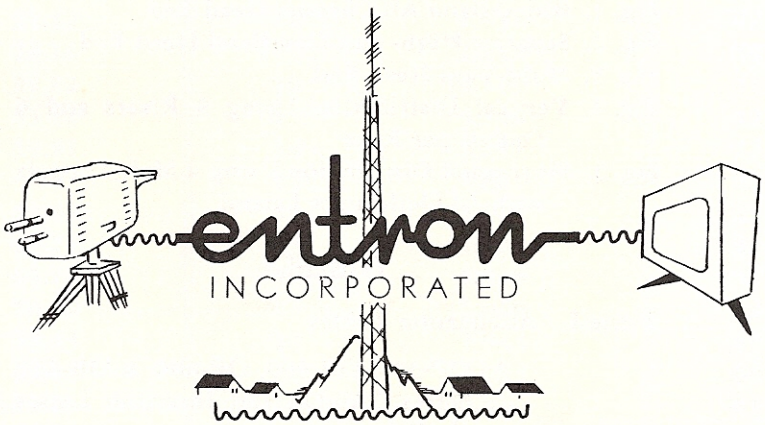
Recommended Practices
For the Design and Installation of
MASTER TELEVISION ANTENNA SYSTEMS



P. O. Box 287 • Bladensburg, Md.

Phone: APpleton 7-9585 Wash., D. C. Exchange

MAY, 1959

Printed in USA

F-1106

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Recommended Practices for the Design and Installation of MASTER TELEVISION ANTENNA SYSTEMS

SCOPE

The purpose of this Manual is to provide information on the design, installation, and cost analysis of a Television Master Antenna System for motels, hotels, apartment houses, schools, and commercial and industrial buildings.

The function of the Television Master Antenna System is to receive signals on antennas, amplify these signals, and distribute them to all outlets in a building. The subscriber, or user of the system, can then plug his television receiver into the outlet and make use of the signal provided in this manner.

Basically, the Television Master Antenna System consists of (1) antennas, (2) head-end equipment, and (3) distribution equipment.

I. BASIC ELEMENTS

A. *Antennas*

Antennas are selected and installed on the basis of local conditions to provide the best possible reception free from ghosts and interference.

1) In locations where all signals will be received from one direction with approximately equal signal strength and quality, use should be made of standard broad-band antennas, such as conicals, V-beams, or all-channel Yagis.

2) In locations where low-band (Channels 2-6) and high-band (Channels 7-13) signals are received from different directions, separate low-band and high-band antennas are to be used.

3) Where local conditions are such that the received signals arrive from several different directions, or where there is a marked difference in signal strengths, it is necessary to use individual Yagi antennas for each channel to be received.

Extreme care must be taken in the installation of the antennas to permit the best possible picture reception. In fringe areas, stacking of Yagi antennas may be necessary to increase gain and reduce interference. Preamplification at the antenna location of antenna signals will also be required in fringe areas. The Entron DRP remote preamplifier, which can be directly or remotely powered, is ideally suited for this application.

Antennas of the type mentioned have an impedance of approximately 300 ohms. To match the coaxial lines from the antennas to the head-end equipment, the Entron AT-753 antenna matching transformer is therefore used. By converting 300 ohms to 75 ohms, this transformer maintains equipment match and thereby decreases voltage-standing-wave-ratios. Excessively high ratios produce, of course, ghosty pictures.

All antennas, masts, cables, and accessories should be carefully installed and firmly supported. As is well known, antenna installations that sway, twist, or vibrate, cause jumpy, unsteady pictures throughout a system.

B. *Head End*

The head end is the heart of the system. Antenna signals are fed into, amplified at, and distributed from this element. Thus, a central location for this equipment is desirable.

If good reception is received with a broad-band antenna, the signals are fed directly to an SA-23 amplifier through RG-59/U coaxial cable, as in Fig. 1.

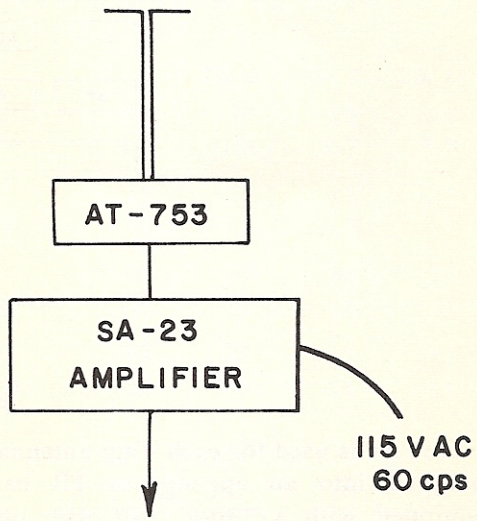

Fig. 1. Broad-Band All-Channel Head End

Where low- and high-band antennas are used, they are connected to an SF-701 band-combining filter, which in turn is connected to the input of the SA-23 amplifier, as shown in Fig. 2.

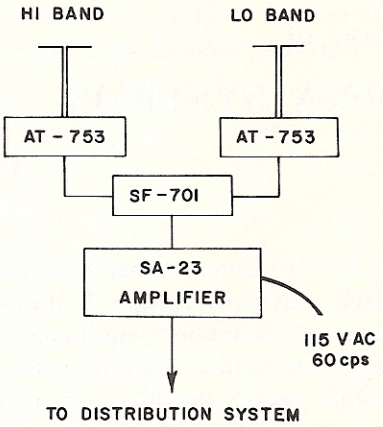

Fig. 2. Separate High- and Low-Band Head End

When Yagi antennas are found to be necessary, the antenna signals are fed to a mixing network. The AF series of filters with the FB filter base is designed for this purpose. The proper AF filter passes only the desired channel and rejects all adjacent channels. This tends to eliminate the interference that might be picked up on a Yagi antenna, and provides an economical means of coupling multiple Yagis, as in Fig. 3.

For each riser in the system, an outlet must be provided. The Entron ES-2 or ES-4 plug-in line splitter or the DL series of line splitters accomplishes this purposes.

The ES series, which is plugged in directly to the SA-23 amplifier output terminal, provides either two- or four-way signal splitting at the amplifier. If further splitting is required, the DL splitters are connected to the receptacles of the ES units at the amplifier or at any other convenient location. Use of this technique can provide for 16 risers from one SA-23.

C. *Distribution System*

The distribution system consists essentially of coaxial cables and set outlets. The cables carry signals from the SA-23 amplifier to individual set outlets.

Where conduit and flush-mounting boxes are provided, OP series outlets are used. Standard telephone or despard cover plates can be selected for these outlets to match interior room decor.

Where conduit systems are not provided, surface-mounted outlets and exposed cables are used for the distribution system. Entron's OB series of surface-mounted outlets are used for this application.

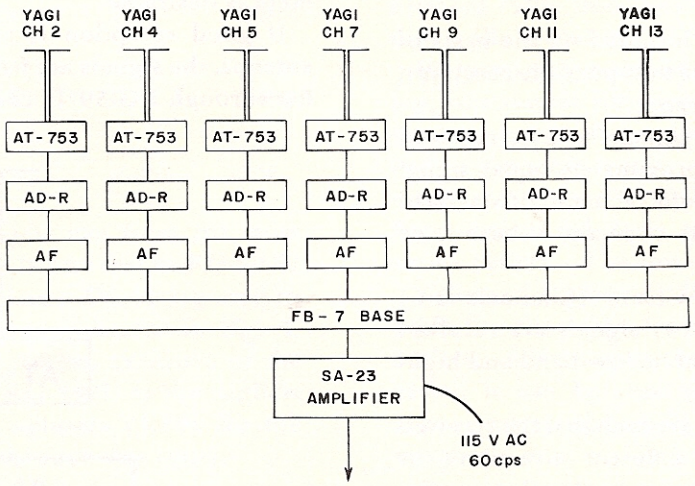

Fig. 3. Multi-Yagi Head End

One AF is used for each Yagi antenna. Each AF is plugged into an appropriate FB base, which is equipped with a 3-foot cord with plug for direct coupling to the SA-23 amplifier.

All antenna signals being mixed in the filter base must be of equal strength. If variations occur, ADR attenuators should be used on the high-strength signals at the input to the AF.

The output of the FB, as indicated above, is plugged into the SA-23 amplifier, where the signals are amplified. After amplification, the signals are fed into the distribution system.

Whenever it is necessary to run cables in crawl spaces, vertical electrical closets, or attic spaces, the DK series of thru-line outlets is used. These units serve as tap-offs on the riser cables, and, if necessary, can be used as riser splitters.

When serving as a tap-off, the DK outlet is used in conjunction with the TC (surface-mounted) or TB (flush-mounted) terminal outlet. Fittings are provided with the DK series for either RG-59/U or RG-11/U type cables. *For exceptionally long cable runs,* the RG-11/U cable, which has approximately 50% less loss than the RG-59/U cable, is recommended.

II. HIGH SIGNAL-STRENGTH AREAS

Where area conditions are such that unusually high signal strengths are encountered, resulting in direct "pick-up" at the television receiver, it is recommended that coaxial connectors be used exclusively and that all connections be made to minimize exposure of the center conductor. The OP-700 or the OB-700 series of outlets should be used exclusively in such cases.

In addition, an Entron CO-6 or CO-10 cable assembly should be installed at the television receiver. Installation should be at the terminals of the tuner, inasmuch as the 300-ohm twin-lead wire normally supplied in the receiver has a tendency to pick up "off-the-air" signals directly. It is the time lag between the signals picked up on the twin-lead and those fed down the distribution system which produces ghosty pictures.

III. TEST EQUIPMENT

For surveys and job installations, the following test equipment should be used:

1) A field strength meter to check signal levels at the antennas, amplifiers, and outlets.
2) A test television receiver, equipped with a 72-300 ohm matching transformer, Entron WBL, at the terminals of the tuner. The receiver is to be used to determine picture quality at the antenna site, at the output of the amplifier, and at the outlets.
3) A volt-ohm meter to check for shorts and opens in cables and to check AC voltages.

IV. SYSTEM DESIGN

To illustrate how a system should be designed, the following examples are given:

Example 1: The objective here is to provide a television master antenna system for a six-story building with eight risers. Since the building is equipped with conduit, the outlets are of the OP type. The configuration of such a system is presented in Fig 4.

To determine the total system losses, calculate the attenuation of the individual components, as presented in the accompanying tables, in the order listed below:

a) Line-splitter losses (in Table E),
b) Losses in cables (Table D),
c) Selected outlet tap-off losses (Tables A, B, or C), and
d) Outlet insertion losses (Tables A, B, or C).

TABLE I. ATTENUATION TABLES

TABLE A.

OP-300, OB-300, OP-600, & OB-600 SERIES TAP-OFF AND INSERTION LOSSES (IN DB)

OB-OP-	*Loss*	*Ch. 2*	*Ch. 6*	*Ch. 7*	*Ch. 13*
310	Tap-off	10	10	10	10
610	Insertion	1.5	1.4	1.5	1.7
315	Tap-off	15	15	16	16
615	Insertion	.3	.3	.2	.3
320	Tap-off	20	20	20	20
620	Insertion	.2	.2	.2	.2
325	Tap-off	25	24	24	24
625	Insertion	.1	.1	.1	.1

TABLE B.

OP-700 & OB-700 SERIES TAP-OFF AND INSERTION LOSSES (IN DB)

OP-OB-	*Loss*	*Ch. 2*	*Ch. 6*	*Ch. 7*	*Ch. 13*
710	Tap-off	10	10	10	10
710	Insertion	1.3	1.3	1.7	1.8
715	Tap-off	15	15	15	15
715	Insertion	.2	.2	.3	.3
720	Tap-off	20	20	20	20
720	Insertion	.1	.1	.1	.1
725	Tap-off	25	25	25	25
725	Insertion	.1	.1	.1	.1

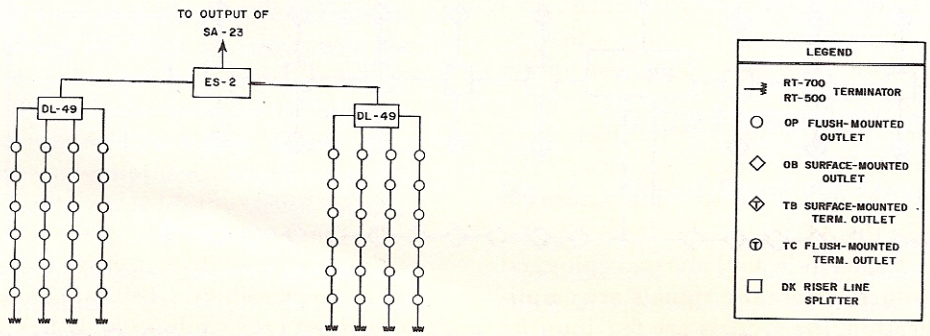

Fig. 4. Vertical Distribution Using 8 Risers and 6 Outlets per Riser

TABLE C.

DK-700 & DK-100 SERIES TAP-OFF AND INSERTION LOSSES (IN DB)

DK-	*Loss*	*Ch.2*	*Ch.6*	*Ch. 7*	*Ch. 13*
710	Tap-off	10	10	10	10
110	Insertion	1.3	1.3	1.7	1.8
715	Tap-off	15	15	15	15
115	Insertion	.2	.2	.3	.5
720	Tap-off	20	20	20	20
120	Insertion	.1	.1	.1	.3
725	Tap-off	25	25	25	25
125	Insertion	.1	.1	.1	.1

TABLE D.

Cable losses (in DB) per 100 ft.

Type	*Ch. 2*	*Ch. 6*	*Ch. 7*	*Ch. 13*
RG-59/U SSP-59 DSP-59	2.7	3.7	5.1	6.1
RG-11/U	1.6	2.1	3.1	3.6
SSP-11 DSP-11	1.3	1.8	2.5	2.9
SSF-59 DSF-59	2.2	2.8	4.1	4.5
SSF-11 DSF-11	1.2	1.5	2.1	2.4

It is assumed that the longest run from the most remote outlet to the head-end is 150 feet of RG-59/U cable. Further, that an ES-2 and a DL-49 are used to provide signals for 8 risers, as indicated in Fig. 4. Then the total losses in the system, exclusive of the outlets, will be 9db for the RG-59/U at the highest frequency and 10db for the splitters (3.5db for the two-way split and 6.5db for the four-way split).

TABLE E.

DL AND ES SPLITTER LOSSES (IN DB)

Model No.	*Fittings*	*Through Loss*
DL-21	ER-300	
DL-29	ER-400	3.5
ES-2	TUG-PLUG	
DL-41	ER-300	
DL-49	ER-400	6.5
ES-4	TUG-PLUG	

Since the output of the amplifier is +53dbmv, the signals available at the outlet will be + 53 dbvm − 10db−9db=+34dbmv. The outlet will normally require no more than 0 to +6dbmv.

By using the applicable OP Table included herein, it will be seen that an OP-725 with 25db attenuation is needed for the last outlet. This provides approximately +8dbmv for the television receiver, less outlet insertion losses.

Example 2: In another illustration, the objective is to provide a master television antenna system for an existing motel with 20 rooms per floor on two floors. The top floors are to be serviced from an attic. The bottom floors are to be serviced by installing the exposed cable from room to room. This configuration is illustrated in Fig. 5.

By locating the amplifier in the center of the building, one output for each of the 4 risers is required. In this case, an ES-4 splitter is used. From the head-end to the most remote outlet, a distance of approximately 250 feet, RG-59/U cable is used. The upper floor, being fed from the attic space, utilizes DK series outlets. The lower floor, OB-type outlets.

A loss of 6.5db prevails for the splitter and one of 15db for the cable, leaving a net of 31.5db for the outlets. Referring to the Tables for the OB and DK series, it can be seen that a 25db outlet provides approximately 4 to 6db of signal for the television receiver.

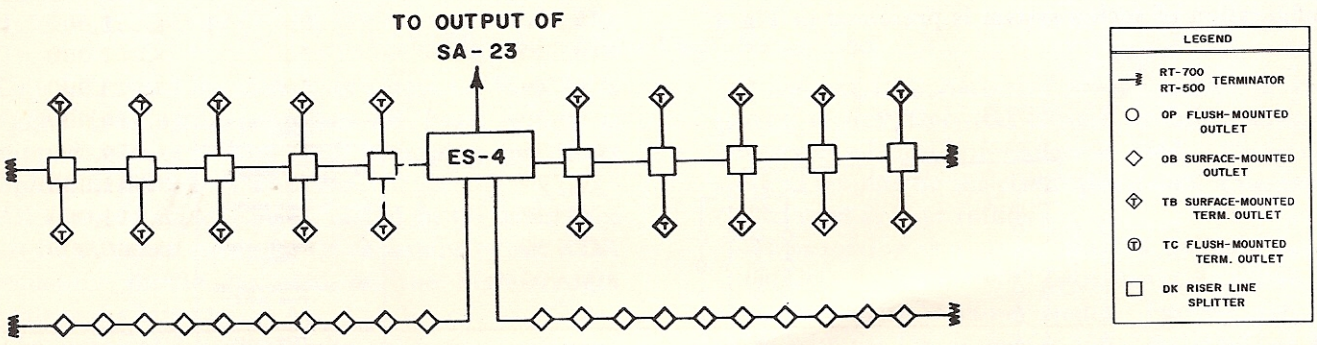

Fig. 5. Horizontal Distribution Using 4 Main Laterals with 10 Outlets per Lateral

TABLE III. DBMV-TO-μV CONVERSION TABLE

(REFERENCE LEVEL: 0 dbmμv = 1000v = 1mv)

dbmv	μv	dbmv	μv	dbmv	μv
−40	10.00	0	1,000	41	112,200
−39	11.22	1	1,122	42	125,900
−38	12.59	2	1,259	43	141,300
−37	14.13	3	1,413	44	158,500
−36	15.85	4	1,585	45	177,800
−35	17.78	5	1,778	46	199,500
−34	19.95	6	1,995	47	223,900
−33	22.39	7	2,239	48	251,200
−32	25.12	8	2,512	49	281,800
−31	28.18	9	2,818	50	316,200
−30	31.62	10	3,162	51	354,800
−29	35.48	11	3,548	52	398,100
−28	39.81	12	3,981	53	446,700
−27	44.67	13	4,467	54	501,200
−26	50.12	14	5,012	55	562,300
−25	56.23	15	5,623	56	631,000
−24	63.10	16	6,310	57	707,900
−23	70.79	17	7,079	58	794,300
−22	79.43	18	7,943	59	891,300
−21	89.13	19	8,913	60	1,000,000
−20	100.0	20	10,000	61	1,122,000
−19	112.2	21	11,220	62	1,259,000
−18	125.9	22	12,590	63	1,413,000
−17	141.3	23	14,130	64	1,585,000
−16	158.5	24	15,850	65	1,778,000
−15	177.8	25	17,780	66	1,995,000
−14	199.5	26	19,950	67	2,239,000
−13	223.9	27	22,390	68	2,512,000
−12	251.2	28	25,120	69	2,818,000
−11	281.8	29	28,180	70	3,162,000
−10	316.2	30	31,620	71	3,548,000
− 9	354.8	31	35,480	72	3,981,000
− 8	398.1	32	39,810	73	4,467,000
− 7	446.7	33	44,670	74	5,012,000
− 6	501.2	34	50,120	75	5,623,000
− 5	562.3	35	56,230	76	6,310,000
− 4	631.0	36	63,100	77	7,079,000
− 3	707.9	37	70,790	78	7,943,000
− 2	794.3	38	79,430	79	8,913,000
− 1	891.3	39	89,130	80	10,000,000
0	1,000.0	40	100,000		

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R-F TRANSMISSION SYSTEMS

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Entron Master Antenna System

ESTIMATING FORM

Equipment	*Quantity*	*Unit Price*	*Total Price*
ANTENNAS			
Antenna, Yagi			
Antenna, Broad-Band			
Mast, Antenna			
Brackets, Antenna Mast-Mounting			
Transformer, Antenna-Matching			
AT-753			
AT-370			
HEAD END			
Amplifier, SA-23			
Splitter			
ES-2			
ES-4			
Splitter, DL-29			
Splitter, DL-49			
Splitter, DL-21			
Splitter, DL-41			
Filter Bases			
FB-4			
FB-7			
Filters, AF			
Equipment Cabinet			
Attenuators, AD-R			
DISTRIBUTION SYSTEM			
Coaxial Cable, RG-59/U			
Coaxial Cable, RG-11/U			
Outlets			
OP-700			
OP-600			
OP-300			
Outlets			
OB-700			
OB-600			
OB-300			
Riser-Line Splitters			
DK-700			
DK-100			
Terminal Outlets			
TB-700			
TC-700			
Terminating Resistor			
RT-500			
RT-700			
SUBSCRIBER CONNECTIONS			
Cable Assemblies			
CO-6			
CO-10			
LABOR			
Antennas (a) Survey			
(b) Installation			
Head End			
Distribution System			
Outlets			

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