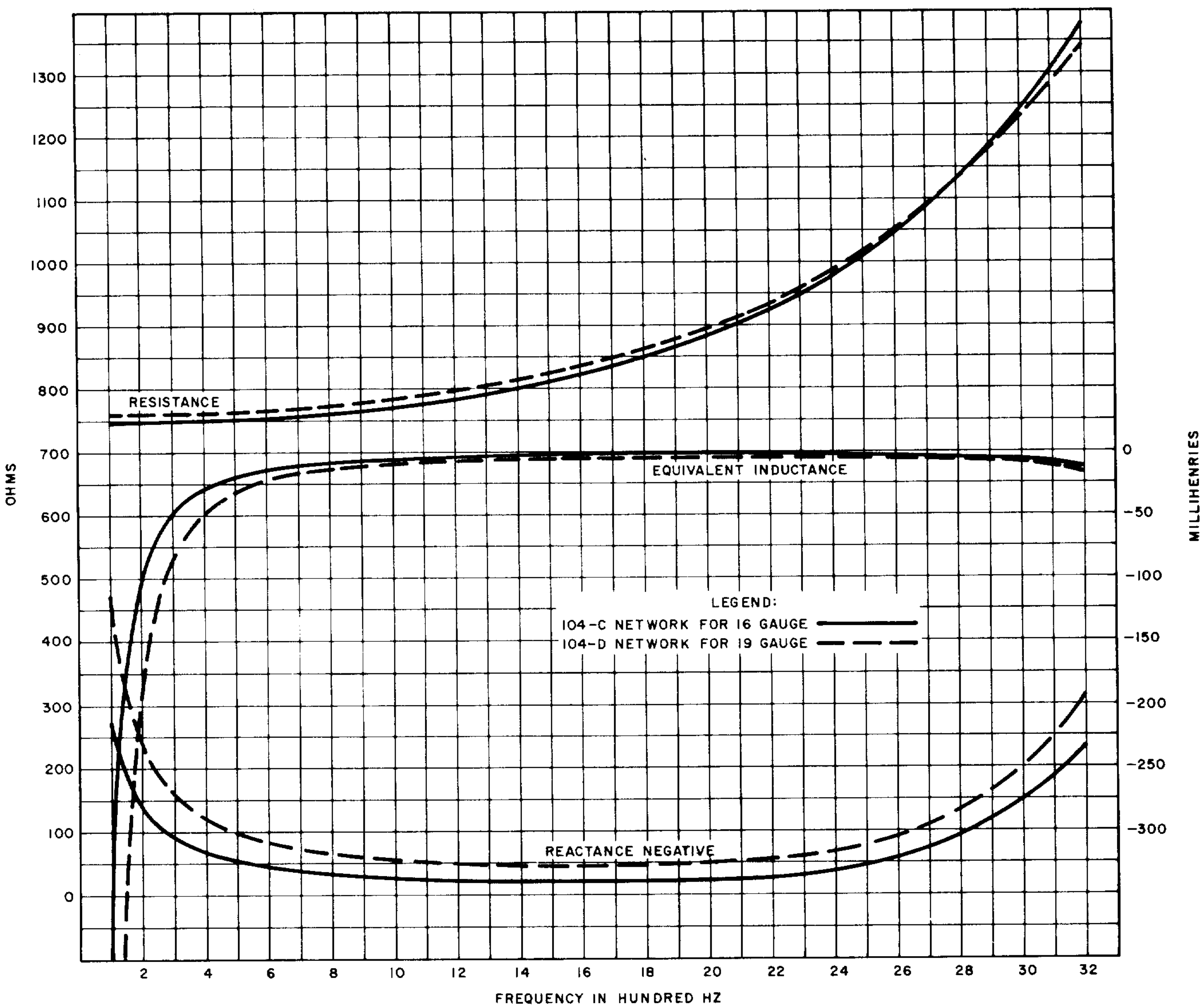


Fig. 7—Mid-Section Impedance of Networks for Toll Cable 104-Type Networks for H-63 Phantom Circuit

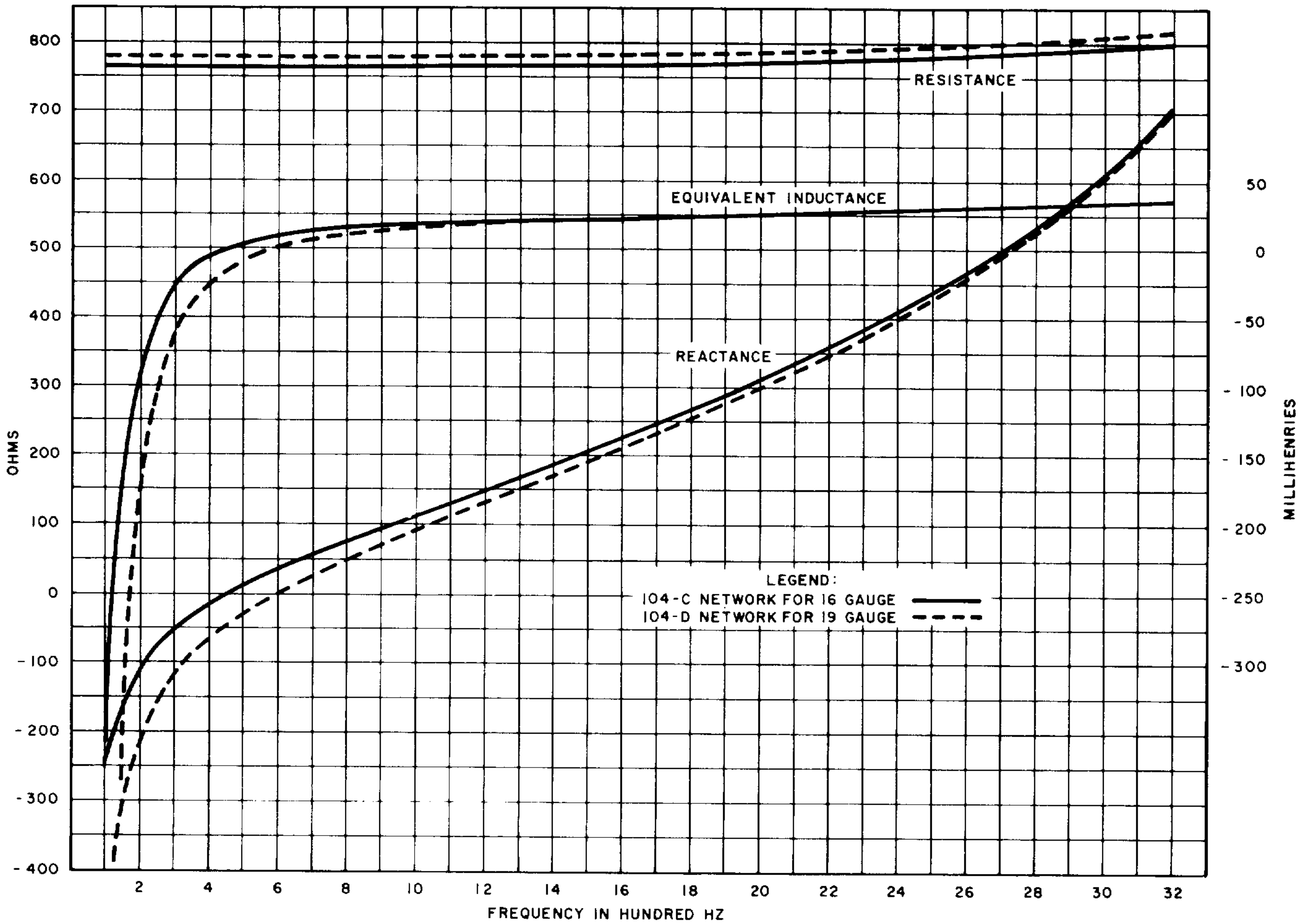


Fig. 8—Impedance of Networks for Toll Cable 104-Type Networks for H-63 Phantom Circuits

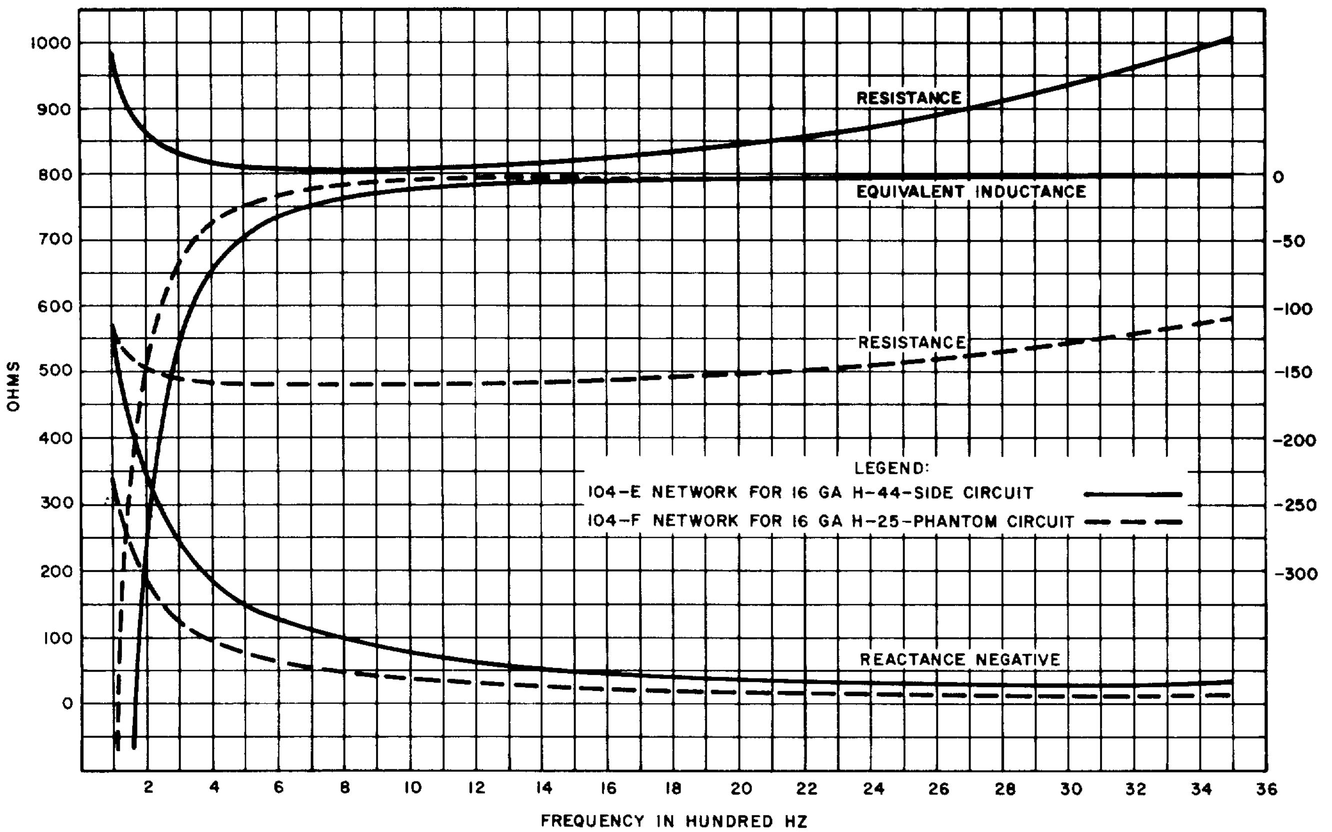


Fig. 9—Mid-Section Impedance of Networks for Toll Cable—104-Type Networks for H-44-25 Circuits

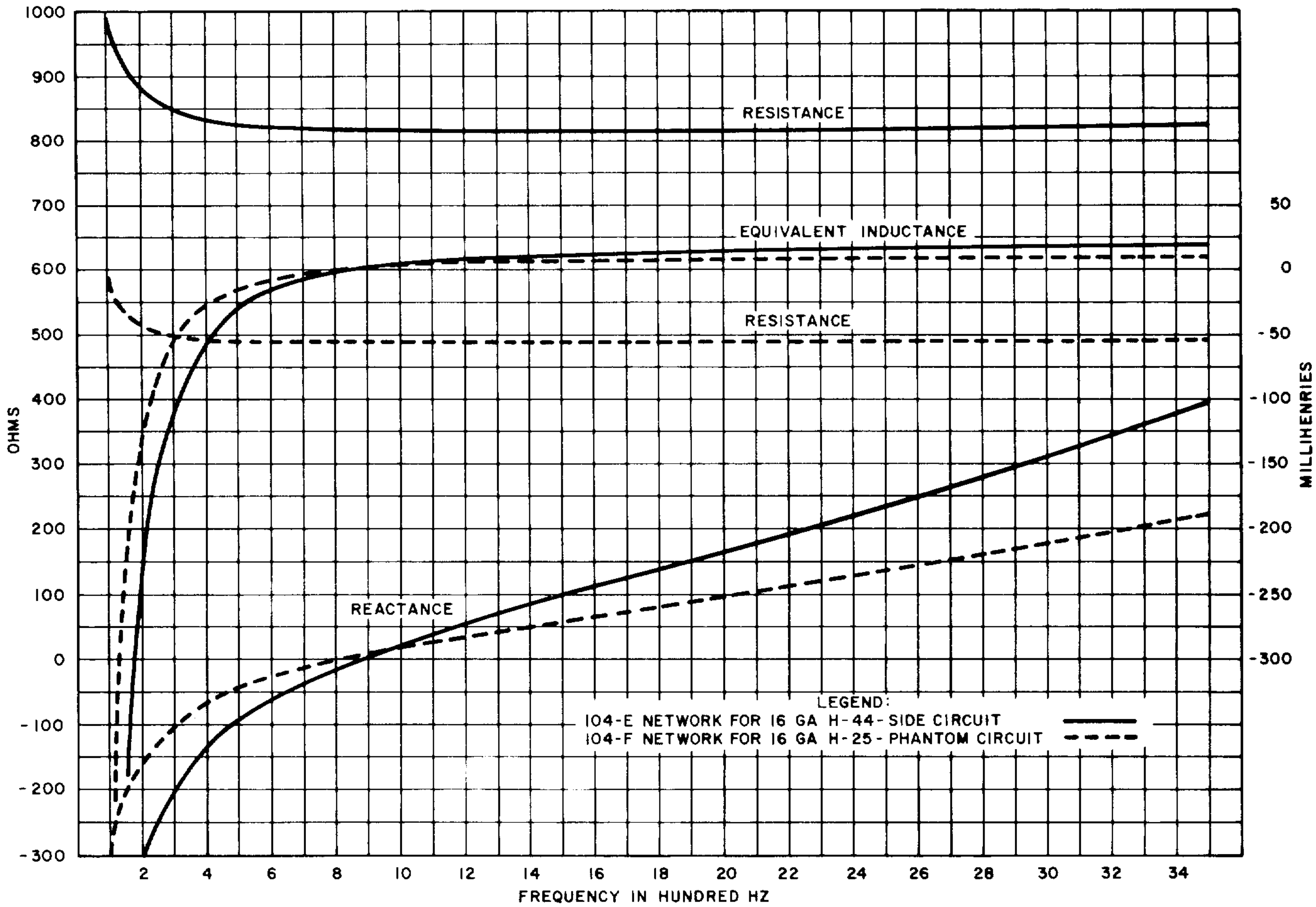


Fig. 10—Impedance of Networks for Toll Cable—104-Type Networks for H-44-25 Circuits

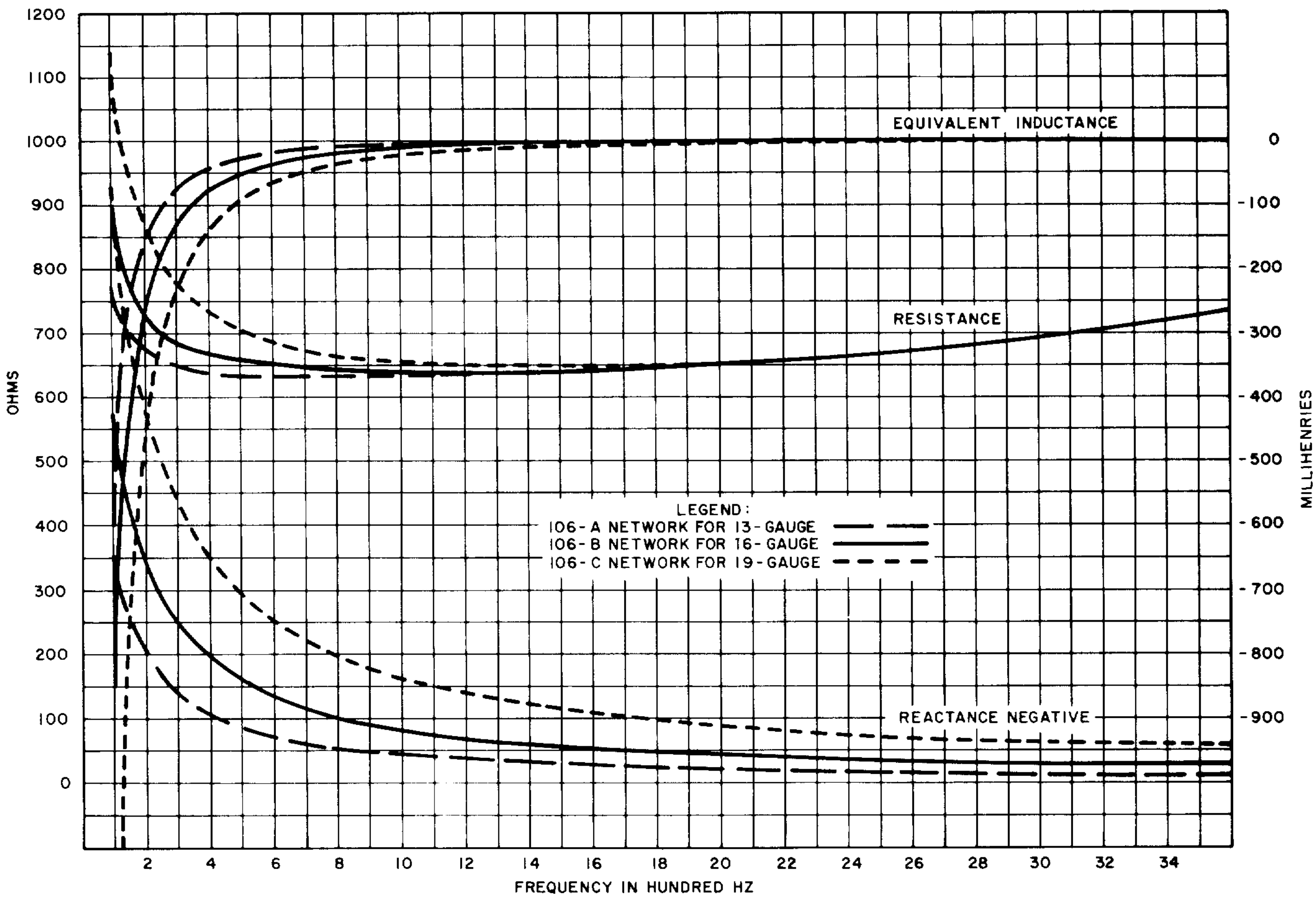


Fig. 11—Mid-Section Impedance of Networks for Toll Entrance Cable—106-Type Networks for H-18-16 Loaded Side Circuits

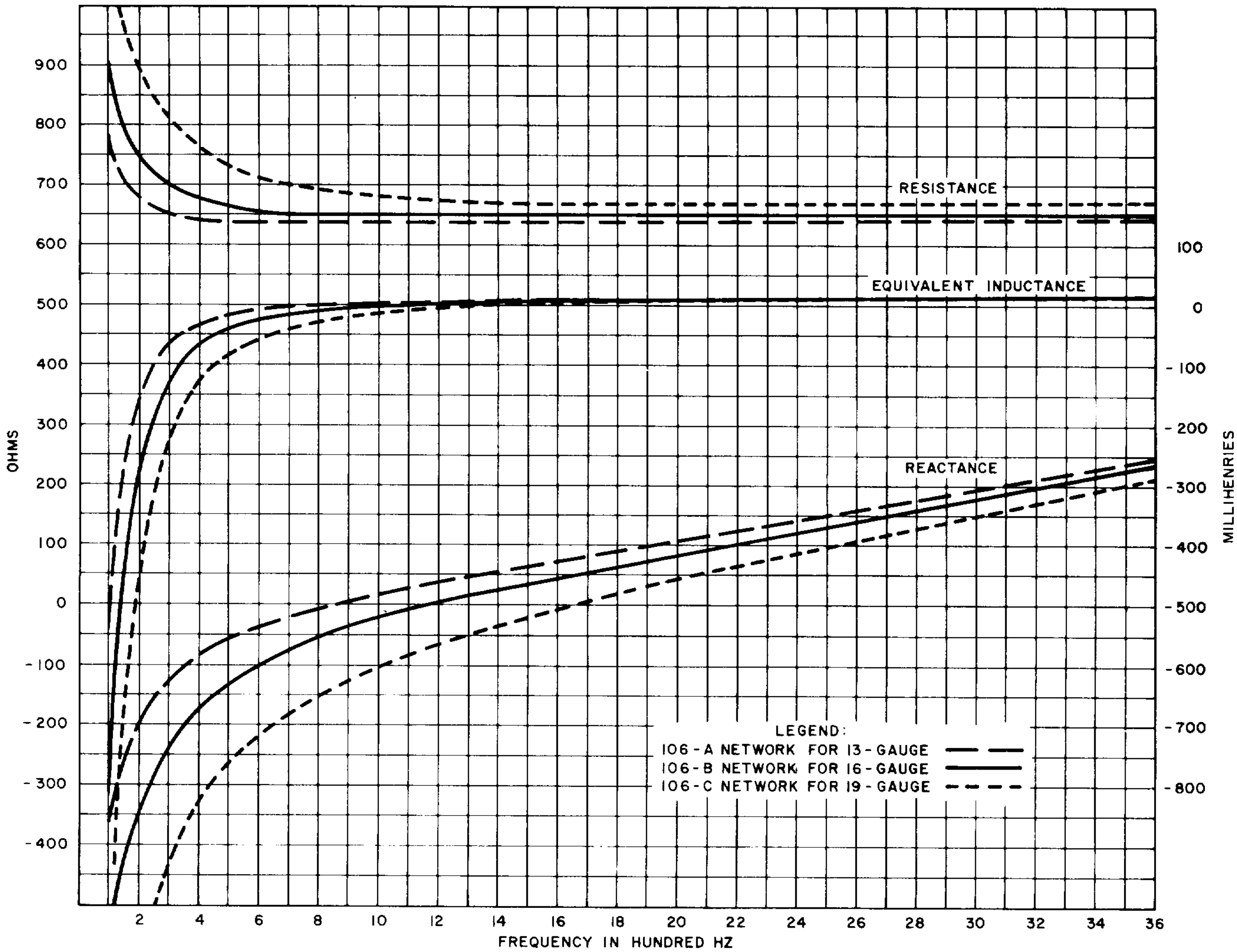


Fig. 12—Impedance of Networks for Toll Entrance Cable—106-Type Networks for H-28-16 Loaded Side Circuits

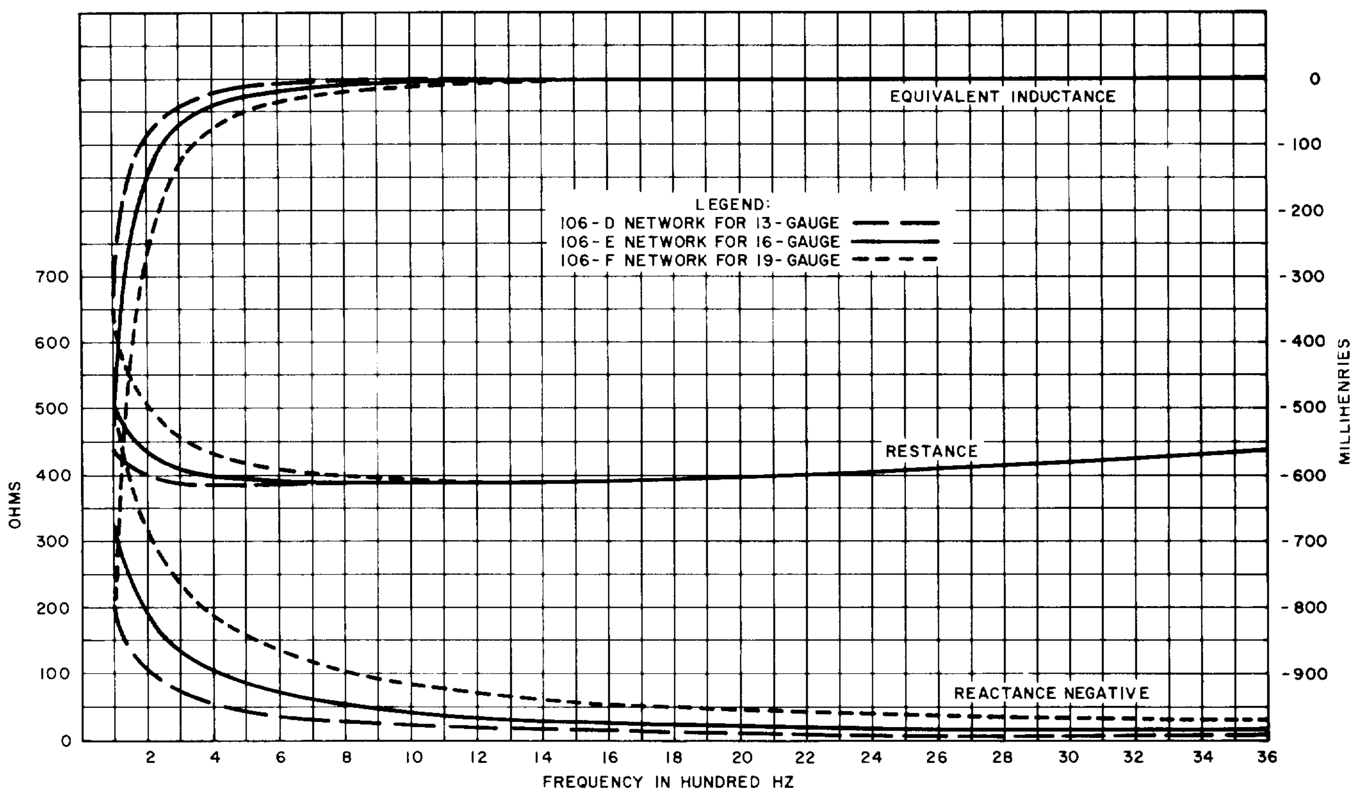


Fig. 13—Mid-Section Impedance of Networks for Toll Entrance Cable—106-Type Networks for H-28-16 Loaded Phantom Circuits

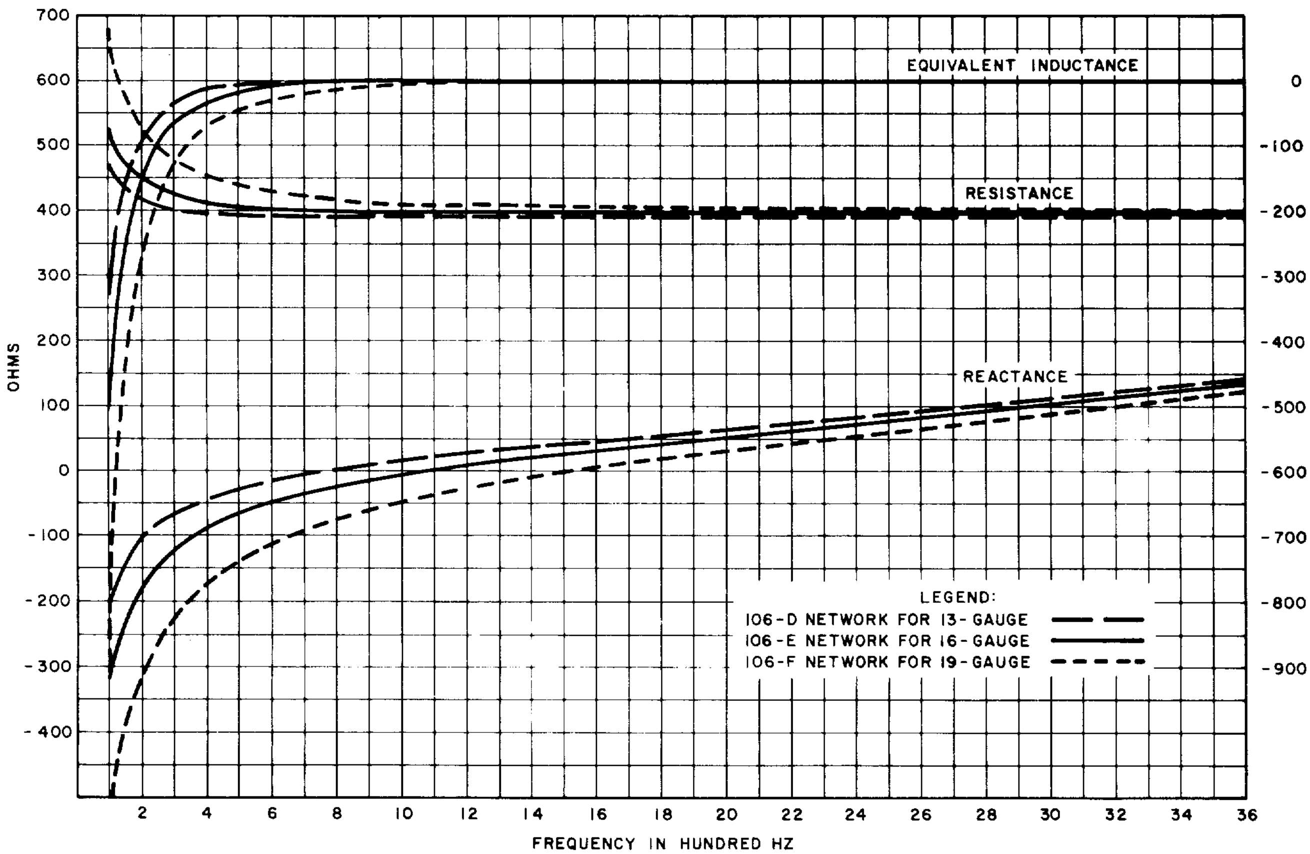


Fig. 14—Impedance of Networks for Toll Entrance Cable—106-Type Networks for H-28-16 Loaded Phantom Circuits

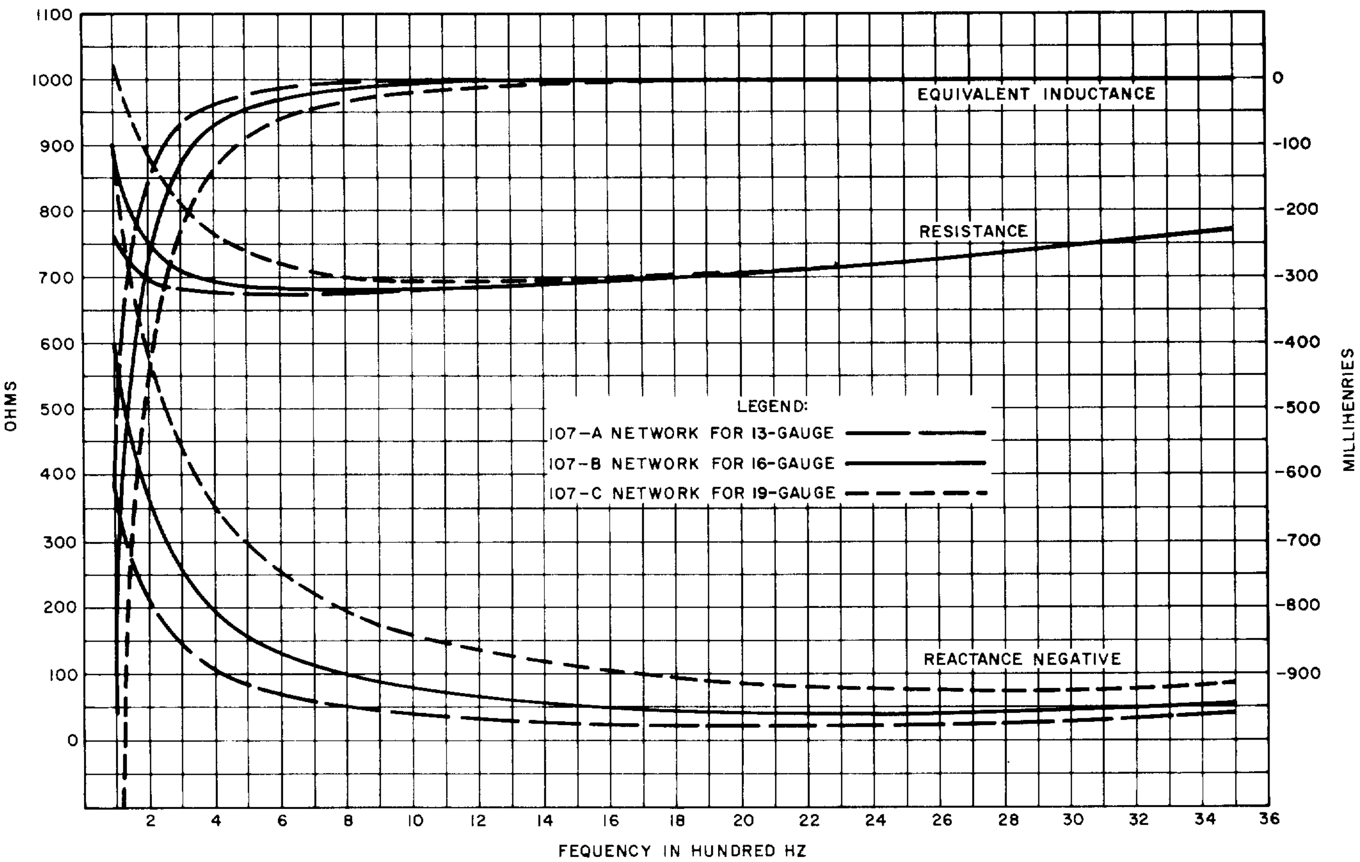


Fig. 15—Mid-Section Impedance of Networks for Toll Entrance Cable—107-Type Networks for H-31-18 Loaded Side Circuits

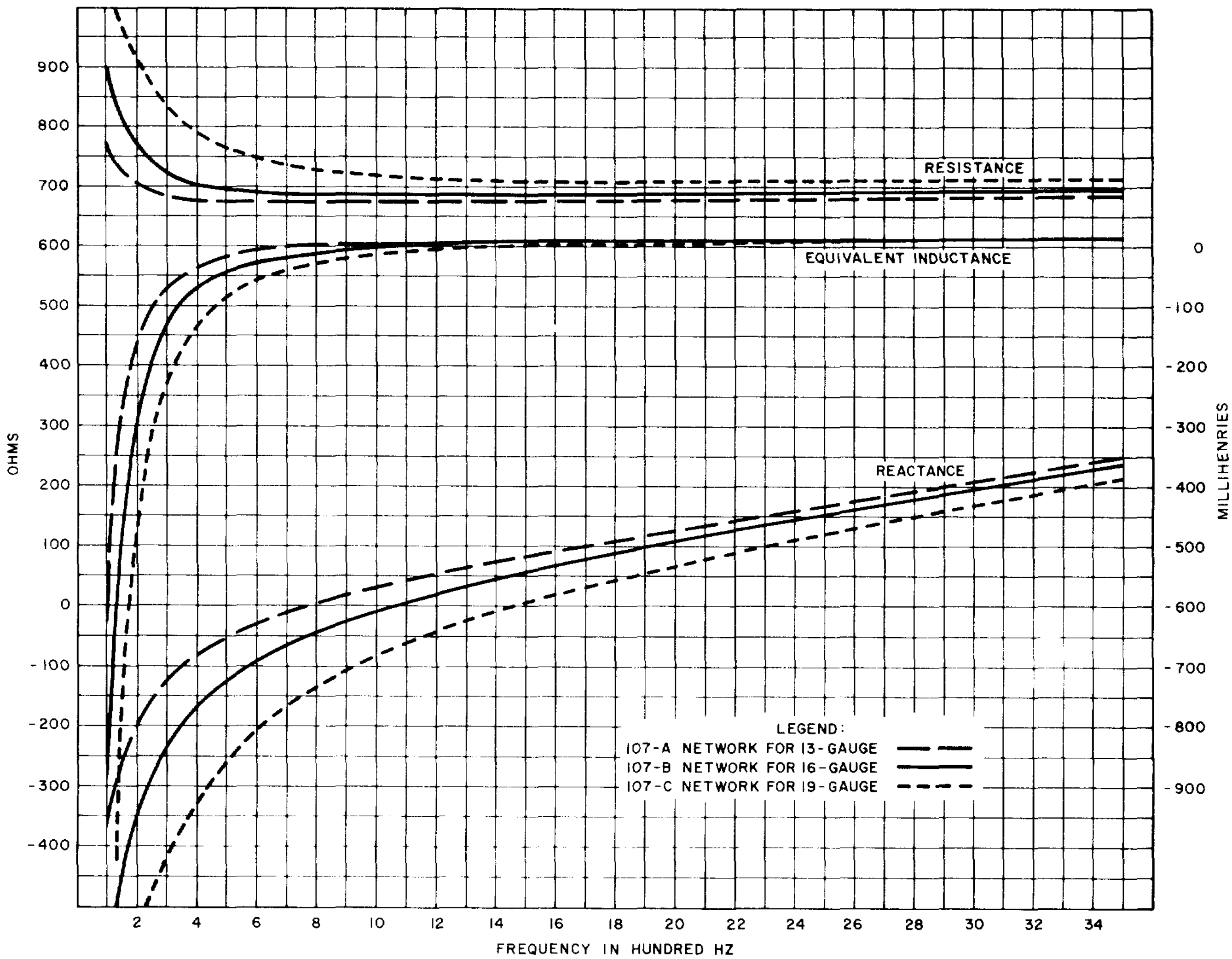


Fig. 16—Impedance of Networks for Toll Entrance Cable—107-Type Networks for H-31-18 Loaded Side Circuits

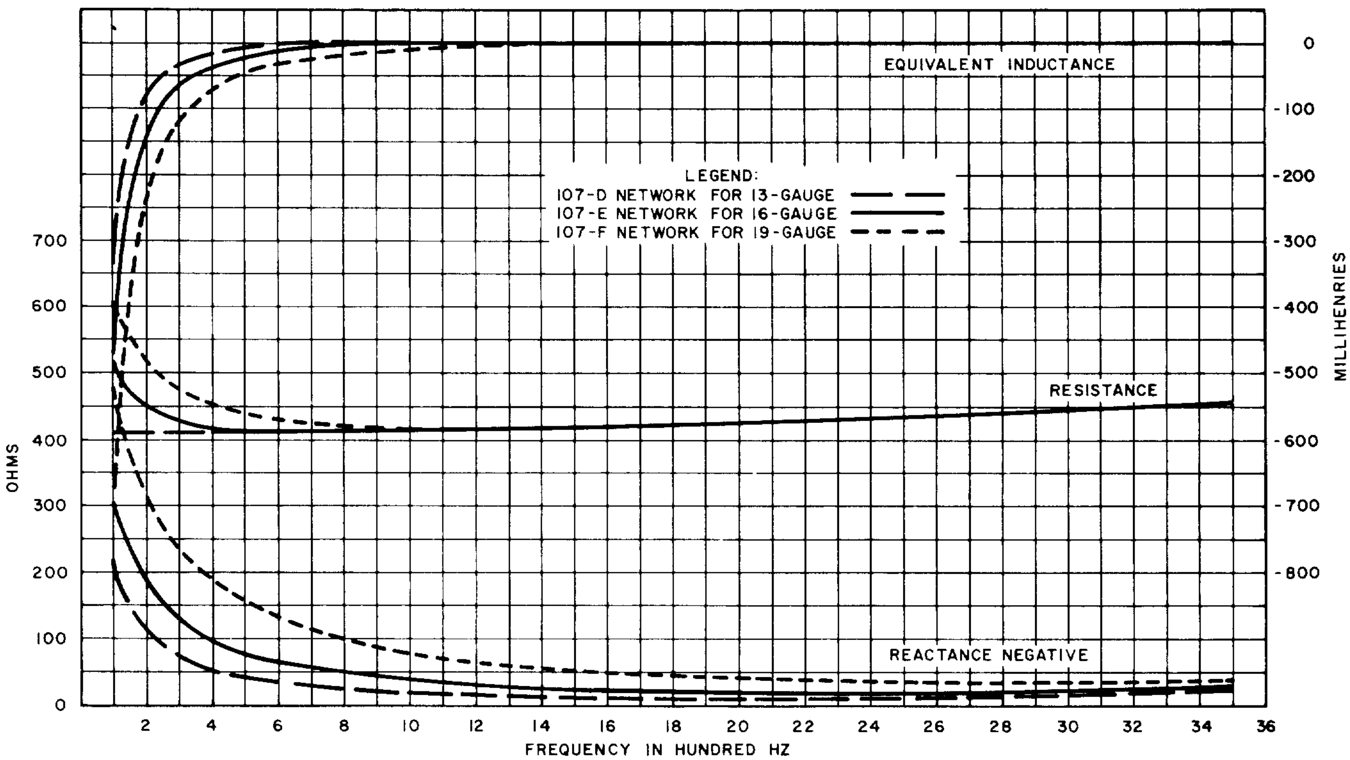


Fig. 17—Mid-Section Impedance of Networks for Toll Entrance Cable—107-Type Networks for H-31-18 Loaded Phantom Circuits

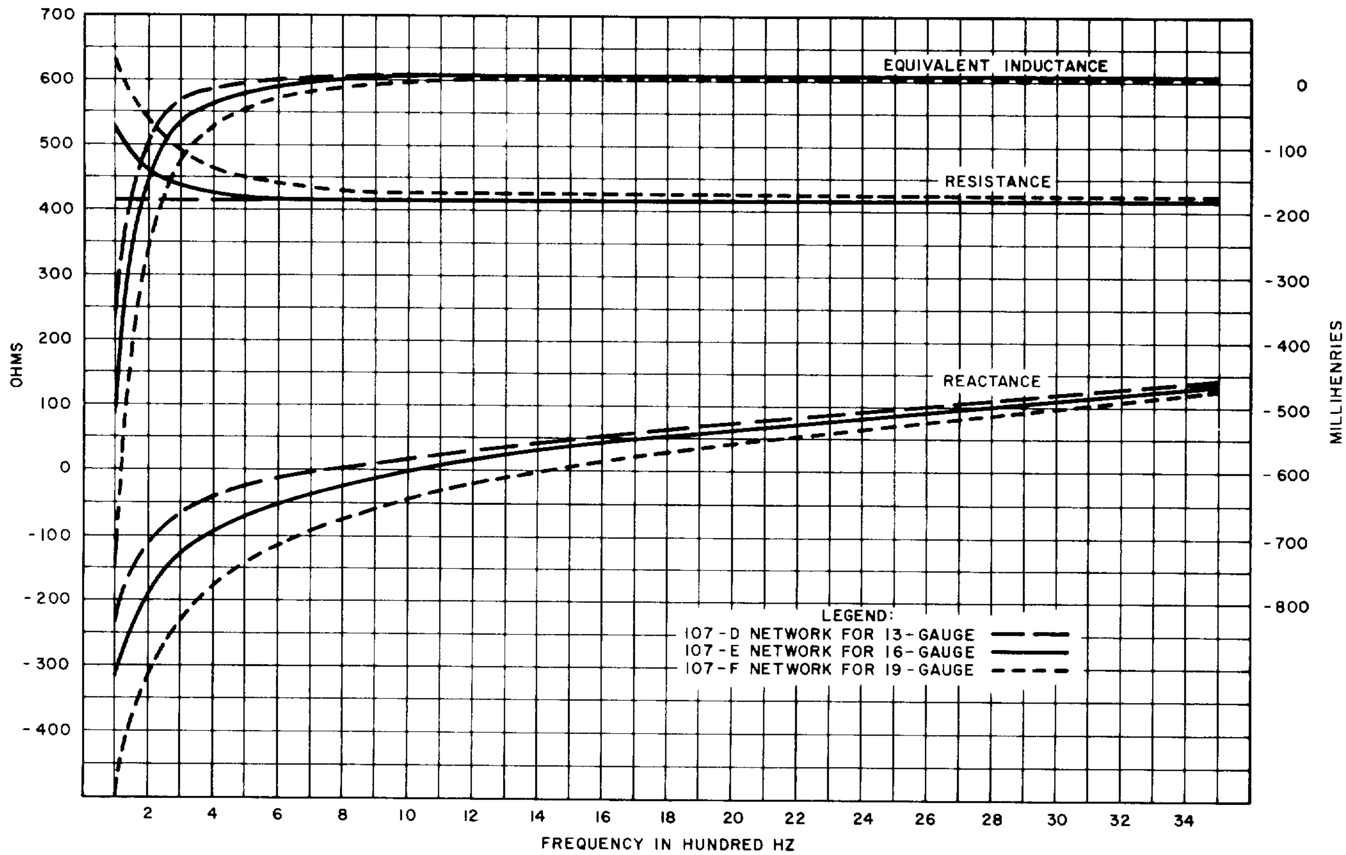


Fig. 18—Impedance of Networks for Toll Entrance Cable—107-Type Networks for H-31-18 Loaded Phantom Circuits

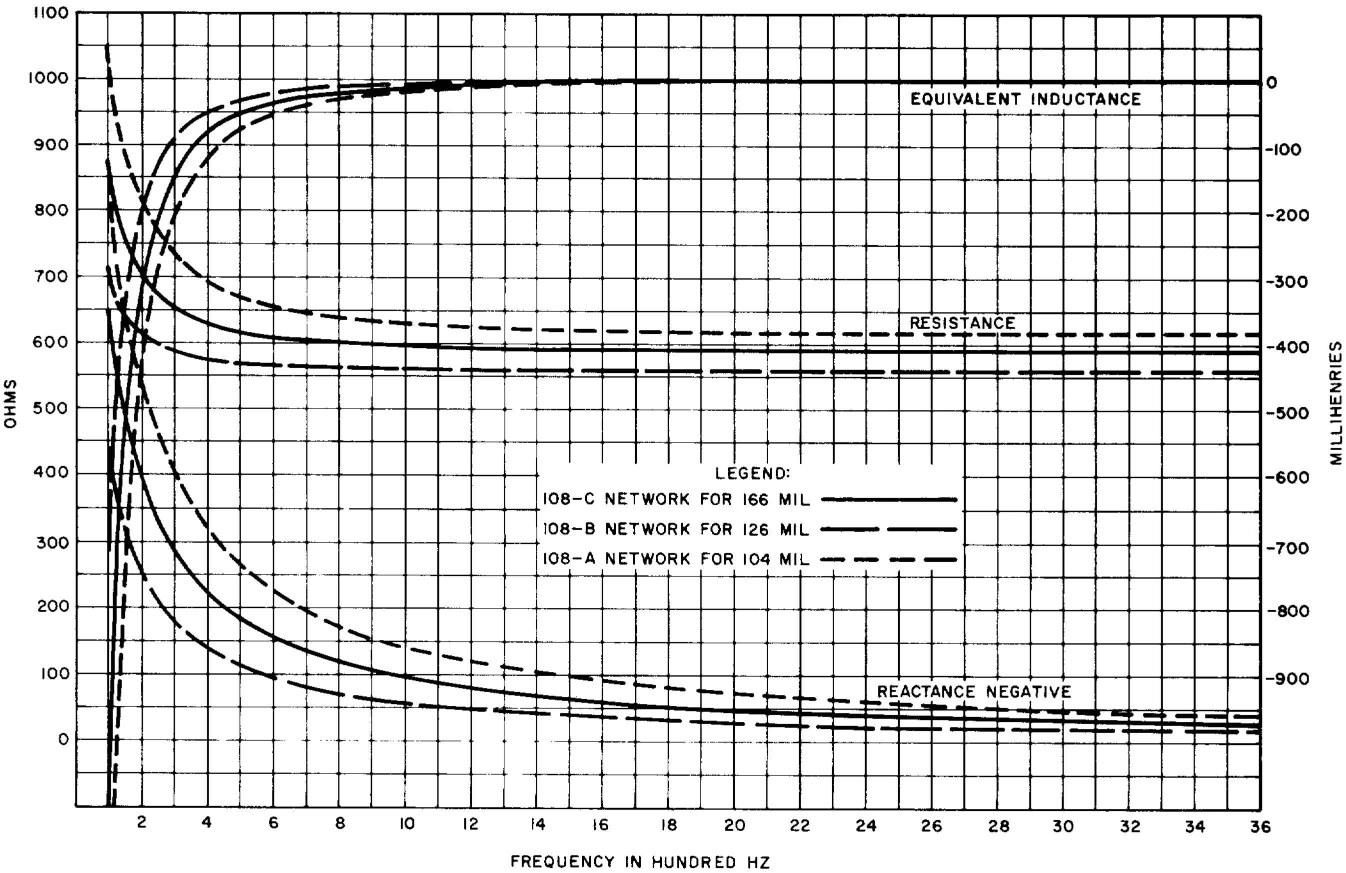


Fig. 19—Impedance of Networks for Toll Entrance Cable—108-Type Networks for H-31-18 Loaded Phantom Circuits

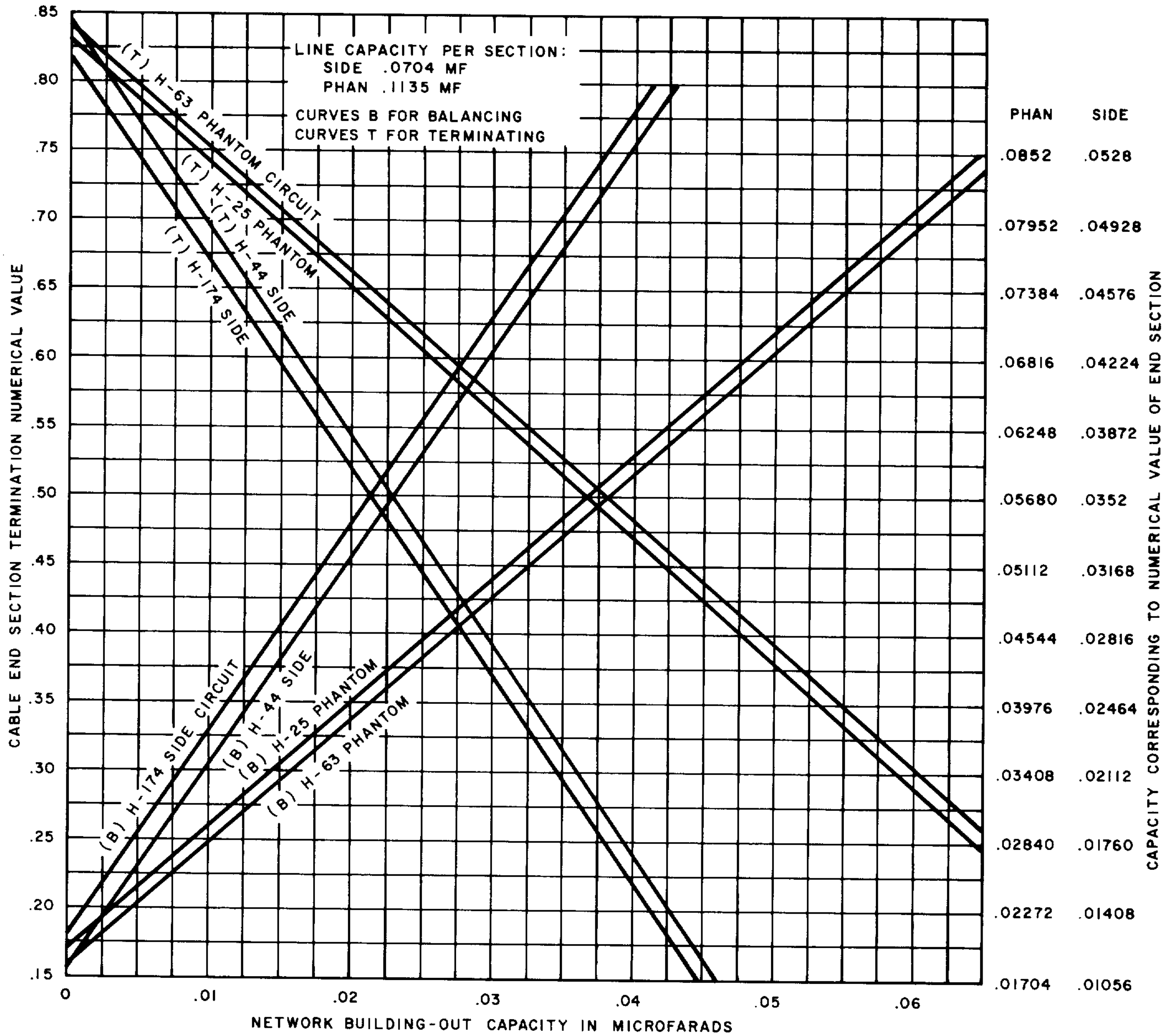


Fig. 20—Network Building-Out Capacity versus Cable End-Section for 104-Type Networks

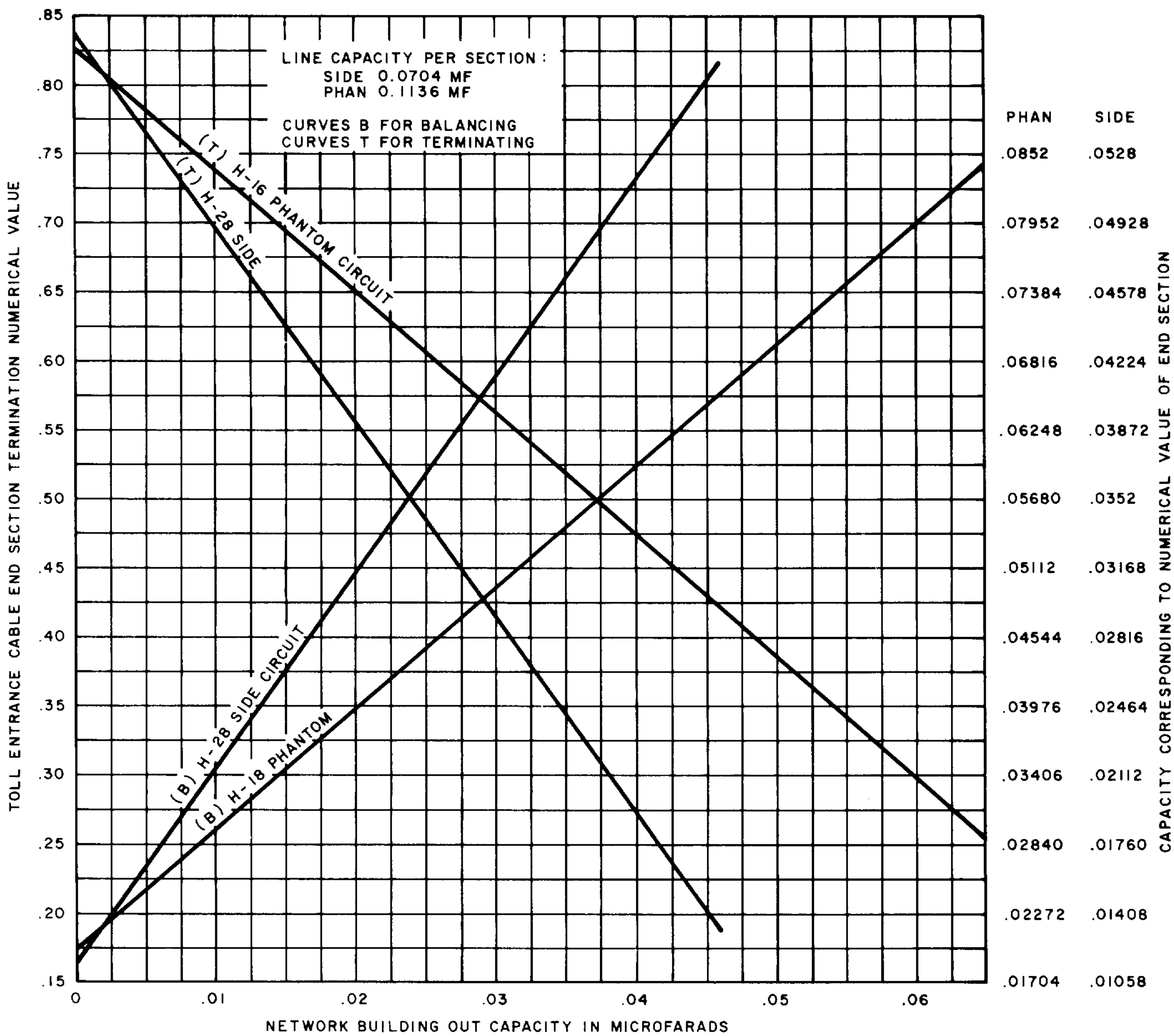


Fig. 21—Network Building-Out Capacity versus Toll Entrance Cable End-Section for H-28-16 Networks

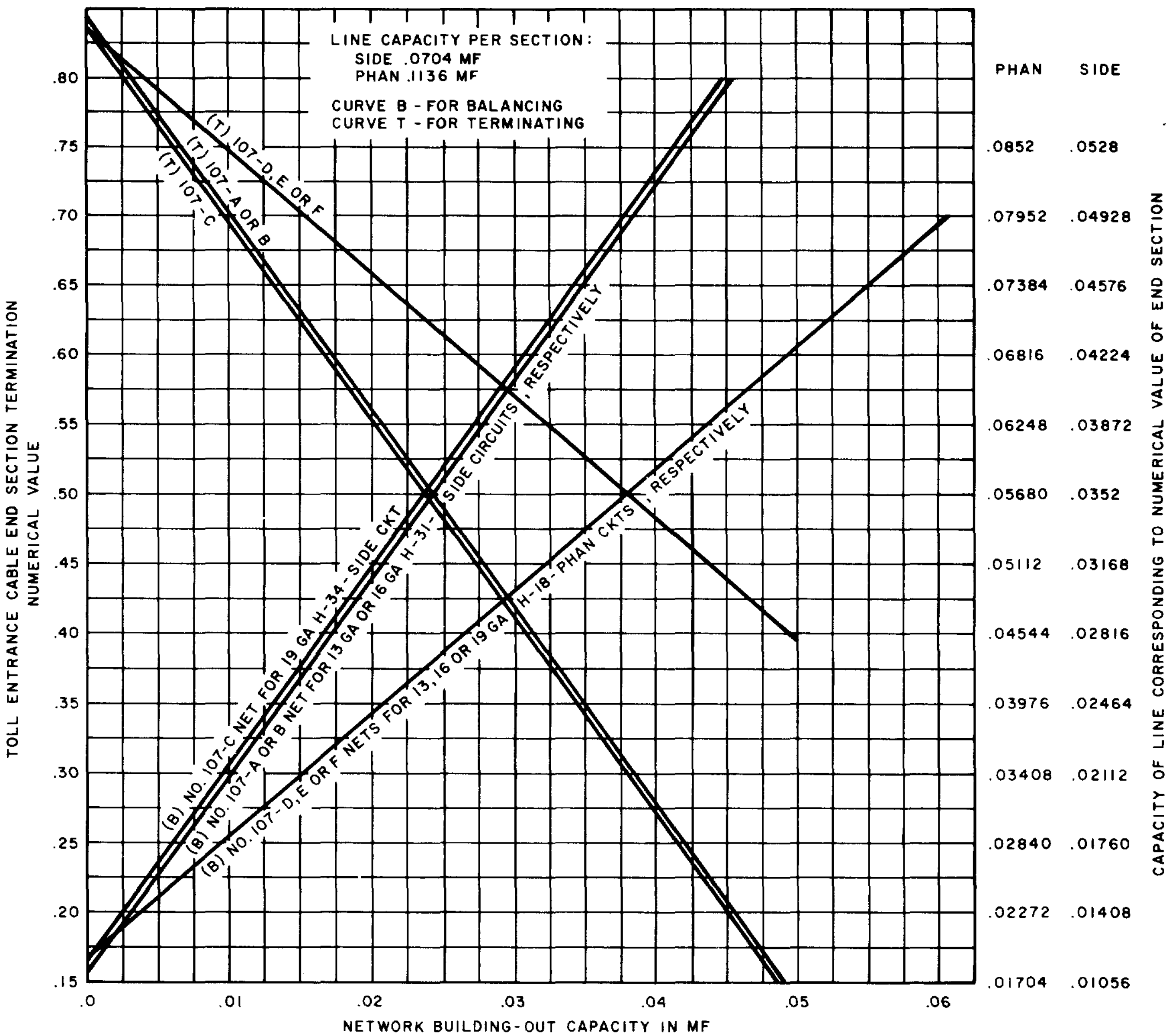
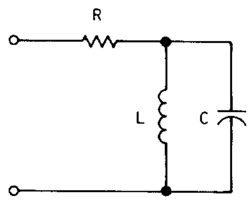
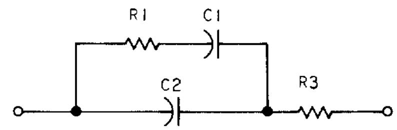


Fig. 22—Network Building-Out Capacity versus Cable End-Section for 107-Type Networks



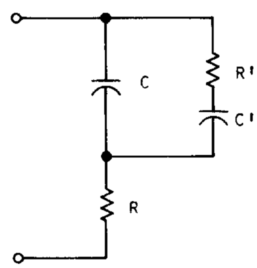
CIRCUIT	CODE NO.	R OHMS	L HENRYS	C MF	END SECTION
SIDE	13-P	800	0.0134	0.0373	0.2
PHANTOM	13-S	475	0.00765	0.0603	0.2

Fig. 23—Nominal Constants of Basic Networks—19-Gauge H-44-25 Circuits



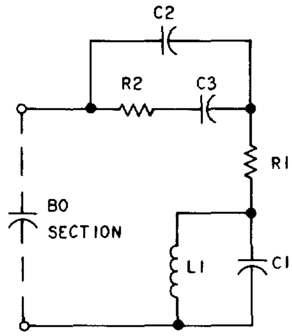
CODE NO.	ASSOCIATED NETWORK	R1 OHMS	R3 OHMS	C1 MF	C2 MF
17-H	13-P	1794	20	1.44	1.13
17-J	13-S	1088	12	2.72	2.15

Fig. 24—Nominal Constants of Low-Frequency Correctors—19-Gauge H-44-25 Circuits



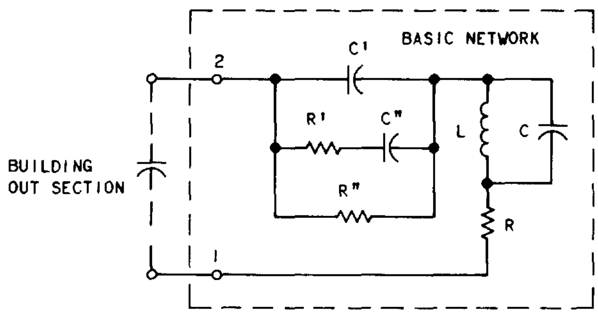
CODE NO. OF NETWORK	FOR USE ON N.L.O.W. CIRCUIT	R OHMS	C MF	R' OHMS	C' MF
102-E	165 MIL NON POLE PAIR	606	2.66	1317	3.54
102-F	165 MIL POLE PAIR	656	2.66	1371	3.35
102-G	165 MIL HALF POLE PAIR	631	2.66	1361	3.45
103-A	165 MIL PHANTOM	371	5.44	745	6.48
102-H	128 MIL NON POLE PAIR	636	1.63	1272	1.98
102-J	128 MIL POLE PAIR	679	1.65	1358	1.98
102-K	128 MIL HALF POLE PAIR	656	1.65	1312	1.98
102-L	128 MIL PHANTOM	387	3.35	774	3.98
102-A	104 MIL NON POLE PAIR	663	1.13	1917	2.52
102-B	104 MIL POLE PAIR	712	1.06	1647	1.81
102-C	104 MIL HALF POLE PAIR	687	1.07	1606	1.91
102-D	104 MIL PHANTOM	398	2.19	971	3.50

Fig. 25—Constants of Line Balancing Networks for Nonloaded, Open-Wire Circuits



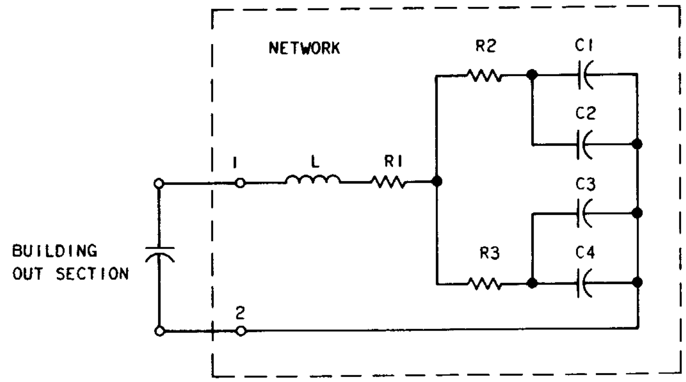
CODE NO. OF NETWORK	FOR USE ON	BALANCING NETWORK							BO SEC CAPACITY FOR 1/2 IN. SEC BO
	SIDE CIRCUIT OF	C1 MF	L1 HEN	R1 OHMS	C2 MF	C3 MF	R2 OHMS	NET. END SECTION	
104-A	H-174-106 H-174-63 # 16 GA	0.036	0.0536	1581	3.92	OMITTED	OMITTED	0.181	0.0214
104-B	H-174-106 H-174-63 # 19 GA	0.036	0.0536	1595	2.17	OMITTED	OMITTED	0.181	0.0214
104-E	H-44-25 # 16 GA	0.0297	0.0148	806	2.21	2.21	1592	0.156	0.0229
	PHANTOM CIRCUIT OF								
104-C	H-174-63 # 16 GA	0.0447	0.0217	756	5.79	OMITTED	OMITTED	0.158	0.0384
104-D	H-174-63 # 19 GA	0.0447	0.0217	772	3.32	OMITTED	OMITTED	0.158	0.0384
104-F	H-44-25 # 16 GA	0.0479	0.0084	482	4.35	SHORTED	1230	0.168	0.0369

Fig. 26—Constants of 104-Type Balancing Networks for 16- and 19-gauge Side and Phantom Circuits



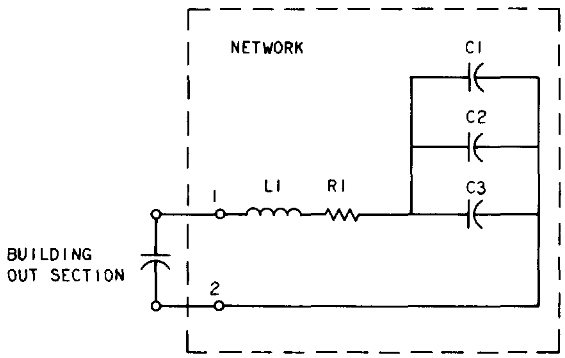
CODE NO. OF NETWORK	FOR USE ON LOADED CABLE	NORMALLY JOINED TO NL OPEN WIRE	NOMINAL VALUES OF NETWORK ELEMENTS							NOMINAL VALUE OF NETWORK END SECTION	BO SECTION IN MF FOR MIDSECTION BO
			C MF	L HY	R OHMS	C' MF	C" MF	R' OHMS	R" OHMS		
106-A	13 GA SIDE	165 MIL SIDE	0.0331	0.00943	630	3.65	SHORTED	1080	OMITTED	0.164	0.0237
106-B	16 GA SIDE	128 MIL SIDE	0.0331	0.00943	640	1.89	0.428	2041	1934	0.164	0.0237
106-C	19 GA SIDE	104 MIL SIDE	0.0331	0.00943	655	0.953	0.421	1930	2900	0.164	0.0237
106-D	13 GA PX	165 MIL PX	0.0510	0.00547	383	6.92	SHORTED	650	OMITTED	0.172	0.0373
106-E	16 GA PX	128 MIL PX	0.0510	0.00547	387	3.60	0.823	1134	1275	0.172	0.0373
106-F	19 GA PX	104 MIL PX	0.0510	0.00547	395	1.80	0.678	1098	1720	0.172	0.0373

Fig. 27—Constants of Line Balancing Networks for H-28-16 Loaded Toll Entrance Cable Circuits



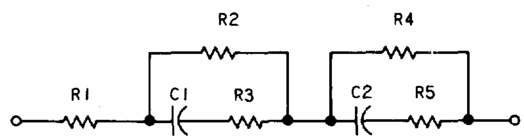
CODE NO. OF NETWORK	FOR USE ON LOADED CABLE	NORMALLY JOINED TO NL OPEN WIRE	NOMINAL VALUES OF NETWORK ELEMENTS								NOMINAL VALUE OF NETWORK END SECTION	BO SECTION IN MF FOR MID SECTION BO
			L (MH)	C1 (MF)	C2 (MF)	C3 (MF)	C4 (MF)	R1 OHMS	R2 OHMS	R3 OHMS		
107-A	13 GA SIDE	165 MIL SIDE	11.81	1.08	2.12	2.12	2.12	544.3	84.8	1390	0.157	0.0242
107-B	16 GA SIDE	128 MIL SIDE	11.81	2.20	1.10	1.10	NONE	235.1	1503	540.8	0.158	0.0241
107-C	19 GA SIDE	104 MIL SIDE	11.81	0.54	1.10	0.54	NONE	274	1382	517.5	0.164	0.0237
107-E	16 GA PX	128 MIL PX	6.614	1.10	2.20	2.50	2.50	332.4	60	839	0.166	0.0380
107-F	19 GA PX	104 MIL PX	6.776	2.12	1.08	1.08	NONE	174.3	848.5	302.4	0.166	0.0380

Fig. 28—Constants of Line Balancing Networks for H-31-18 Loaded Toll Entrance Cable Circuits



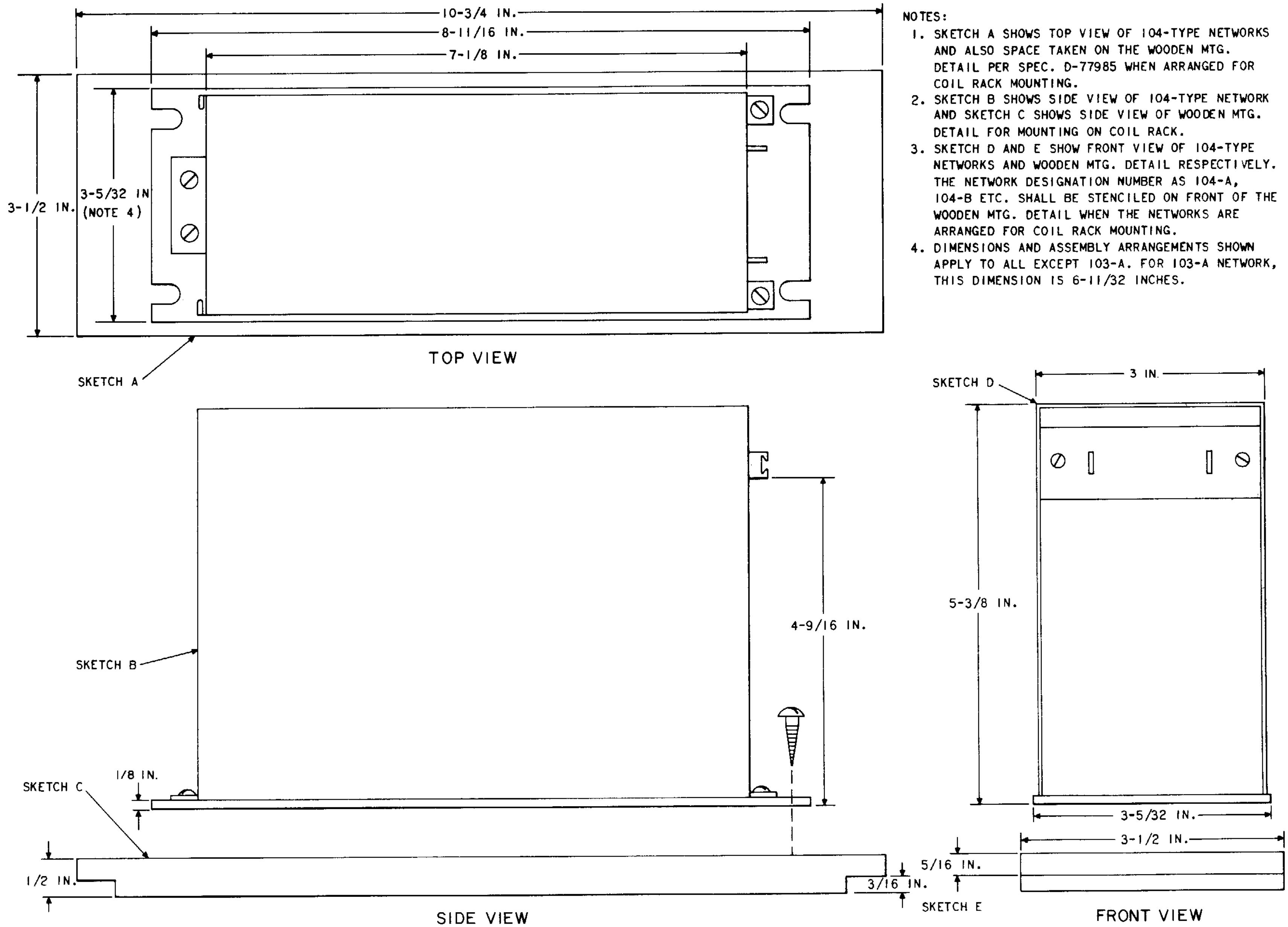
CODE NO. OF NETWORK	FOR USE ON LOADED CABLE	NORMALLY JOINED TO NL OPEN WIRE	NORMAL VALUES OF NETWORK ELEMENTS					NOMINAL VALUE OF NETWORK END SECTION	BO SECTION IN MF FOR MID SECTION BO
			L1	C1 MF	C2 MF	C3 MF	R1 OHMS		
107-D	13 GA PX	165 MIL PX	6.614 MH	2.5	2.38	2.16	388.5	0.166	0.0380

Fig. 29—Constants of Line Balancing Networks for H-31-18 Loaded Toll Entrance Cables



CODE NO. • OF NETWORK	FOR USE ON N.L.O.W. CIRCUIT	R1 OHMS	R2 OHMS	R3 OHMS	R4 OHMS	R5 OHMS	C1 MF	C2 MF
108-C	165 MIL NON POLE PAIR	0	2218	131.8	577.8	1737	3.65	0.54
108-B	128 MIL NON POLE PAIR	0	2950	421	445	432	2.14	1.08
108-A	104 MIL NON POLE PAIR	456	3130	0	478	233	2.08	1.10

Fig. 30—Constants of Line Balancing Networks for Nonloaded, Open-Wire Circuits—8-Inch Spacing



NOTES:

1. SKETCH A SHOWS TOP VIEW OF 104-TYPE NETWORKS AND ALSO SPACE TAKEN ON THE WOODEN MTG. DETAIL PER SPEC. D-77985 WHEN ARRANGED FOR COIL RACK MOUNTING.
2. SKETCH B SHOWS SIDE VIEW OF 104-TYPE NETWORK AND SKETCH C SHOWS SIDE VIEW OF WOODEN MTG. DETAIL FOR MOUNTING ON COIL RACK.
3. SKETCH D AND E SHOW FRONT VIEW OF 104-TYPE NETWORKS AND WOODEN MTG. DETAIL RESPECTIVELY. THE NETWORK DESIGNATION NUMBER AS 104-A, 104-B ETC. SHALL BE STENCILED ON FRONT OF THE WOODEN MTG. DETAIL WHEN THE NETWORKS ARE ARRANGED FOR COIL RACK MOUNTING.
4. DIMENSIONS AND ASSEMBLY ARRANGEMENTS SHOWN APPLY TO ALL EXCEPT 103-A. FOR 103-A NETWORK, THIS DIMENSION IS 6-11/32 INCHES.

Fig. 31—Telephone Repeater Equipment—Balancing Networks—Assembly Details for 101-, 102-, 104-, 107-, and 108-Type and 103-A Networks