BSM # 778B

DATA SYSTEMS — COMMON CIRCUITS, EQUIPMENT AND PROCEDURES
ENVELOPE DELAY CHARACTERISTICS OF 200-TYPE DELAY EQUALIZERS

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1. GENERAL

1.01 This issue replaces issue 1, dated November 1956, and Addendum, issue 1, March, 1959.

1.02 This section describes the 200-type envelope delay equalizers used for reducing delay distortion on telephotograph channels, data circuts, or other systems with similar transmission requirements. Data are included in the form of curves and tabulations covering the nominal envelope delay vs. frequency of 200-type equalizers. Data in tabular form are also included for the nominal attenuation loss between 600-ohm impedances at various frequencies.

1.03 The 200-type envelope delay equalizers replace the 26-type envelope delay equalizers which are rated "manufacture discontinued." The 1102-type envelope delay equalizer which consists of a mounting plate having space for 9 26-type equalizers, a 4-point terminal block and from 4 to 9 26-type equalizers is also rated "manufacture discontinued." The 200-type envelope delay equalizers are electrically equivalent in all respects to the 26 types, differing only in the manner of packaging. With two exceptions the same letter codes are used, that is, the 200-C equalizer is equivalent to the 26-C equalizer, etc. The exceptions are the 200-D which is equivalent to the 26-B and the 200-AK which is equivalent to the 26-A.

1.04 Other sections of practices discuss the theory of envelope delay distortion and its correction, and furnish data to assist in the computation of the expected envelope delay encountered with various types of facilities normally assigned to telephotograph, data transmission and similar services.

2. DESCRIPTION OF EQUALIZERS

2.01 The mounting arrangements for the 200-type envelope delay equalizers are shown on ED-63475-01, and are similar to those for the 128-type filter used in V3 repeaters. The size of the 200-type equalizers will permit mounting up to 9 equalizers on a 3½-in. mounting plate.

2.02 The 200-type delay equalizers were designed to provide a family of delay equalization characteristics which are applicable to a wide range of voice channel facilities. Listed below are the code numbers of the 200-type delay equalizers currently in use.

200-C	200-K	200-T	200-AD
200-D	200-L	200-U	200-AE
200-E	200-M	200-W	200-AF
200-F	200-N	200-Y	200-AG
200-G	200-P	200-AA	200-AH
200-H	200-R	200-AB	200-AJ
200-J	200-S	200-AC	200-AK

2.03 The 200-type equalizer consists of inductors and capacitators arranged in balanced lattice type structures. Figs. 1A, 1B and 1C show three types of arrangements. The difference between Fig. 1B, and Figs. 1A and 1C is that in the latter two, resistors are included in the series or in both the series and the cross lattice paths. The series resistors shown in Figs. 1A and 1C are included for attenuation equalization of the network while the resistors in the cross lattice paths are provided to improve the impedance match of the network when terminated in 600 ohms. Each section of the 200-type equalizer has four terminals designated as shown on the drawings. Terminals 1 and 2 may be considered as the input terminals and 3 and 4 as output terminals. In connecting sections in tandem terminals 3 and 4 of one section are connected to terminals 1 and 2 respectively, of the following section. Care should be taken not to use 1 and 3 or 2 and 4 as the input or output terminals.

2.04 The 200-type delay equalizers are used to correct the envelope delay characteristics of cable circuits, open wire lines and voice channels of carrier systems. The types and number of equalizers required will be determined by the total envelope delay distortion that can be tolerated for the particular service involved.

2.05 The 200-type delay equalizers also present a small attenuation loss which is not constant with frequency. In most cases this loss will be of little consequence compared to the variation that might be expected on the line facility.

2.06 The 200-type delay equalizers for the cable portion of a network are generally located at terminal and bridge points, but may be located at intermediate points, such as at the ends of regulator sections or at points where the cable circuit is connected to an open-wire circuit. It is necessary that these delay equalizers be terminated by approximately 600-ohms impedance on at least one side, and preferably both sides, in order that reflected currents do not cause irregularities in the envelope delay characteristics. In some cases a proper termination on one side of the equalizer may not reduce the reflected current sufficiently. In such a case a 5 db 600-ohm pad may be connected between the line and the improperly terminated side of the equalizer so as to isolate the mismatched line.

2.07 The 200-type delay equalizers for open-wire circuits are usually located at terminal and bridging points and may also be located at intermediate points where open-wire circuits join cable circuits. At terminal or bridging points they are connected in the circuit at the input of the transmitting repeater of the line section they equalize. At an intermediate point where open-wire and cable circuits join they may be connected at the input to the repeater transmitting into the open-wire circuit. With this arrangement the equalizers correct for the delay distortion of the line section following the equalizers, whereas, in the cable circuits they equalize the line section preceding the equalizers. The equalizers are arranged in this manner in the open-wire circuits in order that they may be connected at points of low level and where the impedance facing the equalizer is approximately 600 ohms.

2.08 The 200-type delay equalizer is designed for use with alternating currents only. Supervision or other dc currents should not be allowed to flow through these equalizers since magnetic saturation will alter their delay characteristics considerably.

3. DESCRIPTION OF DATA

3.01 Table I furnishes data covering the nominal loss in db of the various types of 200-type equalizer sections at representative frequencies up to 4000 cycles. Also indicated is the nominal frequency at which the total phase shift is 180 degrees. For most of the 200-type equalizer sections the loss is a maximum at the frequency where the total phase shift is 180 degrees. A few of the 200-type sections have a higher loss at frequencies where the phase shift is less than 180 degrees. This higher loss is due to the steep slope of the phase shift characteristic at lower frequencies.

3.02 Table II furnishes data indicating the nominal delay in microseconds at representative frequencies to 4000 cycles for various 200-type sections. In many cases two or more sections of one type are used in tandem. In order to facilitate the computation of the delay correction obtained when tandem use is required data are shown for some of the 200-type sections indicating the delay for from 2 to 6 sections. Data are also shown for 200-D and 200-C type sections in tandem as these are commonly used in this manner for delay correction of H-44-25 side circuits.

3.03 Fig. 1 shows the schematic circuit arrangement of the various 200-type sections.

3.04 Figs. 2 to 28 inclusive are curves indicating the envelope delay in microseconds vs. frequency characteristic for various 200-type sections in the frequency range from 0 to 4000 cycles. As in Table II data are also shown for the delay of sections of the same type in tandem. In order to facilitate comparison of envelope delay vs. frequency characteristic of line facilities with the delay distortion correction obtained by one or more of a particular 200-type section the curves are plotted with the delay scale inverted. Most of the curves are plotted on the same scale, i.e., each major division = 500 cycles as abscissas and each major division = 200 microseconds as ordinates. In making a visual comparison between the envelope delay characteristic of a line and the delay distortion correction obtained by a particular 200-type section it is important to use the same scales for both characteristics and to plot the delay of the line in a normal manner with increasing values of delay plotted upward.

4. ATTACHMENTS

Table I—200-type Equalizers—Nominal loss in db.

Table II—200-type Equalizers—Delay in Microseconds. (2 sheets)

Fig. 1—Schematic Circuit for 200-type Equalizer Sections.

Figs. 2 to 28 inclusive—Nominal Envelope Delay Characteristic of 200-type Equalizer Sections.

Fig. 2, 1 to 6 200-C Sections

Fig. 3, 1 to 6 200-D Sections

Fig. 4, 200-E, 200-F, 200-G Sections

Fig. 5, 200-K, 200-L, 200-M, 200-P Sections

Fig. 6, 1 to 6 200-H Sections

Fig. 7, 1 to 6 200-J Sections

Fig. 8, 1, to 6 200-N Sections

TABLE I

200-TYPE EQUALIZER SECTIONS

Nominal Loss in DB

Type of Section	Frequency in Cycles 0	300	500	1000	2000	3000	4000	* in cycles
200-C	.12		.19	.23	.21	.12	.08	1,690
200-D	.08		.10	.14	.22	.23	.12	2,600
200-E	0		.01	.02	.04	.06	.10	5,800
200-F	0		.01	.02	.06	.12	.29	4,850
200-G	2.00	.38	.15	.08	.05	.04	.04	1,245
200-H	1.10	.59	.30	.11	.05	.03	.03	2,656
200-J	.13		.14	.15	.15	.16	.15	3,173
200-K	.16		.18	.18	.18	.18	.18	3,755
200-L	.14		.16	.17	.17	.17	.15	2,385
200-M	.18		.19	.20	.20	.21	.20	3,350
200-N	.19		.22	.23	.23	.19	.17	2,005
200-P	.22		.22	.23	.23	.23	.22	3,015
200-R	.22		.25	.27	.27	.21	.17	1,800
200-S	.28		.29	.30	.29	.28	.26	2,713
200-T	.24		.28	.30	.30	.23	.20	1,750
200-U	.27		.28	.29	.30	.30	.29	2,600
200-W	.18		1.02	.13	.02	.01	0	533
200-Y	.46		.45	.46	.47	.42	.43	2,360
200-AA	.27		.28	.28	.31	.25	.23	2,163
200-AB	.53		.54	.44	.40	.42	.43	976
200-AC	.30		.32	.36	.34	.18	.15	2,025
200-AD	.30		.32	.36	.36	.18	.15	2,045
200-AE	.30		.31	.35	.38	.19	.15	2,050
200-AF	.25		.26	.27	.32	.32	.22	3,250
200-AG	.25		.26	.27	.29	.29	.22	3,714
200-AH	.12		.15	.17	.16	.13	.10	2,200
200-AJ	.09		.11	.12	.13	.13	.12	3,333
200-AK	.13		.15	.16	.16	.15	.12	2,800

* Frequency at which total phase shift equals 180 degrees.

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TABLE II

200-TYPE EQUALIZER SECTIONS

DELAY IN MICROSECONDS

No. and Type of Equal.	Frequency in Kilocycles														
	0	0.5	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.5	4.0
1-200C	279	296	316	310	293	267	237	207	179	154	133	115	100	73	55
2-200C	558	592	632	620	586	534	474	414	358	308	266	230	200	146	110
3-200C	837	888	948	930	879	801	711	621	537	462	399	345	300	219	165
4-200C	1116	1184	1264	1240	1172	1068	948	828	716	616	532	460	400	292	220
5-200C	1395	1480	1580	1550	1465	1335	1185	1035	895	770	665	575	500	365	275
6-200C	1674	1776	1896	1860	1758	1602	1422	1242	1074	924	798	690	600	438	330
1-200D	132	141	168	185	202	220	236	246	249	242	228	208	186	134	96
2-200D	264	282	336	370	404	440	472	492	498	484	456	416	372	268	192
3-200D	396	423	504	555	606	660	708	738	747	726	684	624	558	402	288
4-200D	528	564	672	740	808	880	944	984	996	968	912	832	744	536	384
5-200D	660	705	840	925	1010	1100	1180	1230	1245	1210	1140	1040	930	670	480
6-200D	792	846	1008	1110	1212	1320	1416	1476	1494	1452	1368	1248	1116	804	576
1-200C+1-200D	411	437	484	495	495	487	473	453	428	396	361	323	286	207	151
2-200C+2-200D	822	874	968	990	990	974	946	906	856	792	722	646	572	414	302
3-200C+3-200D	1233	1311	1452	1485	1485	1461	1419	1359	1284	1188	1083	969	858	621	453
4-200C+4-200D	1644	1748	1936	1980	1980	1948	1892	1812	1712	1584	1444	1292	1144	828	604
5-200C+5-200D	2055	2185	2420	2475	2475	2435	2365	2265	2140	1980	1805	1615	1430	1035	755
6-200C+6-200D	2466	2622	2904	2970	2970	2922	2838	2718	2568	2376	2166	1938	1716	1242	906
1-200E	13.7	14.0	15.0	15.6	16.3	17.2	18.3	19.6	21.2	23.0	25.3	28.1	31.4	43.8	66.4
1-200F	14.6	15.0	16.6	17.6	18.9	20.3	22.2	24.5	27.5	21.2	36.0	42.3	50.4	86.9	181
1-200G	5113	19.0	32.6	26.6	22.9	20.6	18.9	17.8	16.9	16.2	15.7	15.3	14.8	14.2	13.7
1-200H	2592	154	45.1	33.4	26.3	21.7	18.5	16.3	14.6	13.3	12.3	11.5	10.8	9.7	8.8
2-200H	5184	308	90.2	66.8	52.6	43.4	37.0	32.6	29.2	26.6	24.6	23.0	21.6	19.4	17.6
3-200H	7776	462	135	100	78.9	65.1	55.5	48.9	43.8	39.9	36.9	34.5	32.4	29.1	26.4
4-200H	10368	616	180	134	105	86.8	74.0	65.2	58.4	53.2	49.2	46.0	43.2	38.8	35.2
5-200H	12960	770	226	167	132	108	92.5	81.5	73.0	66.5	61.5	57.5	54.0	48.5	44.0
6-200H	15552	924	271	200	158	130	111	97.8	87.6	79.8	73.8	69.0	64.8	58.2	52.8

No. and Type of Equal.	Frequency in Kilocycles														
	0	0.5	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.5	4.0
1-200J	163	165	167	168	168	167	164	161	157	151	145	137	130	110	93
2-200J	326	330	334	336	336	334	328	322	314	302	290	274	260	220	186
3-200J	489	495	501	504	504	501	492	483	471	453	435	411	390	330	279
4-200J	652	660	668	672	672	668	656	644	628	604	580	548	520	440	372
5-200J	815	825	835	840	835	820	805	785	755	755	725	685	650	550	465
6-200J	978	990	1002	1008	1008	1002	984	966	942	906	870	822	780	660	558
1-200K	117	119	126	129	132	136	140	143	145	146	146	145	142	131	115
1-200L	199	205	219	223	224	222	215	206	193	178	163	148	133	103	80
1-200M	117	121	132	138	145	153	160	166	171	174	175	173	168	147	121
1-200N	198	216	261	278	289	289	277	255	227	199	172	149	127	89	65
2-200N	396	432	522	556	578	578	554	510	454	398	344	298	254	178	130
3-200N	594	648	783	834	867	867	831	765	681	597	516	447	381	267	195
4-200N	792	864	1044	1112	1156	1156	1108	1020	908	796	688	596	508	356	260
5-200N	990	1080	1305	1390	1445	1445	1385	1275	1135	995	860	745	635	445	325
6-200N	1188	1296	1566	1668	1734	1734	1662	1530	1362	1194	1032	894	762	534	390
1-200P	114	120	137	148	160	173	186	199	208	214	213	208	197	158	100
1-200R	191	219	297	332	355	353	327	287	241	199	164	136	113	76	54
2-200R	382	438	594	664	710	706	654	574	482	398	328	272	226	152	108
3-200R	573	657	891	996	1065	1059	981	861	723	597	492	408	339	228	162
4-200R	764	876	1188	1328	1420	1412	1308	1148	964	796	656	544	452	304	216
5-200R	955	1095	1485	1660	1775	1765	1635	1435	1205	995	820	680	565	380	270
6-200R	1146	1314	1782	1992	2130	2118	1962	1722	1446	1194	984	816	678	456	324
1-200S	104	113	139	156	177	201	227	252	271	279	273	254	228	158	107
2-200S	208	226	278	312	354	402	454	504	542	558	546	508	456	316	214
3-200S	312	339	417	468	531	603	681	756	813	837	819	762	684	474	321
4-200S	416	452	556	624	708	804	908	1008	1084	1116	1092	1016	912	632	428
5-200S	520	565	695	780	885	1005	1135	1260	1355	1395	1365	1270	1140	790	535
6-200S	624	678	834	936	1062	1206	1362	1512	1625	1674	1638	1524	1368	948	642

Delay for 1 to 6 sections is shown for types of equalizers often used in tandem.

Indicates approximate frequency in 1.2 - 2.6 kc band with maximum delay.

Indicates approximate frequency in 1.2 - 2.6 kc band with minimum delay.

TABLE II

200-TYPE EQUALIZER SECTIONS

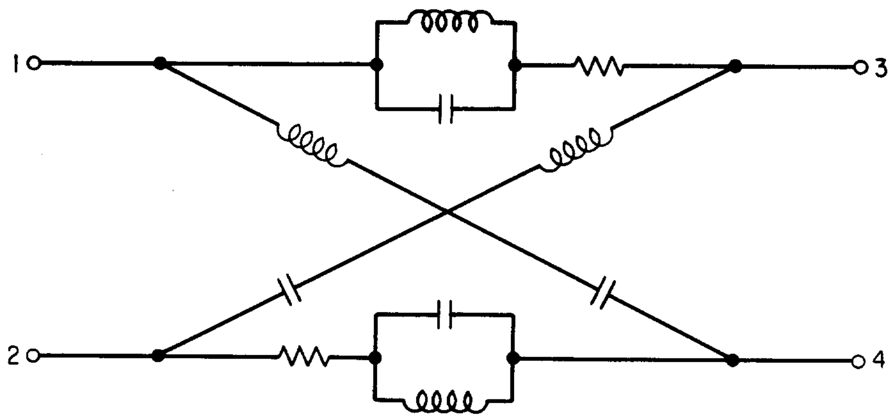
DELAY IN MICROSECONDS

No. and Type of Equal.	Frequency in Kilocycles 0	0.5	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0	3.5	4.0
1-200T	182	213	308	358	386	⌈388⌉	352	298	246	198	⌊159⌋	130	108	70	49
2-200T	364	426	616	716	772	⌈776⌉	704	596	492	396	⌊318⌋	260	216	140	98
3-200T	546	639	924	1074	1158	⌈1164⌉	1056	894	738	594	⌊477⌋	390	324	210	147
4-200T	728	852	1232	1432	1544	⌈1552⌉	1408	1192	984	792	⌊636⌋	520	432	280	196
5-200T	910	1065	1540	1790	1930	⌈1940⌉	1760	1490	1230	990	⌊795⌋	650	540	350	245
6-200T	1092	1278	1848	2148	2316	⌈2328⌉	2112	1788	1476	1188	⌊954⌋	780	648	420	294
1-200U	102	111	141	⌊161⌋	187	216	250	281	303	⌈308⌉	294	263	230	150	98
2-200U	204	222	282	⌊322⌋	374	432	500	562	606	⌈616⌉	588	526	460	300	196
3-200U	306	333	423	⌊483⌋	561	648	750	843	909	⌈924⌉	882	789	690	450	294
4-200U	408	444	564	⌊644⌋	748	864	1000	1124	1212	⌈1232⌉	1176	1052	920	600	392
5-200U	510	555	705	⌊805⌋	935	1080	1250	1405	1515	⌈1540⌉	1470	1350	1150	750	490
6-200U	612	666	846	⌊966⌋	1122	1296	1500	1686	1818	⌈1848⌉	1764	1578	1380	900	588
1-200W	398	1846	218	⌈127⌉	83	59	45	34	27	23	⌊19⌋	15	13	9	7
2-200W	796	3692	436	⌈254⌉	166	118	90	68	54	46	⌊38⌋	30	26	18	14
3-200W	1194	5538	654	⌈381⌉	249	177	135	102	81	69	⌊57⌋	45	39	27	21
4-200W	1592	7384	872	⌈508⌉	332	236	180	136	108	92	⌊76⌋	60	52	36	28
5-200W	1990	9230	1090	⌈635⌉	415	295	225	170	135	115	⌊95⌋	75	65	45	35
6-200W	2388	11076	1308	⌈762⌉	498	354	270	204	162	138	⌊114⌋	90	78	54	42
1-200Y	83	94	132	⌊162⌋	203	262	332	404	⌈448⌉	427	361	285	219	117	70
2-200Y	166	188	264	⌊324⌋	406	524	664	808	⌈896⌉	854	722	570	438	234	140
3-200Y	249	282	396	⌊486⌋	609	786	996	1212	⌈1344⌉	1281	1083	855	657	351	210
4-200Y	332	376	528	⌊648⌋	812	1048	1328	1616	⌈1792⌉	1708	1444	1140	876	468	280
5-200Y	415	470	660	⌊810⌋	1015	1310	1660	2020	⌈2240⌉	2135	1805	1425	1095	585	350
6-200Y	498	564	792	⌊972⌋	1218	1572	1992	2424	⌈2688⌉	2562	2166	1710	1314	702	420
1-200AA	147	163	211	241	272	296	⌈310⌉	305	283	251	⌊214⌋	183	154	97	72
2-200AA	294	326	422	482	544	592	⌈620⌉	610	566	502	⌊428⌋	366	308	194	144
3-200AA	441	489	633	723	816	888	⌈930⌉	915	849	753	⌊642⌋	549	462	291	216
4-200AA	588	652	844	964	1088	1184	⌈1240⌉	1220	1132	1004	⌊856⌋	732	616	388	288
5-200AA	735	815	1055	1205	1360	1480	⌈1550⌉	1525	1415	1255	⌊1070⌋	915	770	485	360
6-200AA	882	978	1266	1446	1632	1776	⌈1860⌉	1830	1698	1506	⌊1284⌋	1098	924	582	432
1-200AB	306	499	676	⌈482⌉	317	218	153	113	87	71	⌊58⌋	48	40	28	21
2-200AB	612	998	1352	⌈964⌉	634	436	306	226	174	142	⌊116⌋	96	80	56	42
3-200AB	918	1497	2027	⌈1446⌉	951	654	459	339	261	213	⌊174⌋	144	120	84	63
4-200AB	1224	1996	2704	⌈1928⌉	1268	872	612	452	348	284	⌊232⌋	192	160	112	84
5-200AB	1530	2495	3380	⌈2410⌉	1585	1090	765	565	435	355	⌊290⌋	240	200	140	105
6-200AB	1836	2994	4056	⌈2892⌉	1902	1308	918	678	522	426	⌊348⌋	288	240	168	126
1-200AC	140	160	227	270	317	357	372	356	315	262	⌊214⌋	173	141	89	60
1-200AD	132	151	219	261	313	359	385	372	333	276	⌊224⌋	180	145	90	59
1-200AE	124	146	210	255	313	368	403	396	350	289	⌊231⌋	183	146	89	58
1-200AF	88	92	107	⌊116⌋	128	141	157	175	193	210	⌈224⌉	231	231	197	150
2-200AF	176	184	214	⌊232⌋	256	282	314	350	386	420	⌈448⌉	462	462	394	300
3-200AF	264	276	321	⌊348⌋	384	423	471	525	579	630	⌈672⌉	693	693	591	450
4-200AF	352	368	428	⌊464⌋	512	564	628	700	772	840	⌈896⌉	924	924	788	600
5-200AF	440	460	535	⌊580⌋	640	705	785	875	965	1050	⌈1120⌉	1155	1155	985	750
6-200AF	528	552	642	⌊696⌋	768	846	942	1050	1158	1260	⌈1344⌉	1386	1386	1182	900
1-200AG	90	93	103	⌊109⌋	115	123	132	142	152	160	⌈167⌉	173	177	171	149
2-200AG	180	186	206	⌊218⌋	230	246	264	284	304	320	⌈334⌉	346	354	342	298
3-200AG	270	279	309	⌊327⌋	345	369	396	426	456	480	⌈501⌉	519	531	513	447
4-200AG	360	372	412	⌊436⌋	460	492	528	568	608	640	⌈668⌉	692	708	684	596
5-200AG	450	465	515	⌊545⌋	575	615	660	710	760	800	⌈835⌉	865	885	855	745
6-200AG	540	558	618	⌊654⌋	690	738	792	852	912	960	⌈1002⌉	1038	1062	1026	894
1-200AH	263	258	242	⌈231⌉	219	205	189	174	159	145	⌊132⌋	120	109	91	78
2-200AH	526	516	484	⌈462⌉	438	410	378	348	318	290	⌊264⌋	240	218	182	156
3-200AH	789	774	726	⌈693⌉	657	615	567	522	477	435	⌊396⌋	360	327	273	234
4-200AH	1052	1032	968	⌈924⌉	876	820	756	696	636	580	⌊528⌋	480	436	364	312
5-200AH	1315	1290	1210	⌈1155⌉	1095	1025	945	870	795	725	⌊660⌋	600	545	455	390
6-200AH	1578	1548	1452	⌈1386⌉	1314	1230	1134	1044	954	870	⌊792⌋	720	654	546	468
1-200AJ	191	186	175	⌈169⌉	162	155	148	141	133	126	⌊119⌋	112	106	91	78
2-200AJ	382	372	350	⌈338⌉	324	310	296	282	266	252	⌊238⌋	224	212	182	156
3-200AJ	573	558	525	⌈507⌉	486	465	444	423	399	378	⌊357⌋	336	318	273	234
4-200AJ	764	744	700	⌈676⌉	648	620	592	564	532	504	⌊476⌋	448	424	364	312
5-200AJ	955	930	875	⌈845⌉	810	775	740	705	665	630	⌊595⌋	560	530	455	390
6-200AJ	1146	1116	1050	⌈1014⌉	972	930	888	846	798	756	⌊714⌋	672	636	546	468
1-200AK	182	184	189	⌈189⌉	189	187	183	178	170	162	⌊152⌋	142	132	109	88
2-200AK	364	368	378	⌈378⌉	378	374	366	356	340	324	⌊304⌋	284	264	218	176
3-200AK	546	552	567	⌈567⌉	567	561	549	534	510	486	⌊456⌋	426	396	327	264
4-200AK	728	736	756	⌈756⌉	756	748	732	712	680	648	⌊608⌋	568	528	436	352
5-200AK	910	920	945	⌈945⌉	945	935	915	890	850	810	⌊760⌋	710	660	545	440
6-200AK	1092	1104	1134	⌈1134⌉	1134	1122	1098	1068	1020	972	⌊912⌋	852	792	654	528

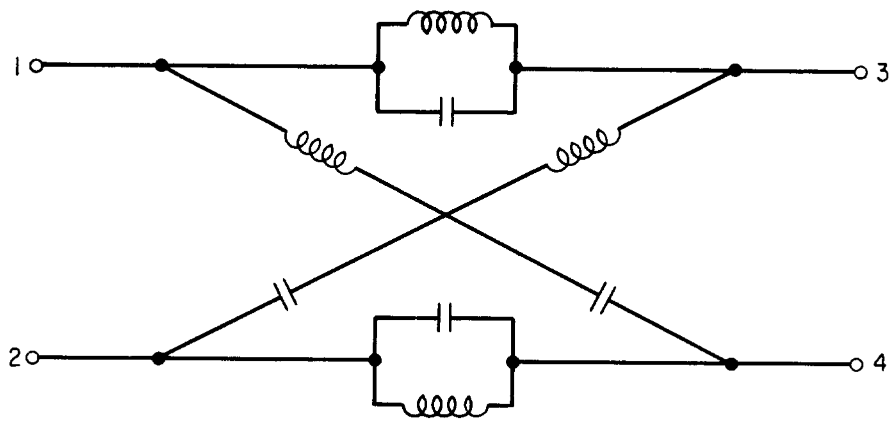
Delay for 1 to 6 sections is shown for types of equalizers often used in tandem.

⌈ ⌉ Indicates approximate frequency in 1.2 - 2.6 kc band with maximum delay.

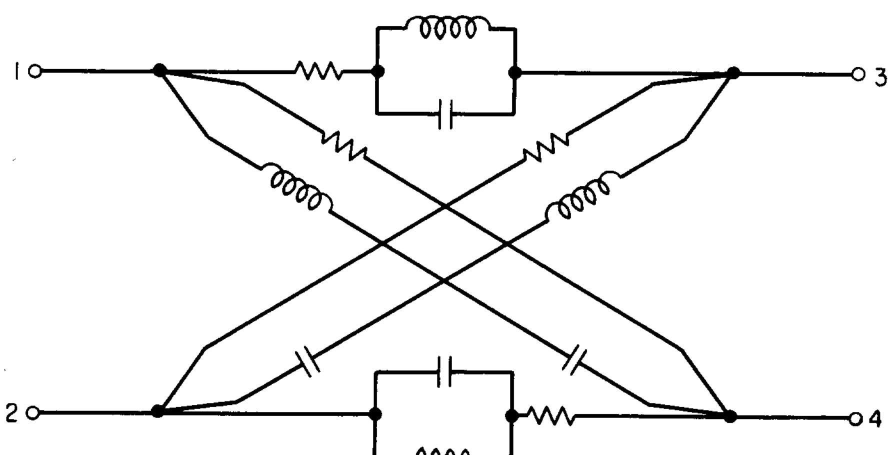
⌊ ⌋ Indicates approximate frequency in 1.2 - 2.6 kc band with minimum delay.



Schematic Circuit for
200 — D, J, K, L, M, N, P, R, S, T, U, Y, AA, AB, and AK Sections
FIG. 1A



Schematic Circuit for
200-C, E, F, G, H, W, AH, and AJ Sections
FIG. 1B



Schematic Circuit for
200 — AC, AD, AE, AF, and AG Sections
FIG. 1C

FIG. 1

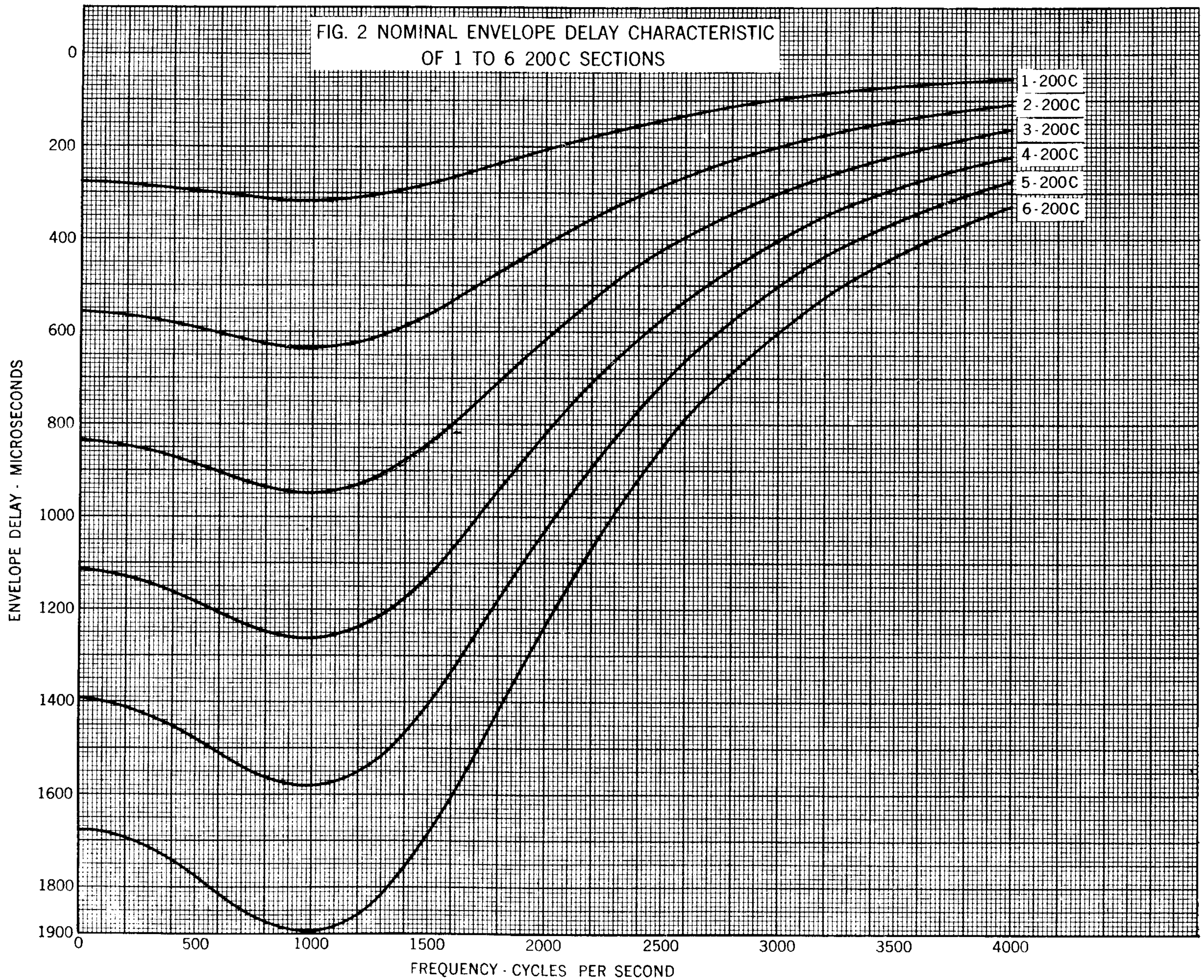


FIG. 2 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200C SECTIONS

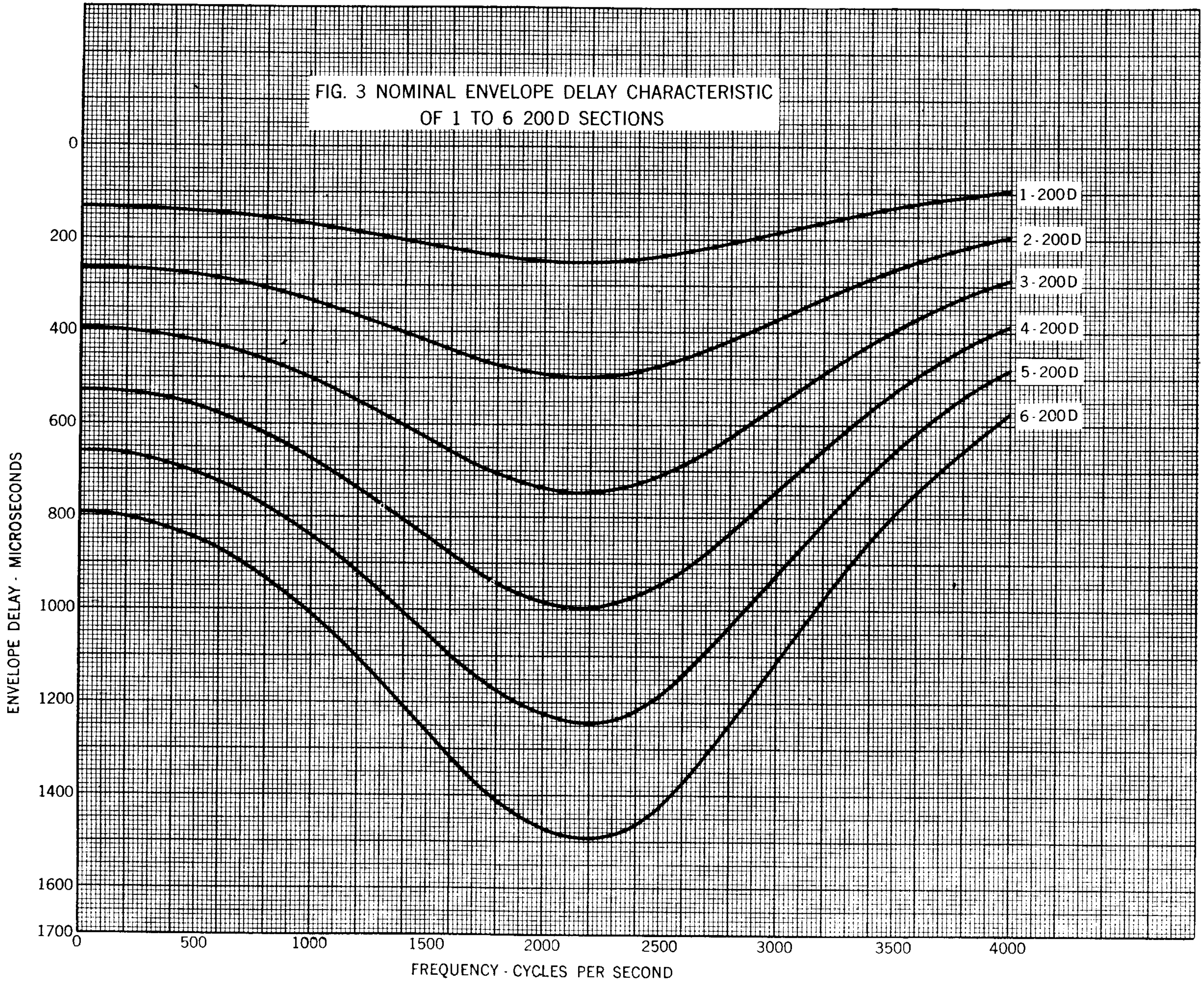


FIG. 3 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200D SECTIONS

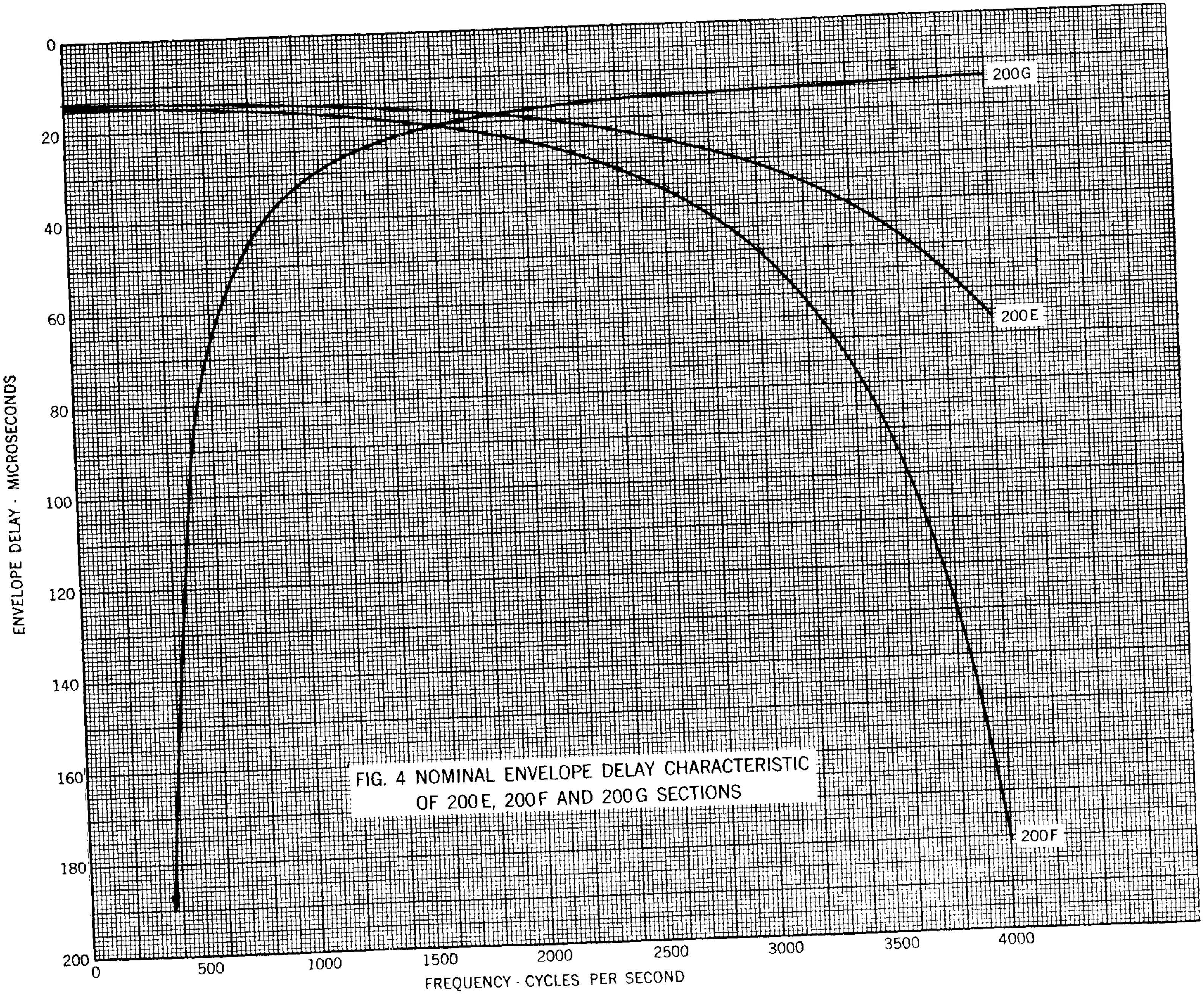


FIG. 4 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 200E, 200F AND 200G SECTIONS

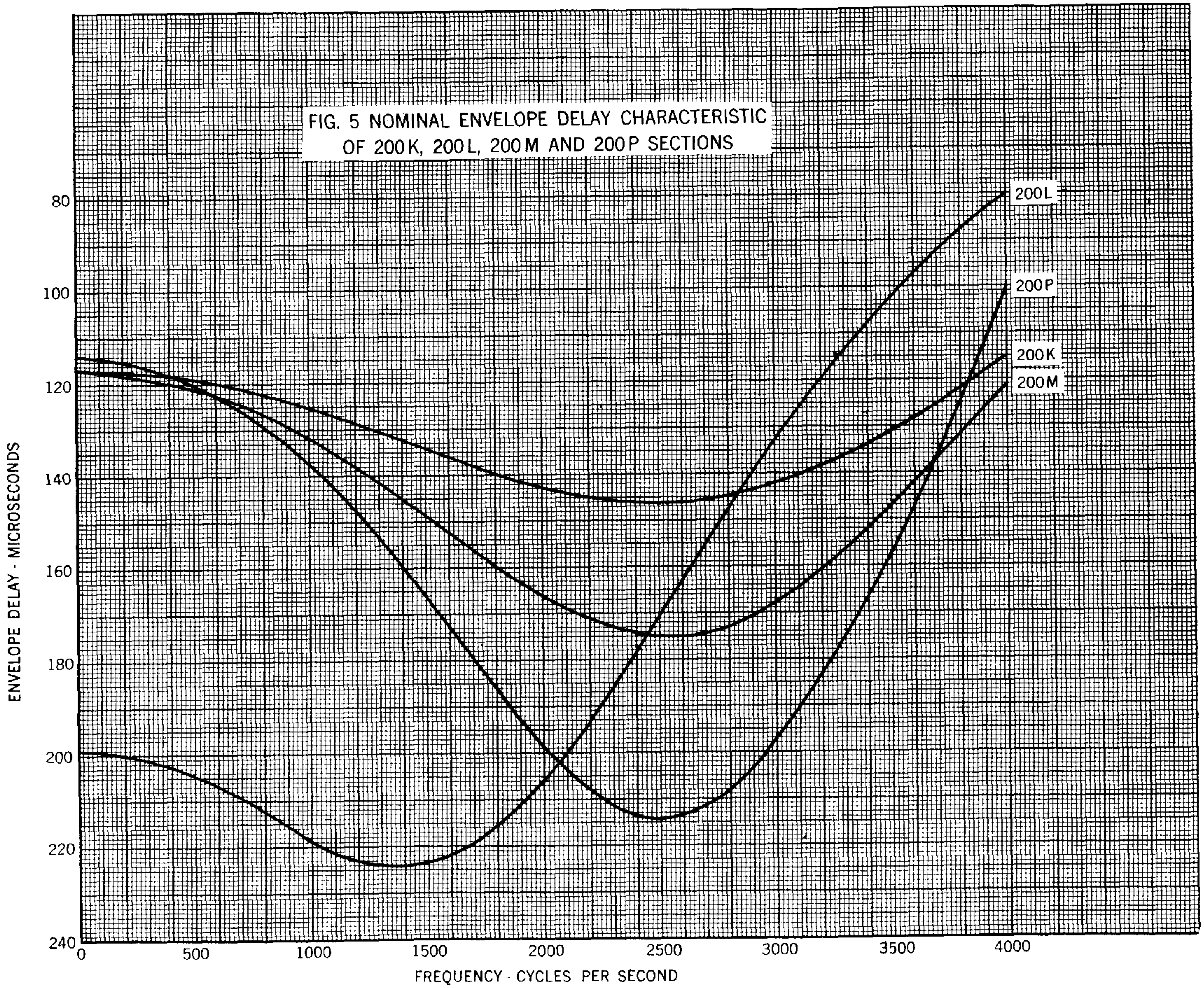
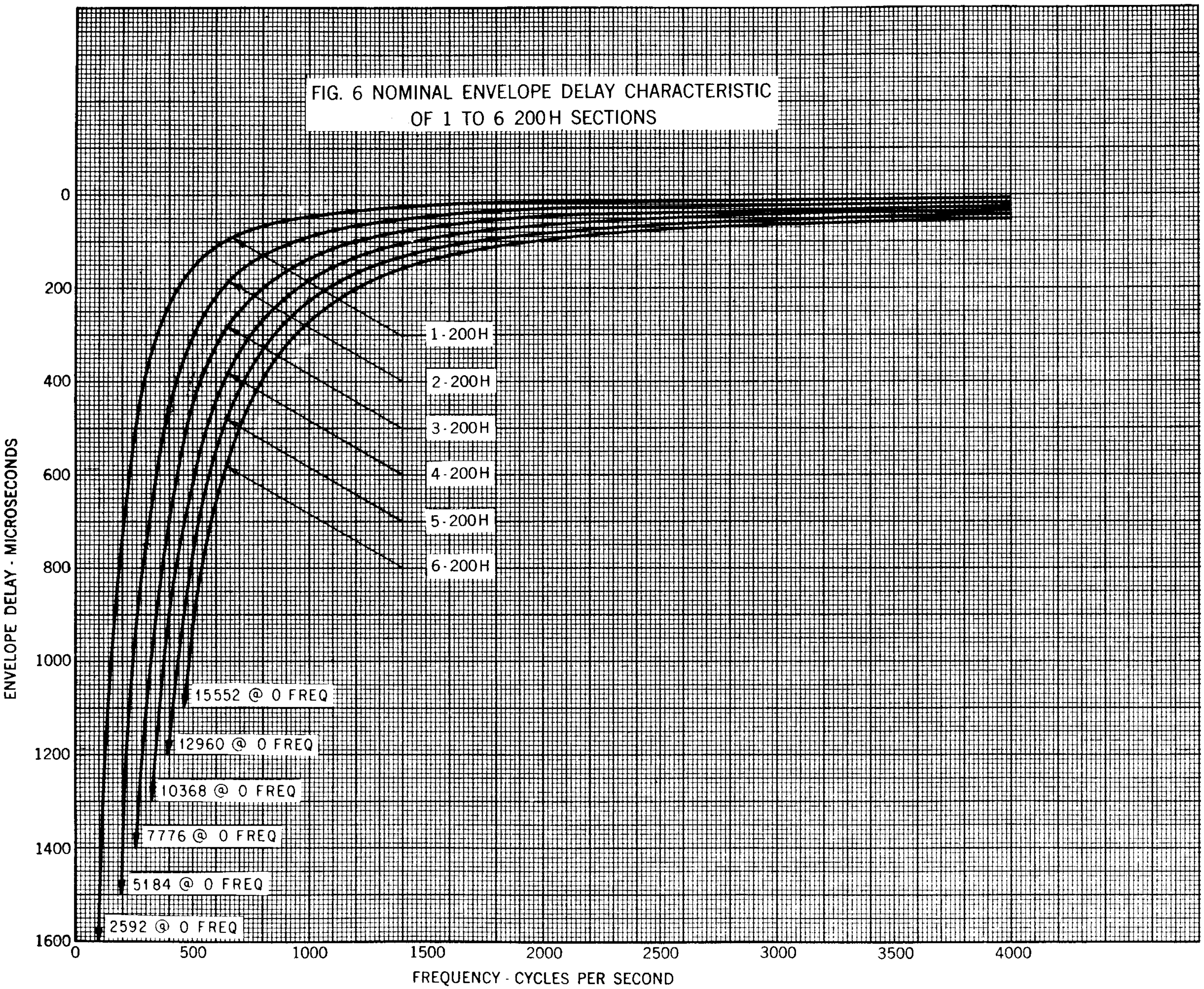


FIG. 5 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 200K, 200L, 200M AND 200P SECTIONS

FIG. 6 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200H SECTIONS



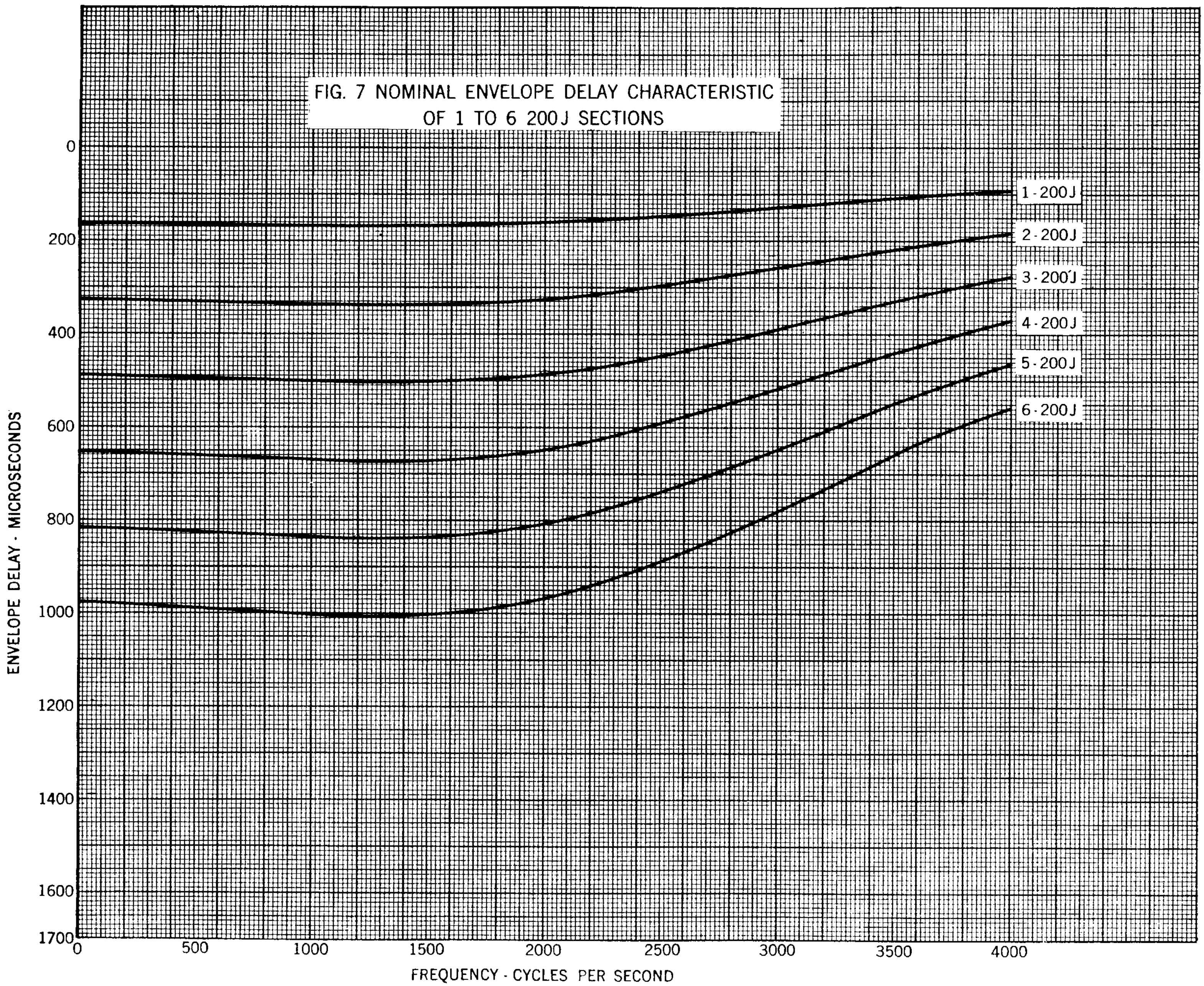
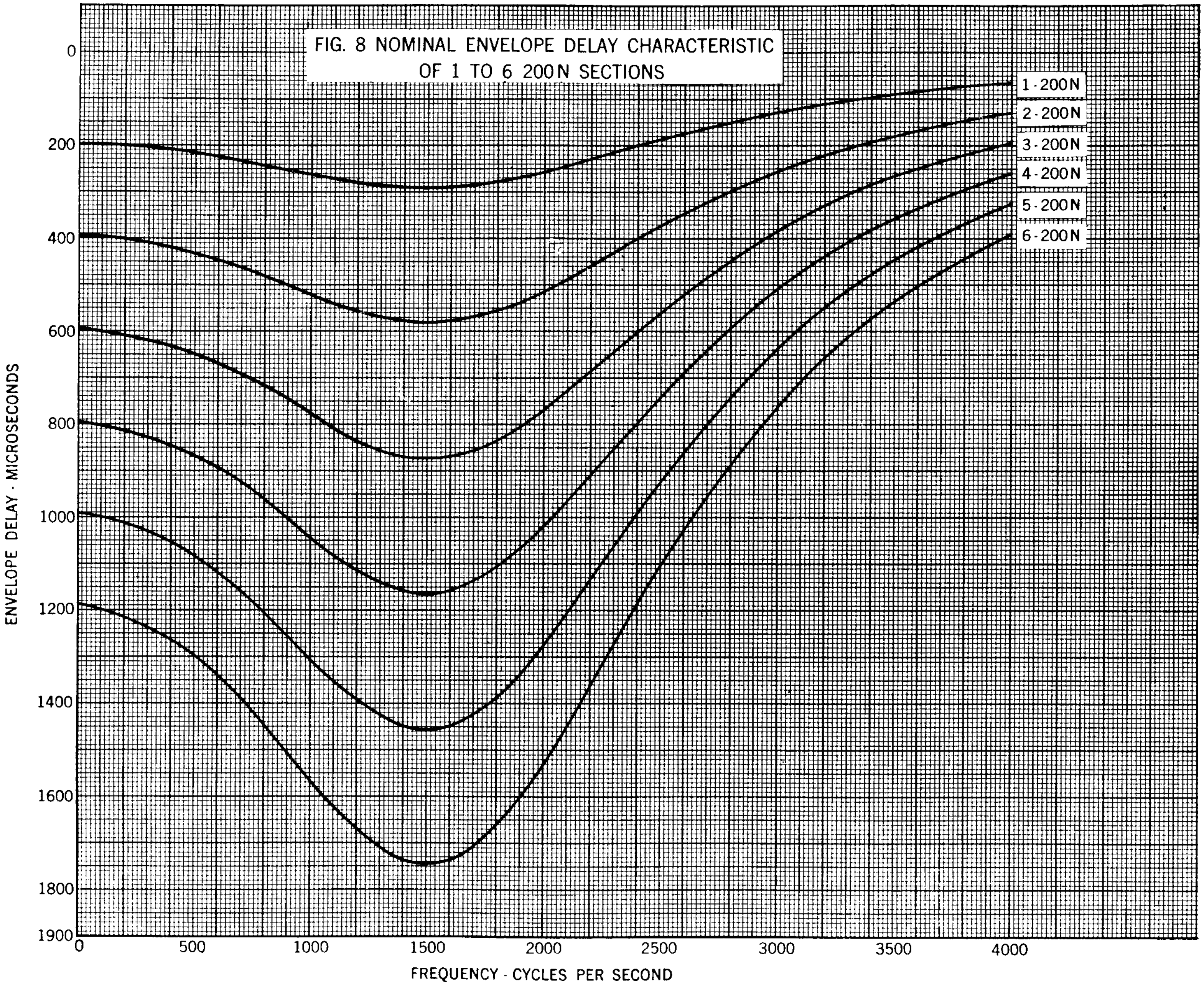


FIG. 7 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200J SECTIONS

FIG. 8 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200N SECTIONS



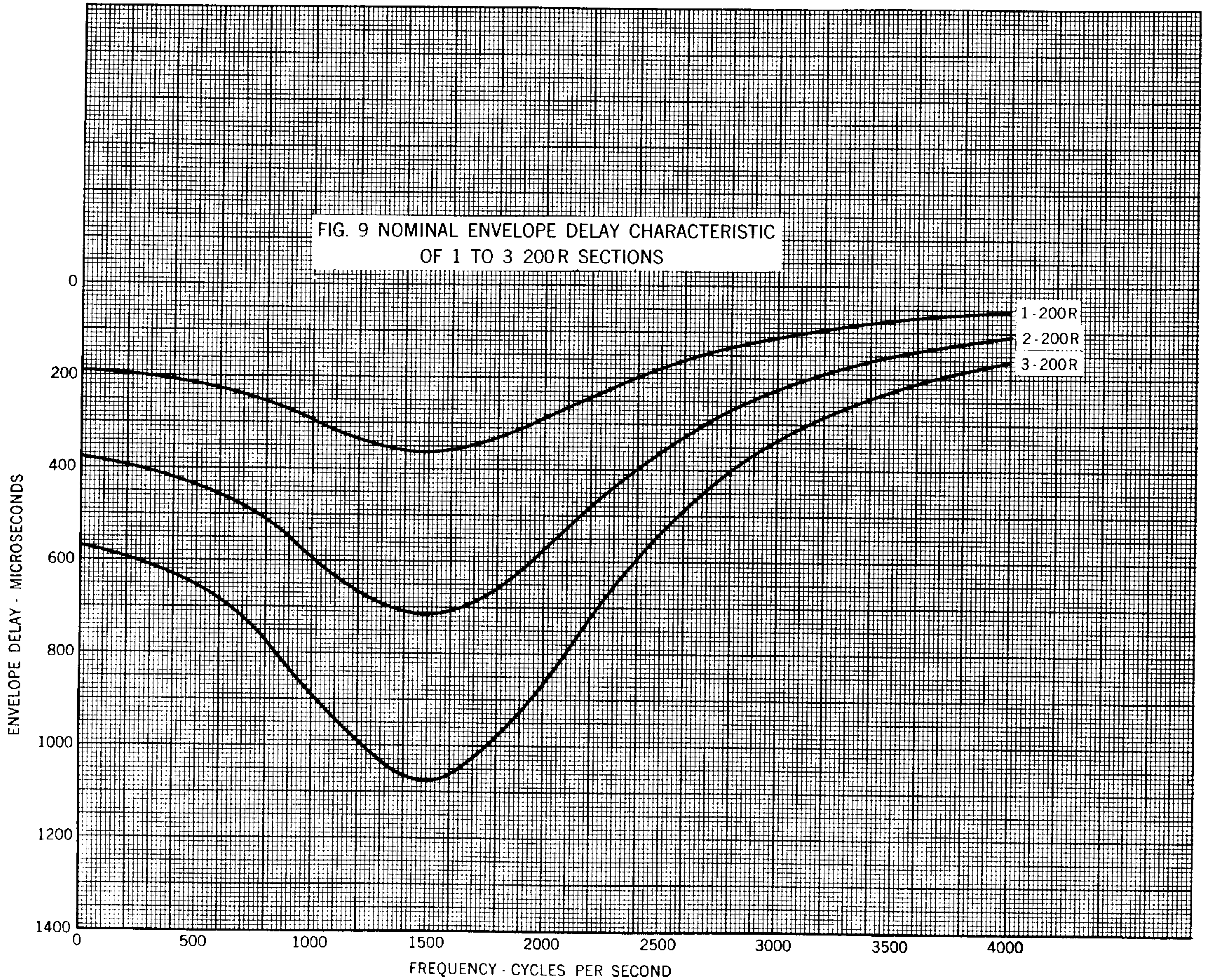


FIG. 9 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 3 200R SECTIONS

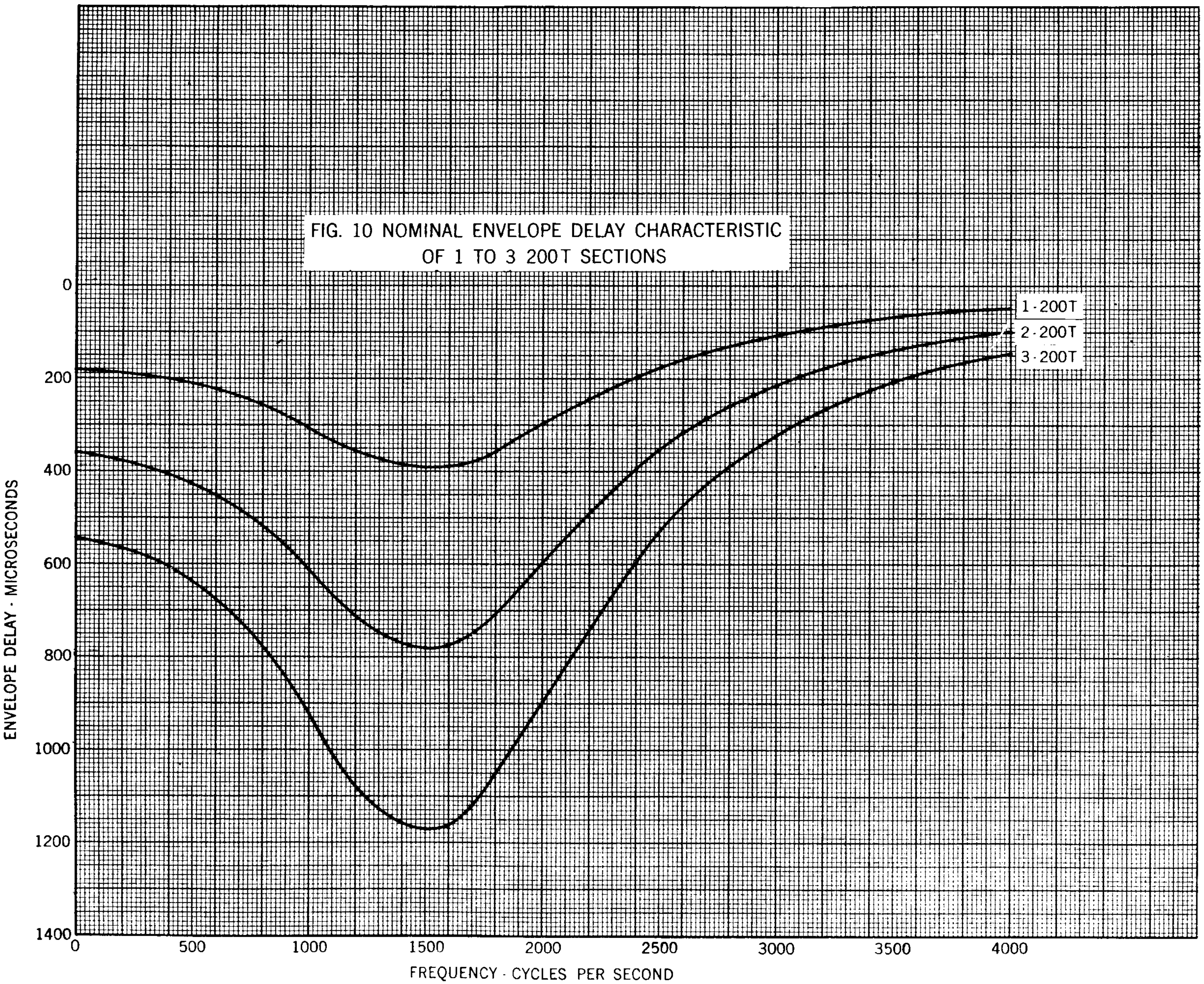


FIG. 10 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 3 200T SECTIONS

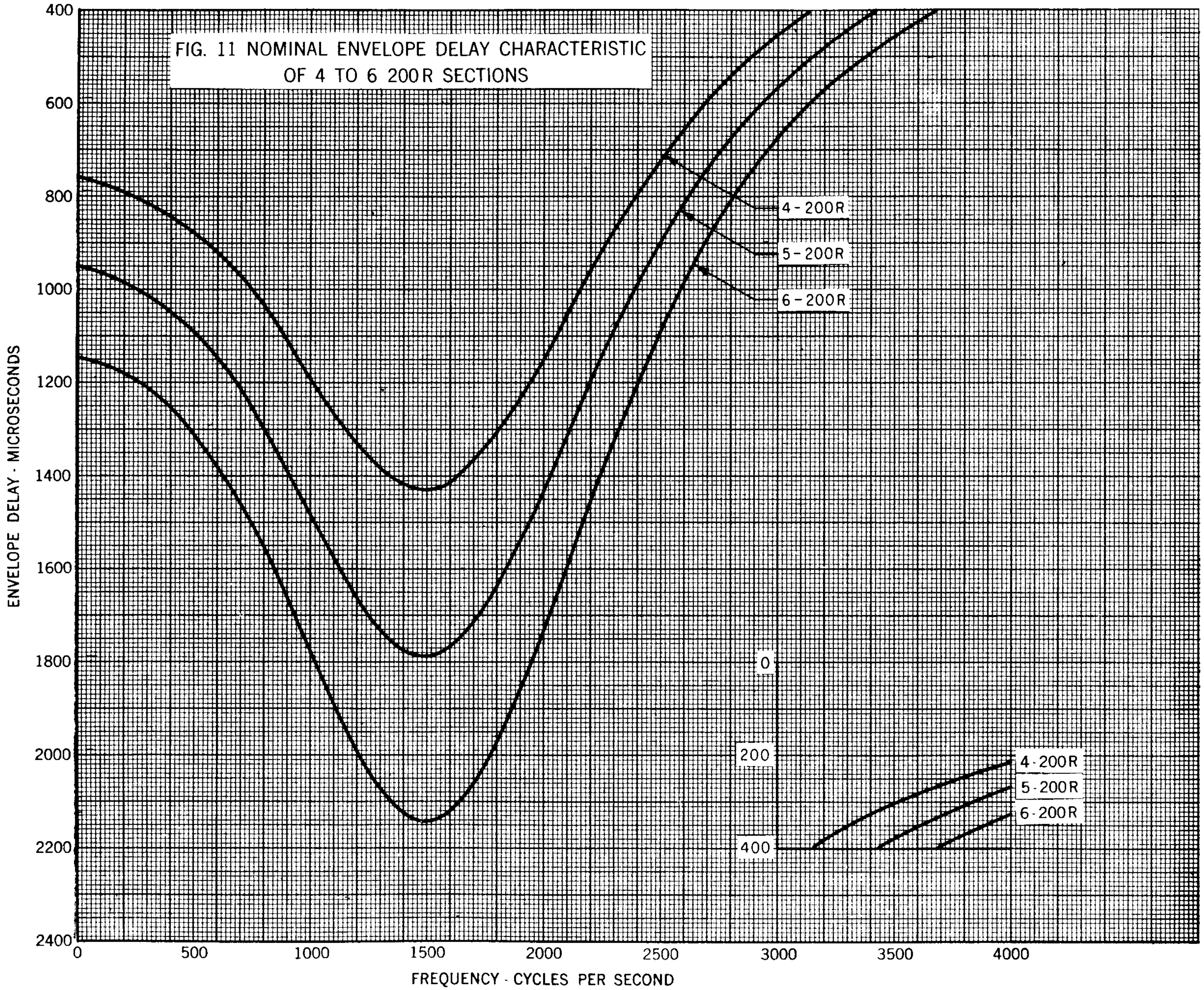


FIG. 11 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 4 TO 6 200R SECTIONS
ENVELOPE DELAY - MICROSECONDS
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
0
500
1000
1500
2000
2500
3000
3500
4000
FREQUENCY - CYCLES PER SECOND
4 - 200R
5 - 200R
6 - 200R
0
200
400
4 - 200R
5 - 200R
6 - 200R

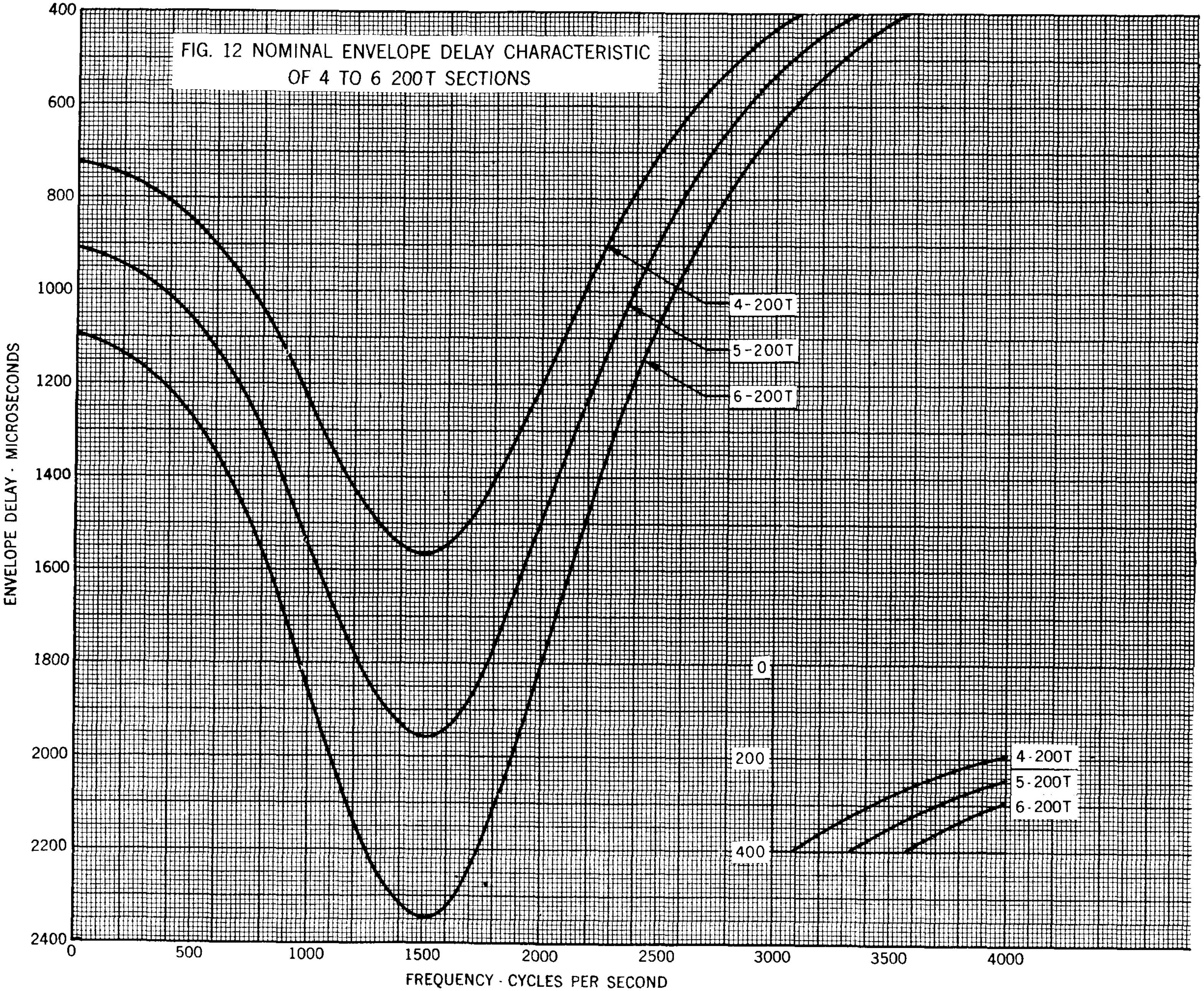


FIG. 12 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 4 TO 6 200T SECTIONS

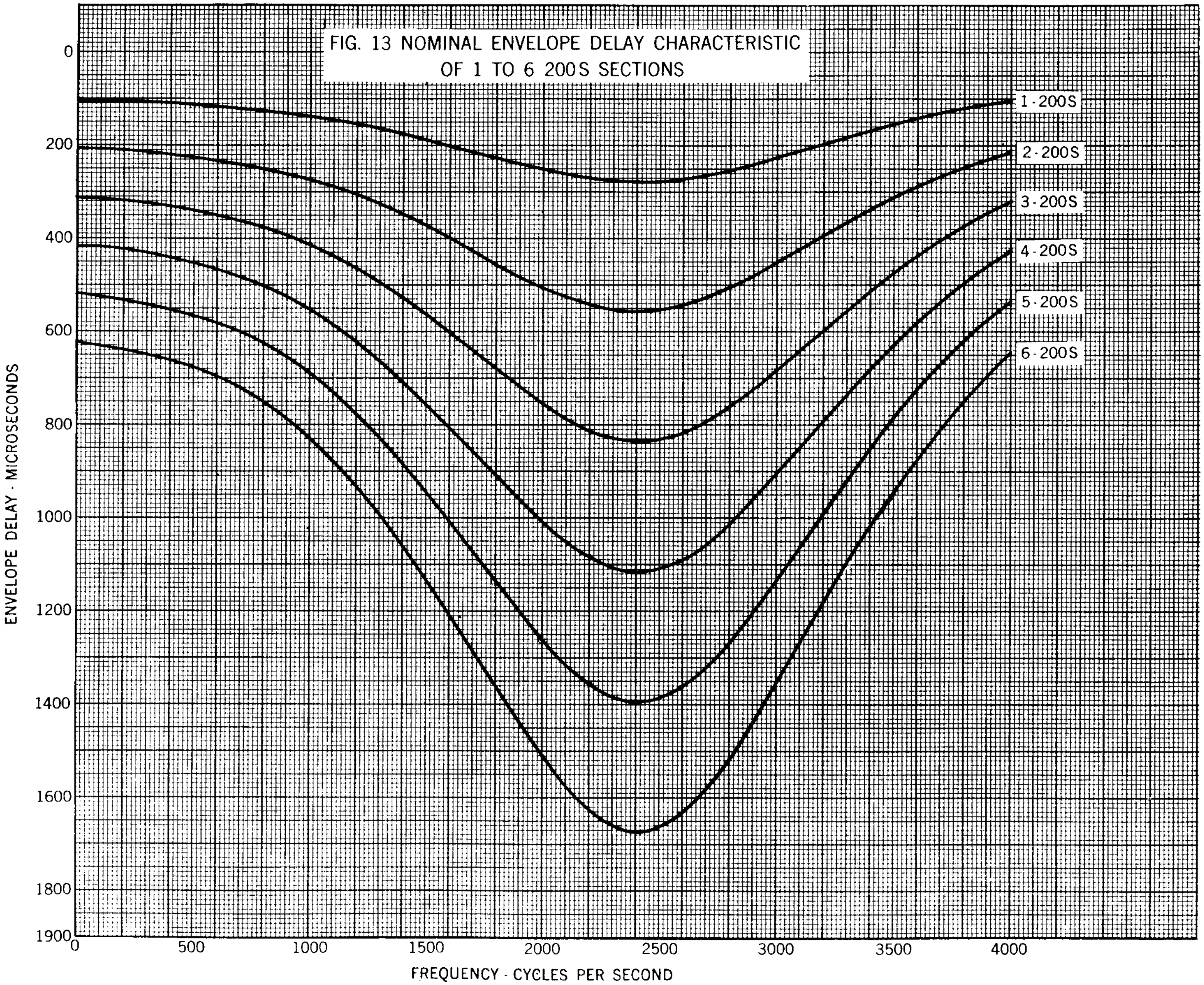


FIG. 13 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200S SECTIONS

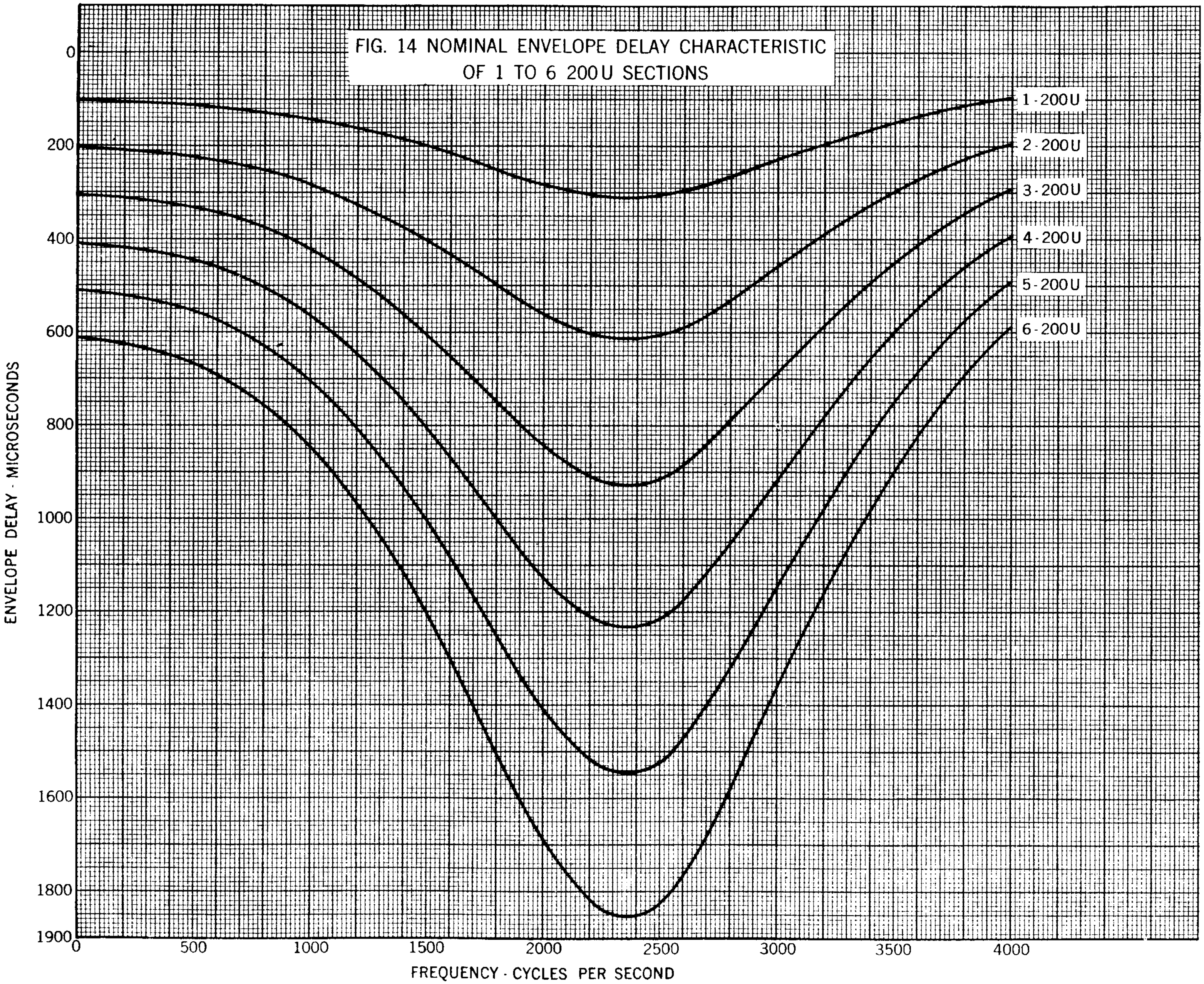


FIG. 14 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200U SECTIONS

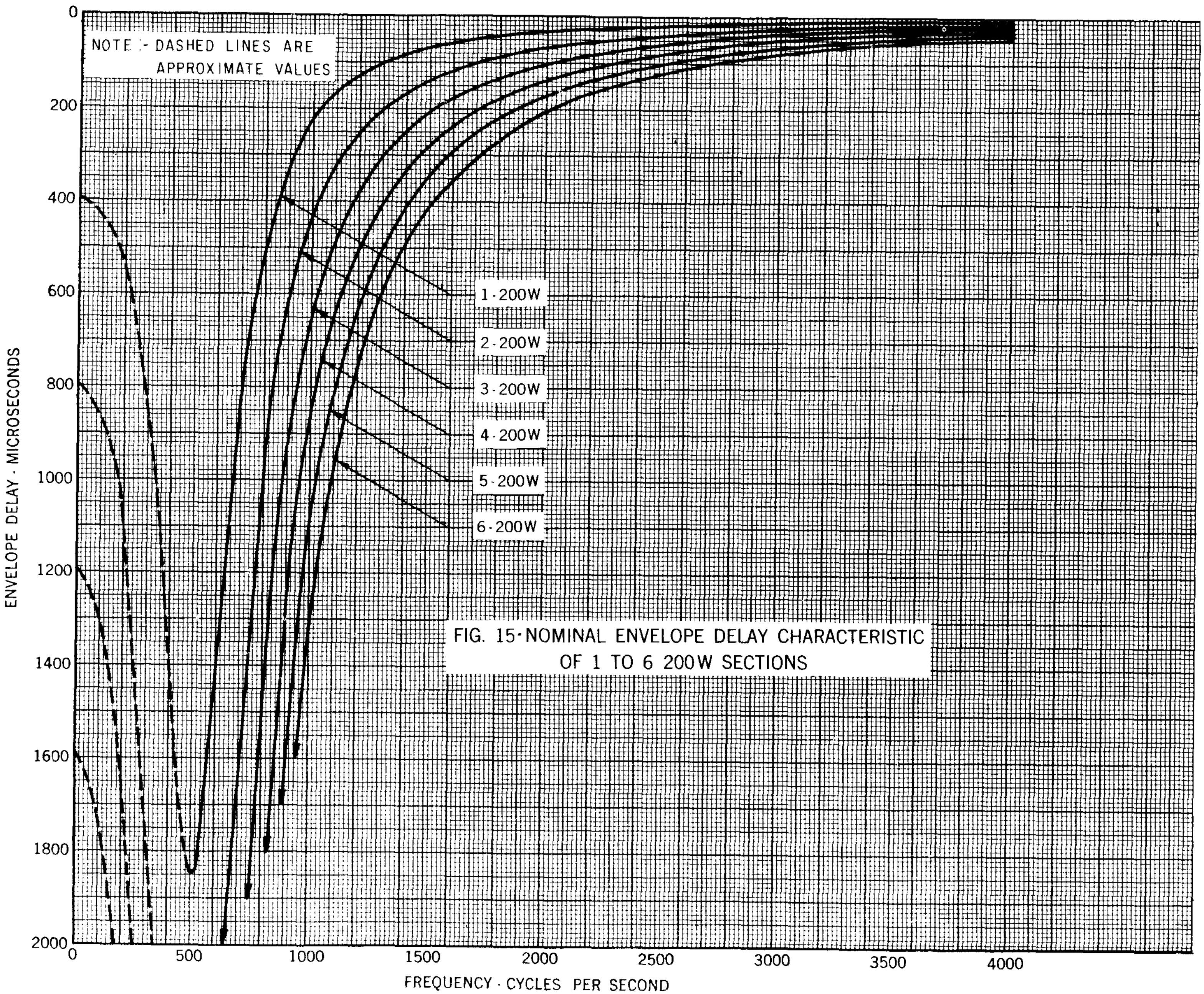


FIG. 15-NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200W SECTIONS

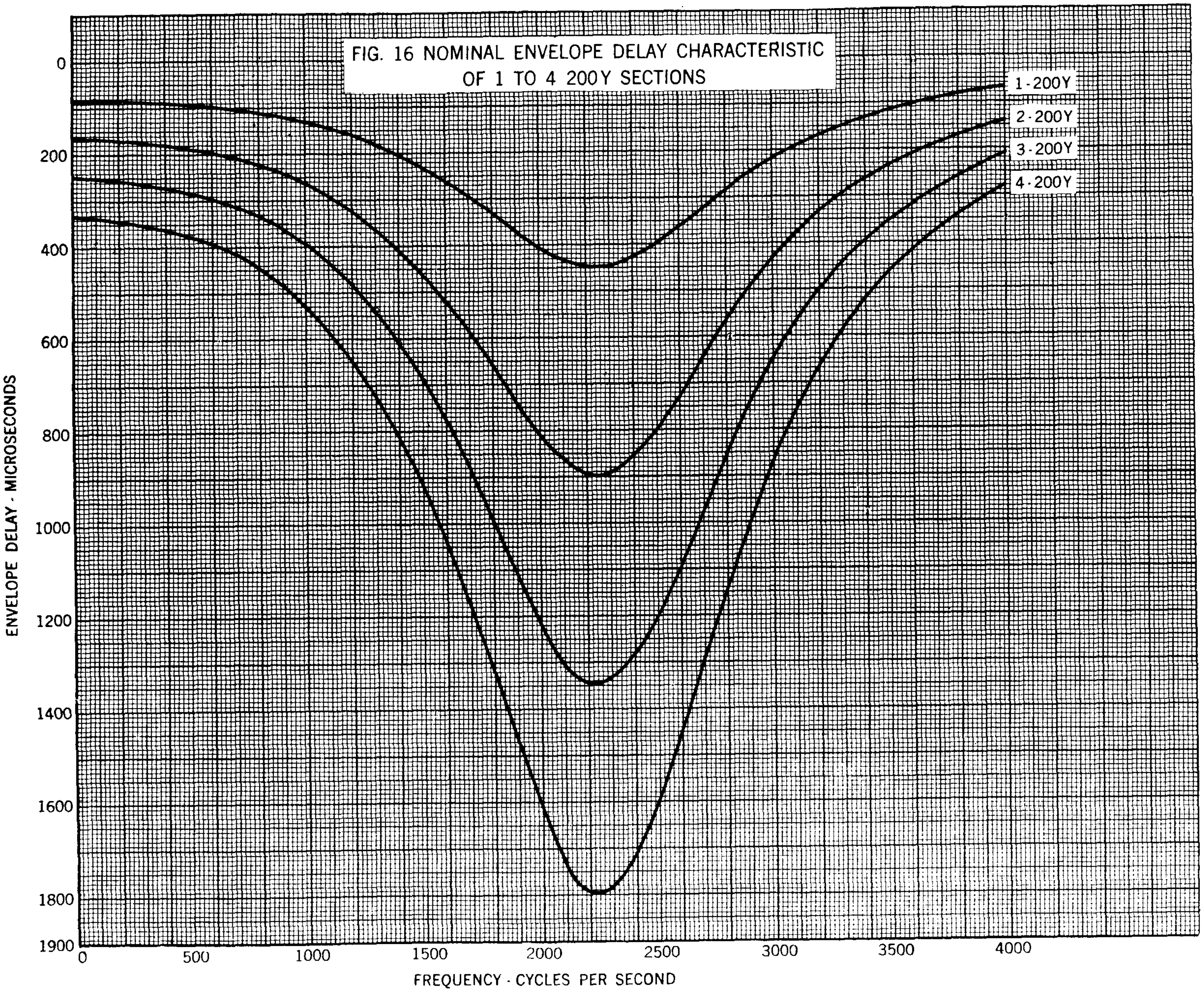


FIG. 16 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 4 200Y SECTIONS

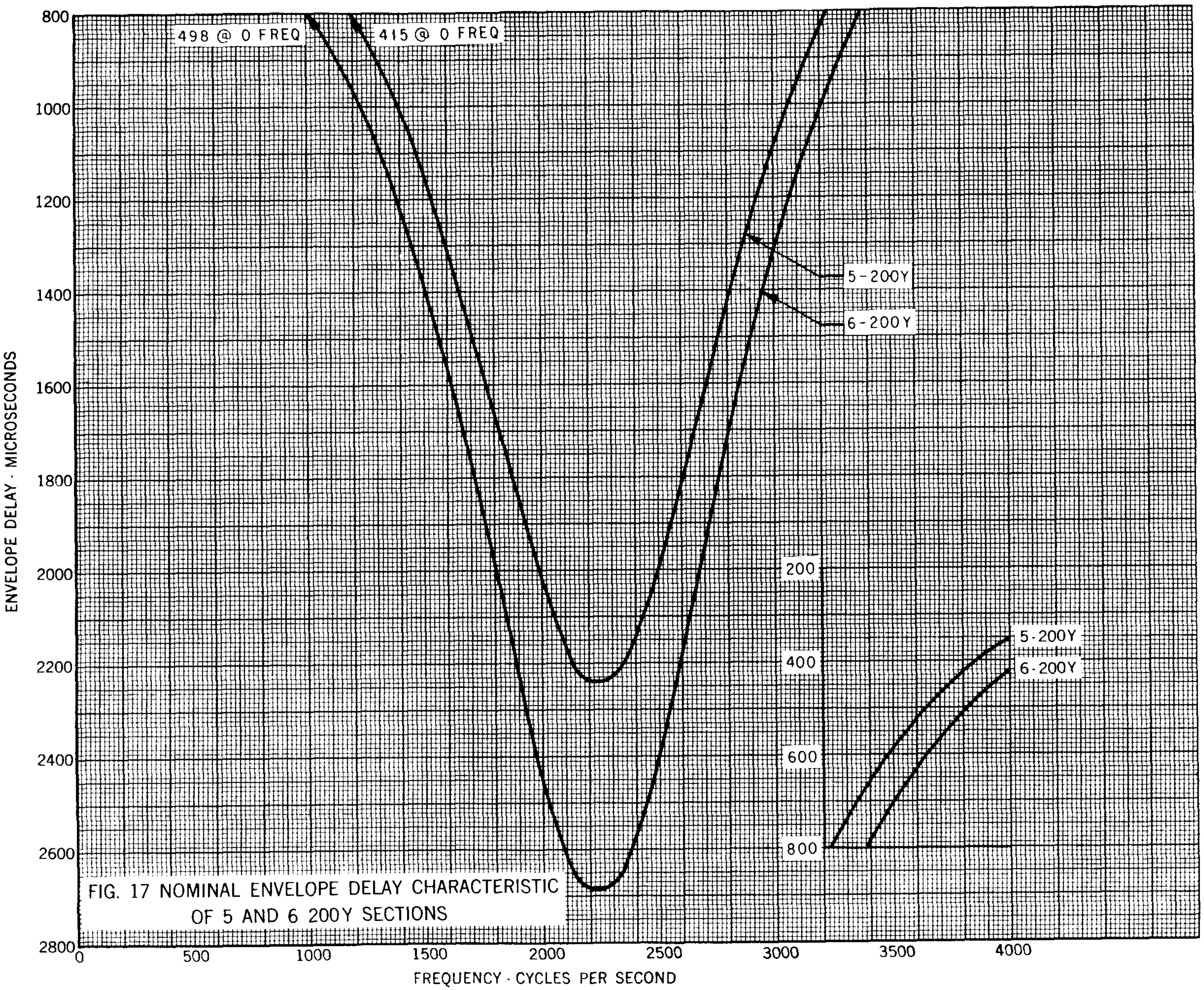


FIG. 17 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 5 AND 6 200Y SECTIONS

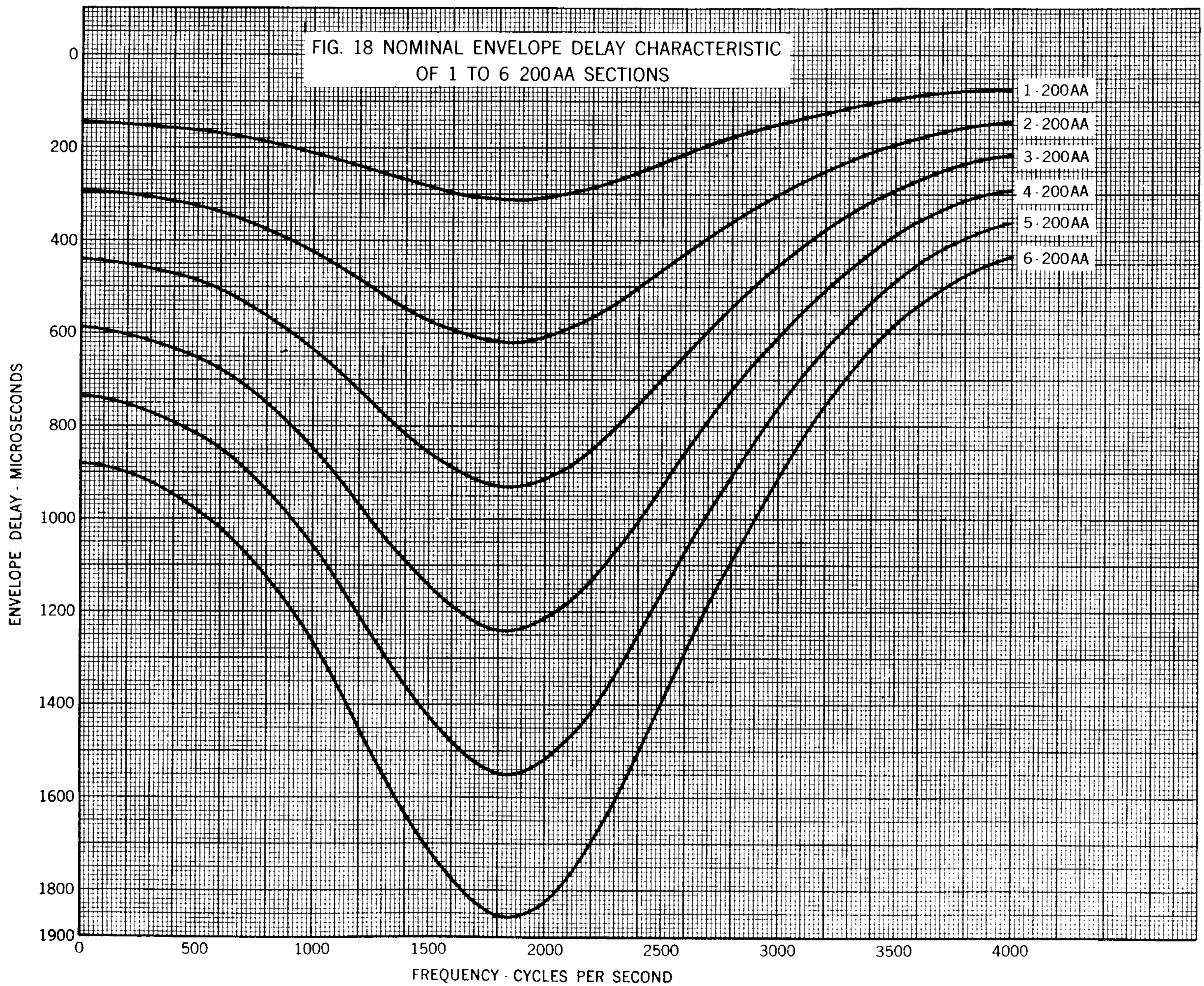


FIG. 18 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200AA SECTIONS

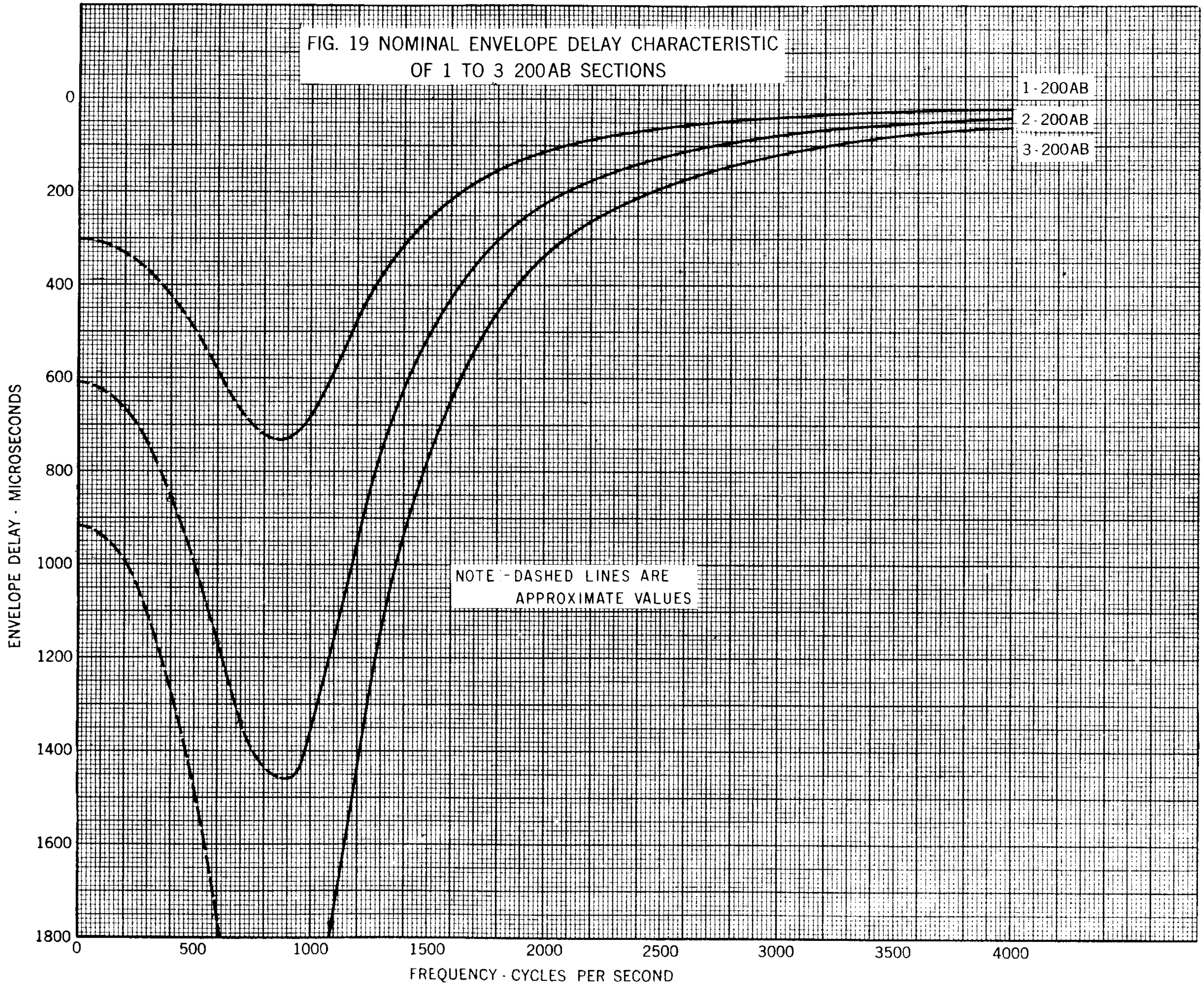


FIG. 19 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 3 200AB SECTIONS

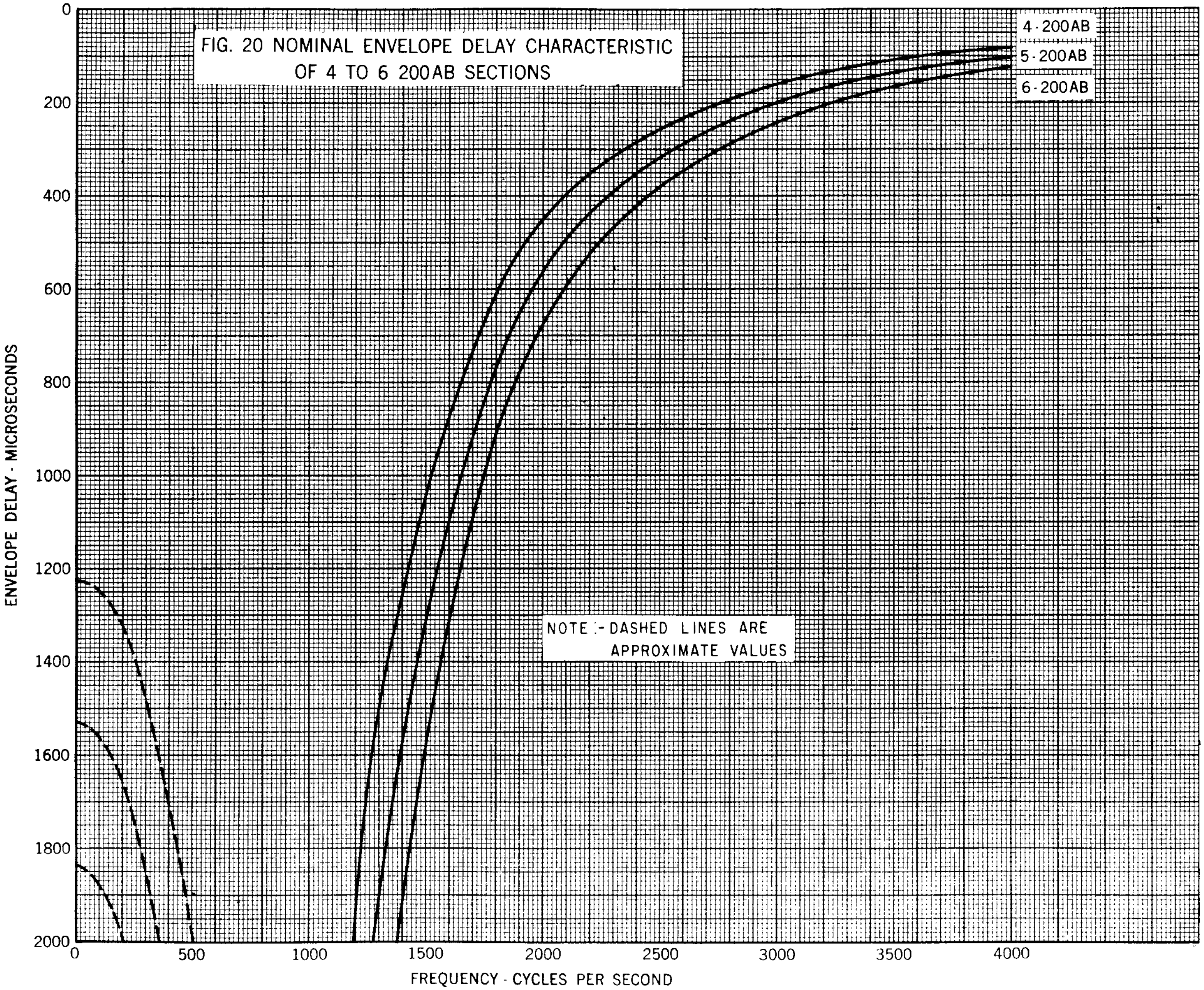


FIG. 20 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 4 TO 6 200AB SECTIONS

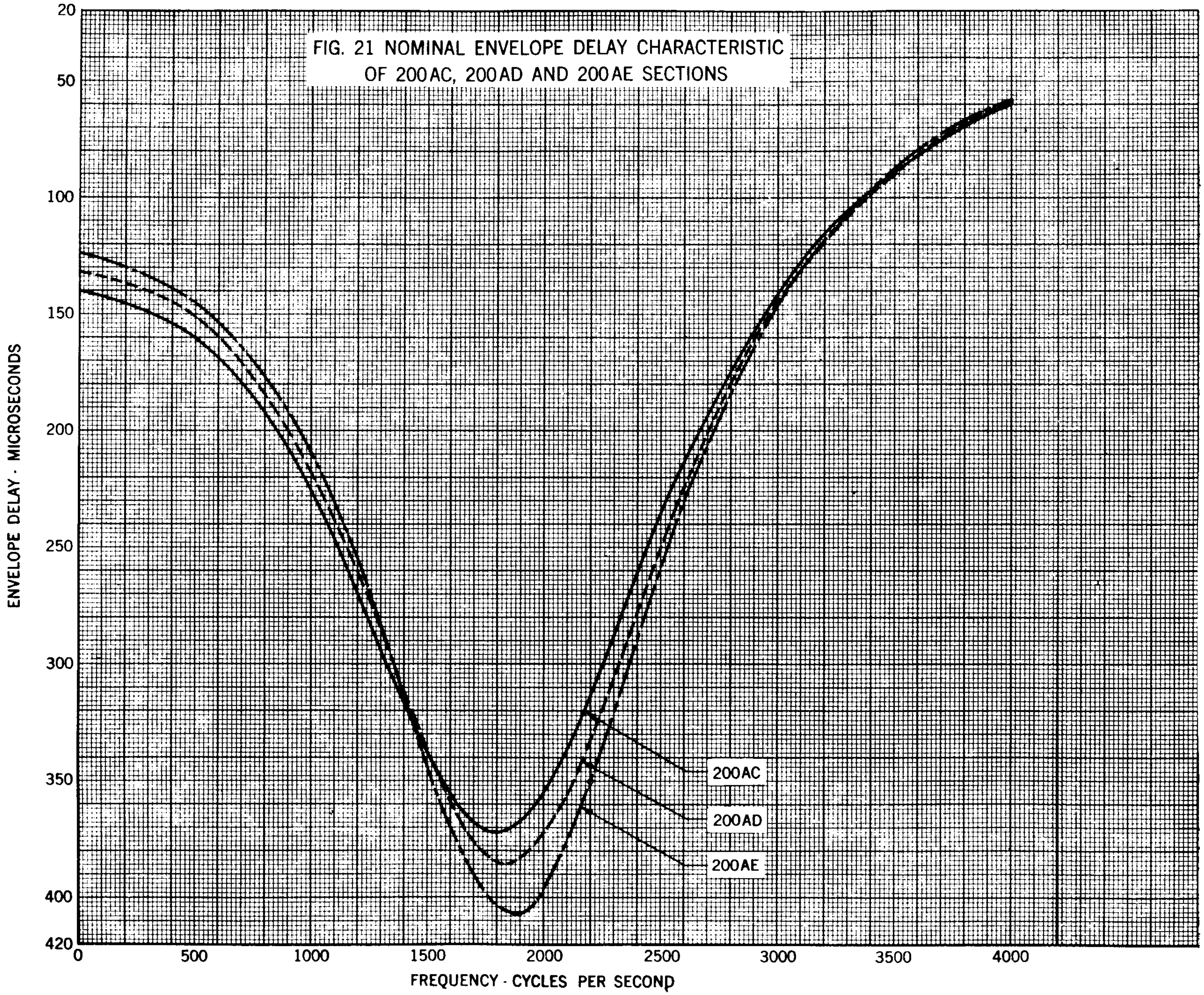


FIG. 21 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 200AC, 200AD AND 200AE SECTIONS

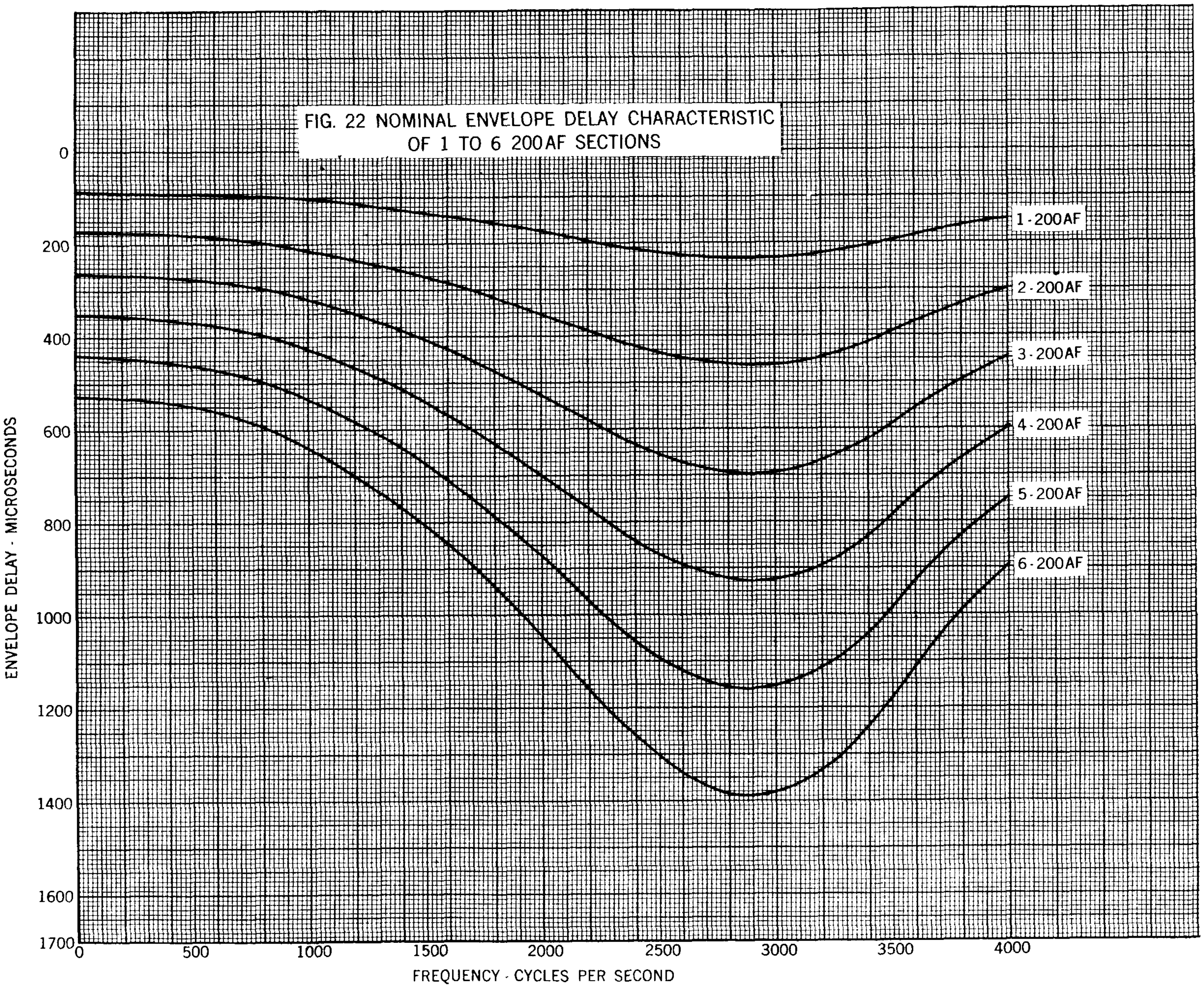


FIG. 22 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200AF SECTIONS

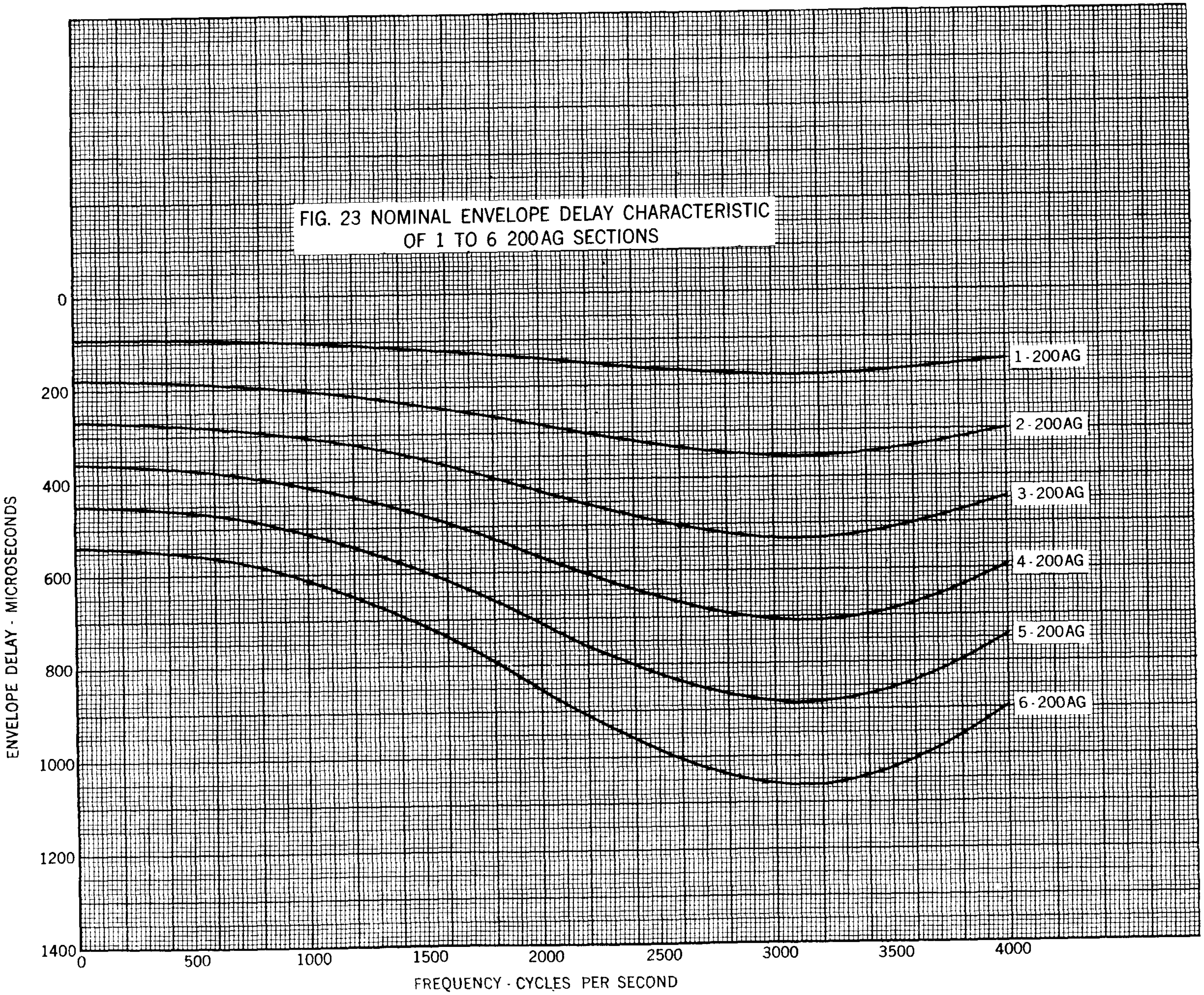
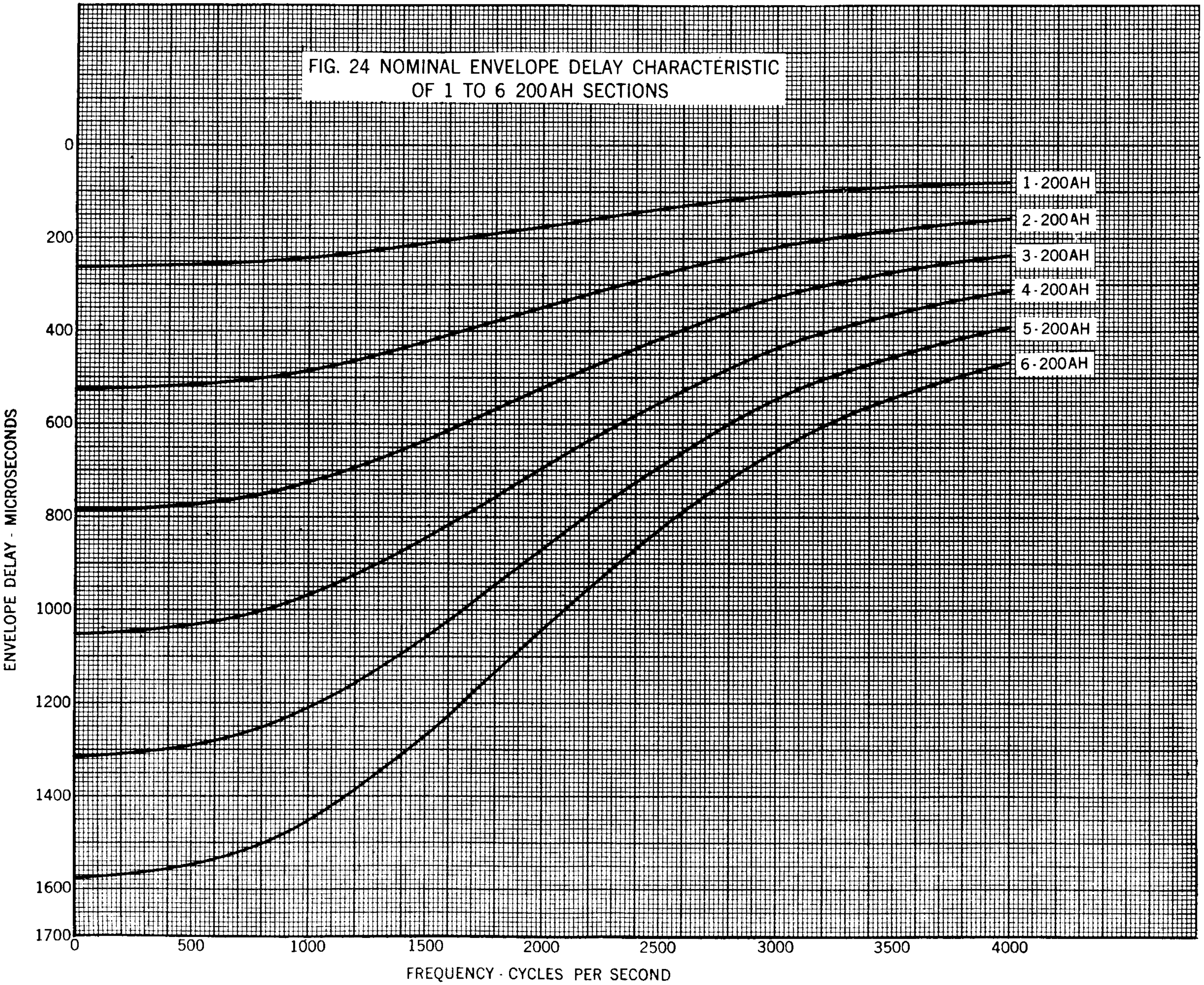


FIG. 23 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200AG SECTIONS

FIG. 24 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200AH SECTIONS



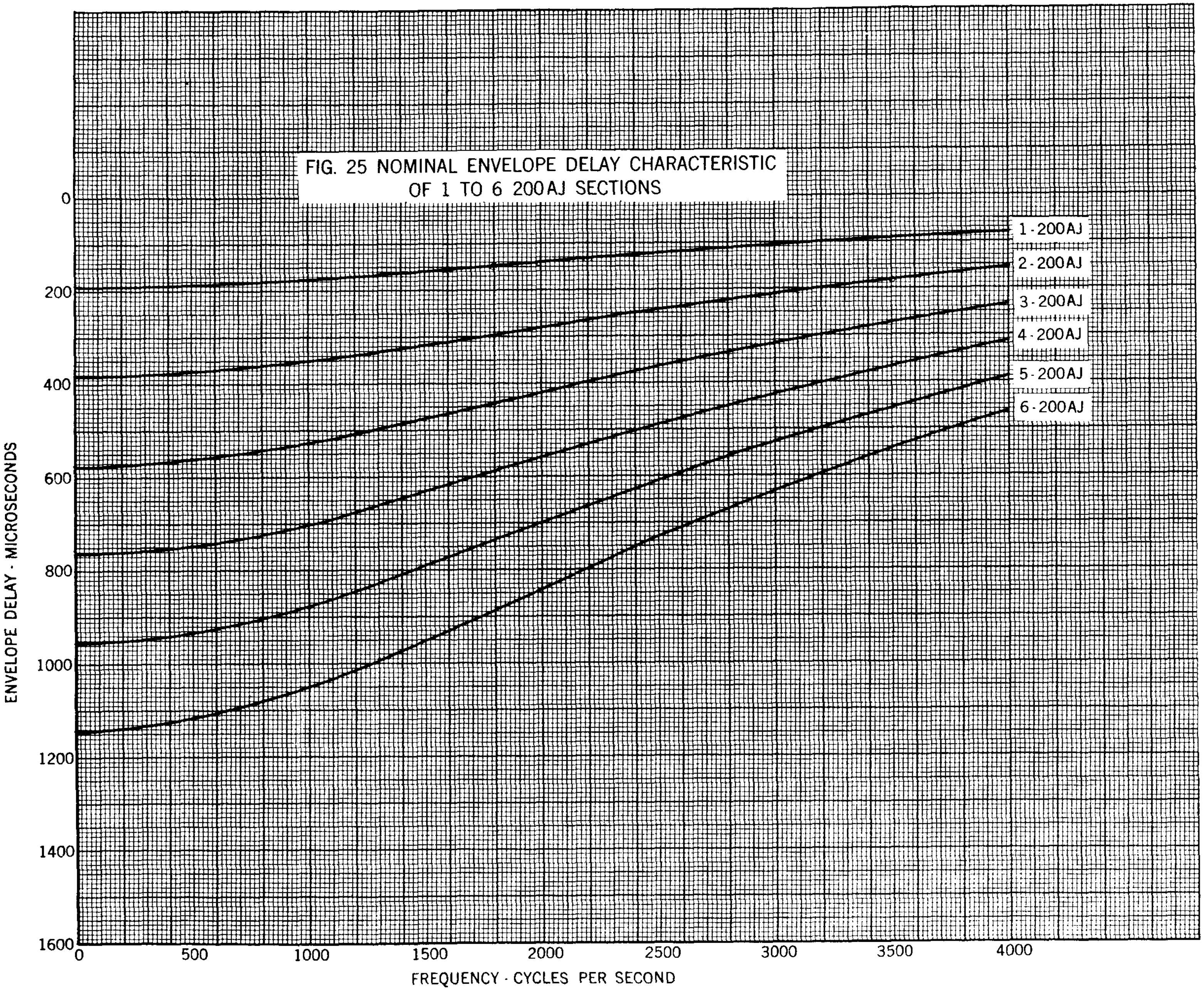
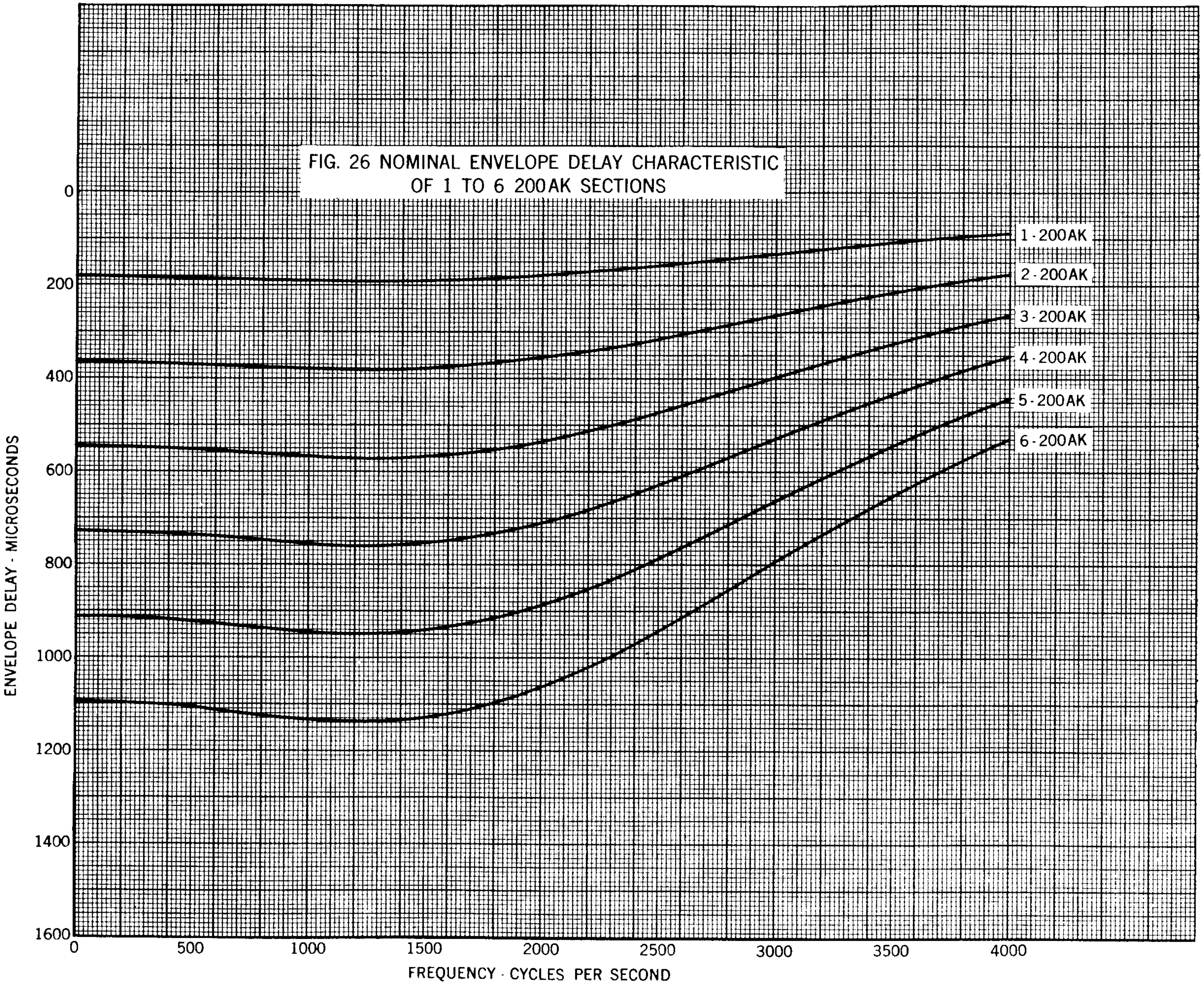


FIG. 25 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200AJ SECTIONS

FIG. 26 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 6 200AK SECTIONS



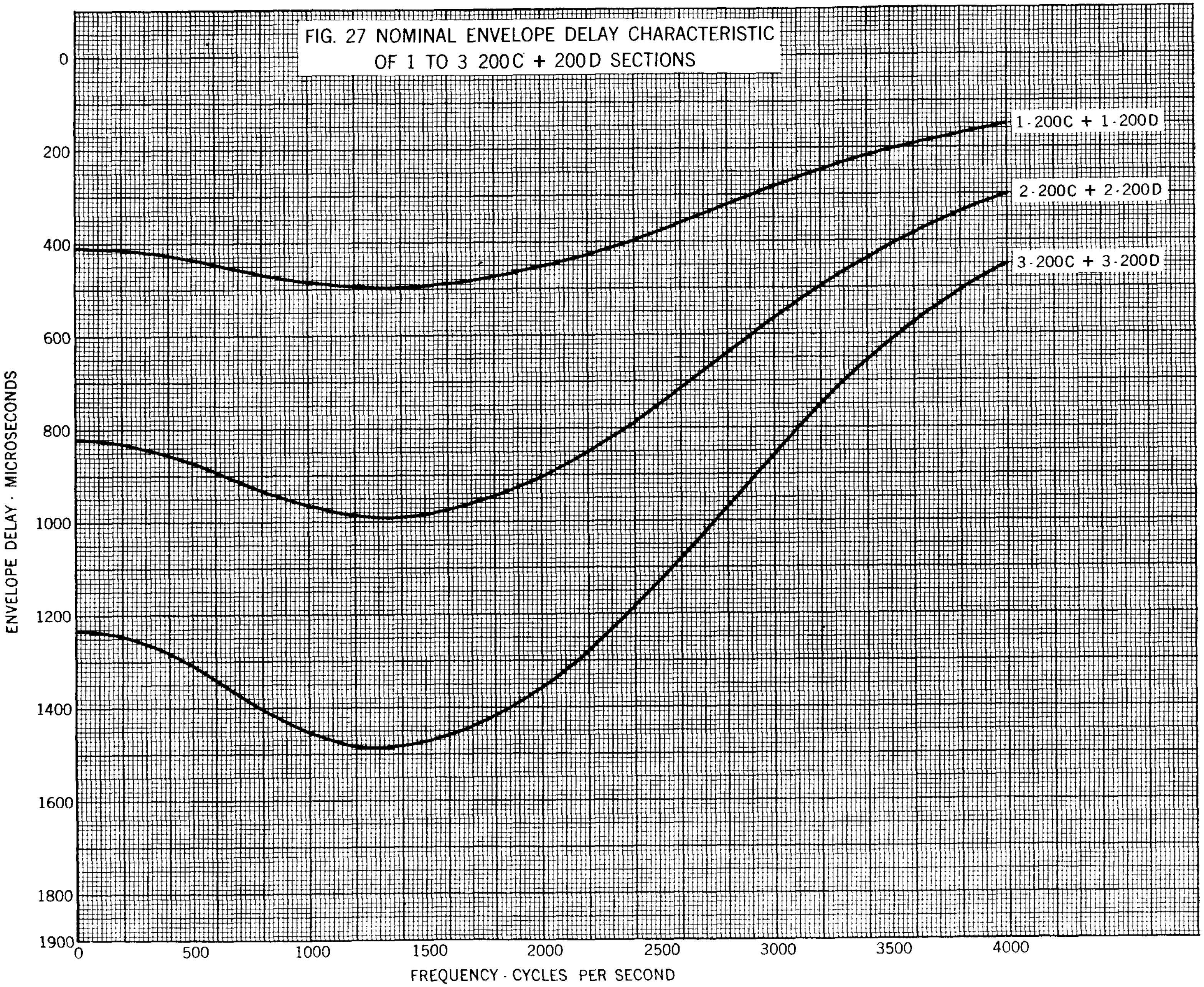


FIG. 27 NOMINAL ENVELOPE DELAY CHARACTERISTIC OF 1 TO 3 200C + 200D SECTIONS

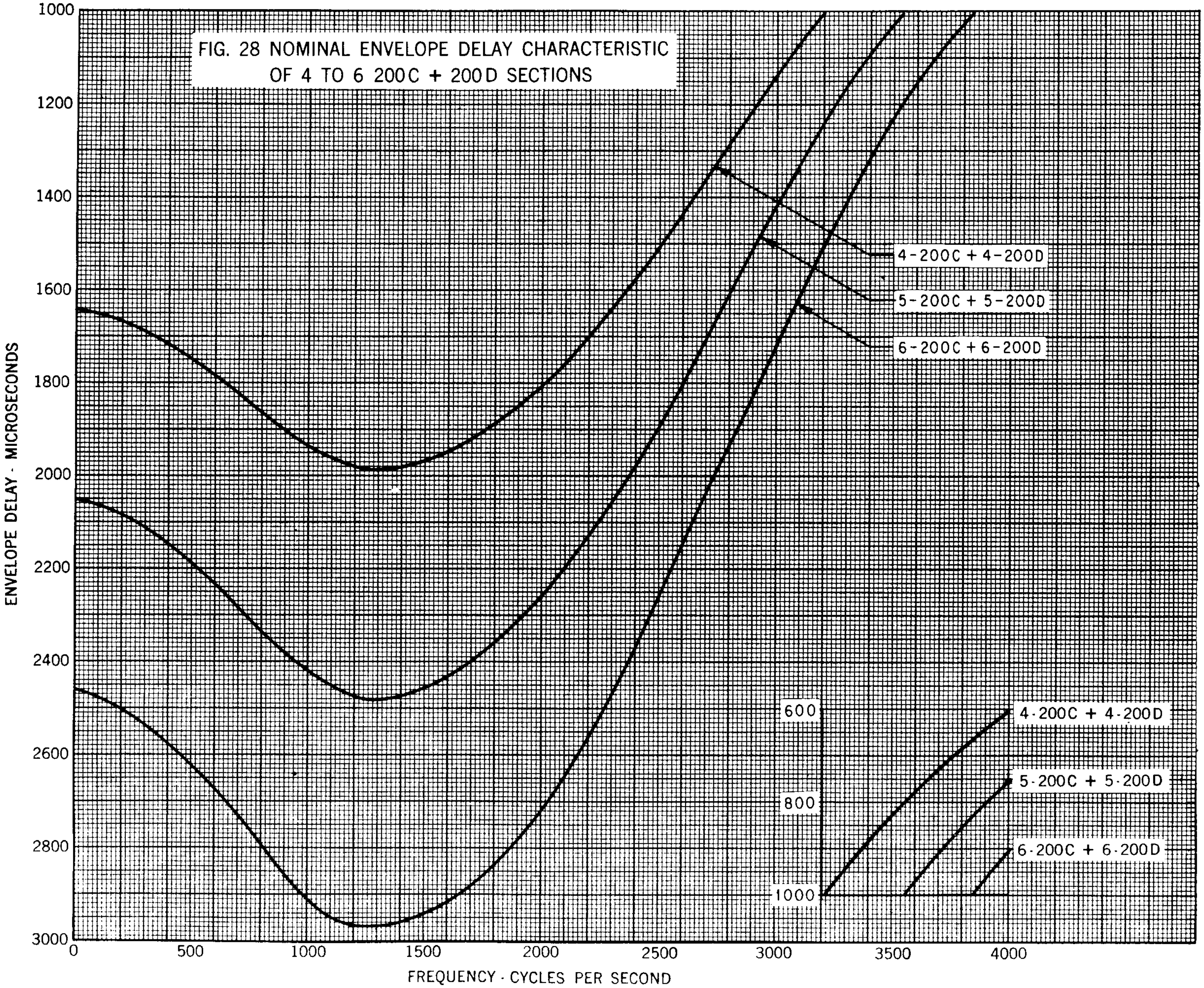


FIG. 28 NOMINAL ENVELOPE DELAY CHARACTERISTIC
OF 4 TO 6 200C + 200D SECTIONS
ENVELOPE DELAY - MICROSECONDS
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
0
500
1000
1500
2000
2500
3000
3500
4000
FREQUENCY - CYCLES PER SECOND
4-200C + 4-200D
5-200C + 5-200D
6-200C + 6-200D
600
800
1000
4-200C + 4-200D
5-200C + 5-200D
6-200C + 6-200D