TRANSMISSION CHARACTERISTICS POLYETHYLENE INSULATED VIDEO PAIRS — 16 PSV AND 16 PEV

1. GENERAL

1.01 This section provides transmission information on the 16-gauge PSV and 16-gauge PEV pairs used with the A2A video transmission system. The pairs are incorporated in standard sheathed cables, usually in conjunction with regular exchange telephone pairs.

2. SHIELDED POLYETHYLENE INSULATED VIDEO PAIRS

2.01 Three types of 16-gauge polyethylene insulated pairs are normally used with the A2A system as follows:

16 PSV-S String-insulated 16-gauge pairs covered with two copper wrappings wound spirally in opposite directions. Manufactured 1947-1950.

16 PSV-L Similar to 16 PSV-S except that inner tape is applied longitudinally instead of spirally with outer tape applied spirally as before. This design results in improved crosstalk performance and a small reduction in attenuation. Manufactured 1950-1954.

16 PEV-L New design in which polyethylene tape and string construction was supplanted by individual insulation of the conductors with expanded (foamed) polyethylene together with expanded polyethylene fillers. Longitudinal and spiral copper tapes are applied as for 16 PSV-L. This construction results in a cable whose impedance can be held to closer tolerances and one with reduced internal echoes due to manufacturing irregularities. Manufactured 1954 to date.

All three types are referred to collectively as 16-gauge video pair. Values of attenuation of the 16 PSV and 16 PEV video pairs are given in Table I. A more complete table of characteristics of these cables is given in Table II.

2.02 Because of the effective shielding of 16-gauge video pairs there are no limitations on direction of transmission or number of circuits obtainable within any given size of cable. For noise reasons the 16-gauge video pairs should be separated from the remainder of the cable conductors at the building entrance and carried to the video equipment under a separate sheath.

2.03 The characteristic impedance (Zo) of 16 PSV and 16 PEV cable is almost a pure resistance of 124 ohms at the higher frequencies. Below about 500 kHz the resistance component increases to about 1000 ohms at 60 Hz and the reactive component, essentially zero at the higher frequencies, increases to about the same value as the resistance at 60 Hz. The characteristic impedance approaches infinity as the frequency approaches zero.

2.04 Variations in attenuation due to temperature changes in 16-gauge video cable are about one-tenth of one per cent per degree Fahrenheit, expressed in db. For all practical purposes it may be assumed that temperature changes cause a slope change equal to one-tenth of one per cent of the normal 4.5 MHz loss for each degree (F) of temperature change. Thus, the primary effect of seasonal temperature variations is to change the effective cable length. To the degree that this is the major effect, varying the amount of equalization will compensate for these changes.

3. OFFICE CABLING

3.01 Several types of solid dielectric coaxial and paired cables are used for office cabling and the transmission losses of these cables are also given in Table I with the complete table of characteristics listed in Table III. The paired cables (except the 754A) may also be used in lieu of 16 PSV and 16 PEV pairs for temporary installations of short lengths in the outside plant. However, since the office cables are not designed for continuous outside plant use, this alternative should be used only under emergency conditions and the paired cables should be scheduled for replacement with 16 PSV or 16 PEV pairs as soon as possible. The transmission characteristics of the office cables are sufficiently similar to those of 16-gauge video pairs that the same equalizers may be used.

TABLE I

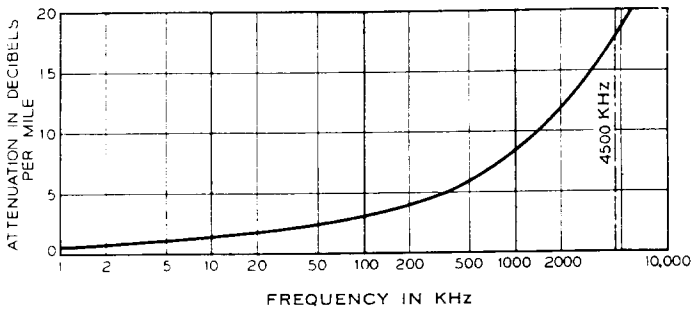
Attenuation of Video Line Facilities

TYPE	SHIELDING	LOSS PER 1000 FEET-DB AT 75°F		LOSS PER MILE-DB AT 75°F	
		0*	4.5 MHz	0*	4.5 MHz
Shielded Video Pairs					
16 PSV-S	Spiral inner tape	0	3.65	0	19.3
16 PSV-L	Longitudinal inner tape	0	3.52	0	18.6
16 PEV-L	Longitudinal inner tape, expanded polyethylene	0	3.52	0	18.6

Office Cabling

PAIRED		AT 70°F	
720	Single braid	0	10.0
754A	Single braid	0	5.3
754B	Single braid	0	5.3
754D	Double braid	0	5.2
754E	Double braid	0	5.2
KT51	Double braid	0	6.6
KT52	Double braid	0	5.3
COAXIAL			
KS-8086	Double braid	0	11.0
724	Double braid	0	5.2

* It may be assumed that for the lengths of cable employed in A2A repeater sections the loss at essentially zero frequency is zero db.



Attenuation of 16 PSVL or 16 PEVL Cable

TABLE II

Nominal Characteristics of 16 PSV-L or 16 PEV-L Video Pair

(16-Gauge Polyethylene String or Foam Insulated Pair, Shielded With One Longitudinal and One Spiral Copper Tape) Temp. Approx. 75°F.

FREQUENCY f Hz	CHARACTERISTIC IMPEDANCE R_o OHMS	CHARACTERISTIC IMPEDANCE X_o OHMS	PER 1000 FEET ATTENUATION 8.69α db	PER 1000 FEET PHASE SHIFT β RADIANS	PER 1000 FEET RESISTANCE R OHMS	PER 1000 FEET INDUCTANCE L MILLIHENRIES	FREQUENCY f MHz	CHARACTERISTIC IMPEDANCE R_o OHMS	CHARACTERISTIC IMPEDANCE X_o OHMS	PER 1000 FEET ATTENUATION 8.69α db	PER 1000 FEET PHASE SHIFT β RADIANS	PER 1000 FEET RESISTANCE R OHMS	PER 1000 FEET INDUCTANCE L MILLIHENRIES
10.0	2585	—2580	0.0139	0.00161	8.30	0.235	0.100	133.5	—10.87	0.588	0.830	18.05	0.1752
12.5	2315	—2308	.0156	.00180	8.30	.235	.125	132.5	— 9.56	.646	1.031	19.70	.1730
15.0	2112	—2106	.0171	.00197	8.30	.235	.150	131.8	— 8.58	.697	1.230	21.1	.1712
17.5	1956	—1949	.0184	.00213	8.30	.235	.175	131.2	— 7.89	.745	1.428	22.5	.1697
20	1829	—1823	.0197	.00228	8.30	.235	.200	130.6	— 7.29	.787	1.625	23.7	.1684
25	1637	—1630	.0221	.00255	8.30	.235	.25	129.8	— 6.44	.870	2.02	26.0	.1664
30	1495	—1487	.0241	.00279	8.30	.235	.30	129.2	— 5.81	.942	2.41	28.0	.1649
35	1383	—1376	.0260	.00302	8.30	.235	.35	128.6	— 5.34	1.000	2.80	29.9	.1636
40	1296	—1287	.0278	.00323	8.30	.235	.40	128.2	— 4.97	1.069	3.19	31.7	.1625
50	1160	—1150	.0311	.00361	8.30	.235	.50	127.6	— 4.41	1.192	3.97	35.0	.1609
60	1060	—1049	.0340	.00396	8.30	.235	.60	127.1	— 4.00	1.294	4.74	37.9	.1597
70	982	— 970	.0367	.00428	8.30	.235	.70	126.7	— 3.67	1.385	5.59	40.6	.1587
80	920	— 904	.0392	.00458	8.30	.235	.80	126.4	— 3.43	1.475	6.29	43.1	.1580
100	824	— 810	0.0437	0.00513	8.30	0.235	1.00	125.9	— 3.03	1.643	7.83	47.6	0.1569
125	739	— 723	.0488	.00574	8.30	.235	1.25	125.5	— 2.69	1.831	9.79	52.9	.1560
150	676	— 658	.0533	.00631	8.30	.235	1.50	125.2	— 2.46	1.999	11.68	57.6	.1552
175	627	— 608	.0576	.00679	8.30	.235	1.75	125.0	— 2.27	2.15	13.61	61.9	.1547
200	588	— 567	.0613	.00731	8.30	.235	2.00	124.8	— 2.12	2.30	15.52	66.0	.1542
250	528	— 505	.0682	.00821	8.30	.235	2.5	124.5	— 1.90	2.57	19.36	73.5	.1535
300	484	— 459	.0744	.00904	8.30	.235	3.0	124.3	— 1.73	2.82	23.2	80.5	.1530
350	450	— 423	.0800	.00981	8.30	.235	3.5	124.1	— 1.60	3.05	27.0	87.0	.1525
400	423	— 394	.0854	.01053	8.30	.235	4.0	124.0	— 1.51	3.26	30.9	93.0	.1522
500	382	— 349	.0944	.01188	8.30	.235	5.0	123.8	— 1.35	3.65	38.5	104.0	.1517
600	352	— 316	.1025	.01313	8.30	.235	6.0	123.6	— 1.23	4.01	46.1	113.9	.1513
700	328	— 290	.1097	.01430	8.30	.235	7.0	123.5	— 1.14	4.33	53.8	123.0	.1510
800	310	— 269	.1163	.01542	8.30	.2345	8.0	123.4	— 1.07	4.64	61.4	131.5	.1508
1000	282	— 236	0.1278	0.01755	8.30	0.2340	10.0	123.3	— 0.96	5.19	76.7	147.0	0.1505
1250	258	— 208	.1404	.0201	8.35	.2325	12.5	123.2	— .86	5.79	95.8	164.4	.1502
1500	242	— 187.4	.1518	.0226	8.45	.2307	15.0	123.1	— .78	6.34	114.8	180.1	.1500
1750	229	— 170.7	.1614	.0249	8.50	.2292	17.5	123.0	— .73	6.89	133.9	194.6	.1498
2000	220	— 157.3	.1700	.0272	8.55	.2277	20.0	122.9	— .68	7.36	152.9	208.0	.1496
2500	203.5	— 136.6	.1846	.0316	8.65	.2250	25	122.8	— .61	8.24	191.0	232.5	.1494
3000	193.0	— 121.5	.1969	.0360	8.75	.2226	30	122.8	— .56	9.04	229	254.7	.1492
3500	185.3	— 109.7	.208	.0403	8.85	.2206	35	122.7	— .51	9.84	267	275	.1491
4000	179.1	— 99.9	.216	.0446	8.90	.2188	40	122.6	— .48	10.44	305	294	.1489
5000	170.4	— 85.4	.231	.0530	9.05	.2155	50	122.6	— .43	11.69	381	329	.1488
6000	164.6	— 74.9	.243	.0614	9.20	.2128	60	122.5	— .39	12.82	457	360	.1486
7000	160.3	— 66.6	.252	.0698	9.30	.2106	70	122.5	— .36	13.85	533	389	.1485
8000	157.1	— 60.1	.260	.0782	9.40	.2085	80	122.4	— .34	14.82	609	416	.1484
10,000	152.7	— 50.8	0.275	0.0950	9.65	0.2053	100	122.4	— 0.31	16.52	761	465	0.1482
12,500	149.2	— 42.9	.290	.1160	9.95	.2020	125	122.3	— .27	18.47	951	520	.1481
15,000	146.8	— 37.4	.303	.1370	10.25	.1994	150	122.3	— .25	20.2	1141	570	.1480
17,500	145.1	— 33.6	.317	.1580	10.60	.1973	175	122.2	— .23	21.9	1331	615	.1480
20,000	143.7	— 30.4	.328	.1788	10.85	.1954	200	122.2	— .22	23.4	1520	658	.1479
25,000	141.8	— 26.0	.351	.221	11.45	.1923	250	122.2	— .19	26.2	1900	735	.1478
30,000	140.4	— 22.9	.371	.262	12.00	.1899	300	122.1	— .18	28.7	2280	805	.1477
35,000	139.3	— 20.6	.390	.303	12.50	.1878	350	122.1	— .16	31.0	2660	870	.1476
40,000	138.4	— 18.9	.408	.344	13.00	.1860	400	122.1	— .15	33.1	3040	930	.1475
50,000	137.0	— 16.4	.444	.426	14.00	.1831	500	122.0	— .14	37.1	3800	1040	.1474
60,000	136.0	— 14.6	.474	.507	14.85	.1809	600	122.0	— .12	40.6	4550	1139	.1474
70,000	135.2	— 13.4	.506	.589	15.75	.1791	700	122.0	— .12	43.9	5310	1230	.1473
80,000	134.5	— 12.4	.536	.669	16.60	.1775	800	121.9	— .11	46.9	6070	1315	.1472
							1000	121.9	— .10	52.5	7580	1470	0.1472

C = 0.0099 μF per 1000 ft., constant

G = 0.000025 x 2πfc (mhos - farads)

$\lambda = \frac{2\pi}{\beta}$ in 1000's of feet

$V = \frac{\omega}{\beta}$ in 1000's of feet per sec.

TABLE III

Nominal Characteristics of 754D & 754E Cable, 10 Hz to 1000 MHz

(Some of the Data Based on Extrapolation, Above 10 MHz)
Temp. Approx. 75°F.

FREQUENCY f Hz	CHARACTERISTIC IMPEDANCE R_o OHMS	CHARACTERISTIC IMPEDANCE X_o OHMS	PER 1000 FEET ATTENUATION 8.69α db	PER 1000 FEET PHASE SHIFT β RADIANS	PER 1000 FEET RESISTANCE R OHMS	PER 1000 FEET INDUCTANCE L MILLIHENRIES	FREQUENCY f MHz	CHARACTERISTIC IMPEDANCE R_o OHMS	CHARACTERISTIC IMPEDANCE X_o OHMS	PER 1000 FEET ATTENUATION 8.69α db	PER 1000 FEET PHASE SHIFT β RADIANS	PER 1000 FEET RESISTANCE R OHMS	PER 1000 FEET INDUCTANCE L MILLIHENRIES
10.0	3280	—3280	0.0225	0.00260	17.00	0.255	0.100	133.4	—12.56	0.869	1.056	26.6	0.222
12.5	2930	—2930	.0252	.00290	17.00	.255	.125	132.7	—11.01	.952	1.313	28.9	.220
15.0	2680	—2670	.0276	.00318	17.00	.255	.150	132.1	— 9.84	1.022	1.569	31.0	.219
17.5	2480	—2470	.0298	.00343	17.00	.255	.175	131.7	— 9.01	1.092	1.824	33.0	.217
20	2320	—2310	.0319	.00367	17.00	.255	.20	131.3	— 8.34	1.156	2.08	34.8	.216
25	2070	—2070	.0356	.00411	17.00	.255	.25	130.6	— 7.33	1.272	2.59	38.1	.214
30	1894	—1889	.0389	.00450	17.00	.255	.30	130.1	— 6.62	1.378	3.09	41.1	.213
35	1754	—1749	.0421	.00486	17.00	.255	.35	129.7	— 6.06	1.474	3.60	43.8	.212
40	1641	—1635	.0450	.00520	17.00	.255	.40	129.4	— 5.63	1.566	4.10	46.4	.211
50	1469	—1462	.0503	.00581	17.00	.255	.50	128.8	— 5.00	1.740	5.10	51.3	.209
60	1341	—1334	.0550	.00637	17.00	.255	.60	128.2	— 4.55	1.903	6.09	55.8	.207
70	1243	—1234	.0594	.00689	17.00	.255	.70	127.8	— 4.19	2.05	7.09	59.8	.206
80	1163	—1154	.0635	.00737	17.00	.255	.80	127.5	— 3.91	2.19	8.08	63.7	.205
100	1041	—1031	0.0709	0.00824	17.00	0.255	1.00	126.8	— 3.49	2.45	10.04	70.8	0.203
125	932	— 921	.0792	.00923	17.00	.255	1.25	126.3	— 3.12	2.73	12.50	78.7	.201
150	852	— 840	.0867	.01012	17.00	.255	1.50	125.8	— 2.84	3.00	14.94	85.8	.1994
175	790	— 777	.0935	.01094	17.00	.255	1.75	125.5	— 2.63	3.24	17.38	92.4	.1982
200	740	— 726	.0998	.01171	17.00	.255	2.00	125.1	— 2.45	3.46	19.81	98.3	.1973
250	663	— 648	.1113	.01312	17.00	.255	2.50	124.7	— 2.18	3.85	24.7	109.0	.1959
300	607	— 590	.1217	.01441	17.00	.255	3.0	124.4	— 1.99	4.24	29.5	119.5	.1949
350	563	— 545	.1311	.01560	17.00	.255	3.5	124.1	— 1.84	4.59	34.4	129.0	.1942
400	528	— 508	.1399	.01672	17.00	.255	4.0	124.0	— 1.72	4.90	39.3	137.5	.1938
500	474	— 453	.1556	.01878	17.00	.255	5.0	123.9	— 1.54	5.50	49.0	153.7	.1933
600	435	— 411	.1697	.0207	17.00	.255	6.0	123.7	— 1.40	6.04	58.8	168.4	.1929
700	405	— 379	.1824	.0224	17.00	.255	7.0	123.6	— 1.30	6.53	68.5	181.9	.1926
800	380	— 353	.1941	.0241	17.00	.255	8.0	123.6	— 1.21	7.00	78.3	194.4	.1924
1000	343	— 313	0.215	0.0272	17.00	0.255	10.0	123.4	— 1.08	7.86	97.7	217	0.1920
1250	311	— 276	.238	.0307	17.00	.254	12.5	123.3	— .96	8.82	122.1	243	.1917
1500	287	— 249	.258	.0341	17.00	.254	15.0	123.2	— .88	9.70	146.3	266	.1914
1750	269	— 228	.275	.0372	17.00	.253	17.5	123.2	— .81	10.50	170.6	288	.1911
2000	254	— 211	.291	.0403	17.00	.253	20	123.1	— .76	11.25	194.9	307	.1909
2500	233	— 185.0	.318	.0461	17.05	.252	25	123.0	— .67	12.66	243	344	.1906
3000	218	— 165.5	.342	.0516	17.10	.251	30	122.9	— .61	13.94	292	377	.1904
3500	206	— 150.2	.362	.0571	17.15	.250	35	122.9	— .57	15.12	340	407	.1902
4000	196.9	— 137.9	.380	.0623	17.20	.249	40	122.8	— .53	16.22	389	435	.1900
5000	183.8	— 119.3	.410	.0728	17.35	.247	50	122.7	— .47	18.26	486	486	.1897
6000	174.9	— 105.3	.435	.0831	17.50	.246	60	122.6	— .43	20.1	583	532	.1895
7000	168.4	— 94.5	.454	.0933	17.65	.245	70	122.6	— .39	21.9	679	575	.1894
8000	163.5	— 85.9	.473	.1035	17.80	.244	80	122.5	— .36	23.5	776	615	.1892
10,000	156.5	— 72.8	0.501	0.1239	18.05	0.242	100	122.5	— .32	26.5	970	687	0.1890
12,500	151.0	— 61.4	.528	.1494	18.35	.240	125	122.4	— .28	29.9	1211	769	.1887
15,000	147.3	— 53.3	.550	.1751	18.65	.238	150	122.3	— .26	33.0	1453	842	.1885
17,500	145.0	— 47.1	.568	.201	18.95	.237	175	122.3	— .24	36.0	1694	909	.1884
20,000	143.2	— 42.5	.586	.227	19.30	.236	200	122.2	— .22	38.8	1935	972	.1882
25,000	140.8	— 35.5	.611	.279	19.80	.234	250	122.2	— .19	43.9	2420	1087	.1880
30,000	139.2	— 30.7	.634	.331	20.3	.232	300	122.1	— .17	48.7	2900	1191	.1878
35,000	138.1	— 27.1	.653	.383	20.8	.231	350	122.1	— .16	53.5	3380	1286	.1877
40,000	137.2	— 24.4	.672	.435	21.2	.230	400	122.0	— .14	57.3	3860	1375	.1876
50,000	136.0	— 20.4	.704	.538	22.0	.228	500	122.0	— .13	65.2	4830	1537	.1874
60,000	135.2	— 17.71	.734	.642	22.8	.226	600	121.9	— .11	72.6	5790	1684	.1872
70,000	134.6	— 15.88	.768	.746	23.8	.225	700	121.8	— .10	79.5	6750	1819	.1871
80,000	134.1	— 14.50	.802	.849	24.7	.224	800	121.8	— .09	86.1	7710	1944	.1870
							1000	121.8	— .08	98.5	9640	2170	0.1868

$C = 0.0126$ μF per 1000 ft., constant

$G = 0.0005 \times 2\pi fc$ (mhos - farads)

$\lambda = \frac{2\pi}{\beta}$ in 1000's of feet

$V = \frac{\omega}{\beta}$ in 1000's of feet per sec.