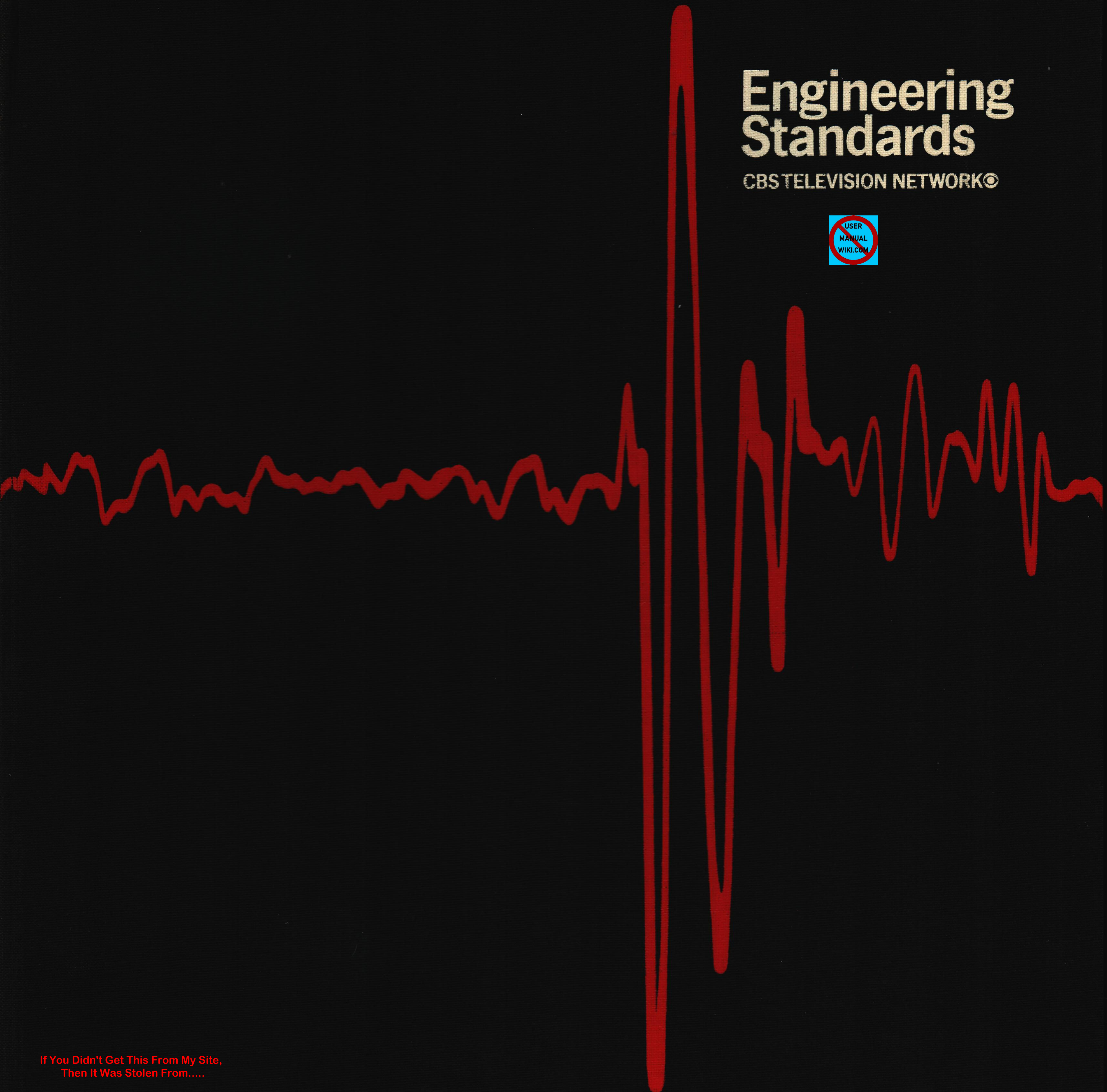
Engineering Standards

CBS TELEVISION NETWORK



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ENGINEERING DEPARTMENT
CBS TELEVISION NETWORK

COPY NUMBER: 94
ASSIGNED TO: TED DENTON, KNX

MICHAEL P SMITH

PREFACE

For the past 20 years, the technical facilities for CBS television broadcasting plants in this country and abroad have been designed and installed by the CBS Television Network Engineering Department. The genesis of this group took place 15 years earlier at which time it was known as CBS General Engineering and was responsible for the design and installation of CBS radio broadcasting facilities.

During these 35 years, a philosophy of broadcast system engineering and construction evolved and a multitude of engineering practices were developed and standardized. These practices have resulted in many installations of advanced design, superior performance, and improved operating efficiency. In addition, by simplifying many of the processes involved, these CBS-developed practices have often significantly reduced the time necessary for the completion of a project.

CBS standard design and construction practices are well known to veteran CBS Engineering and Operating personnel. This is not necessarily the case with newer members of these departments. Further, in some areas, changes and refinements have been made in earlier engineering standards. It is for these reasons that this book has been prepared. Its purpose is to establish the style to be followed in the engineering and construction of CBS television broadcast facilities.

CONTENTS

1. Block Diagrams

CHAPTER 1

BLOCK DIAGRAMS

1 BLOCK DIAGRAMS

A most important step in the design of a broadcasting system is the preparation of a block diagram. CBS standards for block diagrams have been developed over the years and are described in this chapter.

A block diagram illustrates by means of simplified symbols and single interconnecting lines the circuitry of an electronic system. To this basic circuitry information, supplementary data are added identifying circuit components, noting component gains and losses, and indicating the signal level and circuit impedance at important points along the system. Still further notations are often added to indicate more detailed information, such as the exact rack and rack panel where a component is located, and the ac phase from which a component receives its power.

A well-executed block diagram contains an extremely large amount of information about a broadcasting system. There have been occasions in the past where entire systems have been built and installed without the use of additional detailed drawings. While this is not a recommended practice, the block diagram is unquestionably the most important of the system drawings and time spent preparing it accurately and carefully is well justified.

I. SYMBOLS

In block diagrams, the symbol for a system component is usually a rectangle, triangle, or circle with suitable identifying letters placed within it. In addition, there are more graphical symbols for system components such as jacks, headsets, switches, and resistors.

The Engineering Department standard symbols for block diagrams are discussed in this section.

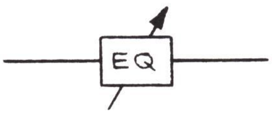
A. The Block Symbol

The basic symbol used to represent system components in block diagrams, and the symbol from which the block diagram derived its name, is a block or rectangle. Letters within the block designate the function of the system component represented by the block. In the example below, the letters PAD identify the component as a fixed attenuator.

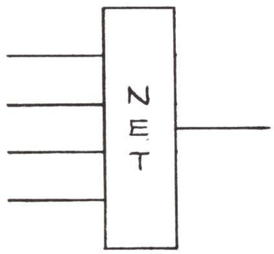
Standard CBS letter designations to be used in the block symbol to identify the component are given in Table 1-1.

Typical applications and adaptations of the block symbol are given in the following examples:

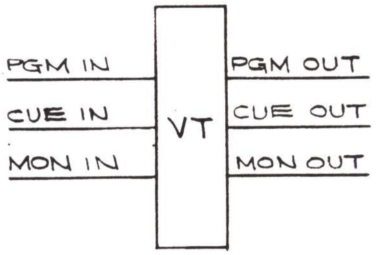
1. Variable or adjustable. An arrow through a symbol indicates that the device has an operational control or controls that affect the final program signal. An adjustable equalizer would therefore be shown:



2. Block size and shape. As a general rule, all rectangles in a block diagram should be uniform in size and shape. However, occasions often arise where block diagrams can be clarified by departing from this rule; for example:

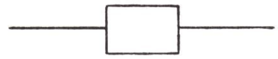


Network with several inputs



Video tape machine with several inputs and outputs

Table 1-1. BLOCK SYMBOL DESIGNATIONS



DES.	EQUIPMENT	DES.	EQUIPMENT
ALC	Amplitude Linearity Sig. Gen.	RDO	Radio Receiver or Tuner
AT	Attenuator - Variable	REV	Reverberation Unit
BCG	Brightness Contrast Sig. Gen.	RG	Recording Unit
BGG	Burst Gate Signal Generator	RG_M	Recording Unit, Magnetic
BK	Black Signal Gen. Monochrome	RG_O	Recording Unit, Optical
CAM	Camera - Television	RSG	Reference Signal Generator
CBG	Color Bar Signal Generator	RU	Reproducing Unit
CBK	Color Black Signal Generator	RU_M	Reproducing Unit, Magnetic
CCP	Camera Control Panel	RU_O	Reproducing Unit, Optical
CKG	Chroma Key Signal Generator	S	Switch or Key Switch
CON	Converter	SCG	Subcarrier Signal Generator
CPG	Convergence Pattern Sig. Gen.	SCM	Sync Comparator Unit
CPXM	Color Picture Monitor	SCU	Scanner Control Unit
CRO	Oscilloscope	SEL	Selector Switching System
DFL	Deflection Signal Generator	SG	Synchronizing Signal Generator
DL	Delay Line or Unit	S^2G	Sine Squared Signal Generator
DU	Distribution Unit	SGL	Sync Generator Locking Unit
EKG	Special Effects Key Sig. Gen.	SHG	Shading Signal Generator
EQ	Equalizer	SL	Slide Projector
F	Frequency Indicator	SPR	Sync Pulse Signal Regenerator
FL	Filter	SRG	Subcarrier Signal Regenerator
FL_{BE}	Filter, Band Elimination	SSG	Sweep Signal Generator
FL_{BP}	Filter, Band Pass	STG	Sawtooth Signal Generator
FL_{HP}	Filter, High Pass	S^2WG	Sine Squared & Window Sig. Gen.
FL_{LP}	Filter, Low Pass	T	Transformer
FSS	Flying Spot Scanner	TF	Terminal Facilities
GPG	Grating Pattern Sig. Gen.	TSG	Timing Signal Generator
K	Relay	TT	Turntable
LS	Loudspeaker	TTG	Transmission Test Signal Generator
MBG	Multiburst Signal Generator	TV	Television Receiver
MIC	Microphone	TVG	Television Signal Generator
MOD	Modulator	TVT	Television Tuner
MPX	Multiplexer	VDU	Vector Display Unit (Vectorscope)
NET	Network	VIT	Vertical Interval Test Sig. Gen.
OSC	Oscillator	VT	Video Tape Recorder & Reproducer
P	Cable Plug	VT_{RG}	Video Tape Recorder Only
PAD	Attenuator - Fixed	VT_{RU}	Video Tape Reproducer Only
PI	Pulse Indicator	WFM	Waveform Monitor
PXM	Picture Monitor	WR	Wall Receptacle
PS	Power Supply	WSG	Window Signal Generator
QMG	Cue Mark Signal Generator	XMTR	Transmitter, General
RC	Remote Control	8MM	8 MM Projector
RCV	Receiver	16MM	16 MM Projector
		35MM	35 MM Projector

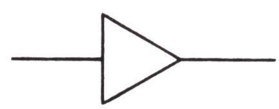
B. Amplifiers

Amplifiers in block diagrams are represented by a triangle with suitable identifying letters within the triangle.

In the above example, the letters AGC identify the amplifier as an automatic-gain-control amplifier. The triangle always points in the direction of transmission.

Standard CBS letter designations to be used in the amplifier symbol are given in Table 1-2.

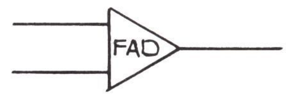
Table 1-2. AMPLIFIER SYMBOL DESIGNATIONS



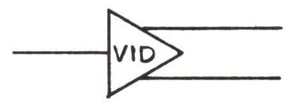
DES.	AMPLIFIER	DES.	AMPLIFIER
AFS	Audio Frequency Shifting	LIM	Limiting
AGC	Automatic Gain Control	MGT	Monitor Gating
APR	Aperture Equalizing	MIX	Mixing
BDG	Bridging	MON	Monitoring
BST	Booster	MPR	Mono-Channel Processing
CHK	Chroma Keying	MSK	Masking
CLA	Clamping	PGM	Program
CLP	Clipping	PHC	Phosphor Correcting
CMP	Compression	PRE	Preliminary
CP	Camera Processing	PUL	Pulse Distribution
CPR	Multi-Channel (Color) Processing	PWR	Power
DC	Direct Current	REC	Recording
DEC	Decoding	SCR	Signal Correcting
DLA	Delaying	SEA	Special Effects
DSH	Dynamic Shading	SMX	Video, Setup, and Sync Mixing
ENC	Encoding	STA	Stabilizing
EXP	Expansion	TRF	Video Isolation and Transfer
FAD	Fading	VAC	Vertical Aperture Correcting
GAM	Gamma Processing	VID	Video Distribution
ISO	Isolation	VSP	Video, Setup, and Sync Separating

Typical applications and adaptations of the amplifier symbol are shown in the following examples:

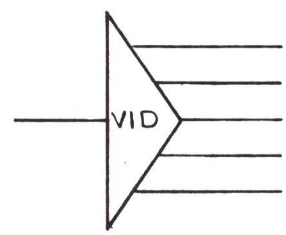
(a) Fading amplifier, two inputs, one output



(b) Video distribution amplifier, one input, two outputs

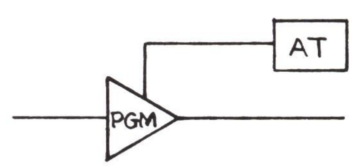


(c) Video distribution amplifier with many outputs (symbol may be expanded vertically as shown)

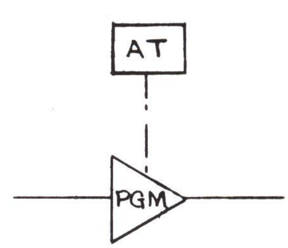


(d) Program amplifier with variable gain

(e) Audio program amplifier with external associated attenuator; audio circuits to attenuator



(f) Audio program amplifier with associated attenuator; control circuits to attenuator



C. Jacks, Plugs, and Jack Fields

Plugs and jacks are represented by the following symbols:

(a) Jack 

(b) Plug 

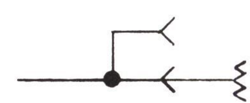
(c) Patch cord 

Typical applications of these symbols are shown in the following examples:

(a) Terminated plug 

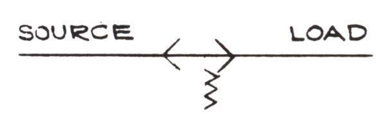
(b) Jack with terminating plug inserted 

(c) Jack with termination on normal contacts 

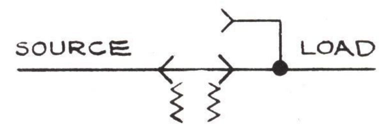
(d) Jack with multiple; termination on normal contacts 

(e) Two jacks connected by patch cord 

(f) Two jacks normalled 

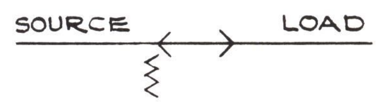
(g) Two jacks normalled; termination resistor automatically connects across normals when plug is inserted in load jack. 

(h) Two jacks normalled;
multiple jack on load. A terminating resistor automatically connects across normals when plug is inserted in either source or load jack.

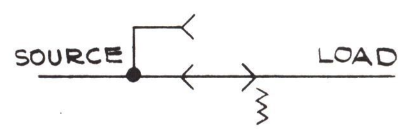


The two examples that follow are applicable to audio jack fields only.

(i) Two jacks normalled;
terminating resistor automatically connects across source when plug is inserted in source jack.



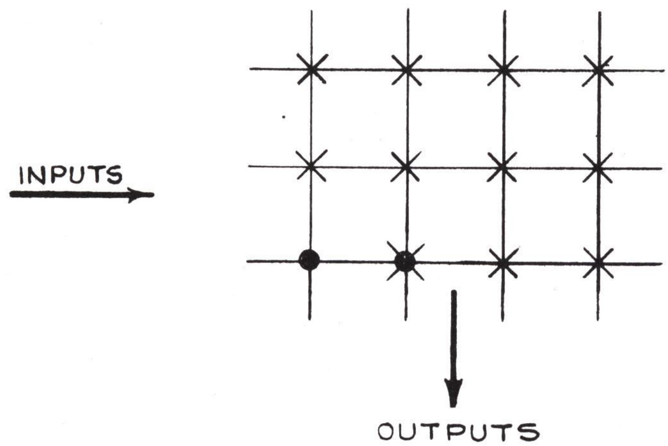
(j) Two jacks normalled;
multiple jack on source. Terminating resistor automatically connects across load when plug is inserted in load jack.



Jack wiring details can be found in Chapter 3, Section III, Jack Field Wiring.

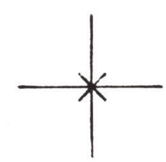
D. Switching Systems

When a large group of relays or equivalent solid-state switching devices are employed in a switching or mixing matrix, it is not practical to use block symbols. Instead, the relays or solid-state switching elements are represented in these cases by a suitable symbol at each crosspoint of the input and output busses, for example:

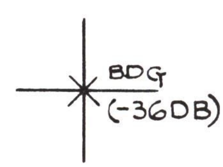


The symbols shown below should be used to represent the crosspoints in the matrix.

(a) Cross point contacts, normally open

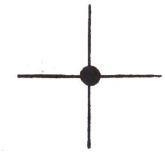


(b) Crosspoint contacts, normally open, bridging connection

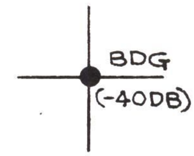


(c) Crosspoint contacts, normally closed

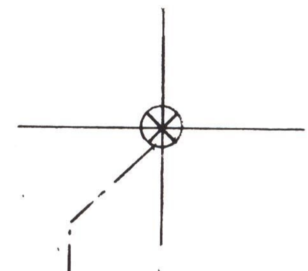
(d) Crosspoint, permanent connection



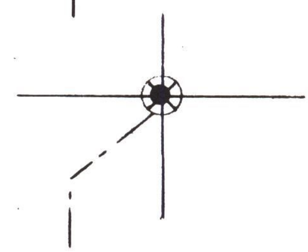
(e) Crosspoint, permanent bridging connection



(f) Crosspoint contacts, normally open, auxiliary control circuit



(g) Crosspoint contacts, normally closed, auxiliary control circuit

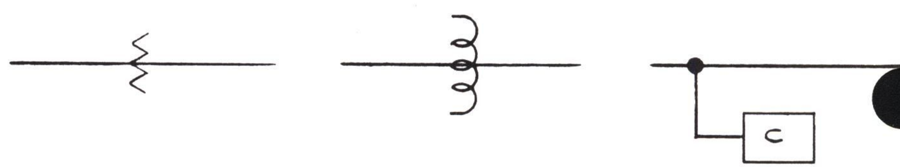


E. Resistors, Inductors, Capacitors

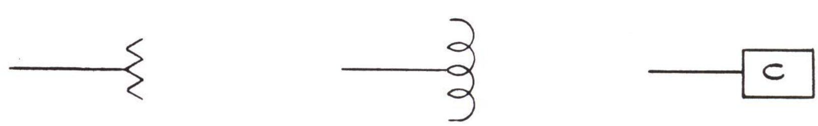
Resistors, inductors, and capacitors in block diagrams are represented as shown below:

(a) Series

(b) Shunt



(c) Terminating

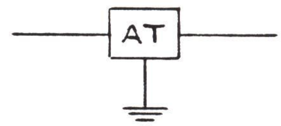


F. Grounds

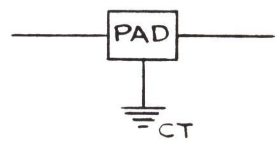
In block diagrams, the symbol  is used for ground connection.

Several applications of the ground symbol in block diagrams are given below:

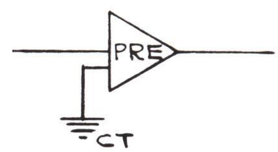
(a) Variable attenuator with common terminal grounded



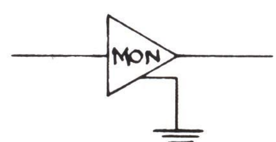
(b) Balanced-to-ground pad with center-tap grounded



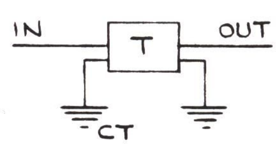
(c) Preliminary amplifier with input center-tap grounded



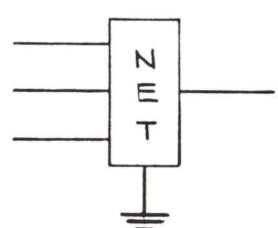
(d) Monitoring amplifier with one side of output grounded



(e) Transformer with center-tap of input winding grounded; one side of output winding grounded



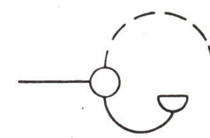
(f) Unbalanced-to-ground network with low-side grounded



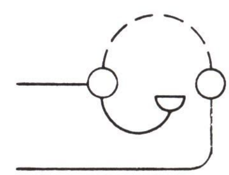
G. Telephone Instruments

Telephone instruments in block diagrams are represented by the following symbols:

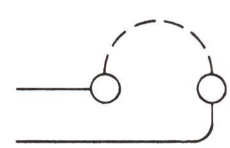
(a) Headset; transmitter and receiver



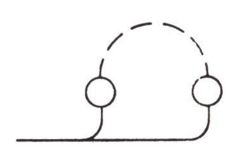
(b) Headset; transmitter and two receivers with different signals



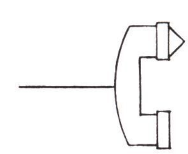
(c) Headset; two receiver units with different signals



(d) Headset; two receiver units with same signal



(e) Handset; transmitter and receiver



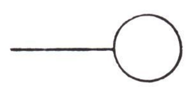
H. Meters

Meters in block diagrams are represented by a circle with suitable identifying letters within the circle, for example:

Ammeter Voltmeter

Standard CBS letter designations to be used in the meter symbol are given in Table 1-3.

Table 1-3. METER SYMBOL DESIGNATIONS

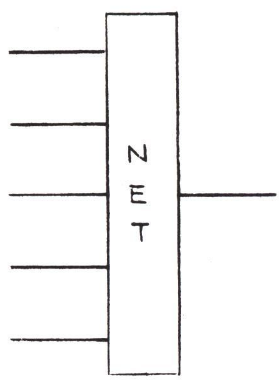


DES.	METER
A	Ammeter
F	Frequency Meter
G	Galvanometer
MA	Milliammeter
OHM	Ohmmeter
V	Voltmeter
VI	Volume Indicator
W	Wattmeter
μA	Microammeter

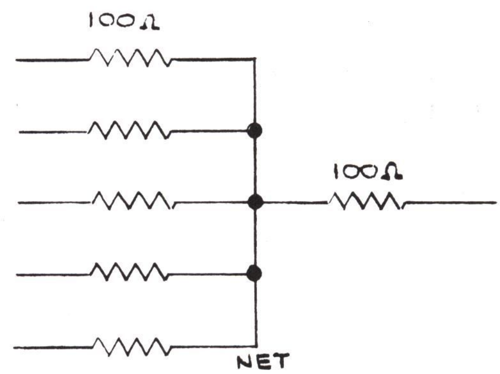
I. Alternate Symbols

Block diagrams can sometimes be made clearer by employing alternate symbols that give more circuit detail than the general block symbol. The symbols listed below may be used in these cases.

1. Networks. Diagram A below shows a network drawn in block style; diagram B is the same network drawn in an alternate style.



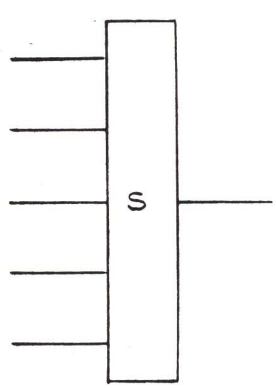
A. Block Symbol



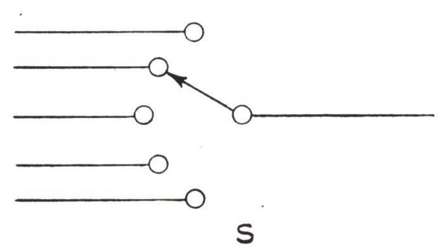
B. Alternate Symbol

The alternate symbol has the advantage that the network circuitry and the resistor values can be shown. The information must be given elsewhere when the symbol is used.

2. Switches. Although there is a block symbol for switch, the operation of a system can often be made clearer by showing more detail of the contact arrangement, for example:



A. Block Symbol



B. Alternate Symbol

J. Transmission Path

Circuit elements in a block diagram are interconnected using the transmission path symbols shown below:

(a) Signal circuit, conductive

(b) Signal circuit, air path

(c) Control circuit

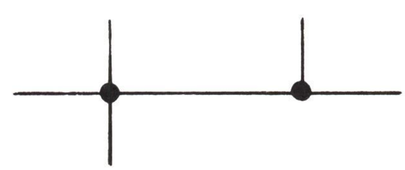
(d) Power circuit

(e) Mechanical coupling

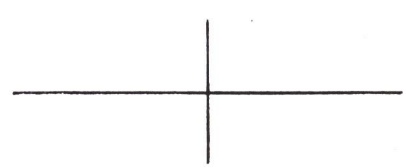
It will be noted that the control circuit symbol is made up of a series of the Continental code letter C; the power circuit, the letter P; and the mechanical coupling, the letter M.

A connection in block diagrams is shown by a black dot, for example:

(a) Circuit connected



(b) Circuit not connected



II. ABBREVIATIONS

When abbreviations are required on block diagrams the standard abbreviations given in Tables 1-4 and 1-5 should be used.

Table 1-4. SIGNAL ABBREVIATIONS

ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
AL	Amplitude Linearity, Non-Composite	I	I Chrominance
ALS	Amplitude Linearity, Composite	MB	Multiburst
B	Blue Video	Q	Q Chrominance
BG	Burst Gating Pulse	R	Red Video
BK	Monochrome Black Video, Non-Composite	RS	Reference, Non-Composite
BKS	Monochrome Black Video, Composite	RSS	Reference, Composite
BL	Blanking Pulse	R-Y	Red minus Luminance
BS	Color Bars, Non-Composite	S	Sync Pulse
BSS	Color Bars, Composite	SC	Subcarrier
B-Y	Blue minus Luminance	SS	Sweep, Non-Composite
CBK	Color Black Video, Non-Composite	SSS	Sweep, Composite
CBKS	Color Black Video, Composite	TP	Test Pattern, Non-Composite
CP	Convergence Pattern, Non-Composite	TPS	Test Pattern, Composite
CPS	Convergence Pattern, Composite	V	Video, Non-Composite (Color unless otherwise noted)
DBG	Delayed Burst Gating Pulse	VD	Vertical Drive Pulse
DBL	Delayed Blanking Pulse	VS	Video, Composite (Color unless otherwise noted)
DHD	Delayed Horizontal Drive Pulse	W	Luminance from separate Luminance Channel
DS	Delayed Sync Pulse	WS	Window, Non-Composite
G	Green Video	WSS	Window, Composite
GP	Grating Pattern, Non-Composite	Y	Luminance derived from R, B, G
GPS	Grating Pattern, Composite		
G-Y	Green minus Luminance		
HD	Horozontal Drive Pulse		

Table 1-5. MISCELLANEOUS ABBREVIATIONS

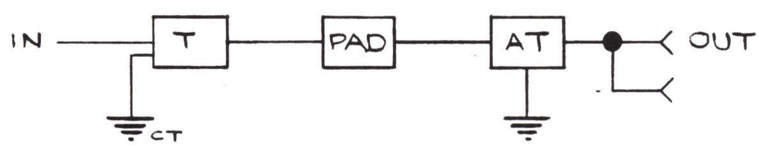
ABBR.	DESCRIPTION	ABBR.	DESCRIPTION
AR	Audio Recording Area	PAR	Parallel
AUX	Auxiliary	PC	Program Control Room
CC	Control Center	PGM	Program
CCC	Closed Circuit Control	PST	Preset
CO	Central Operations	PVW	Preview
CR	Control Room	PX	Patchcross
CT	Center-Tap	REG	Regular
CTF	Central Terminal Frame	REM	Remote
CX	Camera Patch	SC	Switching Center
DIST	Distribution	SL	Slide
E	Relay Coil Energized	SP	Spare
EC	Equipment Center	ST	Studio
EFF	Effects	TC	Telecine Area
EMG	Emergency	TELCO	Telephone Company
FC	Film Control Area	TIE	Tie Line
FR	Film Recording	TER	Terminal Equipment Room
LN	Line	TX	Transmission Center
MC	Master Control	VT	Video Tape Area
MULT	Multiple	XMTR	Transmitter
MX	Master Exchange	[B]	Indicates common power grouping such as ac phase
O	Relay Coil De-energized		

III. GENERAL RULES

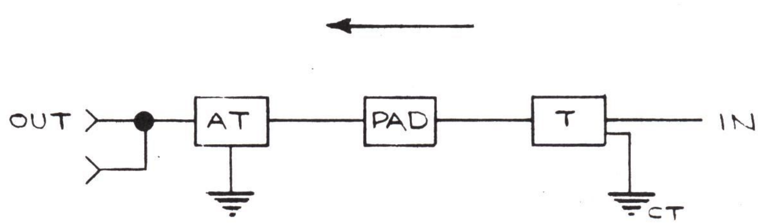
The general rules given below should be followed in preparing block diagrams.

A. Direction of Flow

1. Direction of signal flow on a block diagram should be from left to right, for example:



2. Should it be necessary for a portion of a block diagram to depart from the above rule and flow in the opposite direction, a direction of flow arrow (←——) should be used where required for clarity, for example:



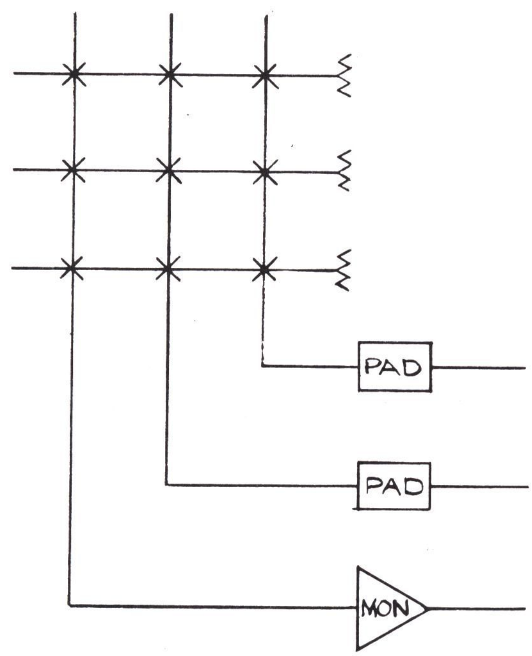
3. Circuits on a block diagram must often run vertically. It is preferred practice that the direction of signal flow, in these cases, be from the top to the bottom of the diagram.

4. It is recognized that, in some cases, rigid adherence to the above rule could result in oversize drawings or drawings whose clarity could be improved. In such cases, it is permissible to depart from the above rule and make the direction of flow from bottom to top. When this is done, a direction of flow arrow should be used where it will improve the clarity of the diagram.

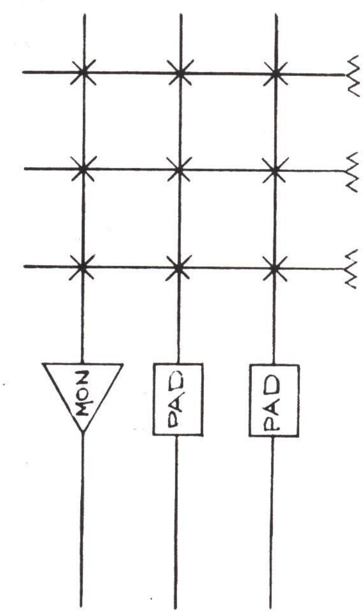
5. The outputs of a switching matrix usually leave the matrix in a vertical direction.

   a. It is preferred practice that these outputs leave the matrix at the bot- rather than the top to conform with paragraph 3 above.

b. It is preferred practice to restore these matrix output circuits to flow in a horizontal direction as in Example A. However, in cases where the clarity of the diagram will be improved, it is permissible to continue the circuits and symbols vertically for a short distance as in Example B.



A. Preferred



B. Acceptable

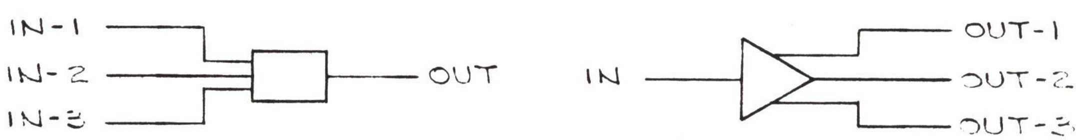
B. Connections to Symbol

1. The signal input normally connects to the left side of the symbol, the output to the right side, for example:

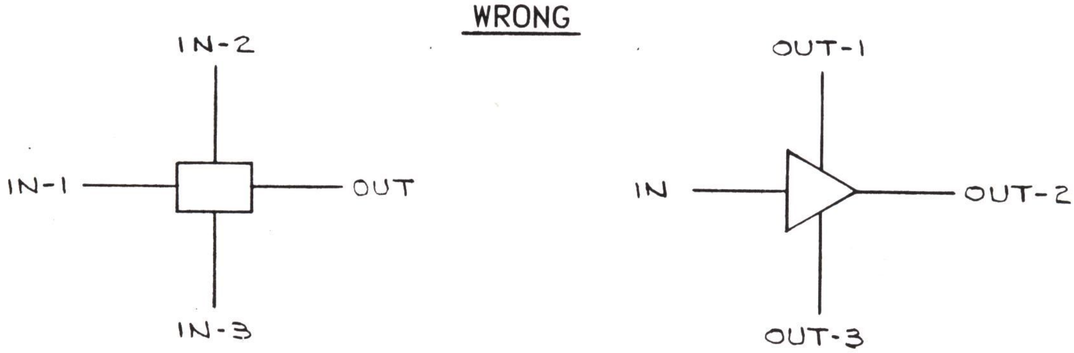
2. Should the direction of signal flow be in the opposite direction (see Section A-2 above), the input and output positions would of course be reversed, for example:

3. If the symbol has more than one input or output, the above rules still apply, that is, signal connections are made to the sides, not to the bottom or top, of the symbol, for example:

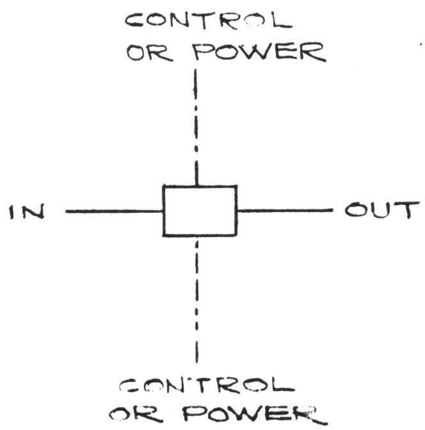
RIGHT

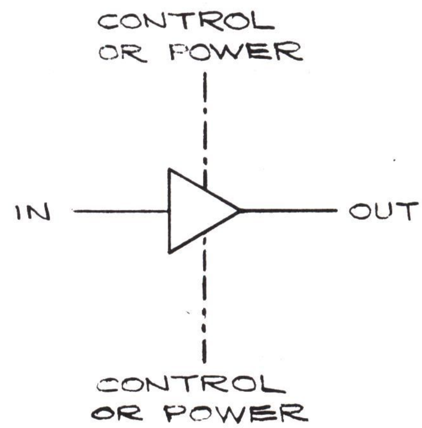


WRONG

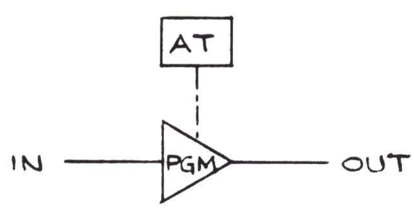


4. Control and power connections, when required, are made to the top and/or bottom of the symbol, for example:

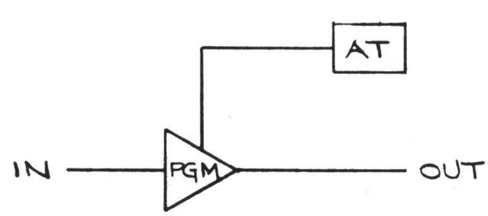




5. Following the above rule, an amplifier with an external volume control operated by means of control voltages (such as a light-dependent-resistor type volume control) would be represented in the following manner:



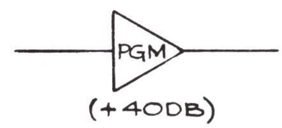
6. However, if actual audio or video signals pass from an internal point within the amplifier to, or through, an external volume control, it would be represented in this manner:



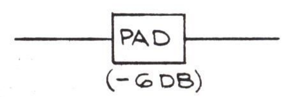
C. Equipment Gain and Loss

On both audio and video block diagrams, the normal circuit gain or loss of an equipment unit is expressed in decibels*. The gain or loss in decibels is written in parenthesis below the circuit element as shown in the following examples:

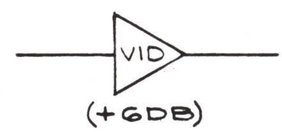
(a) Audio program amplifier, gain 40 dB



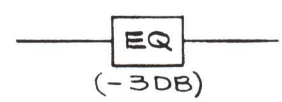
(b) Audio fixed pad, loss 6 dB



(c) Video distribution amplifier, gain 6 dB



(d) Video equalizer, loss 3 dB



D. System Audio Levels

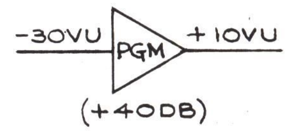
Audio levels on block diagrams are expressed in vu**. The level in vu is written above the circuit transmission path line at the appropriate point in the circuit as shown in the following examples:

---

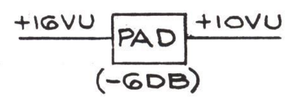
*The decibel, abbreviated dB, is used to express power ratios such as the gain or loss of a system component, or the relative amplification of a device at one frequency as compared to another.

**The vu is used to express the audio program level as read on a standard volume indicator. The level in vu is equal to the number of decibels the program level is above or below a reference level as defined in USA Standard C16.5-1954.

(a) Audio program amplifier, input level -30 vu, output level +10 vu



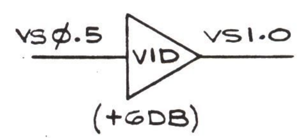
(b) Audio fixed pad, input level +16 vu, output level +10 vu



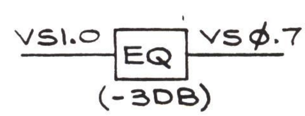
E. System Video Levels

Video levels on block diagrams are expressed by a combination of letters and numbers. The letters (from Table 1-4) identify the type of signal; the numbers give the normal signal level in volts. This combined signal identification and signal level expression is written above the circuit transmission path line at the appropriate point in the circuit as shown in the examples below. Other examples are given in Figure 1-2.

(a) Video distribution amplifier, composite video signal, input 0.5 volt, output 1.0 volt



(b) Video equalizer, composite video signal, input 1.0 volt, output 0.71 volt



The above system is also used for expressing the level of non-composite video signals (for example, Vɸ.66), for sub-carrier signals (SC2.0), for burst gate signals (BG4.0), and for horizontal drive pulse signals, (HD4.0).

To distinguish between the letter O and the numeral zero, the numeral is always written ɸ when it follows a letter.

F. Subscripts

A block diagram may contain several different types of a given system component. For example, an audio block diagram may include a line transformer, a bridging transformer, and a loudspeaker matching transformer. The block diagram symbol for any transformer is a rectangle containing the letter T. Subscript numbers (T_1, T_2, and T_3) are used, therefore, to distinguish among the three transformer types and these are fully identified in the legend, as shown in Figures 1-1 and 1-2.

This same procedure should be followed in all cases where more than one system component of a given category is used.

G. Rectangle or Triangle

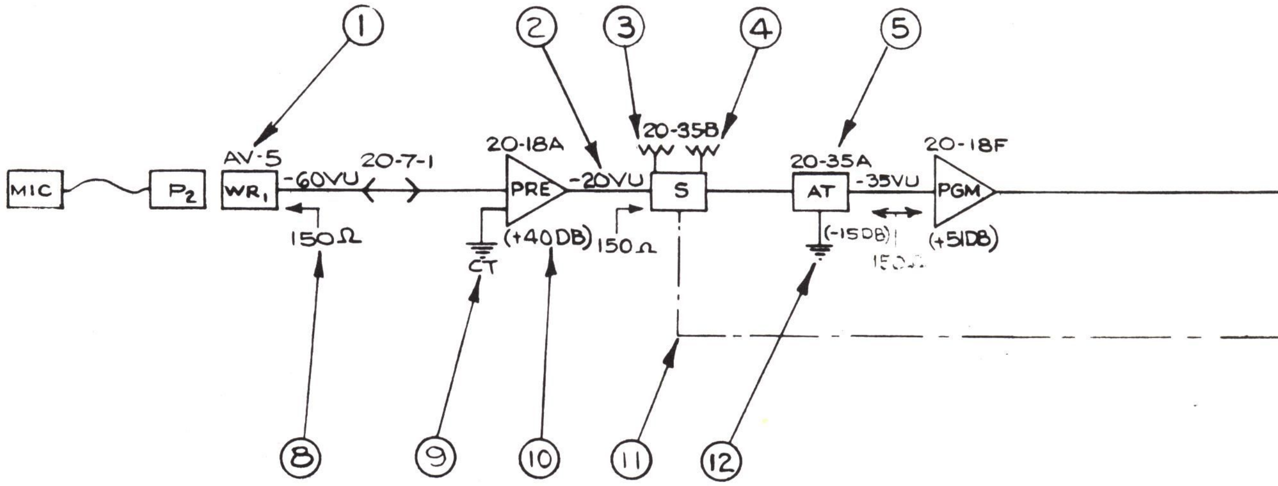
A question sometimes arises as to whether a symbol should be a rectangle or a triangle. In determining which to use, the rules to follow are:

1. If the unit is active and if it amplifies, isolates, or processes an audio, video, or pulse signal, it is classified as an amplifier and should be a triangle.

2. All other units should be in rectangles unless, of course, there is a special symbol for them.

IV. TYPICAL BLOCK DIAGRAMS

Typical broadcast system block diagrams are shown on the following pages. These drawings illustrate the application of the standard symbols already described and also show the methods by which levels, impedances, equipment locations, and other information are noted on block diagrams. Attention is called to the legend without which a block diagram is incomplete.



(1.) Indicates wall receptacle is located in studio outlet box AV-5.

(2.) Indicates program level at designated point in circuit.

(3.) Indicates terminating resistor on input when key is in off position.

(4.) Indicates terminating resistor on output when key is in off position.

(5.) Indicates component location. 20-35A signifies rack 20, 35th rack unit from bottom, position A.

(6.) Indicates location of jack. 20-1-15 indicates jack is in rack 20, jack row 1, jack number 15. Only the source jack need be identified if the load jack is adjacent.

(7.) Indicates location of source and load jacks (both numbers used only when jacks are not adjacent) See note 6 for location code.

(8.) Indicates circuit impedance in direction indicated.

(9.) Indicates center-tap grounded.

(10.) Indicates gain or loss in associated unit of equipment.

(11.) Indicates control circuit.

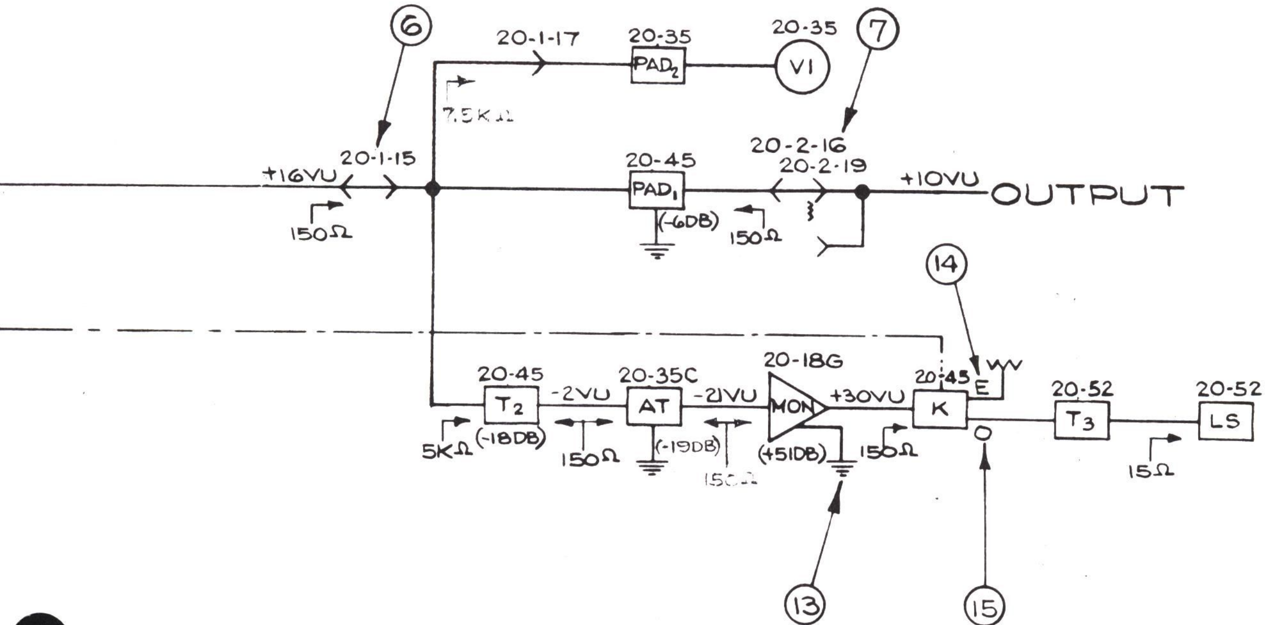
(12.) Indicates common side grounded.

(13.) Indicates one side of amplifier output is grounded.

(14.) Indicates relay coil energized in this position.

(15.) Indicates relay coil de-energized in this position.

FIGURE 1-1. AUDIO BLOCK

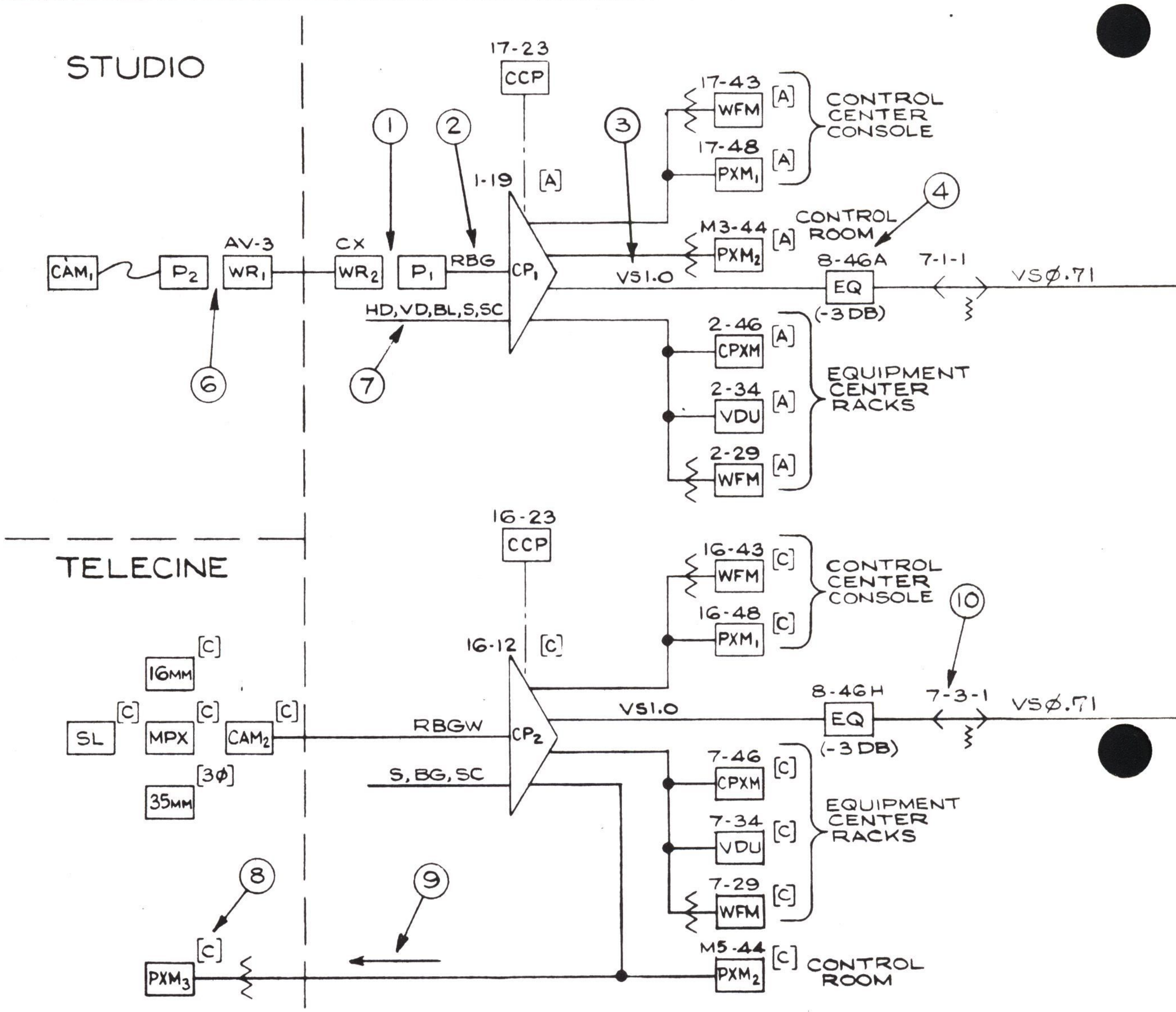


CODE	DESCRIPTION	MFR.
AT	Variable Attenuator 150/150 ohms	Smith T730K
K	Relay	Jones U1017
LS	Loudspeaker	Evans LC1B
MIC	Microphone	Evans BK5B
MON	Monitoring Amplifier	ABC 17Z
P_2*	Plug	Streeter UA12
PAD_1	Fixed H Pad 6 dB 150/150 ohms	Smith H154
PAD_2	VI Attenuator	Smith 1031
PGM	Program Amplifier	ABC 17Z
PRE	Preliminary Amplifier	ABC 16Z
S	Key Switch	Jones 2ARN
T_2	Bridging Transformer 5K 150 ohms	ABC A14421
T_3	Loudspeaker Matching Transformer 150/15 ohms	ABC A14422
VI	Volume Indicator	Brown 14L
WR_1*	Wall Receptacle	Streeter UA13

LEGEND

* Odd number subcript for plugs or receptacles indicates female; even number indicates male.

DIAGRAM USING STANDARD SYMBOLS



(1.) Indicates mating plug and receptacle at camera patch bay.

(2.) Indicates individual red, blue, and green video signals.

(3.) Indicates program level and type of signal at designated point in the system. VS1.0 indicates the signal is composite video (video with sync) at a level of 1.0 volt.

Other examples:

Symbol	Meaning
VØ.66*	0.66 volt non-composite video signal
VS1.4	1.4 volt composite video signal
SC2.0	2.0 volt sub-carrier signal
HD4.0	4.0 volt horizontal drive signal
BG4.0	4.0 volt burst gate signal

* To distinguish between the letter O and the numeral zero, the numeral is always written Ø when it follows a letter.

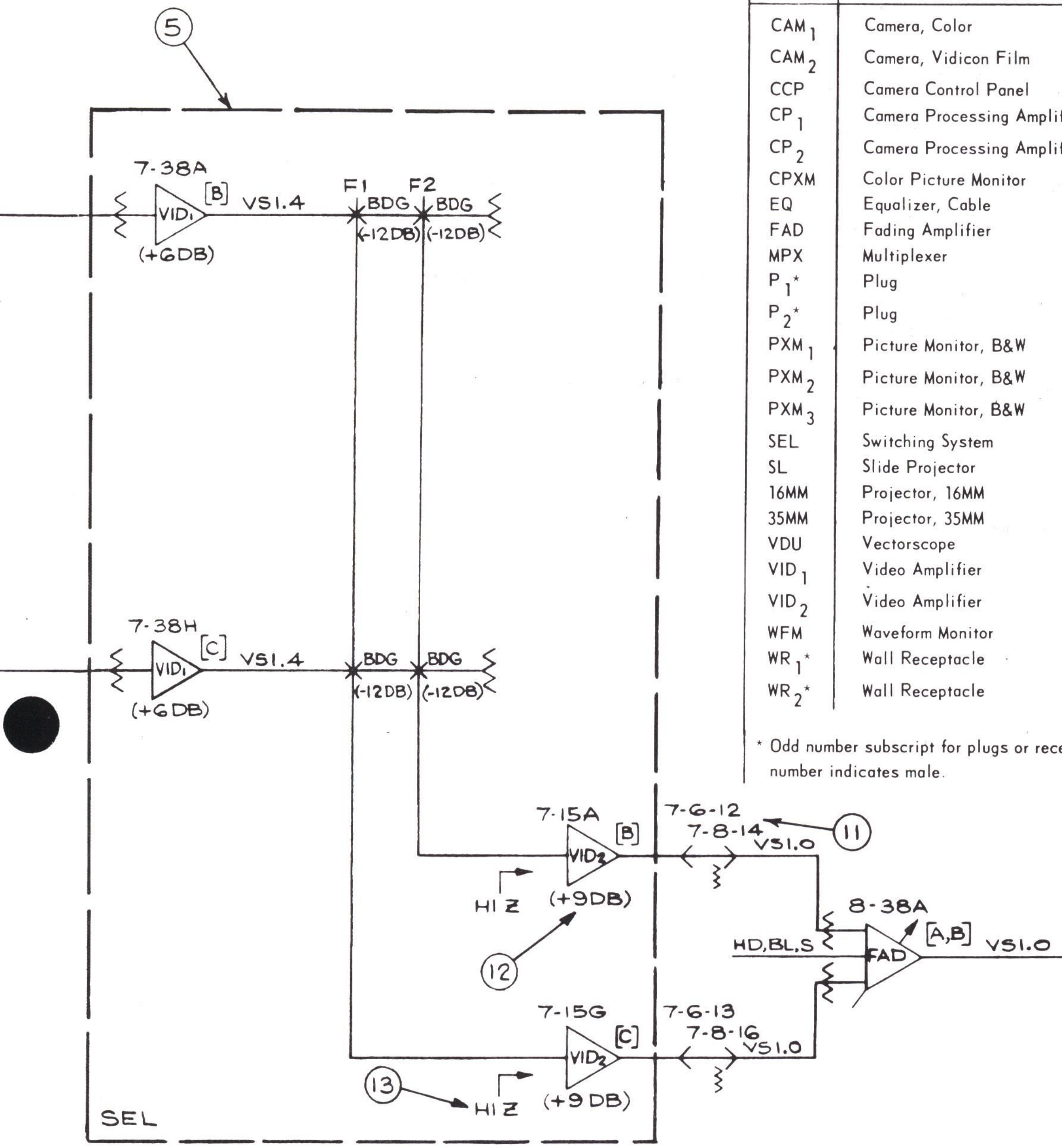
(4.) Indicates rack, rack unit, and compartment location of equipment, for example, 8-46A signifies rack 8, 46th rack unit from bottom, compartment A.

(5.) Area enclosure symbol. Indicates equipment enclosed is a single unit; in this case a complete switching system.

FIGURE 1-2. VIDEO BLOCK

LEGEND		
CODE	DESCRIPTION	MFR.
CAM_1	Camera, Color	Lunsford PC70
CAM_2	Camera, Vidicon Film	Evans TK27
CCP	Camera Control Panel	Lunsford PC70
CP_1	Camera Processing Amplifier	Lunsford PC70
CP_2	Camera Processing Amplifier	Evans TK27
CPXM	Color Picture Monitor	Conrad CYA17RS
EQ	Equalizer, Cable	Arnold 535
FAD	Fading Amplifier	SE 22650B
MPX	Multiplexer	Evans TP15A
P_1*	Plug	KBB TV37C Part 13
P_2*	Plug	KBB TV37C Part 23
PXM_1	Picture Monitor, B&W	Conrad CZB8
PXM_2	Picture Monitor, B&W	Conrad CZB14R
PXM_3	Picture Monitor, B&W	Conrad CZB14C
SEL	Switching System	SE 1000X
SL	Slide Projector	Evans TP7
16MM	Projector, 16MM	Eckert 400
35MM	Projector, 35MM	Drozd PA200
VDU	Vectorscope	Parker 526
VID_1	Video Amplifier	SE R21642B
VID_2	Video Amplifier	SE R21727
WFM	Waveform Monitor	Parker 529
WR_1*	Wall Receptacle	KBB TV37C Part 18
WR_2*	Wall Receptacle	KBB TV37C Part 28

* Odd number subscript for plugs or receptacles indicates female; even number indicates male.



(6.) Indicates mating plug and receptacle at studio outlet box. Receptacle WR is in studio outlet box AV-3.

(7.) Indicates pulse and/or test signal inputs.

(8.) Indicates common power grouping.

(9.) Indicates direction of signal flow.

(10.) Indicates location of jack. 7-3-1 indicates jack is in rack 7, jack row 3, jack number 1. Only the source jack need be identified if the load jack is adjacent.

(11.) Indicates location of source and load jacks (both numbers used only when jacks are not adjacent) See note-10 for location code.

(12.) Indicates gain or loss in associated unit of equipment.

(13.) Indicates circuit impedance in direction indicated.

DIAGRAM USING STANDARD SYMBOLS

REFERENCES

1. USA Standard Y32.2 - 1962, GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONICS DIAGRAMS.

2. USA Standard Y32.2a - 1964, Supplement No. 1 to Y32.2 - 1962, GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONICS DIAGRAMS.

3. EIA Standard TR-115, SYMBOLS AND DESIGNATIONS FOR SINGLE LINE DIAGRAMS FOR AUDIO FACILITIES, (June, 1951)

4. Howard A. Chinn, AUDIO SYSTEM DESIGN FUNDAMENTALS, Audio Engineering, 32:11:11 (November, 1948).

5. Howard A. Chinn, BROADCAST STUDIO AUDIO-FREQUENCY SYSTEMS DESIGN, Proc. IRE, 27:2:83 (February, 1939)

2. Rack Assemblies

CHAPTER 2

EQUIPMENT RACK ASSEMBLIES

2 EQUIPMENT RACK ASSEMBLIES

One of the most convenient and widely-used mounting devices for assemblies of broadcast system components is the equipment rack. The equipment rack has been used for this purpose since the earliest days of radio broadcasting. Standard practices followed by CBS in designing equipment rack assemblies for television broadcasting audio-video systems are discussed in this chapter.

I. EQUIPMENT RACKS

The equipment rack is essentially a metal framework or enclosure upon or within which components of a broadcasting system are mounted. The flexibility provided by the equipment rack permits the system components to be arranged in a variety of ways. Over the years, certain standards have evolved in CBS rack design and construction. These standards are described in the following sections of this chapter.

A. Industry Standards

The essential dimensions of equipment racks and rack panels have been standardized by the Electronic Industries Association (EIA) Standard SE-102. This EIA standard defines the width of rack panels (19 inches), panel height (nominally any multiple of 1-3/4 inches), and the location of mounting holes or slots on rack panels. It also defines the configuration and size of the drilled and tapped holes on the rack panel-mounting rails. The EIA standard also gives recommended rack heights (the EIA standard rack provides 77 inches of panel space but other rack heights in increments of 7 inches are also standard) and rack depths (15, 18, and 24 inches).

CBS rack designs conform to this industry standard, although not all the EIA standard rack sizes are CBS standard sizes.

B. The CBS Rack

Basically, there are two types of equipment racks; the open type, seldom used in broadcast applications, and the enclosed or cabinet type. The rack used in CBS installations, shown in Figure 2-1, is a modified form of the cabinet rack. Its design employs open-frame construction, side plates being installed only where desired. Thus, a group of racks can be arranged in a row without the barrier between adjacent racks that results when conventional cabinet racks, with fixed side walls, are so arranged. Side plates are installed at each end of a row of racks to present a finished appearance. Side plates can also be installed between any desired racks in a row if the shielding, physical barrier, or heat barrier they provide is desired.

A rear rack door, with or without ventilation perforations, is usually installed to improve the appearance of the completed installation. A front door is sometimes installed when ready access to front panel controls is not necessary. A rack top, when conditions permit its use, will not only improve the appearance of an installation but will also protect the rack equipment from falling dust and dirt.

C. CBS Preferred Rack Sizes

There are two preferred CBS equipment rack sizes, which are listed below. Every effort should be made to use these preferred sizes.

Table 2-1. CBS PREFERRED RACK SIZES

CBS TYPE	HEIGHT		DEPTH	WIDTH	
	Overall (less base)	Panel Space	Overall	Overall	Panel
A802422	80 in.	77 in.	24 in.	22 in.	19 in.
A942422	94 in.	91 in.	24 in.	22 in.	19 in.

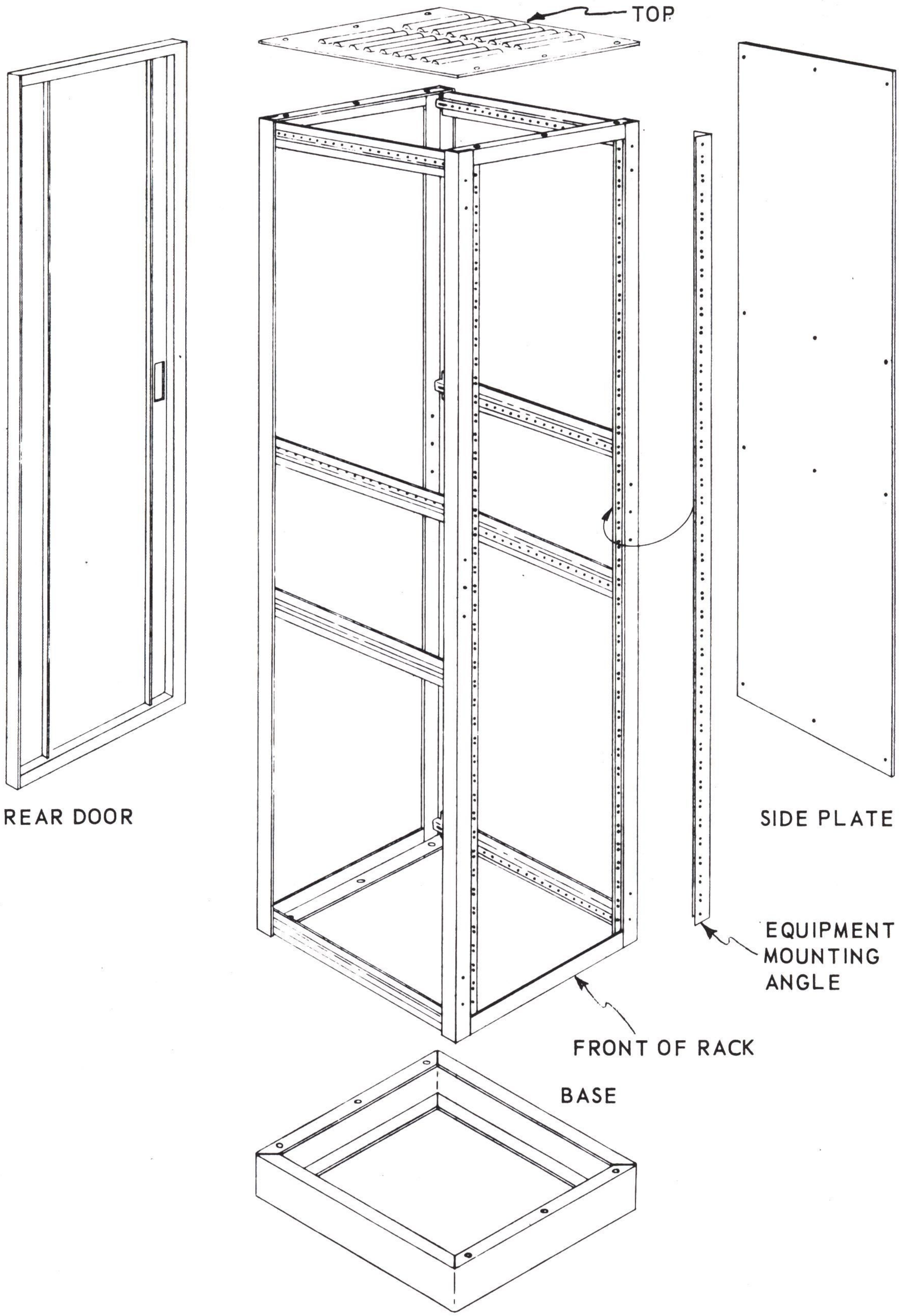


FIGURE 2-1. The CBS equipment rack

D. Special Racks

Physical space limitations or other special design considerations occasionally dictate the use of an equipment rack differing in size from either of the preferred CBS equipment racks.

When a non-preferred size rack must be used, the following general rules should be followed:

(a) The rack height should provide a panel space of 91*, 84, 77*, 70, 63, 56, 49, 42, 35, or 28 inches.

(b) The depth of racks for 19-inch panels should be 18 or 24* inches; the depth of those for 24-inch panels should be 30 inches.

(c) The rack width should provide for panel widths of 19* or 24 inches.

II. DESIGN OF EQUIPMENT RACK ASSEMBLIES

The main points that must be covered by equipment assembly and wiring drawings that define equipment rack assemblies are:

(a) The exact physical placement of all rack mounted equipment. This includes not only the equipment mounted on the front of the rack, but all equipment mounted within the rack.

(b) All information necessary to completely wire the rack.

Many rack equipment assembly and wiring practices have been standardized by the Engineering Department. Accordingly, the preparation of rack equipment assembly and wiring design information has been significantly simplified, for example:

(a) The placement of terminal blocks, ac power wiring, ground bus, and audio, video, and control cables within the rack has been standardized.

(b) Standard forms have been developed to simplify the preparation of rack equipment assembly and rack wiring information. Forms are available covering rack equipment layout, rack ac power and wiring, jack field layout, terminal block wiring, and rack inter-unit connections.

---

*Dimension of CBS preferred rack

(c) An extensive family of standard rack hardware has been developed; see Volume II, "Standard CBS Hardware".

The shop drawings covering the equipment assembly and wiring of an equipment rack must contain all information necessary for the shop to accomplish the desired work. The general rules to follow are discussed below.

A. Equipment Rack Layout

Equipment rack layout drawings show the placement of the equipment in a rack. Standard Engineering Department drawing forms* are available for planning an equipment rack layout. The same drawing forms are used for the finished job drawing.

The general appearance of an equipment rack layout, showing a single rack, is given in Figure 2-2. When several racks are arranged in a row, it is recommended practice to show the entire row on a single drawing. This practice is desirable as it makes it possible to see the interrelationship of all equipment in the entire row of racks.

In the preparation of drawings covering complex rack assemblies, it may be necessary to provide a rear-view rack layout drawing to show equipment locations not clearly illustrated in the front view. This should not be done unless it is necessary to clarify the rack assembly.

Some general rules to follow in laying out equipment racks are:

(a) Use standard CBS racks, rack panels, and rack hardware.

(b) Mount terminal blocks, ac power ducts, and grounds in accordance with standard CBS practices. These practices are covered in Sections B, C, and D that follow.

(c) All racks and panels are to be finished in a standard CBS color.

(d) Give careful thought to operation of the rack. Mount operating controls at a convenient operating height; visual displays (meters, readouts, monitors) at a convenient viewing height and where they can be seen from the operating position.

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*Form 9 for one rack, see Figure 2-2; Form 10 for 2 to 10 racks.

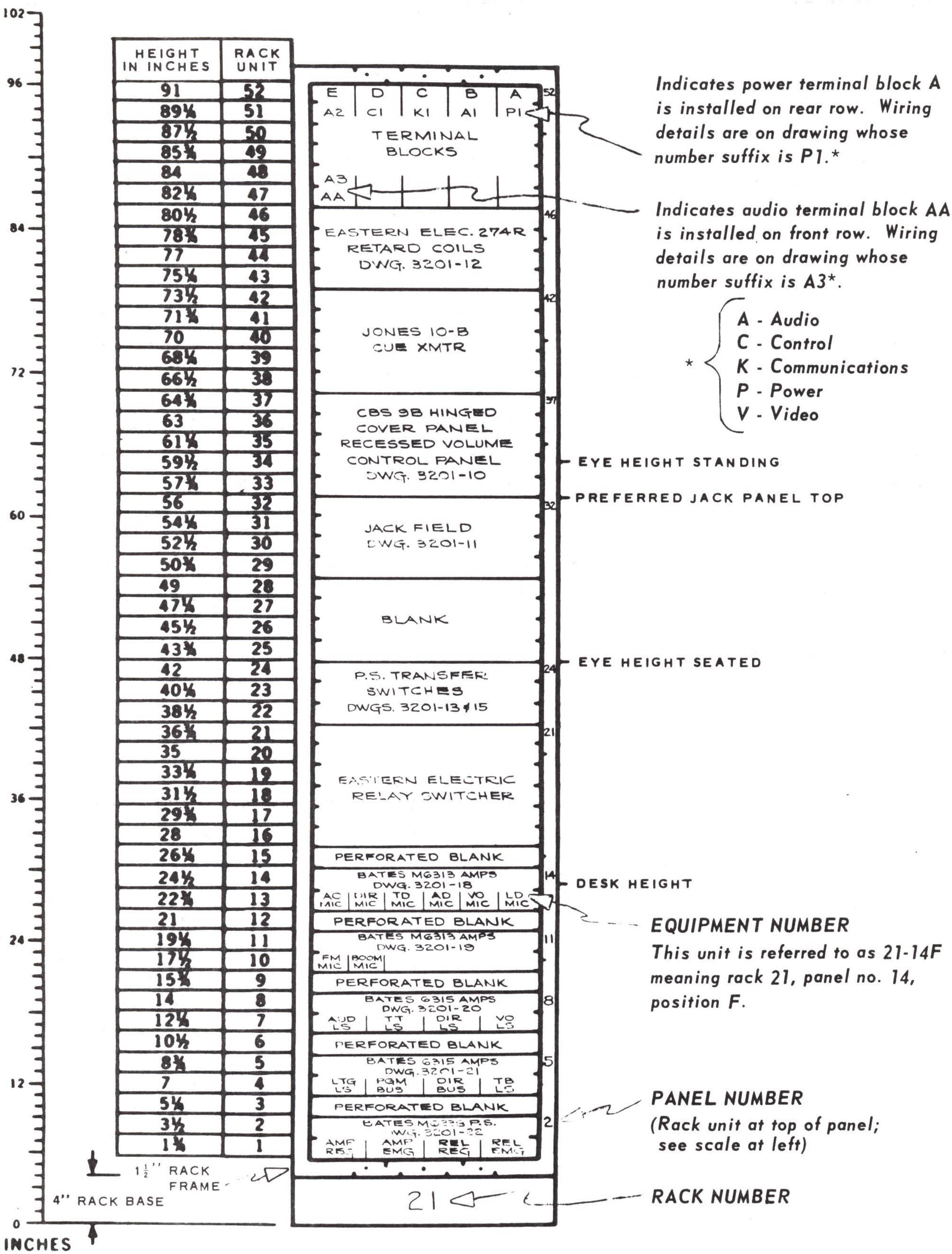


FIGURE 2-2. A typical equipment rack layout

(e) Keep the tops of the jack fields of all racks at the preferred CBS jack field height (rack unit 32; see Figure 2-2). When a jack field extends over several racks, this is particularly important for a pleasing, professional appearance as well as for a functionally effective layout. The CBS standard jack field height has been carefully chosen to provide a standing operator with the best view of the jack designations. An exception to the above rule would be an installation to be operated by a normally-seated operator.

(f) Don't completely fill the rack with equipment. Leave some judiciously chosen space for future modifications and expansion. Be sure to allow adequate space for cables and wiring.

(g) In providing space, don't forget equipment cooling. Space must be allowed to permit the free movement of cooling air past the equipment.

(h) Heavy equipment, in general, should be mounted in the lower part of the rack to facilitate its installation and, when necessary, its replacement. An exception to this rule might be an equipment unit that produces a considerable amount of heat. It may be desirable to mount this unit at the top of the rack to minimize the effect of the heat on other units.

(i) Don't lose sight of the importance of maintenance. All components must be readily accessible for servicing, adjustment, or replacement without disrupting remaining equipment.

B. Equipment Rack Terminal Blocks

Terminal blocks (see Chapter 4, "Terminal Blocks") may be mounted at the bottom or top of a rack. Which of these two locations is used is determined by the entry point of the cables. In general, racks in plants employing overhead wire ducts will have their blocks at the top; those in plants employing floor ducts will have their blocks at the bottom.

1. Terminal Block Installation. The standard location for equipment rack terminal blocks is shown in Figure 2-3. It is standard practice to mount no more than five terminal blocks in the row. These blocks, which are accessible from the rear of the rack, are identified as A, B, C, D, and E from left to right as viewed from the rear of the rack.

A terminal block is always identified by its position in the row; thus, if only one block is installed and it occupies the center position, it will be block C. In racks requiring ac power, the first block on the left (block A) is used as the ac power block. Rack ac power is discussed in more detail in Section C.

Although five terminal blocks can be accommodated in the block space, it is not always desirable to install all five, particularly when the terminal blocks are large units with several hundred terminals. It is important that adequate access space is available to every terminal on every block. Therefore, when large terminal blocks with more than 200 terminals are used, it is recommended practice that the number of blocks in the row be reduced to preserve the access space. When less than five blocks are installed, a block should be designated A, B, C, D, or E depending on the position it occupies on the mounting hardware.

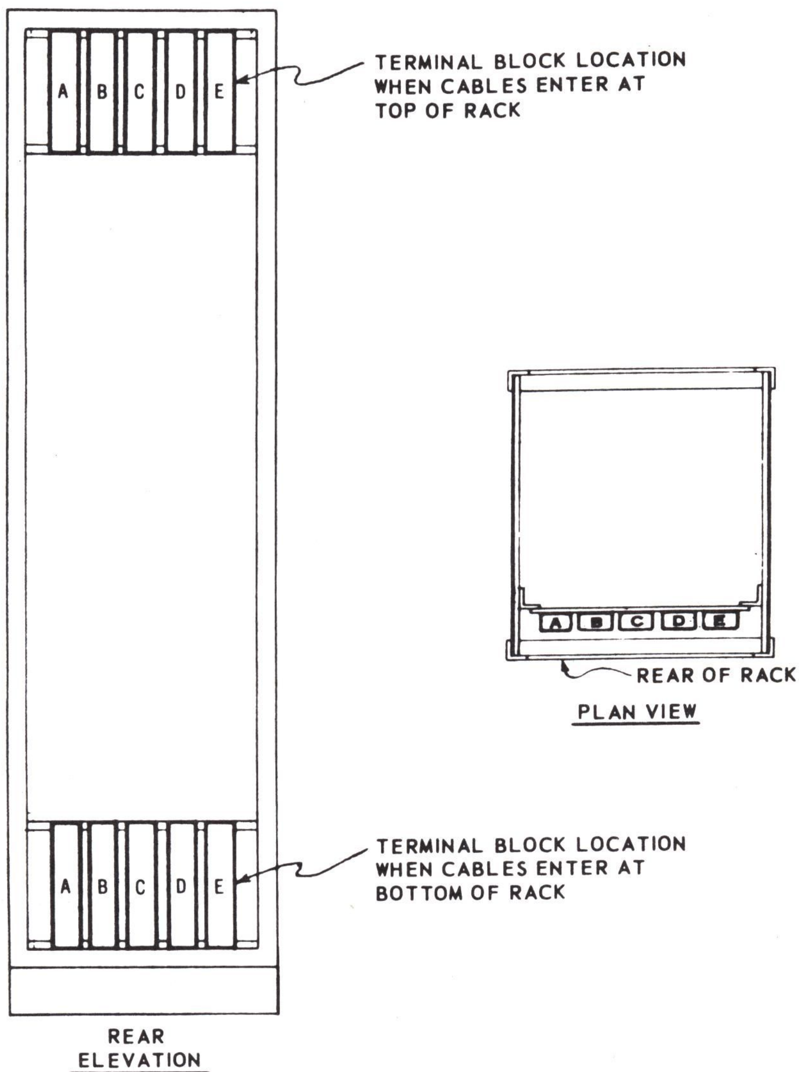


FIGURE 2-3. Standard location of terminal blocks in CBS equipment rack assemblies - rack is shown viewed from rear.

It is CBS recommended practice to allow 10-1/2 inches of vertical rack space for terminal blocks. An exception to this practice is sometimes made in cases where all terminal blocks are small in size and there is little likelihood of future rack modifications. In such cases, the terminal block rack space may be reduced to 8-3/4 inches.

2. Additional Terminal Blocks. Racks are frequently encountered where the terminal blocks that are provided for in the single row at the top or bottom of the rack are inadequate. In such a case, another row of five blocks may be mounted in the forward portion of the rack terminal block area, accessible from the front of the rack, as shown in Figure 2-4. Blocks in this forward row are identified by the letters AA, BB, CC, etc., reading from left to right, as viewed from the front of the rack.

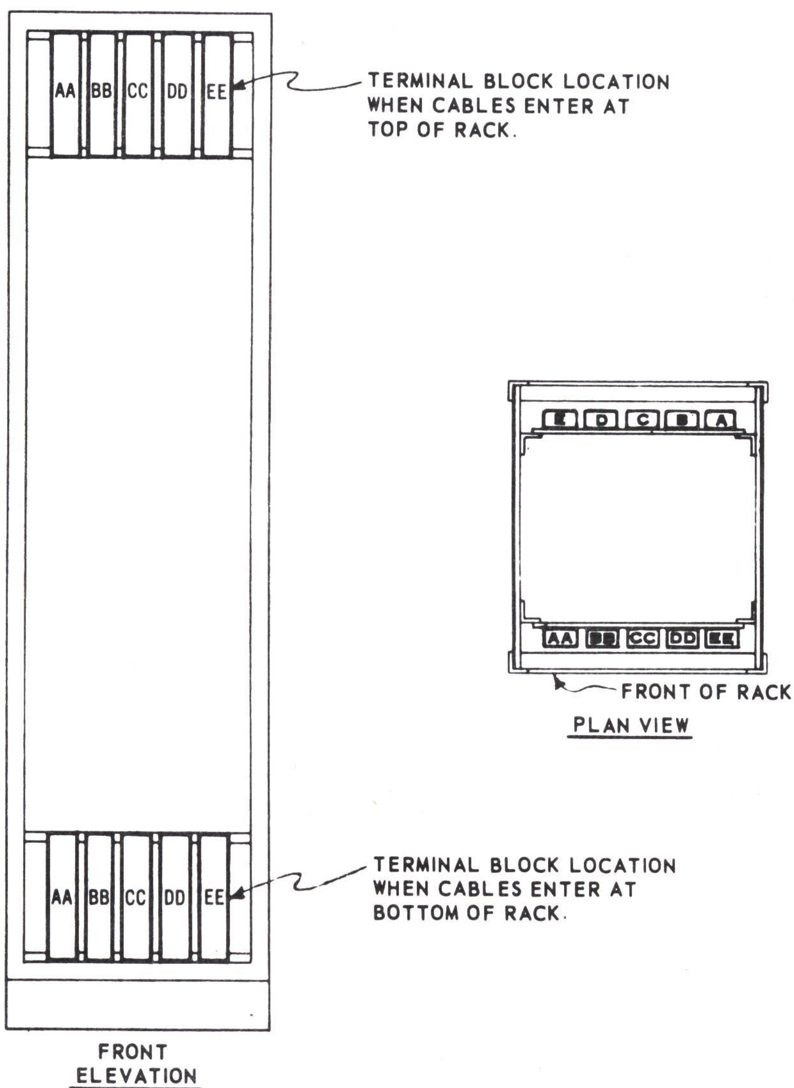


FIGURE 2-4. Standard location for terminal blocks when second row is needed - rack is shown viewed from front.

If still more terminal blocks are required in a particularly complex rack, additional rows of blocks can be mounted directly below (above, if the terminal blocks are at the bottom of the rack) the regular blocks as shown in Figure 2-5. These additional blocks should be identified by the letters F, G, H, etc., for the rear row and FF, GG, HH, etc., for the front row. Identification of blocks on these second rows should always start with F (or FF), even though the full complement of five blocks may not be initially installed in the row above (or below).

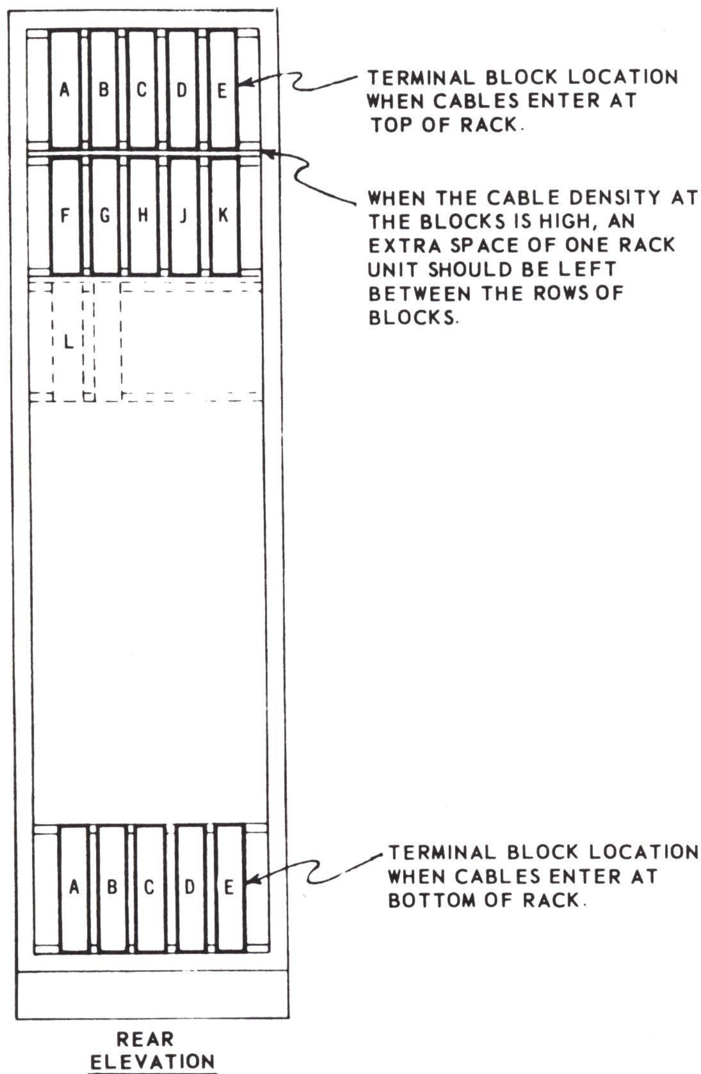


FIGURE 2-5. Additional rows of terminal blocks can be installed as required.

If required, more rows of terminal blocks can be added to a rack in the above manner, following the same block numbering system. The letters I and O should not be used for block identification.

Small equipment units, commensurable in size with a terminal block, have sometimes been mounted in the space intended for a terminal block. This is not desirable and should be resorted to only when no other solution can be found. An acceptable alternative is to mount these small equipment units on terminal block mounting hardware in the rack space immediately below (or above if the blocks are at the bottom of the rack) the terminal blocks.

C. Equipment Rack AC Power

The general arrangement of ac power distribution in a CBS equipment rack assembly is shown in Figure 2-6.

1. AC Terminal Blocks. AC power connections to an equipment rack are made to terminal block A. Block A, normally one, two, or three Marathon type 1006 six terminal blocks, will provide up to 18 terminals. Should more ac terminals than this be required, block B can also be used for ac power. This will provide a maximum of as many as 36 ac terminals. The ac terminal blocks are mounted in protective metal boxes; the CBS type 9A ac terminal block box for the block A position, the CBS type 10A ac terminal block box for the block B position.

In the event that the space allotted for terminal blocks is reduced from the recommended 10-1/2 inches to 8-3/4 inches, the terminal block capacity will be reduced by one-third; that is, block A and block B will provide only 12 terminals each instead of 18. This is because only two Marathon six-terminal blocks, instead of three, will fit in the smaller space. The protective metal boxes in this case will be the CBS type 9B ac terminal block box for the block A position and the CBS type 10B ac terminal block box for the block B position.

2. AC Power Duct. AC power is distributed within an equipment rack through a vertical ac power duct which runs from the top to the bottom of the rack, terminating at one end in the metal box enclosing the ac terminal blocks. This ac power duct, usually NEPCO 1700 surface duct, is mounted in the left-rear corner of the rack as viewed from the rear of the rack. Three-conductor twistlock ac power receptacles (Hubbell 7487 or exact equivalent) for supplying power to the equipment in the rack are mounted on the cover plate of this power duct where needed. Connections from receptacles to terminal blocks are made by means of suitably-sized, insulated, copper wires.

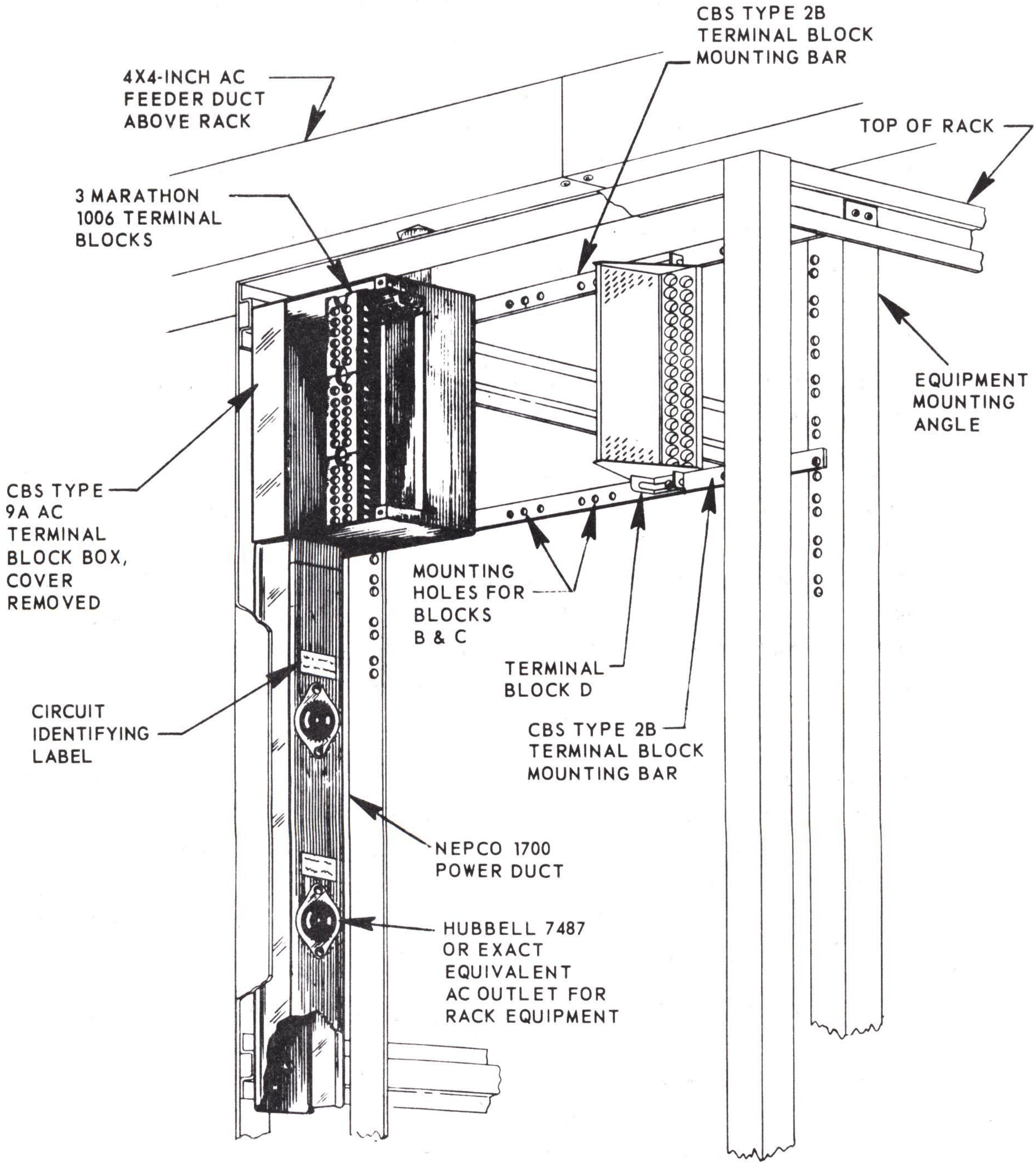


FIGURE 2-6. Rear view of upper portion of equipment rack showing ac power terminal blocks and ac distribution duct.

The third conductor (the center socket) of these three-conductor twistlock ac receptacles is intended to carry a grounding conductor through to the equipment being powered. By means of this ground, the equipment remains grounded even when it is not bolted to the rack, which may be its condition when the equipment is being serviced. This ground is not to be considered equivalent to, or a substitute for, the operational equipment ground described in section D below.

The center socket grounding contact of all ac receptacles in the rack are connected together using green-colored, insulated, #14 AWG copper wire and connected to the ac terminal block using the lowest terminal on the block (terminal 18 if all three 6-terminal blocks are installed). During installation, a grounding jumper is run from this terminal to the system ground bus using a #12 AWG or larger green-colored, insulated, grounding conductor.

An identification label is mounted <u>above</u> each ac receptacle on the power duct as shown in Figure 2-6. This label gives the following information: (a) the rack equipment powered by the receptacle, (b) the receptacle number, (c) the electrical panelboard and circuit breaker feeding the receptacle, and (d) the ac phase.

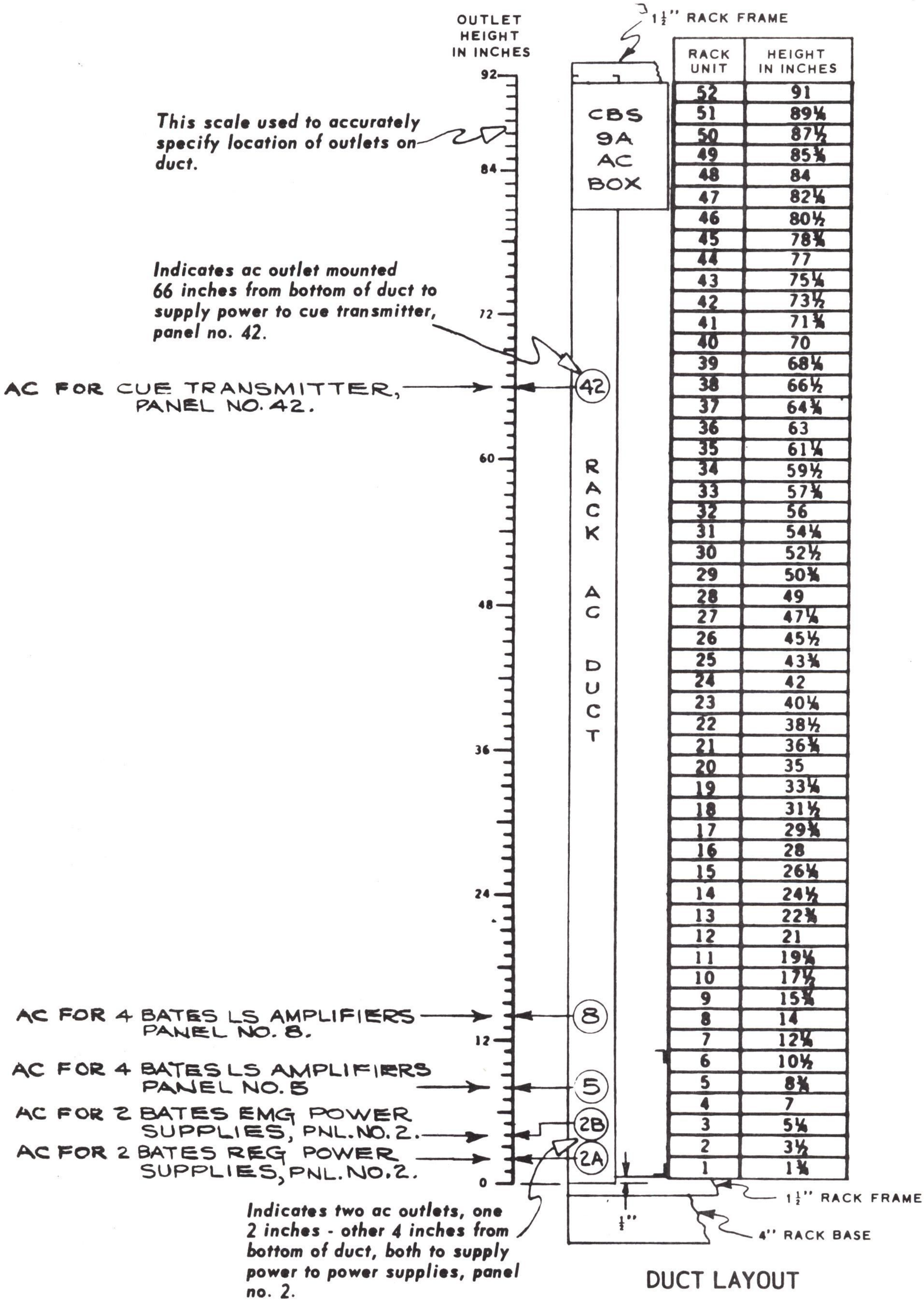
<u>3. Rack AC Power Drawings.</u> The preparation of engineering information covering equipment rack ac wiring is considerably simplified by the use of Engineering Department Form 17. This drawing form presents, on a single 11- by 17- inch drawing, all the ac power information needed for the construction and installation of an average equipment rack assembly. If more than the usual 18-terminal ac terminal block (block A) is required in a rack, an additional Form 17 drawing is used for each additional block. Figure 2-7 illustrates the portion of Form 17 that specifies the physical placement of the ac power receptacles on the rack ac power duct. The portion of Form 17 concerned with internal and external ac wiring connections to the block is covered in Chapter 4, "Terminal Blocks".

D. Equipment Rack Ground Bus

A heavy, copper ground bus, to which all system components and other equipment requiring a ground are connected, is installed in CBS equipment racks. A typical rack ground bus installation is shown in Figure 2-8.

The ground bus is solid copper, 1-inch wide by 3/16-inch thick. It is sometimes pre-drilled and tapped with 10-32 holes spaced 1-3/4 inches apart.

The rack ground bus is installed on the right side of the rack (as viewed from the rear of the rack) and extends vertically from the top to the bottom of the rack. It is normally mounted near the rear of the rack, as shown in Figure 2-8.



RACK UNIT	HEIGHT IN INCHES
52	91
51	89¼
50	87½
49	85¾
48	84
47	82¼
46	80½
45	78¾
44	77
43	75¼
42	73½
41	71¾
40	70
39	68¼
38	66½
37	64¾
36	63
35	61¼
34	59½
33	57¾
32	56
31	54¼
30	52½
29	50¾
28	49
27	47¼
26	45½
25	43¾
24	42
23	40¼
22	38½
21	36¾
20	35
19	33¼
18	31½
17	29¾
16	28
15	26¼
14	24½
13	22¾
12	21
11	19¼
10	17½
9	15¾
8	14
7	12¼
6	10½
5	8¾
4	7
3	5¼
2	3½
1	1¾

DUCT LAYOUT

FIGURE 2-7. Method of specifying location of ac outlets on rack power duct using Engineering Department Form 17. This example is for the rack shown in Figure 2-2.

Connections from equipment in the rack to the ground bus should be made with heavy, green-colored, insulated copper wire or with a heavy copper strap.

The rack ground bus should connect to the plant ground bus using a heavy, low-impedance conductor (see Chapter 6, "Grounding Practices").

E. Equipment Rack Cable Placement

The individual audio, video, control, and dc power cables used in wiring equipment racks are laced or tied into cable groupings of convenient size. Crosstalk between circuits is minimized by forming separate cable groupings for audio, video, control, and power cables. Furthermore, audio cables are subdivided into three separate categories: low-level (below -20 vu), medium-level (-20 vu to +20 vu), and high-level (above +20 vu). Cables carrying control circuits and dc power circuits are usually combined into a common cable grouping.

Figure 2-8 shows the recommended placement for each of the cable groupings within an equipment rack. Low-level and medium-level audio cables are installed on the right side of the rack; high-level audio, video, and control circuit/dc power cables on the left side, as viewed from the rear of the rack. AC power circuits are, of course, always installed in the ac power duct.

In the case of video racks with many coaxial cables and few, if any, audio cables, it is the usual practice to install the cables on both the left and right sides of the rack, preference being given, however, to the left side of the rack.

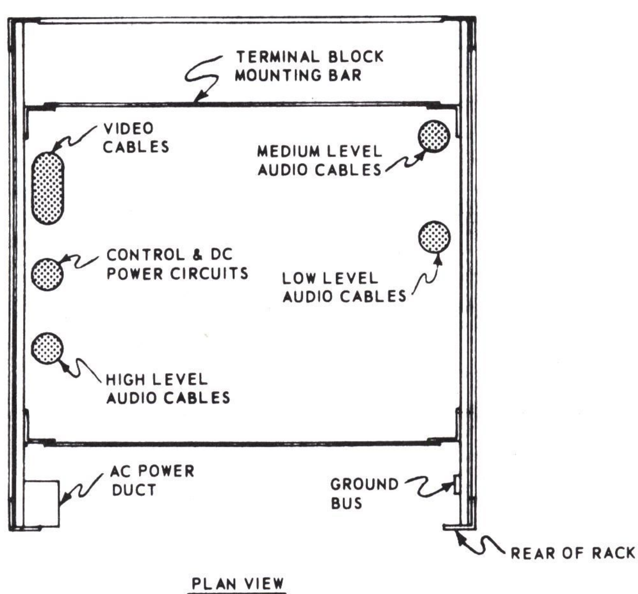


FIGURE 2-8. Placement of cables in equipment rack

F. Rack Wiring Drawings

In addition to drawings showing the physical details of a rack's construction, it is also necessary to prepare engineering drawings showing complete wiring details of an equipment rack. Wiring information for equipment rack assemblies can take the forms discussed in the following paragraphs.

1. Jack Field Wiring. A standard jack field layout and wiring drawing form (Engineering Department Form 1) is available for jack field layout and wiring drawings. The subject of jack field wiring is covered in Chapter 3, "Audio and Video Jack Fields".

2. Terminal Block Wiring. An equipment rack terminal block is the point where rack connections to external equipment and circuits are made.

   All terminal block connections, both internal and external, must be shown on the engineering drawings. The availability of a standard Engineering Department form for every type of regularly-used terminal block simplifies the preparation of these drawings. The preparation of terminal block wiring drawings is covered in Chapter 4, "Terminal Blocks".

3. Equipment Wiring. Rack wiring information, other than that covered above, can be presented in two ways. The first, which is used most often for simple point-to-point wiring, employs Engineering Department Form 11, Figure 2-9, which itemizes each inter-unit connection in the rack in columnal form. The second method of presenting rack wiring information is the wiring diagram. Wiring diagrams are used when the simpler inter-unit connection form is inadequate. CBS standard practices in the preparation of wiring diagrams are covered in Chapter 7, "Wiring Diagrams".

CIRCUIT	FROM	CABLE			TO	NOTES:
		COLOR	TYPE	MARKER		
COLOR BAR GEN OUTPUT	CBG 36-42 RED OUT J1		1CA		VIDEO 36-40C INPUT 1 J1	
	GREEN J2		1CA		D	
	BLUE J3		1CA		E	
	I J4		1CA		F	
	Q J5		1CA		G	
FILM-1 REMOTE CAMERA CONTROL W TARGET	F1 REMOTE CONTROL 36-25 J7 PIN 1	BL/WH	8FA		F1 MON SEL 36-27 J2 PIN 1	
R	2	OR/WH			2	
G	3	GN/WH			3	
B	4	BR/WH			4	
TALLY	5	WH/BL			5	
CAM TALLY	6	WH/OR			6	
-20V	7	WH/GN			7	
GROUND	8	WH/BR			8	
FILM-1 SEQUENTIAL DISPLAY CONTROL	F1 MON SEL 36-27 J3 PIN 1	BK	1FA		WFM/PXM SEL 36-29 J1 PIN 8	
	2	BR	1FA		5	

FIGURE 2-9. Inter-unit connection sheet - Engineering Department Form 11

III. EQUIPMENT COOLING

With the compact electronic components currently available, it is possible to concentrate a great deal of equipment in a rack. While this may be desirable from the viewpoint of space efficiency, it can easily result in excessive heat within the rack with internal rack temperatures rising high enough to exceed the stable operating limit of the equipment. Therefore, it is often necessary to limit the amount of equipment installed in a rack or take other measures to limit the temperature rise to avoid shortening equipment life, to avert substandard equipment performance, and to prevent equipment failures.

A. Controlling Heat

The usual way of keeping rack-mounted equipment cool is to locate the rack in a cool environment such as an air-conditioned room. However, this, in itself, is not always enough to avoid equipment rack heat problems.

General suggestions for further controlling heat in an equipment rack assembly are given below:

(a) Limit the density of heat producing equipment installed in a given rack; leave adequate space for the free movement of air past the equipment. The natural tendency of heated air to rise can produce a considerable movement of room air up through an equipment rack in which there is room for the air to move.

(b) The circulation of air around equipment can sometimes be improved by installing perforated blank rack panels below and above a heat-producing equipment unit. A perforated rear rack door will also improve air circulation.

(c) In selecting equipment, all other factors being equal, give preference to units generating the lowest heat.

(d) Where possible, use equipment with built-in air circulating systems.

(e) It is sometimes possible to locate a high heat-producing unit in another rack, or another room, where the heat load is lower.

(f) In equipment designs where plug-in units mount on a rack shelf, the air circulation around the equipment can be greatly improved by providing openings or perforations in both the mounting shelf and the plug-in equipment units for the passage of air.

(g) In specifications for new equipment designs, state the environment in which the equipment will operate and the temperature limits that can be tolerated.

The heat characteristics and heat limitations of each equipment unit to be used must be known in designing an equipment rack assembly. The rack temperature should never exceed the safe operating limit of the most heat-sensitive equipment unit in the rack.

B. Ventilation of Racks

There are times when the heat-controlling suggestions given above are inadequate to handle the heat generated in an equipment rack. Situations are frequently encountered where space restrictions are so severe that the equipment racks must be substantially filled with heat-producing equipment units. An example would be the equipment racks for an efficient, compact control center where all equipment must be within easy reach. In such a case, the concentration of heat-producing equipment must be accepted and a method found for disposing of the heat. Another example would be equipment racks for a mobile unit. In addition to being well filled with equipment because of the limited space, mobile unit racks must often operate in a difficult heat environment such as all-day operation under a hot summer sun.

A method of cooling rack-mounted equipment under these circumstances is by the use of a ventilated rack; that is, a rack through which a flow of cooling air passes. At the present time, a completely satisfactory self-ventilating equipment rack for broadcast equipment has not evolved. Nevertheless, rack ventilating and rack cooling arrangements have been devised and have been used successfully in CBS installations. Although not without shortcomings, these rack-ventilating arrangements do remove heat from the rack and maintain the equipment at safe operating temperatures. Two methods that have been employed are described below:

1. Rack Ventilation with Room Air. In this method of ventilation, fans are used to draw room air (preferably air-conditioned) into the equipment rack, usually at a point near the floor where the air is coolest. The room air, as it moves up through the rack, cools the equipment as it passes by, over, and through it. When necessary, supplementary fans direct the cooling air into hot spots.

2. Rack Ventilation with Cooled Air. This method of rack ventilation is similar to the above method but employs cooled air directly from an air-conditioning system. The cooled air must be from a system that is never shut down while the equipment is in operation. The cool air is usually introduced into the equipment rack from an under-floor duct or plenum. Fans move the cooled air up through the rack, cooling the equipment in the same manner described above.

With either of the above systems, there are several alternative ways of handling the air when it emerges from the top of the rack. It may (a) be exhausted back into the room, (b) it may be collected in a duct and returned to the air-conditioning system for recooling, or (c) it may be ducted out of doors.

Shortcomings of both of the above rack ventilating systems include:

(a) Dirt and dust are deposited on the rack equipment by the cooling air. This can be minimized to some extent by filtering the air at the point where it enters the rack.

(b) The noise of the fans contributes to the overall room noise level. This can be minimized by using large, slow-moving fans and by vibration-mounting them.

The major problem in making either of the above-described rack cooling systems effective is in arranging the rack equipment components in such a manner that the cooling air comes in contact with all the components that require cooling. Unfortunately, most commercially-available equipment components do not take cooling into account in their design. Until manufacturers of television broadcasting system components recognize and correct this shortcoming in the design of their equipment, the responsibility for keeping the equipment at safe operating temperatures passes, unfortunately, to the user of the equipment.

Another consideration in controlling heat in equipment racks involves the comfort of operating personnel. When an operating position is in close proximity to equipment racks, such as a seated control position in front of a grouping of racks, it is especially important that the rack cooling system does not subject the operator to excessive drafts of air. At the same time, the temperature at the operating position must be in the comfortable range.

REFERENCE DRAWINGS

CBS DWG. NO.	TITLE
S1 SERIES	TYPE A EQUIPMENT RACK AND ASSOCIATED HARDWARE
S1-1	Assembly
S1-2	Panel Mounting Angle, Base, Side Plate and Top, Mechanical Details
S1-3	Doors, Mechanical Details
S1-4	Terminal Block Mounting Hardware, Mechanical Details
S1-5	Grounding Bus, Mechanical Details
S1-6	Cable Distribution Hardware, Mechanical Details
S3 SERIES	RACK AC DUCTS AND BOXES
S3-1	AC Duct Mounting Details
S3-2	CBS Type 9 and 10 AC Terminal Block Boxes
S4 SERIES	CBS RACK PANELS, CHASSIS, AND SHELVES
S4-1	CBS Type 2A Jack Panel
S4-2	Standard Panels
S4-3	Hinged Panel (vertical, 19 inches wide)
S4-4	Hinged Panel (horizontal, 19 inches wide)
S6 SERIES	DESIGNATIONS
S6-1	CBS Type, 1, 4 and 6 Designation Strips

3. Jack Fields

CHAPTER 3

AUDIO AND VIDEO JACK FIELDS

3 AUDIO AND VIDEO JACK FIELDS

Continuity of program service is perhaps the most important requirement in the technical operation of a major television network or television station. For this reason, broadcast systems are normally designed with every possible safeguard to permit the rapid restoration of program service in the event of an equipment failure. Jack fields in the audio and video systems are one such safeguard to program continuity.

I. JACK FIELD APPLICATIONS

A jack field consists of a suitable number of rows of panel-mounted jacks to which are connected the input and output of all important components and circuits in the audio or video system. The system components and circuits are then connected together, or normalled, at the jack field to form the desired system.

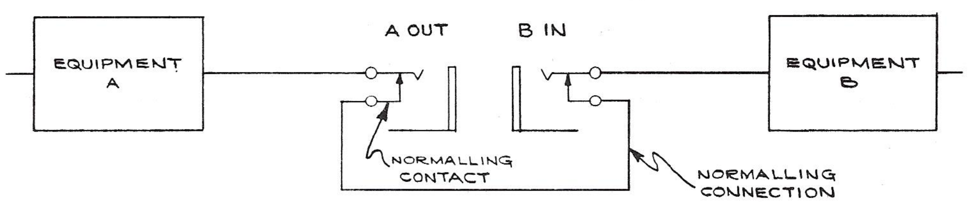


FIGURE 3-1. Schematic representation of normalled jacks. Equipment A is normalled to Equipment. B.

Other connections are often made to the jack field. These include jacks that are multiples of the input or output of important circuit elements. These multiple jacks serve as test or measuring points or as convenient access points where a program circuit can be bridged. Utility equipment and utility circuits not normally connected in the system, but which are available for use when special operating problems arise, also often appear on jack fields.

Connection of the circuit elements to the jacks in the manner described permits access to any desired part of the system by simply inserting a plug into the desired jack. The jack field, therefore, provides a high degree of flexibility in the operation of the system. By means of patch cords, which consist of a short length of cable with a plug at each end, any of the following operations may usually be performed.

(a) A defective component may be replaced in the circuit by another similar unit.

(b) The circuitry of the system may be rearranged.

(c) Special devices may be connected into various parts of the system.

In addition to these operational conveniences, a jack field also greatly simplifies maintenance of the facilities, as it makes it possible to achieve a direct connection to the terminals of any system component that appears on the jack field. Location and repair of a defective component are thereby considerably facilitated. Similarly, test and measurement of the facilities are greatly simplified.

II. JACK FIELD COMPONENTS

Jacks, plugs, patch cords, jack panels, and jack designation strips are the components from which audio and video jack fields are constructed. These components are discussed in the following paragraphs.

A. Audio Plugs and Jacks

CBS has standardized on the telephone-type tip, ring, and sleeve single plug for audio jack fields. The plug used is the Western Electric 291B.

FIGURE 3-2. Western Electric 291B audio plug, ¾ full size

These single plugs have completely superseded (in CBS broadcasting installations) the older double or twin plugs that have been used in broadcasting systems since the early days of radio broadcasting. These double plugs are still frequently encountered in audio installations outside of CBS.

The corresponding audio jack used with the single audio plug is the Western Electric 239E or equivalent.

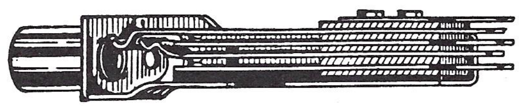


FIGURE 3-3. Western Electric 239E audio jack, ¾ full size

Other audio jacks in this same family that are frequently employed are the Western Electric 240A, which provides an auxiliary make contact, and the Western Electric 242A, which provides an auxiliary break contact.

B. Video Plugs and Jacks

CBS has standardized on the CBS 1A self-normalling video jack for video jackfields. The jack used is the Superior Manufacturing Corporation TV-10J or equivalent.

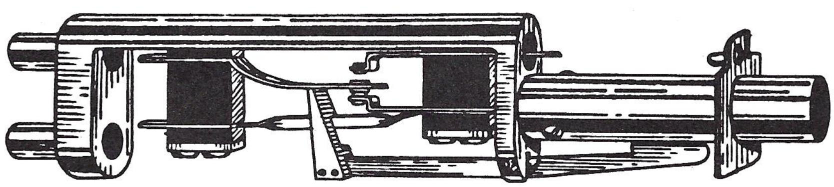


FIGURE 3-4. CBS 1A self-normalling video jack, ¾ full size, cover removed

The corresponding video plug for use with the CBS 1A self-normalling video jack is the Western Electric 358A, Superior TV-30P, or equivalent.

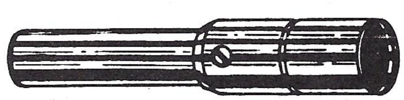


FIGURE 3-5. Western Electric 358A video plug, ¾ full size

There is also available a special short-barrel test plug which can be inserted in the CBS 1A self-normalling jack without actuating the normalling contacts. This special test plug, the Superior TV-40TP, is useful for test and measurement purposes.

C. Patch Cords

Audio patch cords consist of a pair of Western Electric 291B or equivalent audio plugs interconnected by a CBS 2FJ cable. The CBS 2FJ cable is a pre-lugged, two-conductor, tinsel-shielded patch cord cable with a nylon-braid outer jacket. It is a standard CBS stock room item and is available in 1-, 2-, 4-, and 6-foot lengths. Connection from the cable shield to plug is made at one end only to prevent any current flow through the shield.

Video patch cords are made up of two Western Electric 358A or equivalent video plugs interconnected by a suitable length of CBS 1CA coaxial cable. This cable is not prefabricated as in the case of audio patch cords but is cut from bulk cable. Standard video patch cord lengths are 3-, 4-, and 6-feet, although special very short lengths are sometimes required. In the case of video patch cords, the cable shield is connected to the plug at both ends.

D. Jack Panels

The CBS type 2A jack panel is the standard panel to be used for both audio and video jack fields. The CBS 2A is a 19-inch wide rack-mounting metal panel with baked enamel finish. It is a 1-23/32-inches high (one rack unit) with mounting holes for 20 audio or video jacks mounted on 3/4-inch centers.

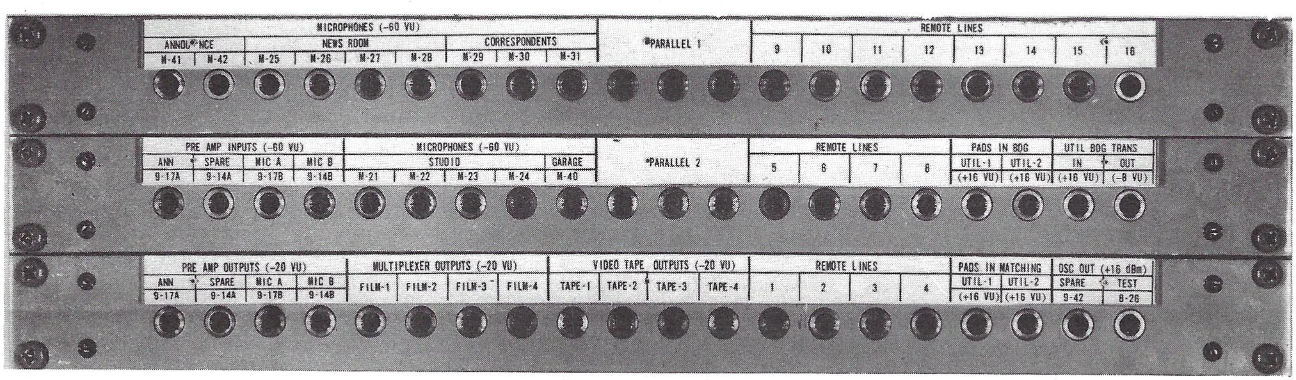


FIGURE 3-6. Jack field employing CBS 2A jack panels, 1/3 full size

Above the 20 jack-mounting holes there are eight ¼-32 tapped holes for eight tip jacks (H.H. Smith No. 147 or equivalent). Each pair of tip jacks supports a CBS 6A clear plastic plug-in jack designation cover strip which is 11/16-inch high by 3-3/4-inches long. Four CBS 6A plastic plug-in strips are required for each row of 20 jacks.

The rear of the CBS 2A jack panel has been left unpainted to provide a good electrical contact for automatically grounding the frame of each jack.

Occasions sometimes arise where jacks must be mounted in a space that is not the standard 19-inch rack panel width. An example would be a jack panel mounted in limited space on the wing of a control console. In such a case, a panel must be custom designed to fit the space available. The following rules should be observed:

(a) The jacks in each horizontal row should be mounted on 3/4-inch centers.

(b) The rows of jacks should be spaced 1-3/4-inches on centers vertically. An exception to this rule may be made in the case of audio jack fields. If space is very limited, the jack row spacing can be reduced as low as 1-1/4-inches.

III. JACK FIELD LAYOUT AND WIRING DRAWINGS

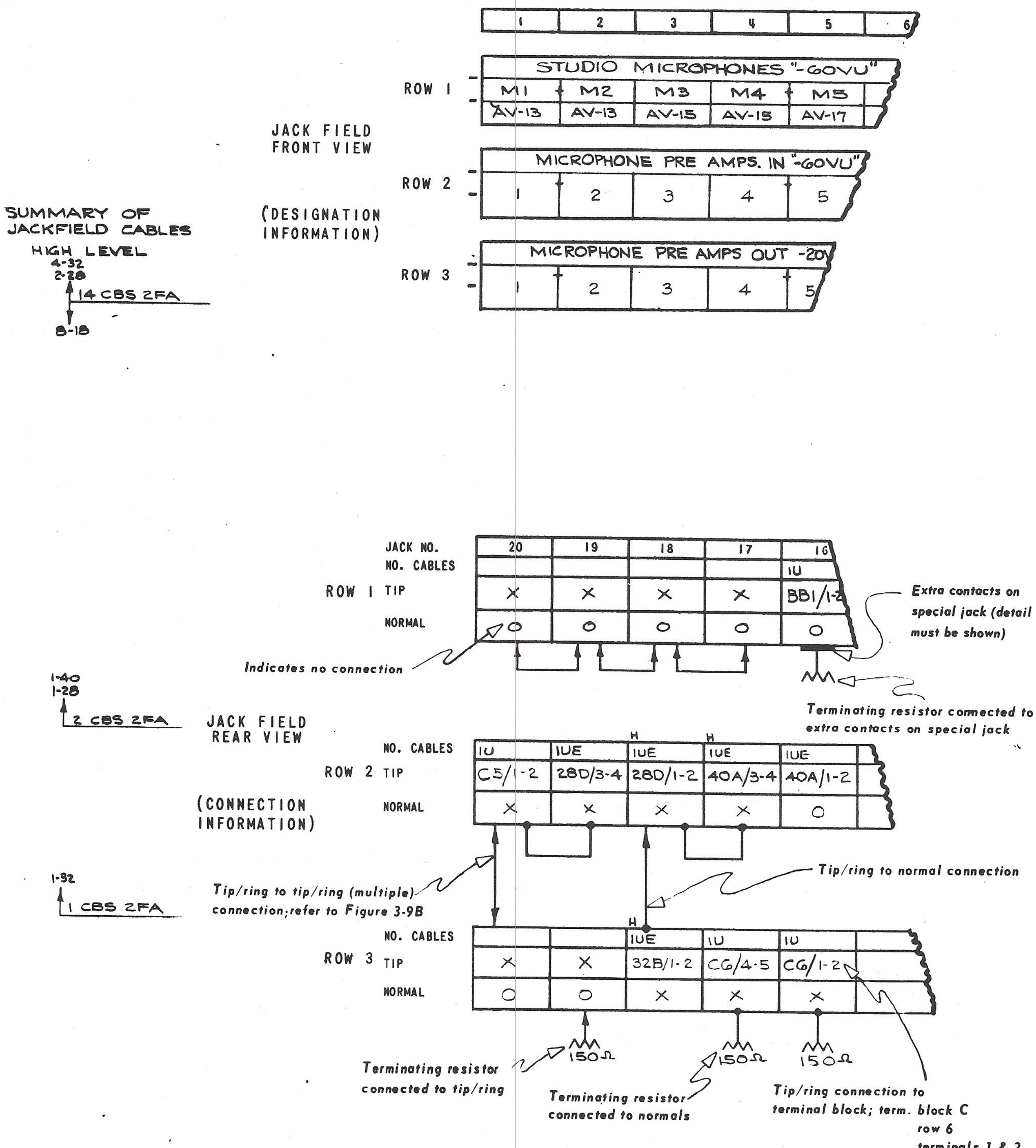
The design of an audio or video system requires the preparation of detailed jack field drawings which give complete layout information as well as wiring details. This information is necessary for the shop to assemble and wire the jack field.

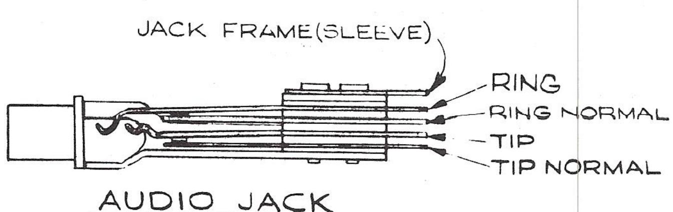
Jack field drawings are commonly referred to as "jack field layouts". Jack field layout drawings are made on specially-prepared drawing forms (Engineering Department Form 1) which give both a front view and rear view of the jack field.

Standard CBS methods of preparing jack field layout drawings are described in this section. Examples of an audio jack field layout and a video jack field layout are given in Figures 3-7 and 3-8 respectively.

A. Layout and Designations

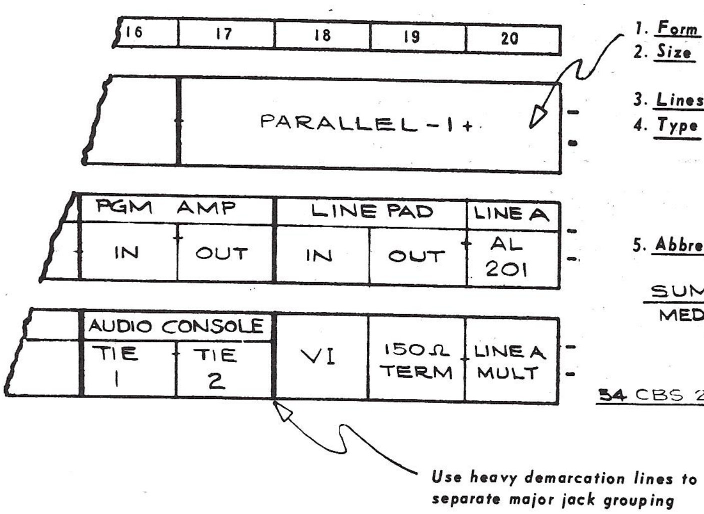
The front view of the jack field layout drawing shows the physical placement of each jack in the jack field and the exact wording of the jack designations that are to appear above each jack. Examples are shown in Figures 3-7 and 3-8.





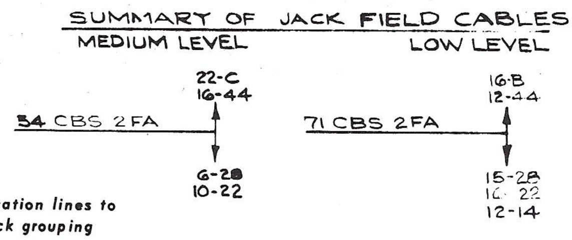
NOTE:
RED CONDUCTOR CONNECTS TO "TIP".
BLACK CONDUCTOR CONNECTS TO "RING".
SHIELD CONDUCTOR CONNECTS TO JACK FRAME.

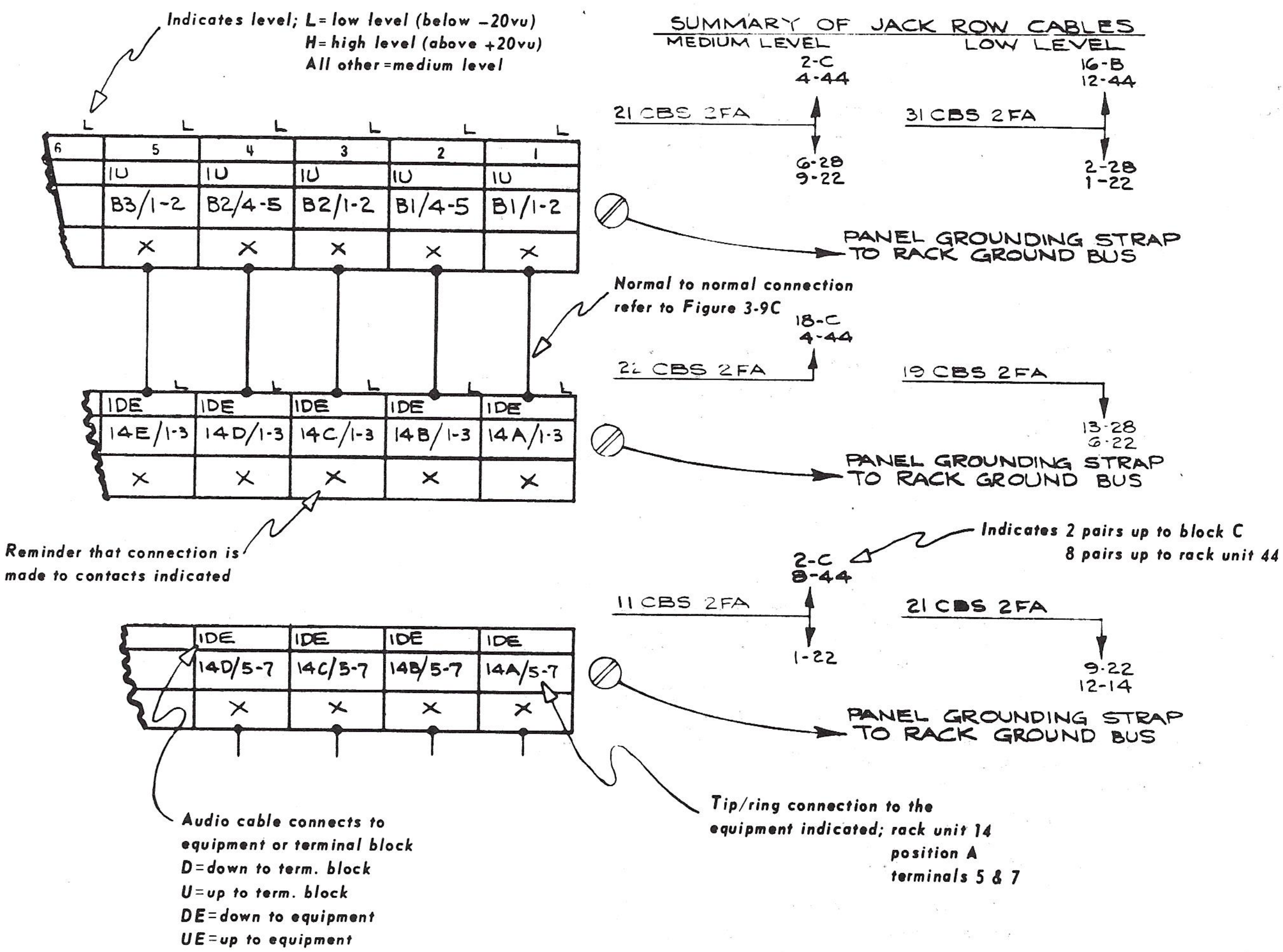
FIGURE 3-7. AUDIO



JACK FIELD DESIGNATIONS

1. **Form** Jack designations are varityped on CTN Engineering Form D 1.
2. **Size** The size of each jack designation is 0.66 by 0.75 inches (2/3 by 3/4 inches).
3. **Lines** Each jack designation accommodates 3 lines of varityping.
4. **Type** Use Varityper 430-12 font for all designations except where limited by space restrictions; maximum 9 characters, including spaces, per line. Varityper 430-10 font may be used when 430-12 font will not fit available space; maximum 12 characters, including spaces, per line.
5. **Abbreviations** Do not abbreviate words if there is room to spell them out.





JACKFIELD LAYOUT

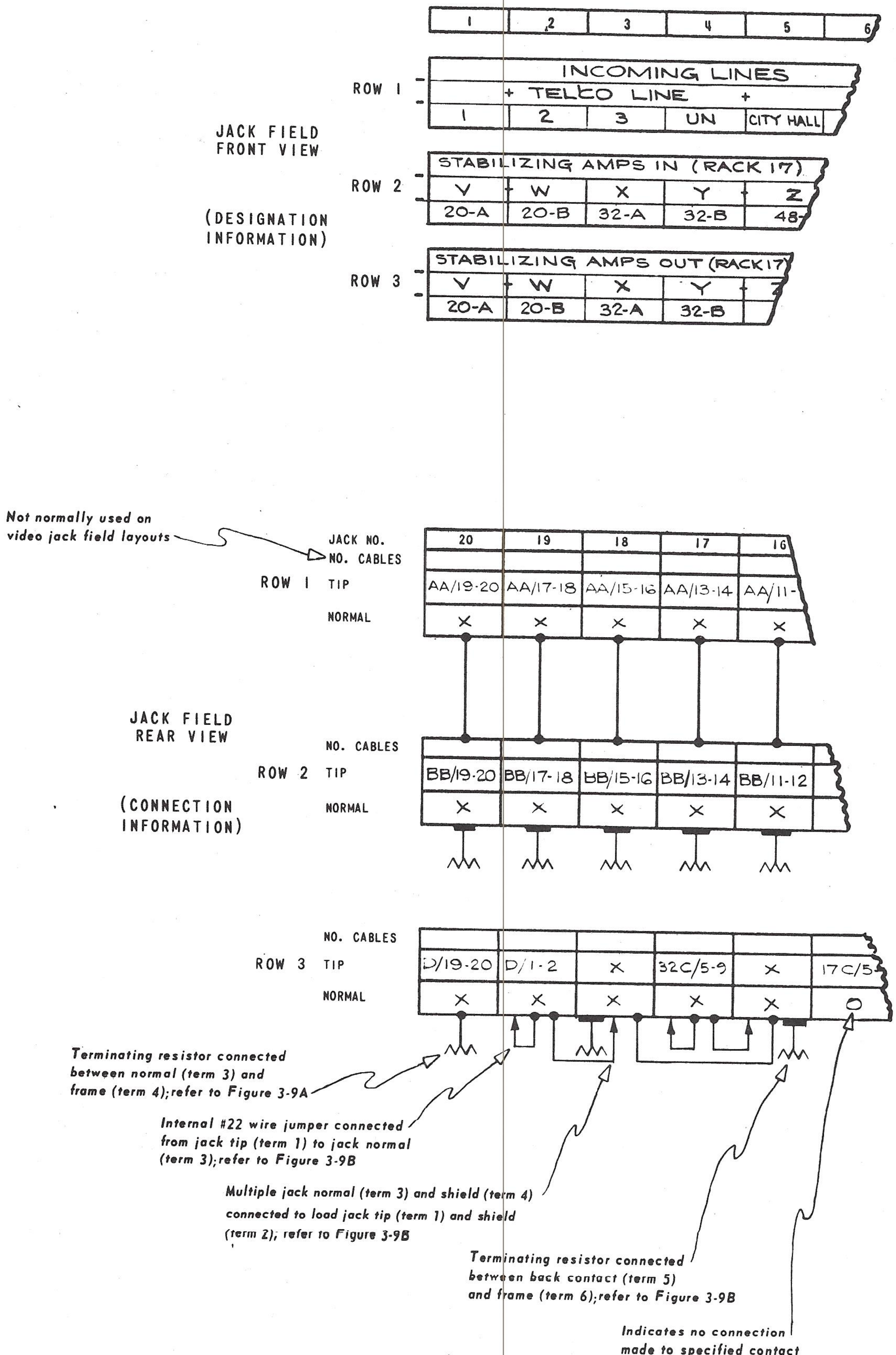
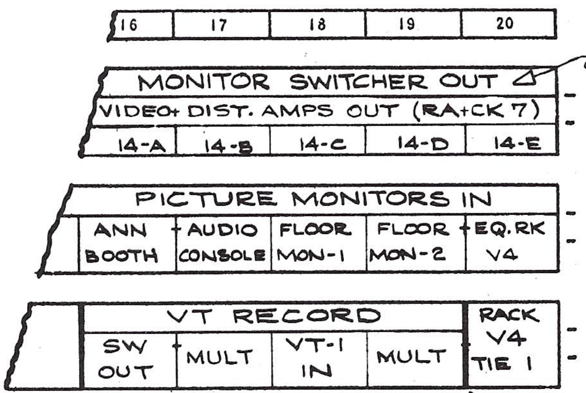


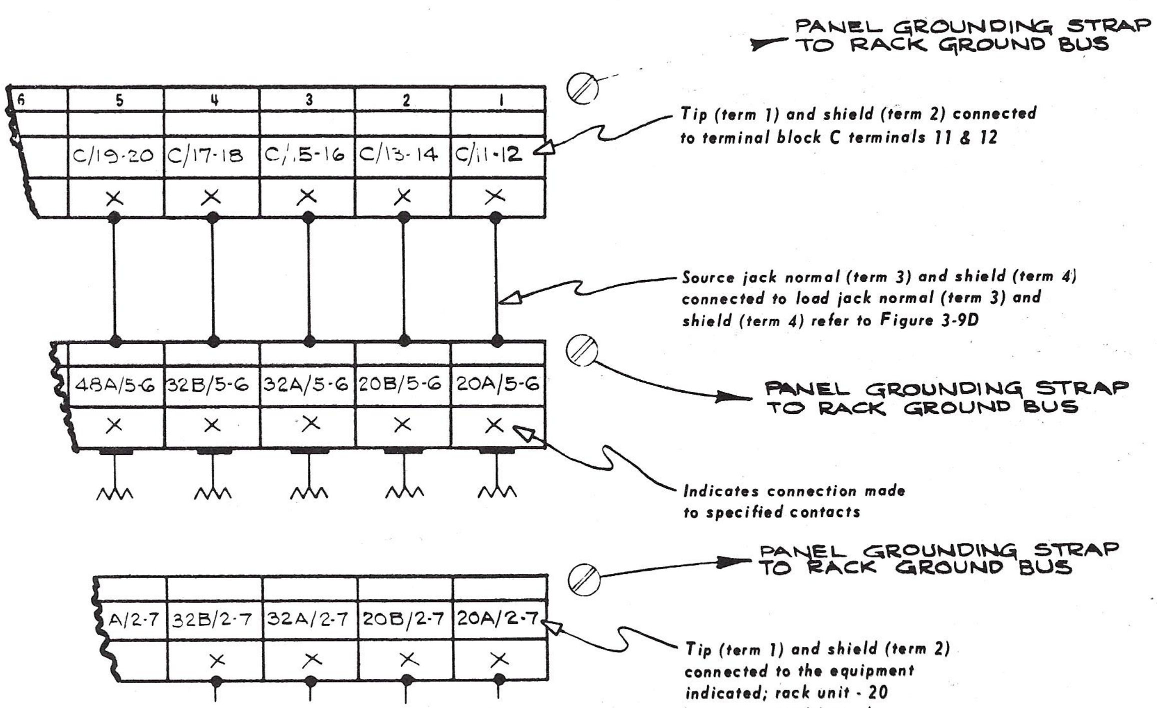
FIGURE 3-8. VIDEO

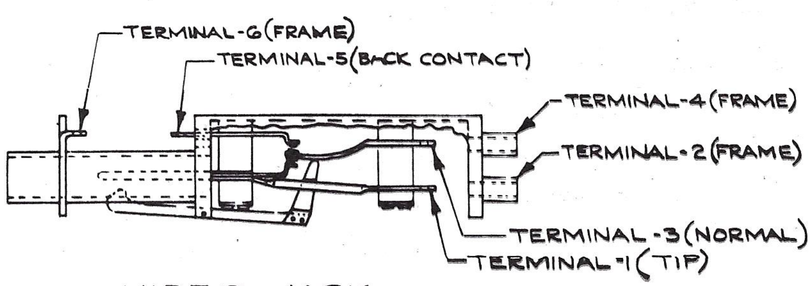


Use heavy demarcation lines to separate major jack grouping

JACK FIELD DESIGNATIONS

1. ***Form*** *Jack designations are varityped on CTN Engineering Form D 1.*
2. ***Size*** *The size of each jack designation is 0.66 by 0.75 inches (2/3 by 3/4 inches).*
3. ***Lines*** *Each jack designation accommodates 3 lines of varityping.*
4. ***Type*** *Use Varityper 430-12 font for all designations except where limited by space restrictions; maximum 9 characters, including spaces, per line. Varityper 430-10 font may be used when 430-12 font will not fit available space; maximum 12 characters, including spaces, per line.*
5. ***Abbreviations*** *Do not abbreviate words if there is room to spell them out.*





VIDEO JACK

JACKFIELD LAYOUT

1. Circuit Flow. The direction of circuit flow on a jack field should, in general, be from left to right and/or top to bottom. It should never be from right to left.

Circuit flow from bottom to top may sometimes be desirable. It has been used in audio control consoles and made possible a substantial shortening of low-level cables.

2. Jack Designations. The equipment or circuit to which each jack in an audio or video jack field connects must be clearly identified. For this purpose, a plastic-protected paper designation strip is provided above each row of jacks upon which suitable jack-identifying information is typed.

Considerable thought should be given to the wording of each jack designation. It should be clear, concise, and in operating rather than engineering language. Samples of jack designations and standards to be observed in their preparation are given in Figures 3-7 and 3-8.

3. Relationship to Block Diagram. When possible, a jack field should be arranged in such a manner that its layout resembles the layout of the system block diagram. Most operators look for and expect this relationship.

4. Similar Audio and Video Systems. In many cases, the audio and video portion of television systems are basically quite similar. In such cases, every effort should be made to have the audio jack field and the video jack field resemble each other as closely as possible, both in general layout and in the style and wording of the designations.

5. Cost. Jacks are costly. There must be a reason for each jack. A jack should be provided only when it is essential to the operation, maintenance, or continuity of service of the system.

B. Jack Field Wiring

The rear view of the jack field layout drawing gives complete wiring details. Figures 3-7 and 3-8 illustrate the standard CBS methods, practices, and symbols that have been developed to present this wiring information.

1. Jack Wiring Details. In Chapter 1, Section 1-C, a number of jack applications were described. Figure 3-9 shows the actual detailed jack wiring and inter-jack wiring for each of these cases, all of which are frequently encountered in audio and video systems. In this figure, all jacks are shown with the contacts in their normal position; that is, their position when a plug is not inserted in them.

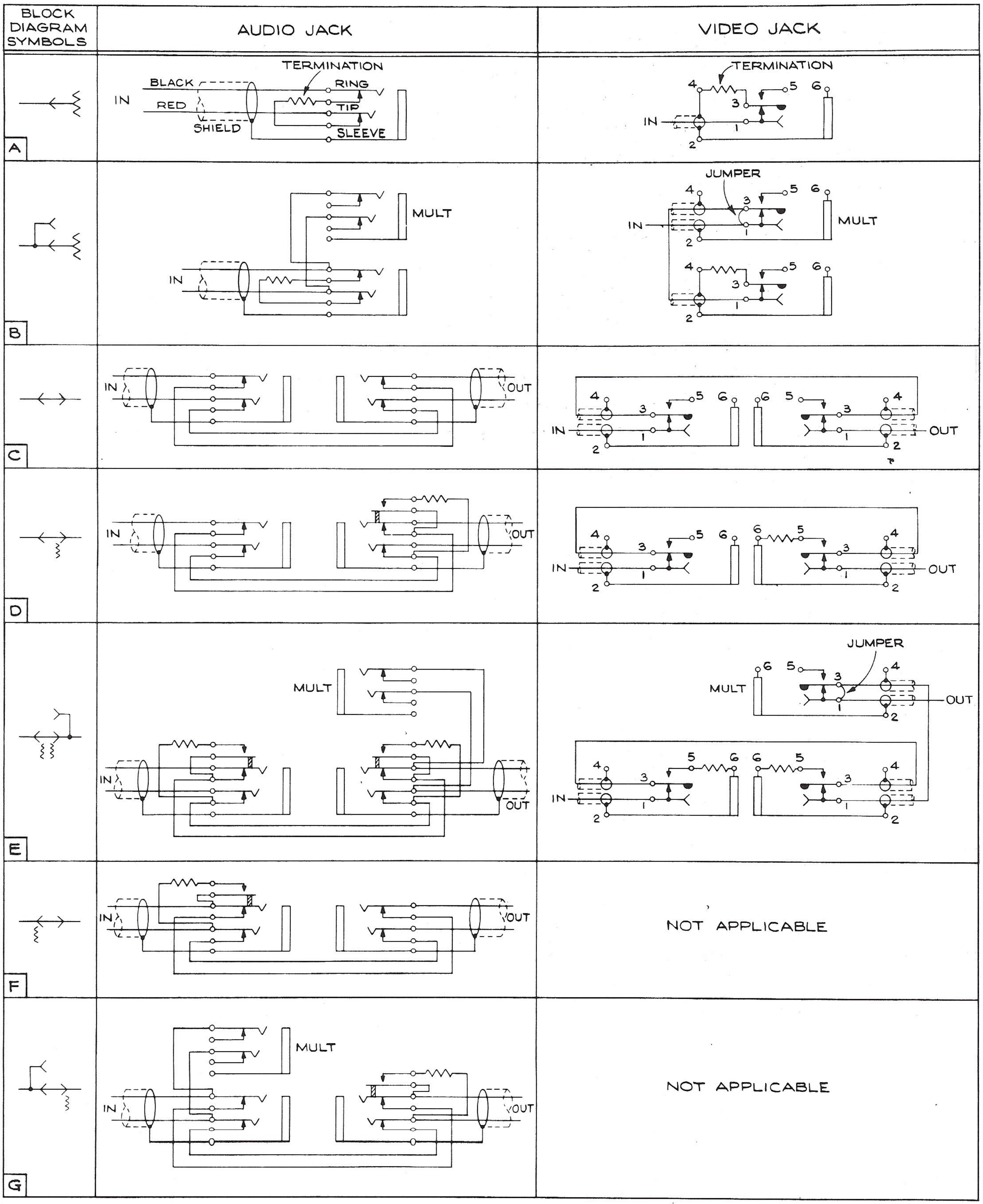


Figure 3-9. Jack Wiring Details

2. Audio Cable Shield Grounding. To avoid the flow of ground loop currents through audio cable shields, it is standard practice to ground the shield of audio cables at one point only. When the audio cable connects to a jack field, the shield ground connection is always made at that point. This is accomplished by connecting all jack field cable shields to the ground terminal of the associated jack, as shown in Figure 3-9.

An exception to the above practice would be necessary in the special case of an audio cable running directly from a jack in one rack to a jack in a nearby rack without passing through terminal blocks (at which point the cable shield circuit would normally be broken). This could happen where two or more racks are bolted together and are wired as a single unit. In this special case, the cable shield would be grounded at only one of the two jacks. A note "do not connect shield to jack" should be included on the jack field layout drawing to call attention to this change from standard jack field wiring procedure.

REFERENCES

1. Charles J. Neenan, CBS SELF-NORMALLING VIDEO JACK, Jour. SMPTE, 68:10:675 (October, 1959)

2. Howard A. Chinn and Robert B. Monroe, SINGLE JACKS FOR BROADCAST APPLICATION, Audio Engineering, 31:6:12 (July, 1947)

REFERENCE DRAWINGS

CBS DWG. NO.	TITLE
S4-1	CBS Type 2A Jack Panel
S6-1	CBS Type 1, 4 and 6 Designation Strips

4. Terminal Blocks

CHAPTER 4

TERMINAL BLOCKS

4 TERMINAL BLOCKS

Terminal blocks are used in equipment racks, control consoles, and other equipment assemblies as a convenient connecting point for the audio, video, control, and power cables that connect to the unit. They are also used in terminal frames and junction cabinets where intra- and inter-plant cable runs meet and interconnect.

Terminal blocks have been used in broadcasting plants for many years being a practice adopted from the telephone industry. Terminal blocks are capable of handling many connections in a relatively small space and provide a convenient point of access to the circuits for maintenance and test.

The different types of terminal blocks used in CBS installations, their application, as well as methods of presenting terminal block wiring information on engineering drawings, are discussed in this chapter.

I. TERMINAL BLOCK APPLICATIONS

Terminal blocks are employed at points in broadcasting systems where there is a junction of interconnecting cables such as occurs in equipment racks, control consoles, terminal frames, and junction cabinets. Accordingly, a "terminal" block is actually a junction point rather than a terminal, or end point, of a circuit, and the name junction block would more clearly describe the function performed. To provide a separate terminal point for each of the two conductors that meet at a terminal block, each terminal is double-ended as illustrated in Figure 4-1.

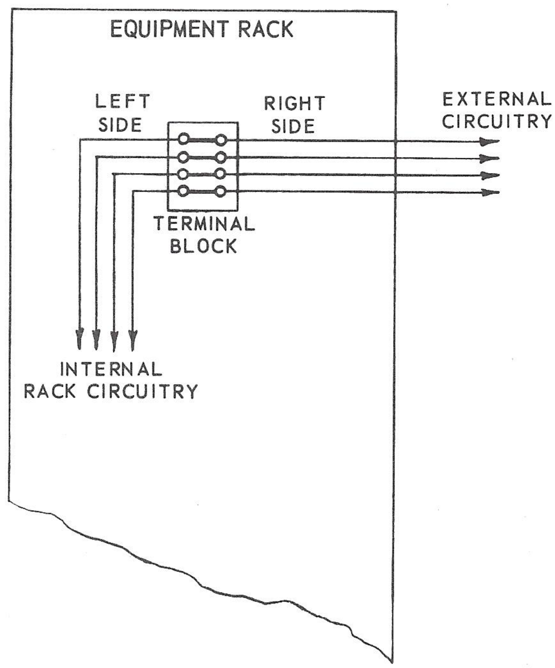


FIGURE 4-1. Each terminal on a terminal block is double-ended, providing a separate connecting point for each of the two conductors that meet there. Internal circuits are connected to the left side of a terminal block; external circuits to the right side.

When a terminal block is mounted in the conventional upright position (see Chapter 2, "Equipment Rack Assemblies"), one side of each double-ended terminal is accessible from the left side of the block; the other from the right side of the block. In equipment racks or consoles it is standard practice to employ the left side for internal circuitry (wiring to equipment within the rack or console in which the block is mounted). The right side is used for external circuitry (wiring to external equipment and facilities); see Figure 4-1. In terminal frames or junction cabinets, the same procedure is followed. The left side of the block is used for internal circuitry (wiring to equipment in the area of the plant in which the block is located); the right side is used for external circuitry (cable runs to other areas of the plant). Figure 4-2 illustrates such a case.

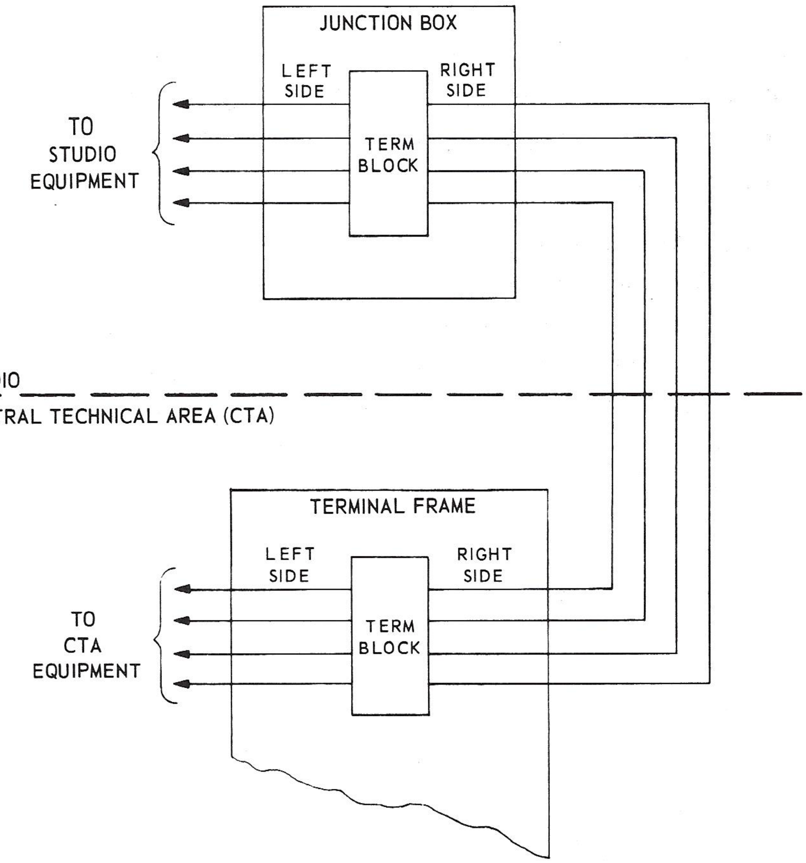


FIGURE 4-2. Terminal block wiring on Studio-to-Central Technical Area cable runs.

II. TERMINAL BLOCK TYPES

Several types of terminal blocks, each of which is described in the following paragraphs, are used in CBS installations. One type, used for audio and control circuits, is available in three sizes; 120, 180, and 300 terminals. Another type, used for video circuits, provides terminals for 15 coaxial cables. Still another, used for ac power circuits, provides terminals for six power conductors. Finally, a general-purpose block with twelve well-protected terminals is employed in applications such as low-voltage dc power distribution or 120-volt ac control circuits.

Each of these terminal blocks, together with information on their application, is described in the following sections of this chapter.

A. Audio Terminal Blocks

Three different terminal blocks are used for audio circuits. All three are similar, differing in size and in the number of terminals provided. Details of these terminal blocks, which are also used for low-voltage control circuits (see Section B, below), are given in Figures 4-4 and 4-5.

These terminal blocks employ solderless, tinned, copper terminal pins and tinned phosphor bronze push-on terminal lugs, Figure 4-3, which result in a terminal block that is actually a plug-in connector on a wire-by-wire basis. This plug-in feature facilitates troubleshooting, as it permits wires to be quickly removed, replaced, or rearranged. On new installations, the plug-in feature makes it possible to shorten the installation time of a rack or console if the interconnecting cables have been dressed and the push-on terminal lugs applied to incoming cables prior to the arrival of the equipment.

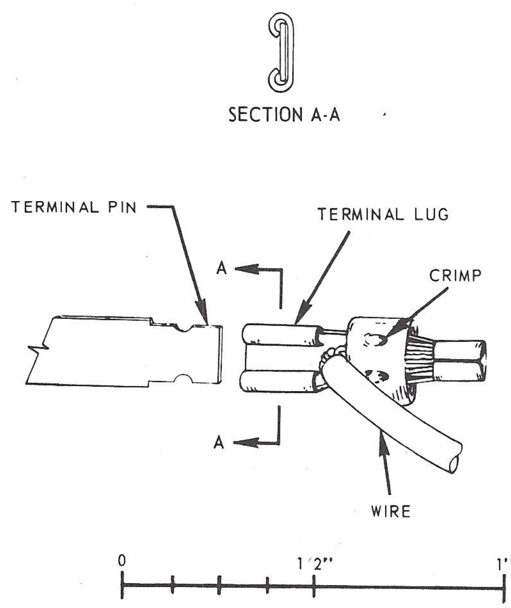
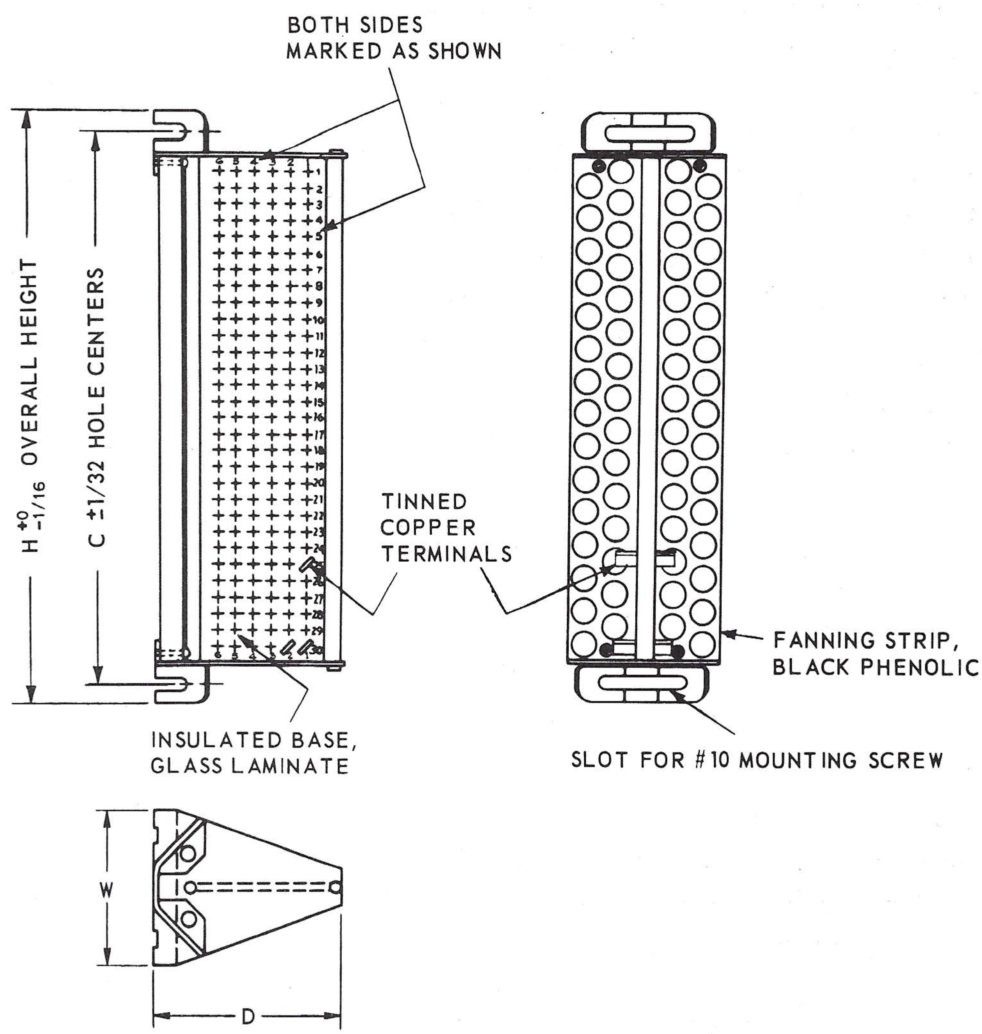


FIGURE 4-3. A close-up sketch of the solderless, push-on terminal pin and terminal lug used on the audio and low-voltage control circuit terminal blocks.



CBS TYPE NO.	TERMINALS			DIMENSIONS (INCHES)			
	NUMBER	NO. OF ROWS	TERMS/ROW	H	D	C	W
CBS 2006	120	20	6	$7^{3}/_{8}$	$3^{5}/_{32}$	$6^{11}/_{16}$	$2^{5}/_{8}$
CBS 3006	180	30	6	$10^{3}/_{16}$	$3^{5}/_{32}$	$9^{1}/_{2}$	$2^{5}/_{8}$
CBS 3010	300	30	10	$10^{3}/_{16}$	$4^{13}/_{32}$	$9^{1}/_{2}$	$2^{5}/_{8}$

FIGURE 4-4. Terminal blocks used in CBS installations for audio and low-voltage control circuits. Preference should be given to the six-terminal-deep types for audio applications and to the 10-terminal-deep type for control circuit applications. Location of a desired terminal is facilitated by the stenciled numbers at the top, bottom, and front of the block.

The black phenolic cable fanning strips, which serve to hold the individual cables in their proper position, can be easily removed from the block. This may be most desirable when cables must be prepared for the installation of a rack or console prior to its arrival on a job. By removing the right side fanning strip of each block and sending them ahead to the installation site, the cables may be dressed, inserted through the correct cable hole in the fanning strip, and lugged; all prior to the arrival of the equipment. All that remains when the equipment arrives is to bolt it in place, reinstall the fanning strip on the block, and plug in the terminal lugs.

To improve accessibility to the terminals during construction, installation, or maintenance, the block is provided with tri-positional, slotted mounting brackets which permit it to be pivoted 45 degrees to the left or right of its normal mounting position.

Standard CBS audio cables consist of a pair of color-coded conductors enclosed in a shield; see Chapter 7, "Wiring Diagrams". Both the conductors and the shield are connected to the terminal block; therefore, three block terminals are required for each audio cable. Accordingly, the six-terminal-deep block will accommodate two audio cables on each row; the ten-terminal-deep block (on the infrequent occasions it is used for audio circuits) will accommodate three cables per row, the tenth terminal on each row not being used.

A particular terminal on these terminal blocks is identified by row number and terminal number; for example, row 6, terminal 3 (six rows down from the top, the third terminal in from the front of the block). Terminal identifying information is presented on engineering drawings as a concise grouping of the block designation letter, row number, and terminal number or numbers; for example, B6/1-2 indicates block B, row 6, terminals 1 and 2 (only the terminals to which the actual audio conductors connect are given; the shield terminal, which would be terminal 3 in this case, is understood).

In connecting audio cables to the terminals, the shielded and jacketed cable is brought right into the fanning strip cable hole, Figure 4-5, the unshielded leads being as short as possible.

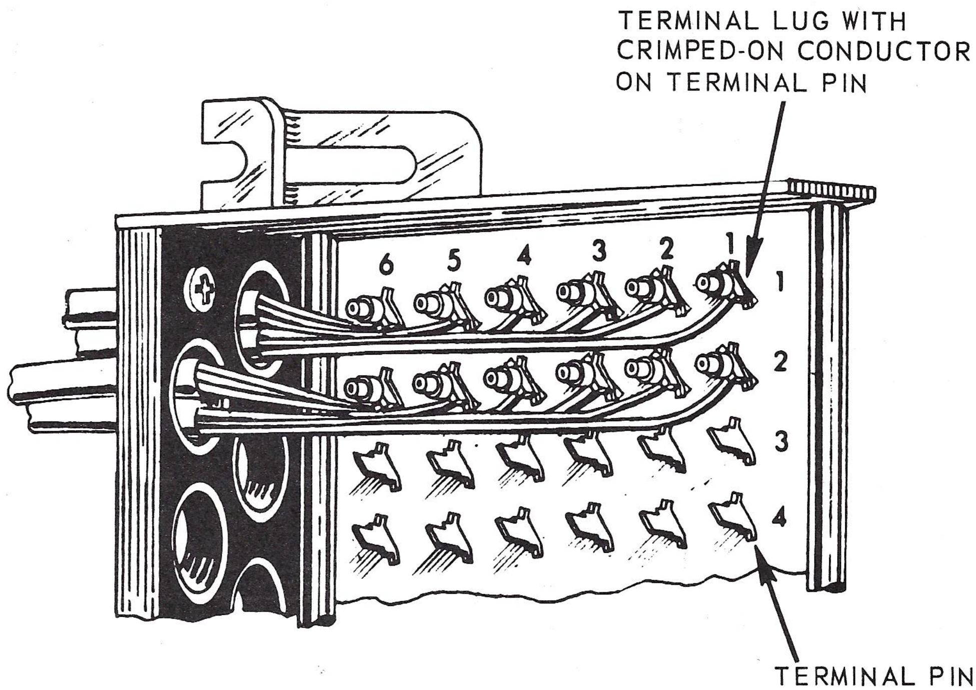


FIGURE 4-5. Audio cable connection to terminal block. Terminal lugs are crimped on the connecting wires and the terminal lugs then pushed on to the terminal pins as shown.

It is often necessary to provide jumper connections, commonly known as "strapping", between two or more terminals on a block to which connections already exist. This is accomplished by using a second type of terminal lug, known as a "piggyback" lug, which plugs on the rear barrel of a terminal lug as shown in Figure 4-6.

The manufacturer of these terminal blocks, Thomas & Betts, make available both the regular terminal lugs and the piggyback lugs made up into long continuous chains of jumpers, commonly known as "daisy chains". These daisy chains consist of terminal lugs interconnected with #22 AWG stranded, tinned, yellow plastic insulated wire. The standard spacing of the lugs on these chains is 2-3/16 inches but other spacing is available on special order.

Strapping on terminal blocks is always made on the left (internal wiring) side of a terminal block.

The method of showing audio terminal block wiring and cross-connection data on engineering drawings is illustrated in Figure 4-7.

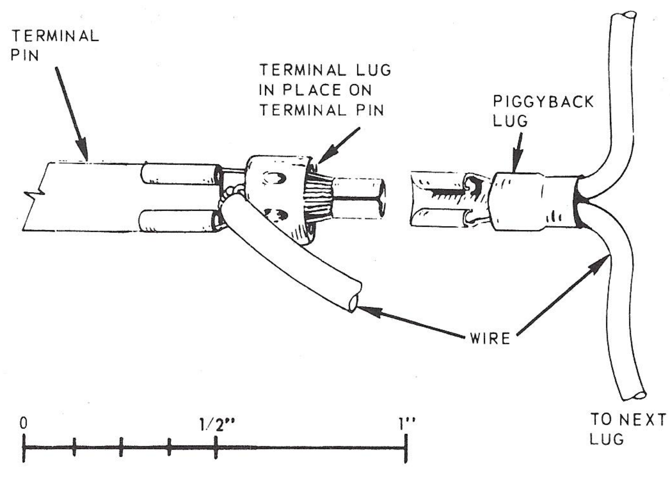
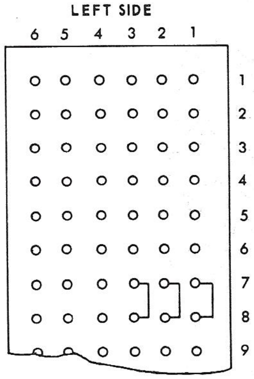


FIGURE 4-6. Piggyback lug ready to plug on the rear barrel of a terminal lug. These lugs are used for strapping two or more terminals to which connections already exist. Piggyback lugs are available prefabricated into chains, known as "daisy chains", for use where a group of terminals must be connected together, or strapped.

ROW	CIRCUIT	LEFT SIDE OF BLOCK — INTERNAL CONNECTION	CABLE MARKER	TERM	RIGHT SIDE OF BLOCK — EXTERNAL CONNECTION	CABLE MARKER	LEV
1	ST-A UTIL CHNL-1	ROW 1, JACK 5		1-2	RACK 18 BLOCK AA7/1-2	500	M
		X		3	X		
2	ATT IN	PNL 44A/5-8 (TRANS OUT)		1-2	RACK 2 BLOCK C30/1-2	501	
		X		3	X		
3	ATT OUT	PNL 7C/1-9 (PGM AMP IN)		1-2	RACK 2 BLOCK C30/4-5	502	
		X		3	X		
4	UTIL CHNL-3	ROW 1, JACK 11		1-2	RACK 18 BLOCK AA7/4-5	503	
		X		3	X		
5	ATT IN	PNL 44B/5-8 (TRANS OUT)		1-2	RACK 3 BLOCK C10/1-2	504	
		X		3	X		
6	ATT OUT	PNL 7D/1-9 (PGM AMP IN)		1-2	RACK 3 BLOCK C10/4-5	505	
		X		3	X		
7	UTIL LN TO A/V BOXES 1 & 2	ROW 6, JACK 17		1-2	ST-A A/V OUTLET BOX-1	506	
		X		3	X		
	MULT	STRAP		1-2	-2	507	
				3	X		
				1-2			
				3			

BLOCK STRAPPING
LEFT SIDE



30 ROWS 6 TERMS DEEP

FOR AUDIO CABLE

CONNECT RED CONDUCTOR TO 1 OR 4 TERMINAL
CONNECT BLACK CONDUCTOR TO 2 OR 5 TERMINAL
CONNECT SHIELD CONDUCTOR TO 3 OR 6 TERMINAL

X - CONNECT SHIELD TO SHIELD TERMINAL
G - CONNECT SHIELD TO SHIELD TERMINAL & GROUND
NC - SHIELD NOT CONNECTED

LEVEL
L - LOW
M - MEDIUM
H - HIGH

FIGURE 4-7. Audio terminal block wiring and cross-connection data are prepared and presented on Engineering Department Form 15B, portions of which are illustrated above. Wiring details of terminals 4, 5, and 6 are given in a section of the form not shown here because of space limitations. Form 15B is used for either the 120-terminal or the 180-terminal blocks. See Chapter 11 for explanation of abbreviations used on these drawings.

B. Control Circuit Terminal Blocks

The three terminal blocks described in Section A, above, are also used for low-voltage control circuits and all of the discussion of their construction and application given in that section applies when they are used in control circuit applications. A typical control circuit terminal block installation employing a 300-terminal block is shown in Figure 4-8.

Control circuits sometimes employ a single conductor, rather than a pair of conductors as in audio systems, for a specific circuit function. Therefore, the wiring and cross-connection data drawing form used for audio terminal blocks cannot be used. The drawing form that has been developed for showing control circuit terminal block wiring and cross-connection data is shown in Figure 4-9.

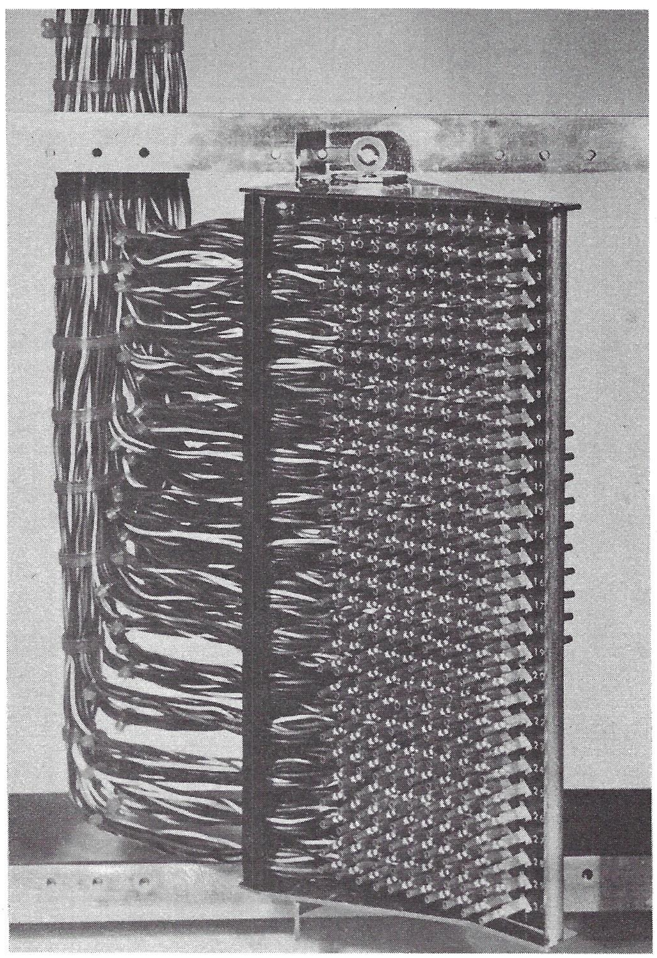
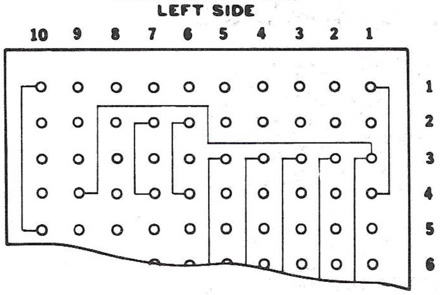


FIGURE 4-8. A 300-terminal control circuit terminal block. The terminals on the left side have been made more accessible for assembly and wiring by pivoting the entire block as discussed in the text.

Control circuit interconnections usually employ multi-conductor cables, such as CBS 8FA (8-conductor), CBS 16FA (16-conductor), and CBS 32FA (32-conductor) cable, although CBS 2FA (2-conductor and shield) audio cable is occasionally used, usually in audio system control circuits.

ROW	TERM	CIRCUIT	LEFT SIDE OF BLOCK					RIGHT SIDE OF BLOCK			
			INTERNAL CONNECTION	STRAP TO	CABLE			EXTERNAL CONNECTION	CABLE		
					COLOR	TYPE	MKR		COLOR	TYPE	MKR
1	1	DIR CONTROL COM	STRAP	4/1				PROD CONS BLK M 1/1	BL/WH	CBS	
	2	TC	REL TERM BOARD 5/12		WH/BL	CBS		2	WH/BL	32FA	
	3	VT-AREA	5/20		OR/WH	IFA		3	OR/WH		
	4	CO	5/28		WH/OR			4	WH/OR		
	5	TX	5/36		GN/WH			5	GN/WH		
	6	FR	5/44		WH/GN			6	WH/GN		
	7	UTIL	5/52		BR/WH			7	BR/WH		
	8	SP-1	5/60		WH/BR			8	WH/BR		
	9	SP-2	5/62		SL/WH			9	SL/WH		
	10	VT-MACH	STRAP	5/10				10	WH/SL		
2	1	TB	REL 2 J/21		BL/RD	CBS		2/1	BL/RD		
	2	AO	TERM BOARD 5/84		RD/BL	IFA		2	RD/BL		
	3	LD/VO	5/92		OR/WH			3	OR/WH		
	4	ER	5/100		WH/OR			4	WH/OR		
	5	MAINT	5/108		GN/WH			5	GN/WH		
	6	OQ	12 C/21	4/6	WH/GN			6	WH/GN		300
	7	BQ	11 C/21	4/7	BR/WH			7	BR/WH		
	8							8	WH/BR		
	9							9	SL/RD		
	10							10	RD/SL		
	1	TB IN USE	STRAP	7/1 4/9				3/1	BL/BK		
	2			7/2				2	BK/BL		
	3			7/3				3	OR/BK		
	4			7/4				4	BK/OR		
	5			7/5				5	GN/BK		
								6	BK/GN		
								7	BR/BK		
								8	BK/BR		
								9	SL/BK		
								10	BK/SL		

BLOCK STRAPPING
LEFT SIDE



30 ROWS 10 TERMS. DEEP

FIGURE 4-9. Control circuit terminal block wiring and cross-connection information is prepared and presented on Engineering Department Form 16B, portions of which are shown above. Form 16B provides space for complete wiring information of a 300-terminal block. The same form may be used for the smaller 180- or 120-terminal blocks, filling in only the portions required. The notation under the block-strapping sketch indicates the size block to be used. See Chapter 11 for explanation of the abbreviations used on these drawings.

C. Video Terminal Blocks

The CBS standard video terminal block is the single-row, 30-terminal unit shown in Figure 4-10. This terminal block accommodates 15 video cables, two terminals being required for each cable. Figure 4-11 shows a video cable connected to the block. The center conductor of the coaxial cable always connects to the odd-numbered terminal; the outer conductor to the even-numbered terminal.

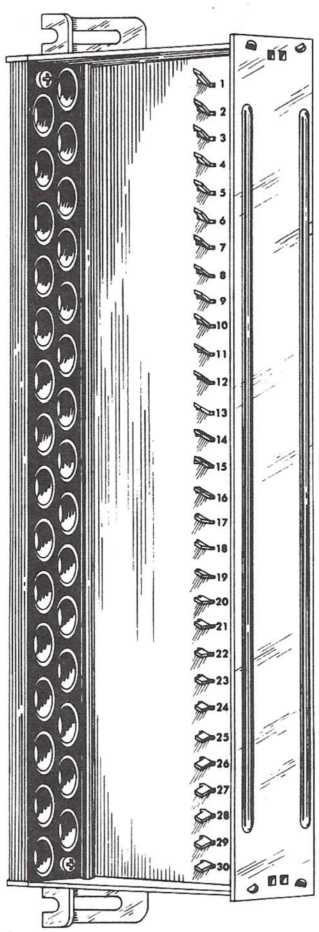


FIGURE 4-10. Terminal block for video circuits.

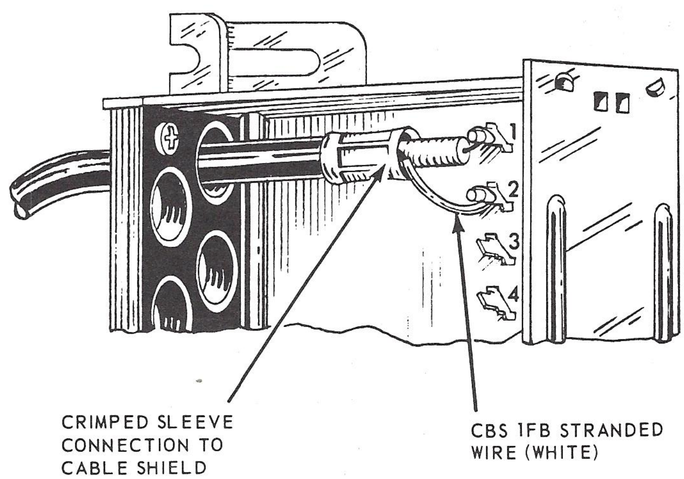


FIGURE 4-11. Video cable connection to terminal block. Cable always enters the block through the inner row of fanning strip holes.

This video terminal block, the CBS type 3001, is another of the family of terminal blocks used for audio and control circuits. It employs the type of terminal pin and push-on terminal lug shown in Figure 4-3. However, in the case of the video terminal block, it has proven desirable in some installations to solder the terminal lugs to the terminal pins after the system alignment and timing has been completed.

Video terminal block wiring and cross-connection data are shown on the engineering drawing form illustrated in Figure 4-12.

BLK	TERM	CIRCUIT	LEFT SIDE OF BLOCK				RIGHT SIDE OF BLOCK				TERM
			INTERNAL CONNECTION	CABLE			EXTERNAL CONNECTION	CABLE			
				COLOR	TYPE	MARKED		COLOR	TYPE	MARKED	
A	1-2	PICT MON (C1) VIDEO	VID AMP PNL 44 A/OUT		ICA		RACK 4 BLOCK D/1-2		ICA	144-J	1-2
	3-4	(C2)	B/OUT				3-4			145-J	3-4
	5-6	(C3)	C/OUT				5-6			146-J	5-6
	7-8	(C4)	D/OUT				7-8			147-J	7-8
	9-10	(PVW1)	E/OUT				RACK 6 BLOCK D/1-2			148-J	9-10
	11-12										11 12
	13-14										13-14
											15-16
											17-18
											19-20
											21-22

VIDEO CABLE CONNECTION:
ODD TERMINAL - CENTER CONDUCTOR
EVEN TERMINAL- OUTER CONDUCTOR

FIGURE 4-12. Video terminal block wiring and cross-connection data are prepared and presented on Engineering Department Form 13A as shown above. See Chapter 11 for explanation of the abbreviations used on these drawings.

D. AC Power Terminal Blocks

AC power terminal blocks have already been mentioned in Chapter 2, "Equipment Rack Assemblies". The standard terminal block for ac power in racks, consoles, and other equipment assemblies is the Marathon 1006, Figure 4-13. The six clamp-type terminals on this compact block each carry a power rating of 65 amperes, 600 volts. They will handle solid conductors in sizes from No. 6 to No. 18 AWG and stranded conductors from No. 8 to No. 16 AWG.

As already discussed in Chapter 2, one to three of these 6-terminal blocks can be mounted in a CBS type 9A ac terminal block box in the block A position as shown in Figure 4-14. This will provide 18 terminals. If additional ac terminal blocks are required, they may be mounted in the block B position in a CBS type 10A ac terminal block box, also shown in Figure 4-14. Smaller ac terminal block boxes, the 8-3/4-inch high CBS types 9B and 10B, which accommodate only two of the 6-terminal blocks each, are also available when the rack space allotted to terminal blocks must be reduced from the recommended 10-1/2 inches to 8-3/4 inches.

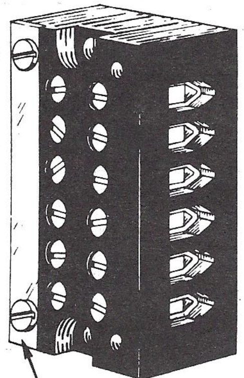


FIGURE 4-13. The standard ac power terminal block used in equipment racks and consoles. The top terminal is terminal number one; the bottom terminal number six. This terminal block is 3-3/8 inches high, 1-3/8 inches wide, and 1-inch deep.

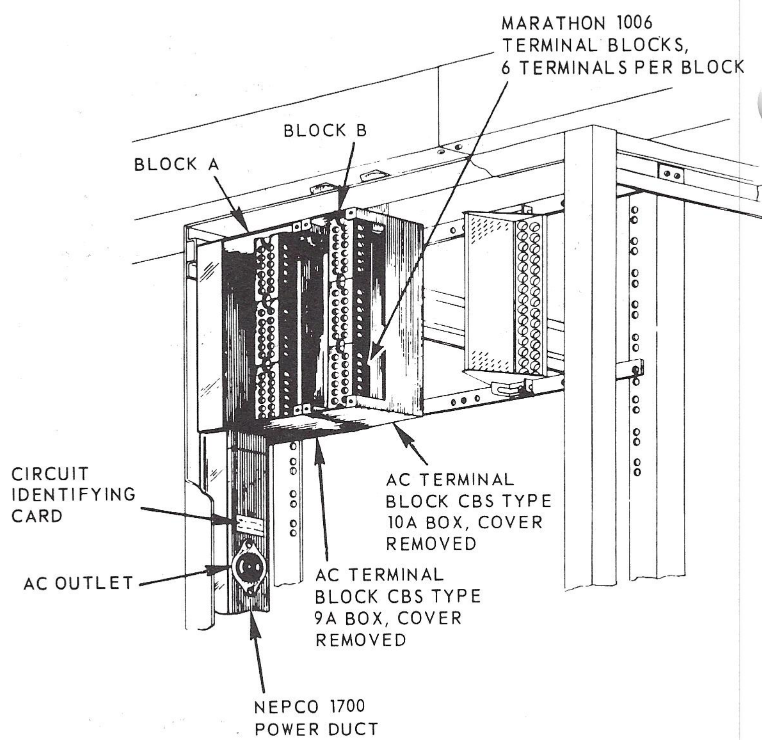
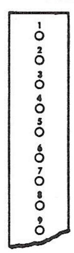


FIGURE 4-14. Rear view of an equipment rack with ac terminal blocks mounted in both the A and B block positions.

The method that has been developed for showing ac terminal block wiring and cross-connect data on engineering drawings is illustrated in Figure 4-15.

TERM	CIRCUIT: FUNCTION	CIRCUIT: PANEL CKT NO.	CIRCUIT: Ø	LEFT SIDE OF BLOCK: INTERNAL CONN.	LEFT SIDE OF BLOCK: CABLE COLOR	LEFT SIDE OF BLOCK: CABLE TYPE	LEFT SIDE OF BLOCK: CABLE MARKER	RIGHT SIDE OF BLOCK: EXTERNAL CONN.	RIGHT SIDE OF BLOCK: CABLE COLOR	RIGHT SIDE OF BLOCK: CABLE TYPE	RIGHT SIDE OF BLOCK: CABLE MARKER	TERM
1	REG PWR SUP	EP 1-1	A	RECPT'S 2A	BK	14TW	22	EP 1-1	BK	12TW	3-7	1
2					WH				WH			2
3	EMG PWR SUP	1-2	B	2B	RD		20	1-2	RD		3-9	3
4					WH				WH			4
5	AMPS & CUE XMTR	1-3	C	42	BL		30	1-3	BL		3-1	5
6				8 5	WH				WH			6
7												7
8												8
												9
												10
												11

BLOCK STRAPPING
LEFT SIDE



NOTE:
CONNECT HIGH SIDE OF A-C FEED TO ODD TERMINAL.
CONNECT LOW SIDE (NEUTRAL) OF A-C FEED TO EVEN TERMINAL.
USE SEPARATE NEUTRAL (WHITE) FOR EACH CIRCUIT.

FIGURE 4-15. AC terminal block wiring information is prepared and presented on Engineering Department Form 17, an example of which is shown above. Form 17 accommodates wiring data on up to three of these six-terminal ac blocks, the usual maximum complement in an average rack or console. Should more than three terminal blocks be required in a special case, a second Form 17 drawing is used. In addition to the wiring and strapping data shown above, Form 17 also contains a detail of the ac duct layout, not included above, but shown in Figure 2-7, Chapter 2. See Chapter 11 for explanation of the abbreviations used on these drawings.

E. General-Purpose Terminal Blocks

A general-purpose terminal block frequently employed in CBS audio-video systems is the General Electric EB5-6422494-G12, Figure 4-16. This block is used in applications requiring well-insulated, high-current terminals. Typical applications would be the distribution of low-voltage power, or control circuits using 120 volts for the control voltage.

The body of this terminal block is molded phenolic, the design of which provides a barrier between adjacent terminals. A swinging phenolic cover completely protects the terminals when closed. The twelve screw-type terminals are rated at 30 amperes, 600 volts, and accommodate conductors from No. 18 to No. 10 AWG in size.

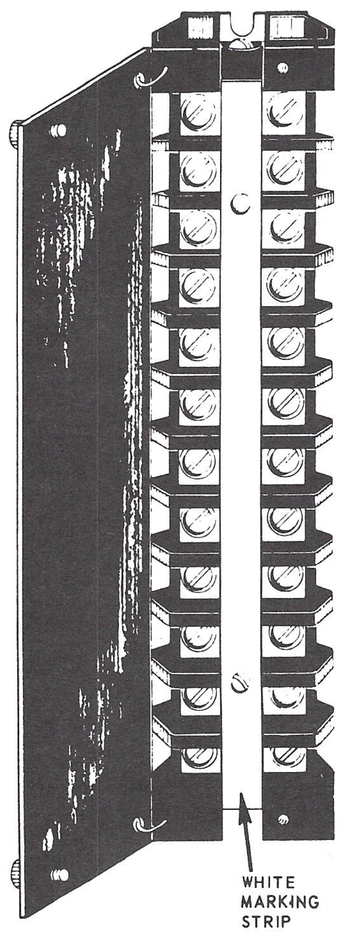
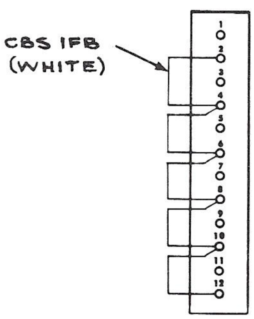


FIGURE 4-16. A general-purpose terminal block for applications requiring heavy, well-insulated terminals. The terminals are numbered one through 12 running from top to bottom. This terminal block is 8-3/16 inches high, 2-inches wide, and 1-5/16 inches deep.

The method of showing wiring and cross-connect data for these general-purpose terminal blocks on engineering drawings is shown in Figure 4-17.

BLK	TERM	CIRCUIT	LEFT SIDE OF BLOCK				RIGHT SIDE OF BLOCK				TERM
			INTERNAL CONNECTION	CABLE			EXTERNAL CONNECTION	CABLE			
				COLOR	TYPE	MARKER		COLOR	TYPE	MARKER	
B	1	24V TO ST SW L1/L2	PNL 18 BKR 1 OUT	PK	CBS IFB		RACK 1 BLK AA 1	RD	CBS 2FP	P111	1
	2	COM	24V COM	WH			2	WH			2
	3	E1/E2	BKR 2 OUT	YL			3	RD		P112	3
	4	COM	STRAP	WH			4	WH			4
	5	PVW 1A/2A	PNL 18 BKR 3 OUT	BL			5	RD		P113	5
	6	COM	STRAP	WH			6	WH			6
	7	SW CONT TALLIES	PNL 18 BKR 4 OUT	OR			7	RD		P114	7
	8	COM	STRAP	WH			8	WH			8
	9	NON-SYNC SW PGM	PNL 18 BKR 5 OUT	BR			RACK 2 1	RD		P115	9
	10	COM	STRAP	WH			2	WH			10
	11	PVW 1B/2B	PNL 18 BKR 6 OUT	TN			3	RD		P116	11
	12	COM	STRAP	WH			4	WH			12

BLOCK STRAPPING
LEFT SIDE



B

FIGURE 4-17. Wiring and cross-connect data for the general-purpose terminal block is prepared and presented on Engineering Department Form 12, an example of which is shown above. Form 12 provides space for data on up to three of these general-purpose terminal blocks. See Chapter 11 for explanation of the abbreviations used on these drawings.

III. TERMINAL BLOCK DESIGN PRACTICES

The following good design practices should be adhered to in the planning and layout of wiring to a terminal block:

(a) Connections to a terminal block should be planned and organized in such a manner that internal and external connections join with a minimum of strapping. When strapping must be used, it should be kept simple.

(b) Multi-conductor control cables (such as CBS 32FA) should always be connected to the right side of a terminal block in their standard color code order (see Chapter 7, "Wiring Diagrams"). Where possible, internal connections should also be organized so they break out in standard color code order on the left side of the block.

(c) When the cable density at the blocks is high, an extra rack unit of space should be provided between the blocks and adjacent equipment to provide room for the cables.

(d) A terminal block is intended primarily for the connection of cables to a unit of equipment. It is not intended, and should not be used, as a mounting board for diodes, resistors, networks, and other small components. Such equipment should be mounted elsewhere.

REFERENCES

1. Charles J. Neenan, MODERN CONSTRUCTION PRACTICES FOR CBS AUDIO-VIDEO SYSTEMS, IEEE Transactions on Broadcasting, BC 9:2:37 (August, 1963).

2. CBS Engineering Report E2305A, SOLDERLESS CONNECTOR BLOCKS, Charles J. Neenan, (September 16, 1960).

5. Consoles, Panels, AV Outlets

CHAPTER 5

CONTROL CONSOLES, CONTROL PANELS, AV OUTLETS

5

CONTROL CONSOLES, CONTROL PANELS, AV OUTLETS

Three different subjects are covered in this chapter; control consoles, control panels, and AV outlets. The design principles and practices described have evolved over the years as a result of the experience of CBS engineering and operating personnel in the design and operation of television broadcasting systems. Facilities designed in accordance with these principles and practices are employed at CBS television broadcasting plants throughout the country.

I. CONTROL CONSOLES

As described in Chapter 2, the system components that make up a television broadcasting system are usually mounted in equipment racks. On the other hand, the operating controls and monitoring facilities used in the day-to-day operation of the system are, in most cases, consolidated on control consoles located in the various control areas of the plant.

A control console is a desk-like structure that provides operating positions for one or more technical or production personnel. Each operating position is equipped with the necessary control, communication, and monitoring facilities for the performance of a specific operating function. Thus, in a television studio control room such as the one shown in Figure 5-1, we find a production console where video switching and program direction take place, a video console where video signals are controlled, an audio console where audio program material is mixed and controlled, and a lighting console where studio lighting is controlled, An announcer's console, containing a microphone and suitable communication and monitoring facilities, is located in the announcer's booth. Control consoles for other plant control functions will be found at control points in other areas of a television plant.

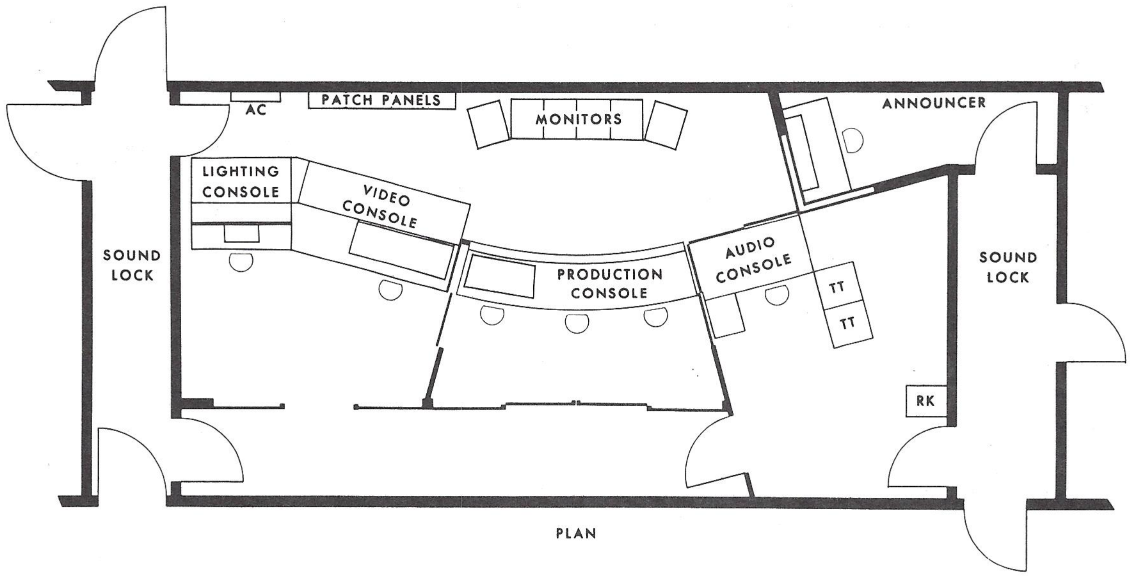


FIGURE 5-1. Plan view of a studio control room showing the various control consoles.

A. Design Considerations

Operating personnel spend many hours each day performing their jobs at control consoles in television broadcasting plants. Accordingly, considerable effort and care in the design of a control console to make it a comfortable and efficient place to work is is well justified.

1. Human Factors. A console design must take into account the physical dimensions, as well as the physical limitations, of the human body. It must accommodate, comfortably and efficiently, personnel of various physical sizes; from those who are small in stature to those who are large.

Industrial designers have adopted a system of "percentiles" as a convenient way of dividing people into groups according to physical size. Physical measurements made on large groups of adult males (data has also been compiled for women and children) have been broken down into 100 percentage groups called percentiles. Percentile 1 represents the smallest physique in the group; percentile 100 the largest. Percentile 50 represents the mean.

Such anthropometric data are quite useful in determining the physical dimensions necessary for control consoles or any other device that is to be operated by humans. In using such data for design purposes, it is not necessary to work with the data of all 100 percentile groups. The extreme top 2-1/2 percentile and extreme bottom 2-1/2 percentile represent people of unusual and relatively rare dimensions. It is reasonable to ignore these extremes in the design of control consoles. A console that will comfortably and efficiently accommodate the remaining 95% of the human male population (percentiles 2.5 through 97.5) will usually prove adequate in practice. Anthropometric charts giving dimensions of the human body for percentiles 2.5, 50, and 97.5 have been published* and these data will be found to be of considerable value in designing a control console or evaluating a console design. If a console design accommodates these three theoretical physiques, it should be reasonably adequate for other physiques lying within these extremes.

2. Mock-Ups. A full-scale mock-up is a excellent way of evaluating a proposed console design before proceeding with detailing and actual construction. A mock-up permits operating personnel to sit at a full-scale simulation of the proposed console and experience the ease (or difficulty) of manipulating controls and viewing the monitoring devices.

A mock-up can be a simple plywood or cardboard structure of the same physical dimensions as the proposed console. To this plywood or cardboard structure are fastened full-scale pencil sketches (or full-scale prints of engineering drawings) of the various panels and displays. In many cases, it is desirable to affix actual knobs to the mock-up to determine whether their operation will be convenient and natural, and not awkward or tiring.

It is not always necessary to build a plywood or cardboard structure to evaluate a console design. A simple, but often entirely adequate mock-up can be improvised using a table or desk pushed against a wall. Pencil sketches (or prints of engineering drawings) are used as described above fastening them to both the table or desk and the wall as required by the console design. Sloping panel portions of the console can be fabricated of cardboard.

*Henry Dreyfuss, THE MEASURE OF MAN, 2nd ed., Whitney Library of Design, New York, N.Y., (1967).

3. Types of Consoles. When considered from the viewpoint of physical construction, there are three types of control consoles in general use:

(a) The relatively-simple desk type console described in Section B below.

(b) A consolidation of a desk type console and equipment racks described in Section C below.

(c) The so-called "consolette" which is a small, self-contained table-top control unit and is not discussed here.

B. The Desk Type Console

The flat-top, rectangular-shaped, desk-like structure of Figure 5-2A is a relatively simple form of control console. In such a console, control panels may be flush-mounted into the flat working surface.

Some improvement in the ease of operating panel-mounted controls, as well as improvement in reading panel engraving, can be obtained by sloping the control panel as shown in Figure 5-2B.

Equipment that need not be within convenient reach of the operator (meters and readouts, for example) can be mounted in a turret-like structure at the rear of the console, as in Figure 5-2C. The operator's view of equipment on the turret can be improved by angling this panel so that it lies at right angles to the operator's line of sight.

It is often desirable to mount panels on a console using both the sloping panel arrangement of Figure 5-2B (for frequently-used controls) and the rear-turret arrangement of Figure 5-2C (for meters, readouts, and infrequently-used controls). Such a dual-slope arrangement is shown in Figure 5-2D.

Figure 5-3 shows a production console that incorporates panels mounted in all of the various ways discussed above. In addition, it incorporates a recessed panel for the telephone dials.

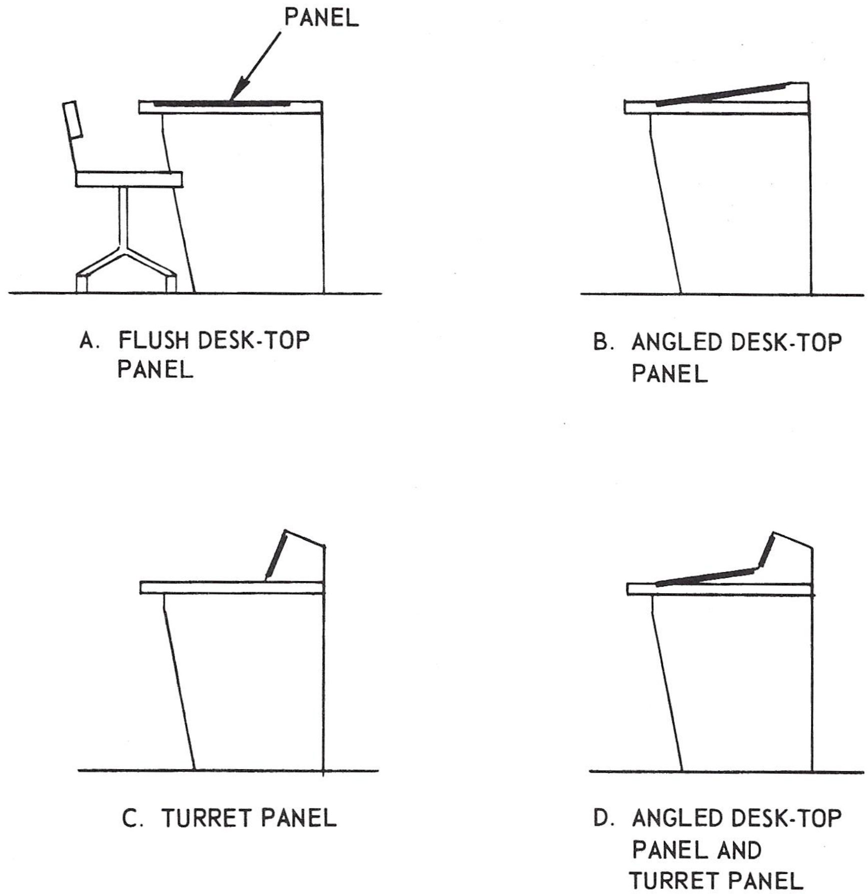


FIGURE 5-2. Section views of desk type control consoles showing various panel positions possible.

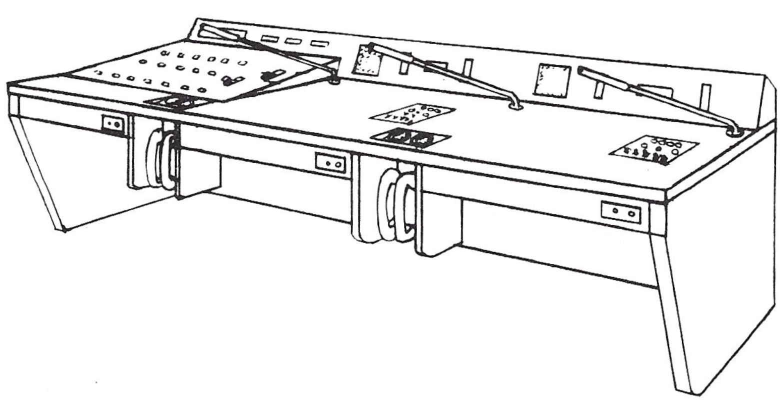


FIGURE 5-3. A production console providing operating positions for a video switcher, program director, and assistant.

1. Special Forms. Circumstances sometimes make it desirable to depart from the console with a rectangular-shaped working surface. Consider the console of Figure 5-4A whose length is so great that some of the controls lie beyond the convenient reach of the operator. A U-shaped console which, in effect, wraps the console controls around the operator, as illustrated in Figures 5-4B, 5-4C, and 5-4D, will bring the controls on all panels within more convenient reach of the operator.

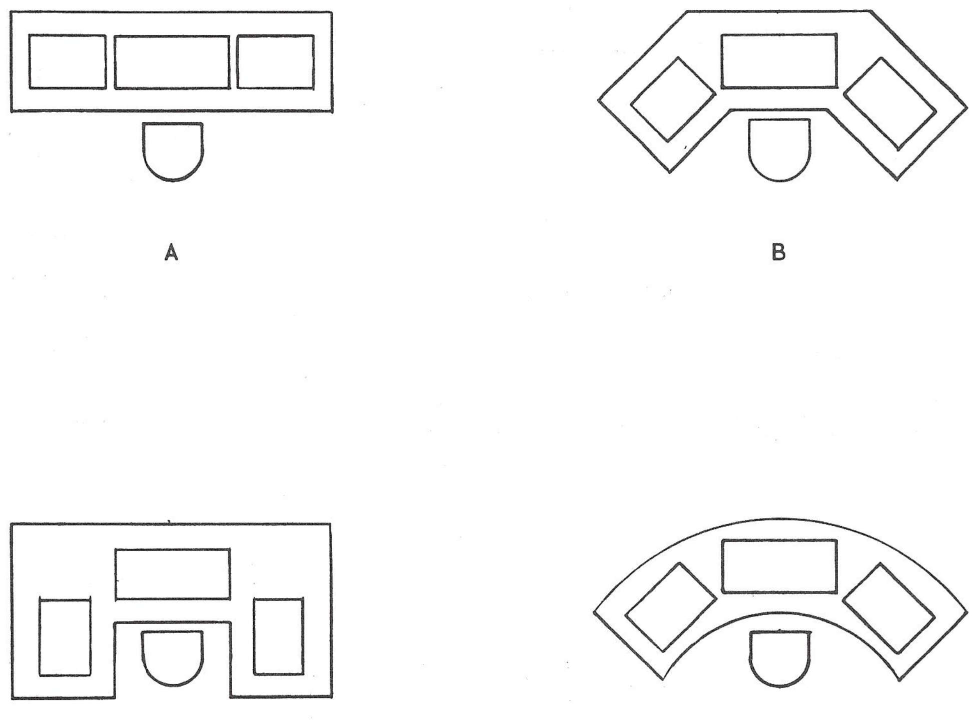


FIGURE 5-4. The wrap-around console designs of B, C, and D bring console controls within easier reach of the operator than the rectangular console of A.

Figure 5-5 illustrates a self-contained wrap-around studio audio console of relatively complex configuration in which the plug-in amplifiers and other components have been mounted in compartments below desk level.

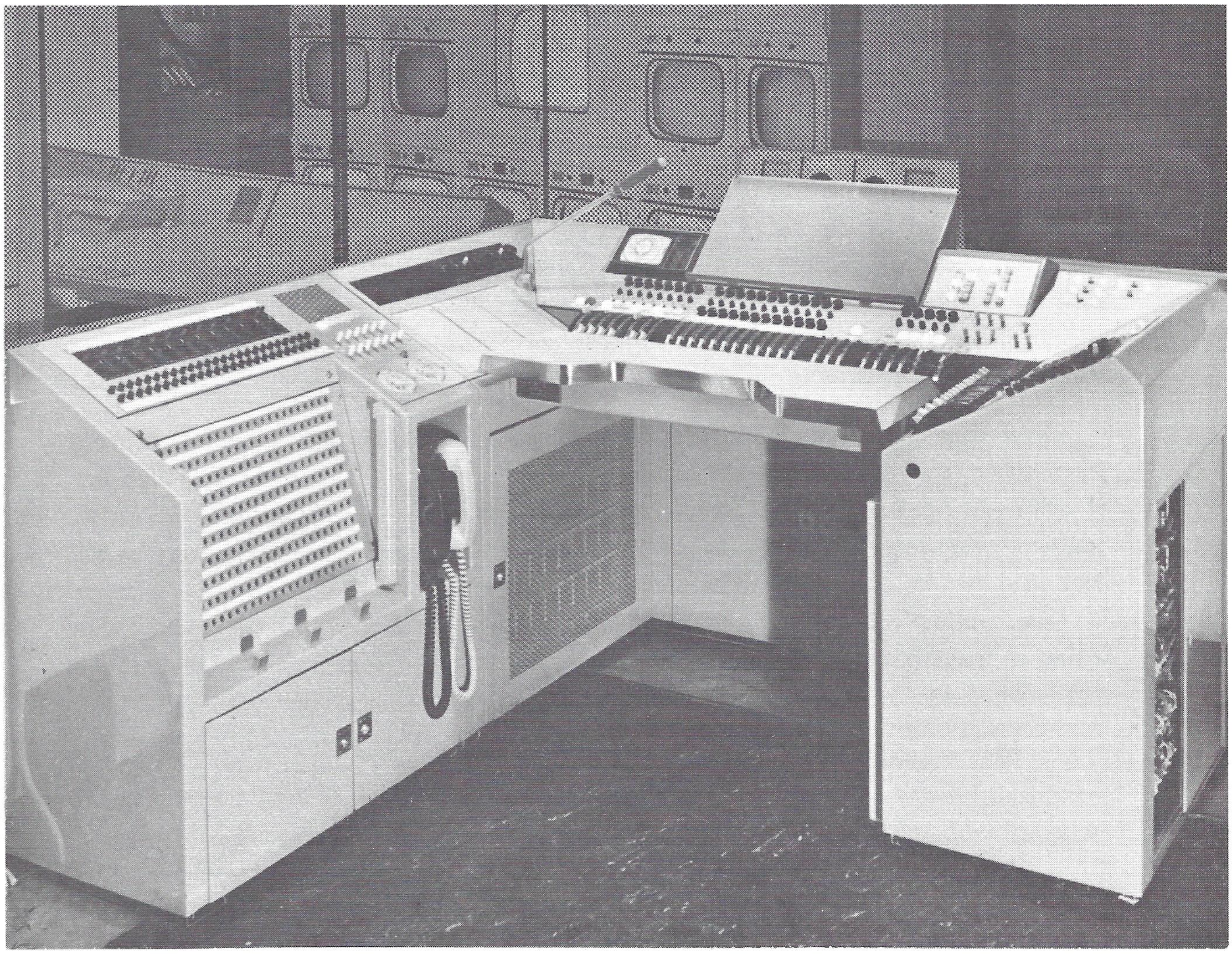


FIGURE 5-5. A self-contained studio audio console of the wrap-around type.

Another unconventional console configuration is illustrated in the production console shown in Figure 5-1. During the production of a television program, visual communication among control room personnel is quite important. However, if the three-man production console of Figure 5-1 was rectangular in shape (rather then curved) visual contact between the two end men would be blocked by the man seated at the center. A curved console, such as the one shown in Figure 5-1, (which could be considered a section of a round table), reduces this difficulty and allows improved visual communication among all three men. In the case illustrated, the curved console also improves the ease of viewing the bank of picture monitors for the men at each end of the console.

C. The Desk-Rack Type Console

In the design of control consoles, equipment requirements are frequently encountered which dictate a substantial amount of panel space for picture monitors, waveform monitors, vectorscopes, readouts, meters, and even loudspeakers. This is particularly true in the case of control consoles in technical control areas such as program control rooms and control centers.

A convenient and relatively simple way of providing a large amount of console panel space is to combine a desk type console unit, such as described above, with a row of equipment racks or similar modular rack-like frames, as shown in Figure 5-6. The additional panel space provided by the rack units, added to that already available on the desk unit, results in a combination that provides, literally, an abundance of panel space for most applications. Further, the rack units permit conventional rack construction and wiring techniques to be used. As these techniques are well understood by construction personnel, assembly and wiring of a console of this type will be expedited.

Many variations in console configuration to adapt it to a specific application are possible by means of relatively simple modifications to the rack or desk structure. For example, angling of panels on a control console, as shown by the examples of Figures 5-7 and 5-8, will improve the operator's view of controls and other equipment mounted on these panels.

1. Improving Operator's View of Equipment on End Racks. As the length of a desk-rack type console is increased, the angle at which the operator views equipment mounted on racks toward the ends of the console becomes greater and may result in foreshortened images on picture monitors or other viewing difficulties. The operator's view of these rack-mounted units can be improved by angling the end racks as shown in Figure 5-9.

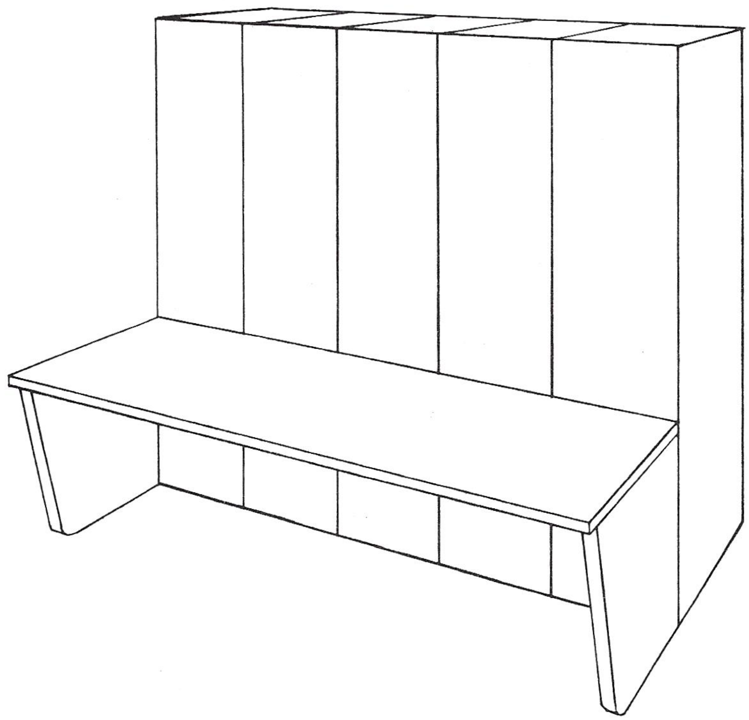


FIGURE 5-6. The desk-rack type console combines the desk type console and the equipment rack.

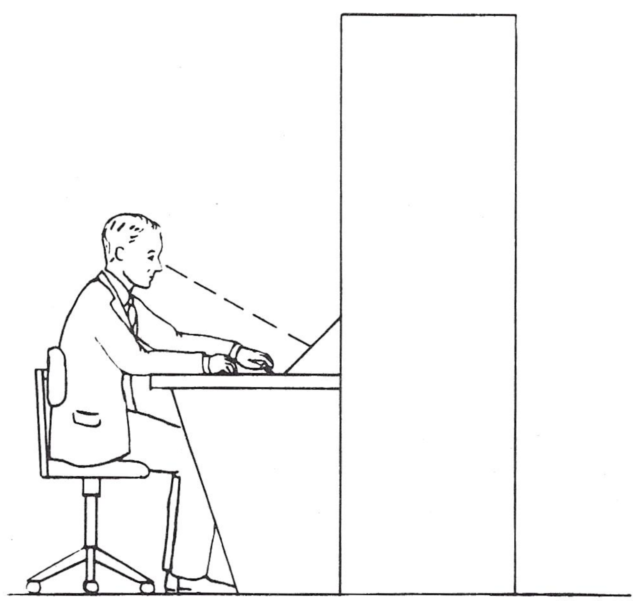


FIGURE 5-7. Angled control panel improves operator's view of controls. If slide-mounted equipment is installed at an angle, its weight should be counterbalanced.

2. Vision Over Console. The desk-rack type console assemblies of Figures 5-6 through 5-9, while providing a large amount of panel space, completely block the operator's forward view. However, the arrangement of equipment in a control room often dictates a console design that will allow the operator, and others seated at the console, to see over the top of it. If forward vision is necessary, the desk-rack type of construction need not be abandoned if the panel space requirements are modest. A console arrangement using the desk-rack type of construction, which provides the operator with limited forward vision, is shown in Figure 5-10. The panel space provided by the racks in this case is quite limited.

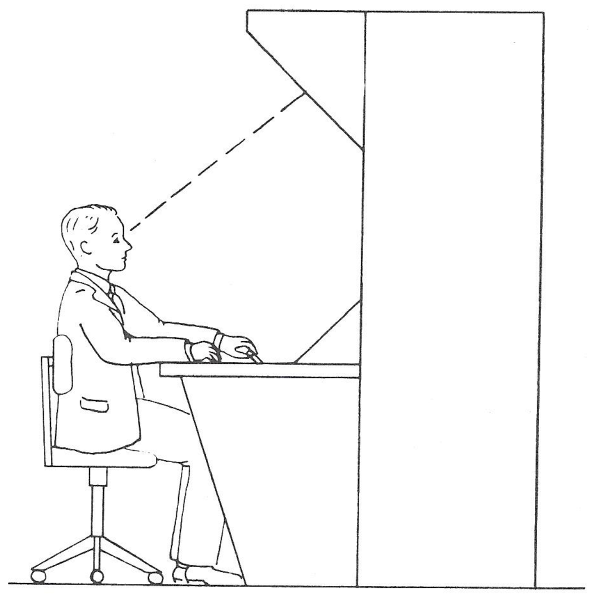


FIGURE 5-8. View of equipment on overhead panels can also be improved by angling. These overhead, downward-sloping panels are an ideal location for meters, indicators, readouts, and loudspeakers. Avoid locating heavy equipment in these areas. If slide-mounted equipment is involved, the slides must be mounted in a horizontal plane; never at a downward angle.

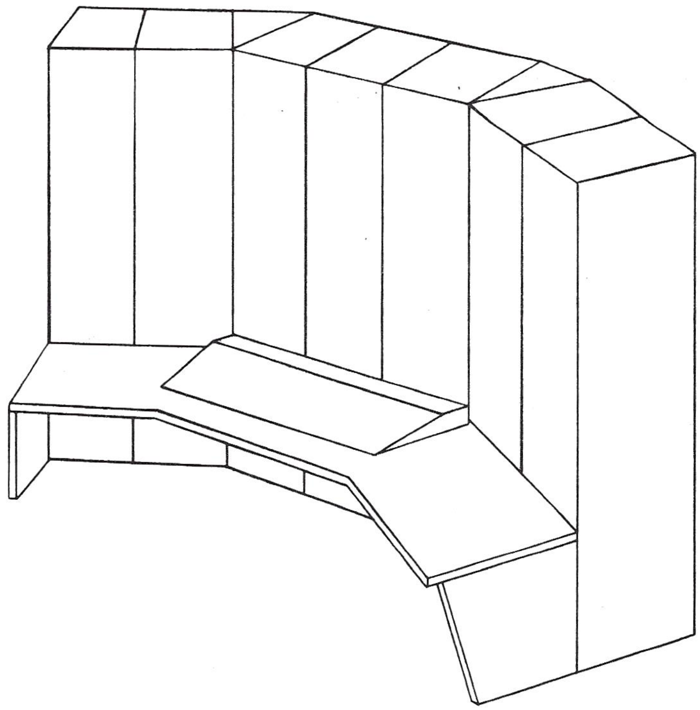


FIGURE 5-9. Angling improves operator's vision of equipment on end racks.

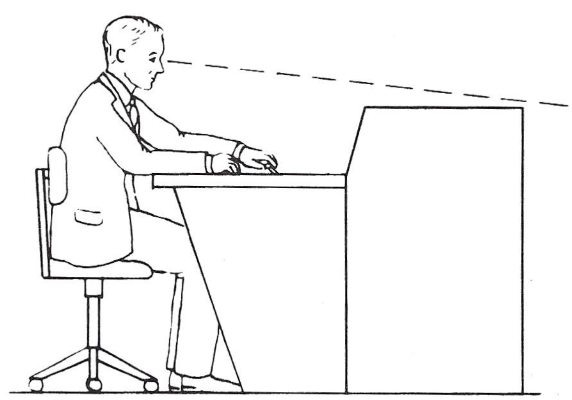


FIGURE 5-10. A see-over desk-rack type control console.
Panel space is quite limited.

If a greater field of vision over the console is needed but the panel height cannot be reduced, a significant improvement in the view over the console can be achieved simply by sloping the top of the console as illustrated in Figure 5-11. This, of course, applies not only to the desk-rack type of console, but to any control console. On consoles equipped with side wings, the operator's view over these wings can also be improved by sloping the top surface of the wings as shown in Figure 5-12.

A further advantage of a sloped console top is the fact that it prevents the use of these surfaces as storage space (which, besides being unsightly, often interferes with equipment ventilation) or as a coffee counter (which could result in coffee being spilled on the equipment).

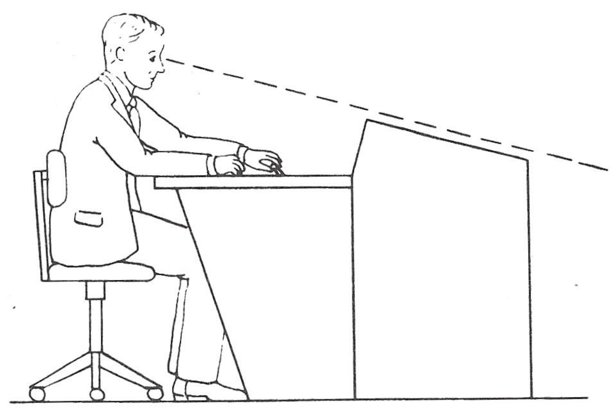


FIGURE 5-11. Vision over top of console can be improved by sloping top.

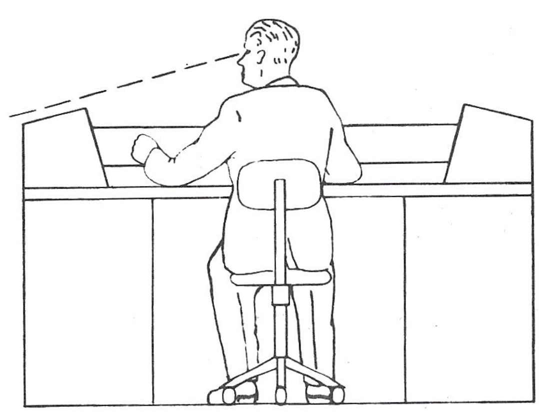


FIGURE 5-12. Vision over side wings of console can be improved by sloping their tops.

3. Racks for Desk-Rack Type Consoles. The CBS type A equipment rack (see Chapter 2) is used in some types of desk-rack type console assemblies. This 22-inch wide (overall) equipment rack is intended to accommodate system components that are designed to mount in the 19-inch wide mounting space provided by standard equipment racks.

Because control consoles frequently must accommodate system components of widths other than 19-inches, a different type of equipment rack frame especially for use in control consoles has evolved.

As system components became smaller and more compact, picture monitors and waveform monitors became available that could be rack mounted on sliders in a 10-inch wide rack space. To accommodate these 10-inch wide picture and waveform monitors, as well as to accommodate system components greater than 19-inches in width (such as large-size picture monitors), the CBS type B equipment rack series was developed. An example of a desk-rack type control console using CBS type B rack frames is shown in Figure 5-13.

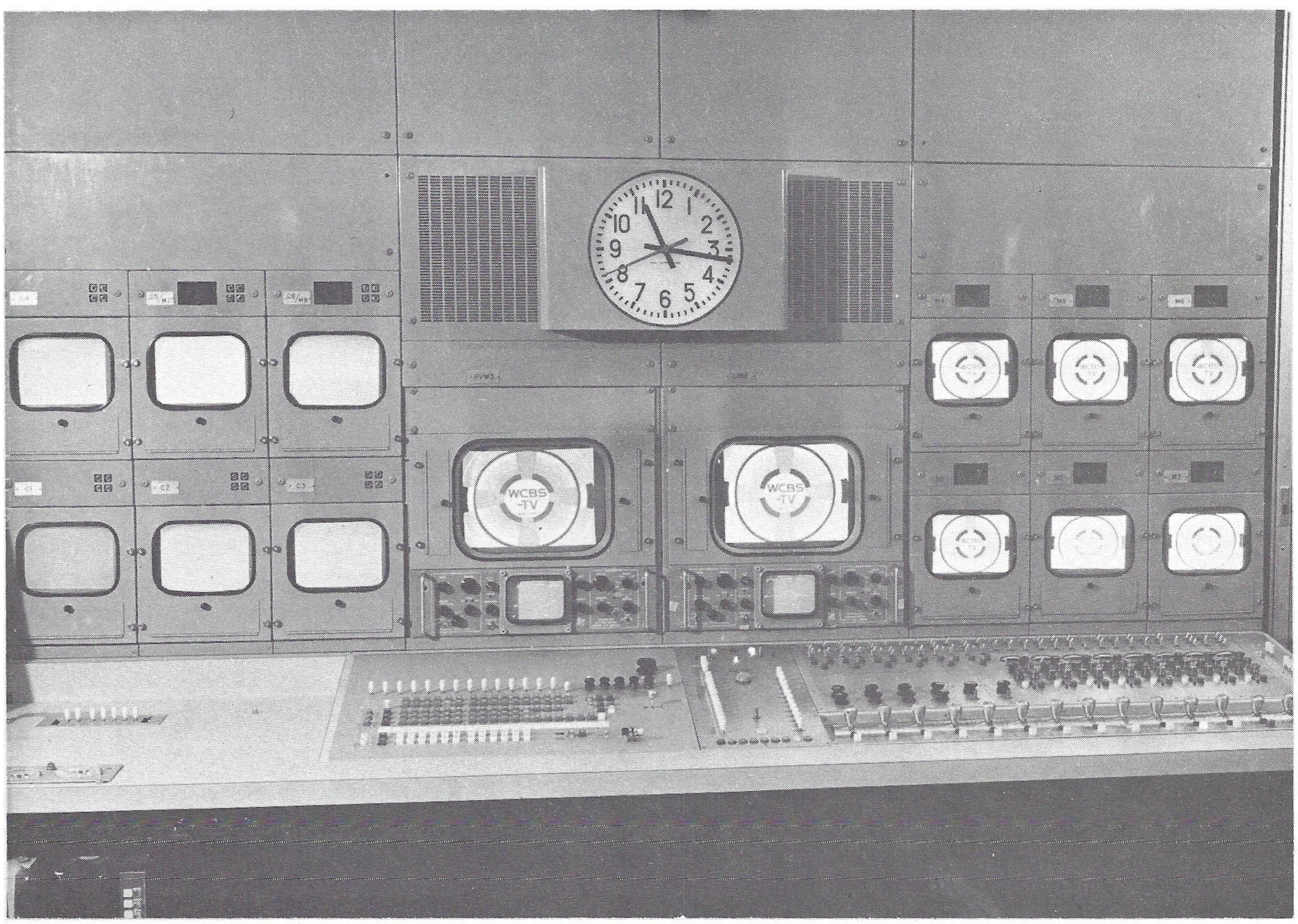


FIGURE 5-13. A desk-rack type control console using CBS type B rack frames.

A brief description of the CBS type B equipment rack frame is given below:

(a) The basic CBS type B rack frame, which accommodates standard 19-inch rack panels or non-standard 20-inch rack panels, is 20 inches in overall width compared to the 22-inch overall width of the CBS type A equipment rack.

(b) The CBS type B rack frame series includes other frames that are 10, 30, and 40 inches in width.

(c) 10-inch wide picture and waveform monitors are accommodated on the CBS type B rack frame by special slider-equipped mounting hardware and suitable modifications to the rack mounting rails. The basic 20-inch rack frame can accommodate two of the 10-inch wide monitors; the wider frames can accommodate proportionally more.

(d) The CBS type B family of rack frames is intended primarily for picture monitors, waveform monitors, and other display and monitoring equipment used on consoles and in monitor display racks. The CBS type B rack frames do not provide adequate cable space for regular equipment rack service and therefore should be limited to use in console and display rack applications.

The CBS type B rack frame makes it possible to design a more compact control console than would be possible using the regular CBS type A equipment rack. The reason for this lies in its smaller width. If six 22-inch wide equipment racks are used in a console assembly, the overall width would be 11 feet. If six 20-inch wide equipment rack frames are substituted, the overall width will be 10 feet; a reduction of one foot. This saving can be of considerable help in making a console's dimensions meet a building space requirement or meet a human factor requirement.

CBS drawings giving details of the type B equipment rack are listed at the end of this chapter.

4. Inter-Compartment Cable Runs. In desk-rack type console wiring, it is the preferred practice, insofar as possible, to make cable runs directly from compartment to compartment without passing through terminal blocks. Although this requires that the console compartments be bolted together in the shop, it simplifies the wiring of the console by eliminating four terminal block connections on each inter-compartment conductor.

D. Control Console Drawings

As in the case of an equipment rack assembly, the design of a control console entails the preparation of a complete set of mechanical and electrical engineering drawings adequate in detail to permit a shop to build the console exactly as conceived by the designer.

Important points that must be covered by these control console drawings include:

(a) Mechanical details of the console housing and each panel on the console..

(b) The exact physical placement of all equipment and components on and within the console.

(c) All information necessary to wire the console.

1. Console Housing. To insure that the console housing will be built as intended, it is essential that the mechanical drawings covering its design be complete and well detailed. If this is not the case, and decisions are left up to the shop where the console housing is fabricated, it is quite likely that the finished unit will differ in some respects from what was intended.

2. Console Layout. The placement of console equipment is shown on a console layout drawing which is comparable to (but often considerably more extensive in scope than) a rack layout drawing (see Chapter 2). An example of a console layout drawing covering a desk-rack type console is given in Figure 5-14. Placement of smaller equipment and components is shown in the mechanical and electrical drawings covering the individual panels and chassis of the console.

3. Console Wiring. The practices employed in wiring equipment rack assemblies described in Chapter 2 (such as grouping cables according to function and level to minimize crosstalk, and the use of a copper bar console ground bus comparable to the rack ground bus) should be followed, insofar as possible, in wiring control consoles. Jack field wiring in control consoles should be presented as described in Chapter 3; terminal block wiring as described in Chapter 4; wiring diagrams as described in Chapter 7.

CONSOLE

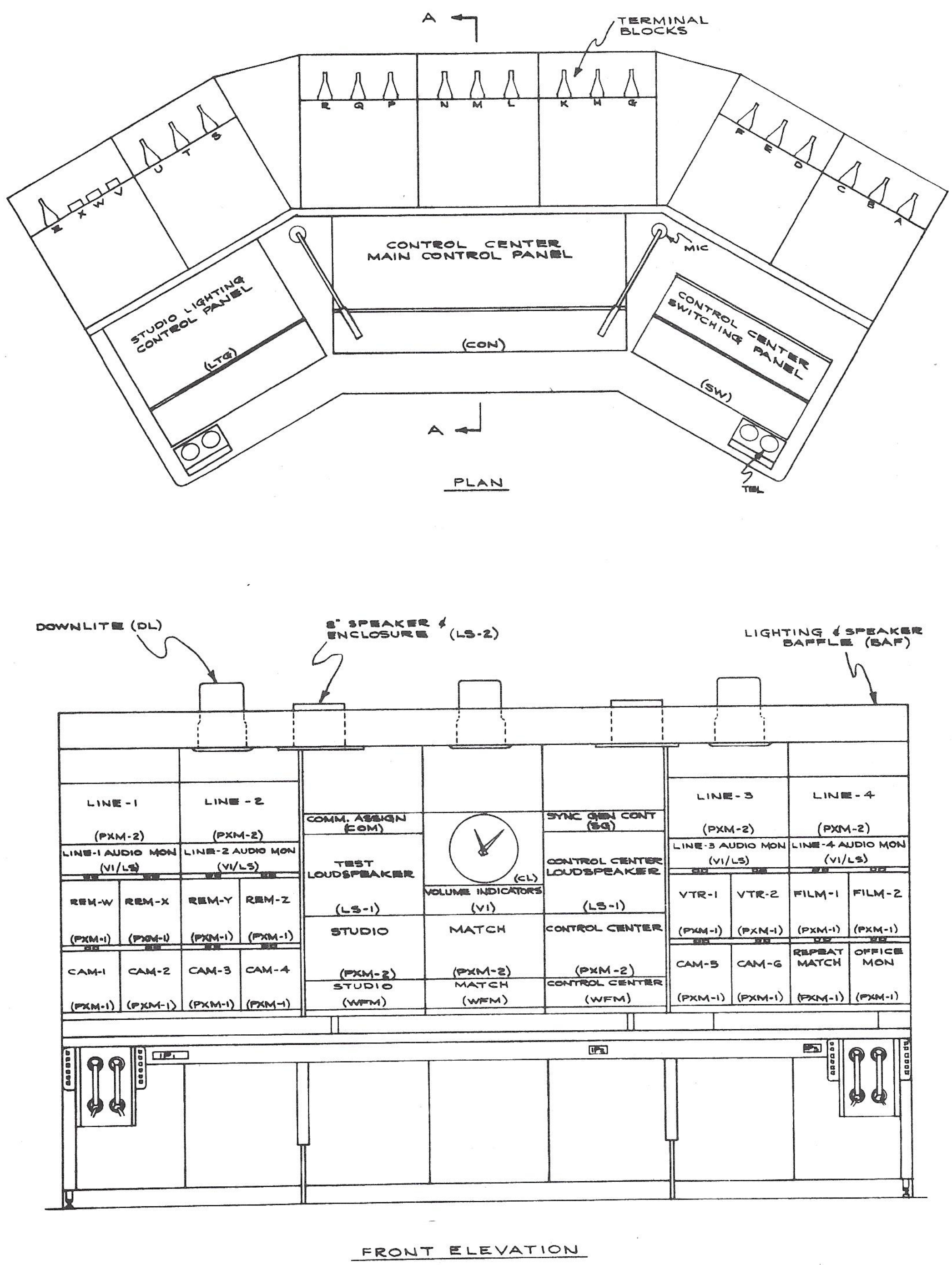
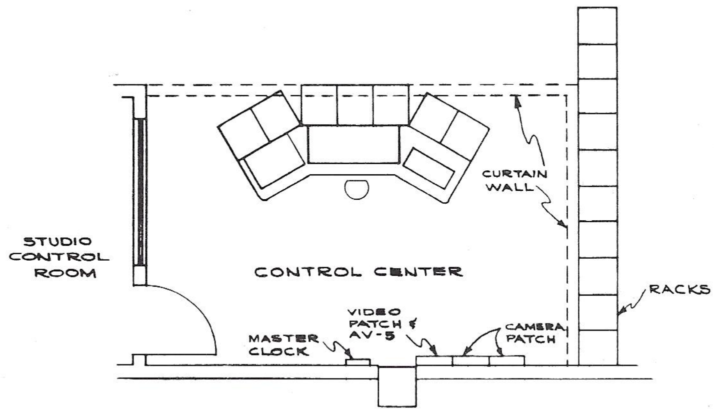
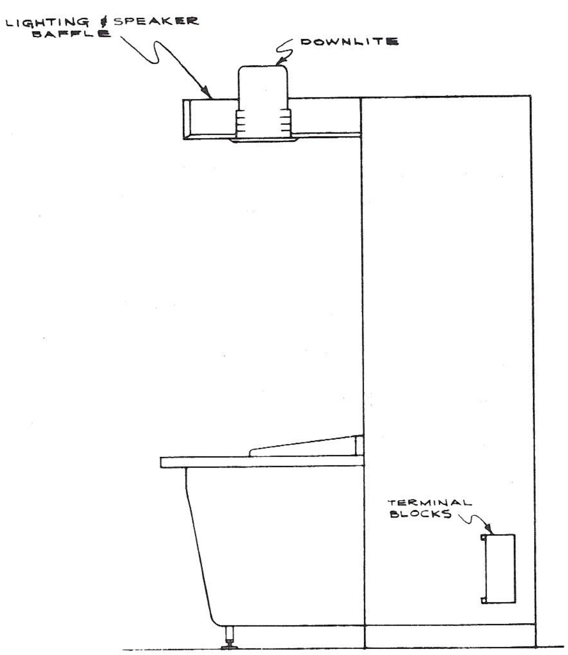


FIGURE 5-14. A console layout drawing must show the location of all equipment in the console.

LAYOUT



FLOOR PLAN



SECTION "A-A"

LEGEND

CODE	DESCRIPTION	MANUFACTURER
CL	CLOCK	GAVAF 10" SURFACE MOUNT NON-ILLUMINATED
COM	COMMUNICATION ASSIGNMENT PANEL	CBS
DL	DOWNLITE	CARREAU 549N8321 WITH SPEC. 2½"x5" RECTANGULAR APERTURE
IP_1	LIGHTING INTERPHONE STATION	CBS
IP_2	VIDEO OPERATOR INTERPHONE STATION	CBS
IP_3	DIRECTOR INTERPHONE STATION	CBS
LS-1	MONITORING LOUDSPEAKER	LTD - G
LS-2	INTERCOM LOUDSPEAKER	EVANS SL-8B IN CABOT XCP8-7" HIGH ENCLOSURE WITH RS8-A BAFFLE PLATE
MIC	INTERCOM MICROPHONE	VE 648, 448 BOOM
PXM-1	PICTURE MONITOR, 8 INCH, ON ROLL-OUT SLIDES	CONRAD CZB-8
PXM-2	PICTURE MONITOR, 14 INCH, ON ROLL-OUT SLIDES	CONRAD CZB-14
TEL	TELEPHONES	TELCO
VI	VOLUME INDICATOR PANEL	CBS
VI/LS	OUTGOING LINE AUDIO MONITORING PANEL	CBS
WFM	WAVEFORM MONITOR ON ROLL-OUT SLIDES	PARKER 529RM
	REFERENCE DWGS	
BAF	LIGHTING & SPEAKER BAFFLE	CBS DWG 999-68
COM	COMMUNICATION ASSIGNMENT PANEL	" " 999-91
CON	CONTROL CENTER MAIN CONTROL PANEL	" " 999-56
LTG	STUDIO LIGHTING CONTROL PANEL	" " 999-55
SG	SYNC GENERATOR REMOTE CONTROL PANEL	" " 999-91
SW	CONTROL CENTER SWITCHER CONTROL PANEL	" " 999-25
VI	VOLUME INDICATOR PANEL	" " 999-92
VI/LS	OUTGOING LINE AUDIO MONITORING PANEL	" " 999-92
IP_1	LIGHTING INTERPHONE STATION	" " 999-216
IP_2	VIDEO OPERATOR INTERPHONE STATION	" " 999-203
IP_3	DIRECTOR INTERPHONE STATION	" " 999-203

E. Control Console Design Practices

In designing control consoles for CBS installations, the design practices given below should be observed.

1. Standardization. Use CBS standard racks, standard hardware, and standard details insofar as possible.

2. Desk Height. The desk surface should be at a comfortable working height; 29 inches ± 1 inch has proven satisfactory. Kneeroom under the desk surface must not be intruded upon by equipment. There should be 25 inches clear from the floor to any downward protruding equipment in the knee area.

3. Console Finish. The standard finish for CBS control consoles is CBS light gray. (CBS light gray enamel should be used).

Desk surfaces, which are usually fabricated of plywood, should be covered with General Electric TX-4371 "Gray Mist" satin-finish Textolite, or equivalent. Edges of the desk surface should be finished with the same material. Under surfaces of the Textolite-covered desk top should have a smooth finish and be sealed with dark gray or black paint or enamel.

Control panels mounted on the desk surface are usually given a natural aluminum finish as discussed in Section II of this chapter.

4. Console Size. In designing a console, keep in mind access to the building where it will be installed. Will the console fit through passageways, including turns, and doorways? Will it fit on the elevator? It is sometimes necessary to build a console in two or more smaller sections to permit access to the installation site.

5. Stability. Control consoles, like equipment racks, should be built with a low center of gravity to reduce the possibility of the unit toppling during construction and shipping. Even after being bolted to the floor during installation, a console is frequently required to sustain the weight of several people sitting on the desk edge. This must be taken into account both in the console design and in the selection of floor fastenings.

6. Console Ventilating or Cooling. Unless suitable steps are taken to control the temperature within a console (particularly one containing numerous heat-producing devices), the temperature may rise to a point where dependable operation is jeopardized. To prevent excessive console temperatures, it is of the greatest importance to provide means for removing heat from the console. In addition, the heat removal must be accomplished with the least possible noise. Follow the principles of ventilating and cooling given in Chapter 2.

7. Console Lighting. Provide good console lighting. This usually requires the careful coordination of general room lighting with special built-in console lighting.

Lighting a control console presents a problem of meeting two requirements that, at first consideration, seem to be in sharp conflict; i.e., some areas of a console (such as desk-surface operating positions and desk-mounted control panels) require good lighting, while other areas (such as picture and waveform monitors) should receive minimum light. In addition to meeting the above requirements, the control console lighting must be accomplished without creating specular reflections or glare from control panels, the faces of monitor tubes, or the glass control room windows. Furthermore, the console lighting system should be designed so shadows from equipment or the operator will not fall on desk-surface operating positions.

The usual solution to control console lighting, an example of which can be seen in Figure 5-14, involves the use of overhead downlight fixtures with special apertures (or angled light-directing louvres) in their escutcheon plates that place pools of light of suitable size and shape on the required areas of the console. Care should be taken to keep the color temperature of the light compatible with the white balance to which the color picture monitors are adjusted. Dimmers are desirable to provide a range of adjustment to suit the preference of the operator. When dimmers are provided, it is desirable that the color temperature remain relatively consistent at any setting.

8. Simplicity. Arrange the console control panels and monitoring displays in the most simple, straightforward, and understandable manner. Avoid unnecessary complexity. Simple designs are usually best.

9. Identification of Equipment. Clearly identify each display and each control by suitable labelling or engraving. Use lettering of adequate size for engraving and labels; older personnel often have difficulty reading small lettering. Mount panels at an angle that enhances the operator's vision of equipment and engraving.

10. Controls. Controls on a console require careful consideration in selection and application; for example:

(a) Limit the number of controls on the console to those essential for the performance of the job.

(b) The most frequently-used controls should be the most accessible.

(c) Arrange the controls so operating functions will be divided between both hands of the operator. Foot-operated controls may be used where practical.

(d) Controls must be located to fall within the reach limitations of the smallest operator. (Headroom, kneeroom, and other clearances, on the other hand, must be designed to accommodate the largest operator).

(e) The pointers of all control knobs on a console should fall in the same general position under normal operating conditions.

11. Cable Space. Adequate access space should be provided for cables to enter the console. Adequate space must also be provided for cable runs within the console.

12. Protection Against Liquids. Every reasonable precaution should be taken in the design of a control console to protect the components and wiring from damage by the accidental spilling of liquids.

13. Console Maintenance. Consider maintenance and servicing in designing a console; for example:

(a) Suitable lighting for maintenance work on the console should be provided. Built-in compartment lighting that comes on automatically when a compartment door is opened is quite desirable. As a minimum, an adequate number of reel-type cable retracting trouble lights (with plastic or plastic-insulated metal lamp cage) should be provided.

(b) Utility AC outlets for the operation of test and measuring equipment (as well as soldering irons) should be provided.

(c) Large desk-mounted panels should be hinged to permit convenient access to equipment on the underside. Panel lift handles and suitable built-in hardware to hold the panel securely in the open position should be provided. Hinges are also desirable on rack panels that must be frequently opened for access to equipment or behind-the-panel controls.

II. CONTROL PANELS

Control panels are required for many different purposes in a television broadcasting plant. They are mounted on control consoles, equipment racks, wall cabinets, film projectors, video tape machines, and on other equipment. Control panels range from relatively simple panels with a switch or two, to complex audio-video switching system control panels involving hundreds of controls.

It is the purpose of this section to discuss CBS practices in the design and construction of control panels.

A. Control Panel Construction

From the viewpoint of physical construction, control panels in CBS facilities usually fall into one of the two following classifications:

(a) A solid panel, usually metal, which both supports the equipment and contains the panel engraving.

(b) A two-layer panel assembly, both layers usually metal, consisting of an equipment-supporting under panel and a top escutcheon panel. The top panel contains the panel engraving, thereby improving the finished appearance by covering equipment mounting screws on the under panel; see Figure 5-15. Being more expensive, this type of construction should be limited to applications where appearance is important. (It may be necessary to use two-layer panels where equipment-mounting screws, unless covered, would conflict with panel engraving).

1. Panel Thickness. Solid metal panels should be either 1/8-inch or 3/16-inch thick depending on the weight of equipment they are to carry, as well as on the rigidity required. Two-layer panel assemblies usually employ an under panel 1/8-inch thick and a top (escutcheon) panel 1/16-inch thick. When used on equipment racks, it is necessary to shim panels of either type out to a total thickness of 5/16-inch (the standard rack panel thickness) in order that the surfaces of all panels will line up.

On large panels containing a substantial amount of equipment (such as a video switching panel), it is usually necessary to employ rear-of-panel stiffening members (or a reinforcing structual framework) to insure adequate panel rigidity.

2. Panel Material. CBS control panels are fabricated of 2024-T3 aluminum; a hard but easily-machinable aluminum alloy.

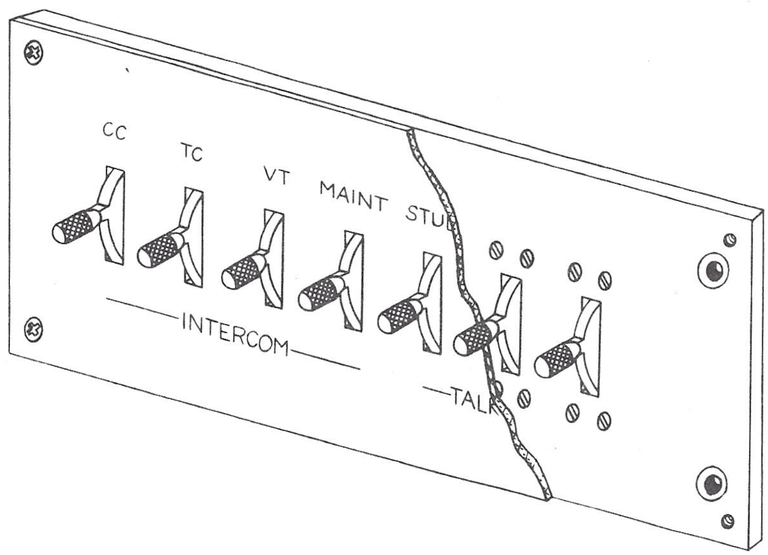


FIGURE 5-15. An escutcheon panel improves the appearance of a panel by covering the heads of equipment mounting screws.

3. Panel Finish. Except in rare cases where a non-standard finish is called for (for example, to match the decor of a special room) the following panel finishes should be used:

(a) Equipment rack control panels, and control panels mounted on the rack portions of desk-rack type control consoles, should be finished with CBS light gray baking enamel (LGBK); see Chapter 11. Engraving on these panels should be filled with white.

(b) Desk-mounted control panels should be given a fine-grained, hand-rubbed, satin finish with a clear anodize (or alumilite) treatment. Except in unusual circumstances, the grain should be horizontally oriented (that is, it should run from the left to the right side of the panel rather than from top side to bottom side). In most cases, a horizontal grain produces a more pleasing appearance and, in addition, minimizes light reflections from the panel. The engraving on these panels should be filled with black.

To obtain a satisfactory panel finish, the hand-rubbed grain must be applied in a direction that is parallel to the grain-like surface markings that are produced on sheet aluminum in the manufacturing process.

(c) Other control panels may have either the light gray baked enamel or clear anodize finish; whichever adapts better to the particular application. The anodize finish will hold up better over a long period of time.

B. Control Panel Layout

Control panels are installed in many different locations in a television plant. Some control panels are mounted on equipment racks where adjustments are made by standing operators. Other panels are installed on control consoles where they are operated by seated operators. Still other control panels are mounted on equipment units, such as the communication panel on a film projector. In order to produce an effective panel layout with functionally-located controls and well-placed panel engraving, the location of the panel in the finished plant must be known at the time it is being designed. If this is not known, it may result in an awkward-to-operate panel, or one in which the panel engraving is blocked from view by projecting equipment components or the operator's hands.

A control panel should present a pleasing appearance. Equally important, the layout of the panel must take into account the human factors of operating. Controls should be placed with due consideration to their relative importance. Frequently-used controls should be most accessible. Operation of controls should require the minimum physical and mental effort. The panel layout should minimize the possibility of operating errors.

A good way to arrive at a control panel layout that is pleasing in appearance as well as functional in operation is through the use of a paper mock-up. All that is needed is a set of full-scale paper cutouts representing the various control and equipment to be mounted on the panel, and a sheet of paper or light cardboard the size of the finished control panel. The paper cutouts can be moved about freely on the paper panel, trying various possible arrangements, until the most satisfactory layout is achieved. This mock-up method is especially useful in the study and design of a complex panel as, being full scale, it permits the designer to experience, to some extent, the feel of the finished product. It permits experimenting with actual switching operations to determine the ease, or difficulty, with which they can be achieved. Furthermore, a mock-up permits getting opinions and reactions from operating personnel in the early design stages, before design detailing or construction is started.

A number of guidelines of good practice in control panel design are given below:

(a) Frequently-used controls should be the most accessible.

(b) Avoid control configurations that are cluttered, confusing, or ambiguous.

(c) The motion of a control should be compatible with the result produced. A volume control should move up (or clockwise if it is the rotary type) for an increase in level. A switch should be thrown up to raise an object; down to lower it.

(d) The physical movement of a control should be as natural and free of effort as possible (but not so free of effort that it can be moved accidently; see (e) below). This involves careful consideration of many factors including (1) the shape of the control knob, (2) the type of motion necessary for its operation (rotation, up-down, side-to-side), (3) the degree of motion necessary, (4) the angle of the panel on which the control is mounted, (5) the position of the operator's hand and arm in reaching the control.

(e) Allow adequate space between controls so an operator with large hands will not accidently move one control while adjusting another.

(f) Install a protective barrier or similar protection around critical controls that could cause operating difficulties or loss of program if accidently operated.

(g) Use different size control knobs for different control functions, for example, use:

Large knobs for primary controls.

Medium knobs for secondary controls.

Small knobs for set-up controls.

Screw driver adjustment for maintenance controls.

(h) Use different color knobs to differentiate various control functions.

(i) No matter how attractive their appearance, do not use knobs without fluting or other provisions for a sure and comfortable grip. The knobs should have an easily-visible pointer (in applications where a pointer is needed), the position of which can be determined by feel without looking at the knob. Two knobs that meet these requirements are shown in Figure 5-16.

(j) Provide good separation between program channel controls and those that affect only monitoring or non-program circuits. When close spacing cannot be avoided, use different size knobs, or different color knobs, or controls with a different feel (detents, for example), or a combination of two or all three of the above.

FIGURE 5-16. Two good knobs for control panels. They are available in a variety of sizes and colors.

(k) Determine the range of control required and design the associated circuitry so this amount and no more is provided by the control. If greater range is required in setting up the system, this greater range should be restricted to the set-up control.

C. Control Panel Engraving

A plain, easily-readable, block-style typeface should be used for panel engraving. The CBS standard typeface is Gorton Normal, see Figure 5-17. Gorton Condensed typeface, which is the same style as Gorton Normal, may be used when space is limited.

In specifying engraving, it is also necessary to specify the height of the characters and the width of the finished engraved line. For all normal work, CBS standard engraving character sizes from Table 5-1 should be used.

ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890

GORTON NORMAL

ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890

GORTON CONDENSED

FIGURE 5-17. Examples of Gorton typeface. Gorton Normal is normally used, Gorton Condensed is used when space is limited.

TABLE 5-1. STANDARD CBS ENGRAVING SIZES

CHARACTER HEIGHT, INCHES*	WIDTH OF ENGRAVED LINE (FACE WIDTH), INCHES**	ILLUSTRATION, FULL SCALE
1/16	0.012	COLUMBIA
3/32	0.016	COLUMBIA
1/8	0.020	COLUMBIA
5/32	0.024	COLUMBIA
3/16	0.028	COLUMBIA
7/32	0.032	COLUMBIA
1/4	0.035	COLUMBIA
3/8	0.050	COLUMBIA
1/2	0.065	COLUM
3/4	0.095	COLU

*ACTUALLY "NOMINAL" HEIGHT, SEE FIGURE 5-18.

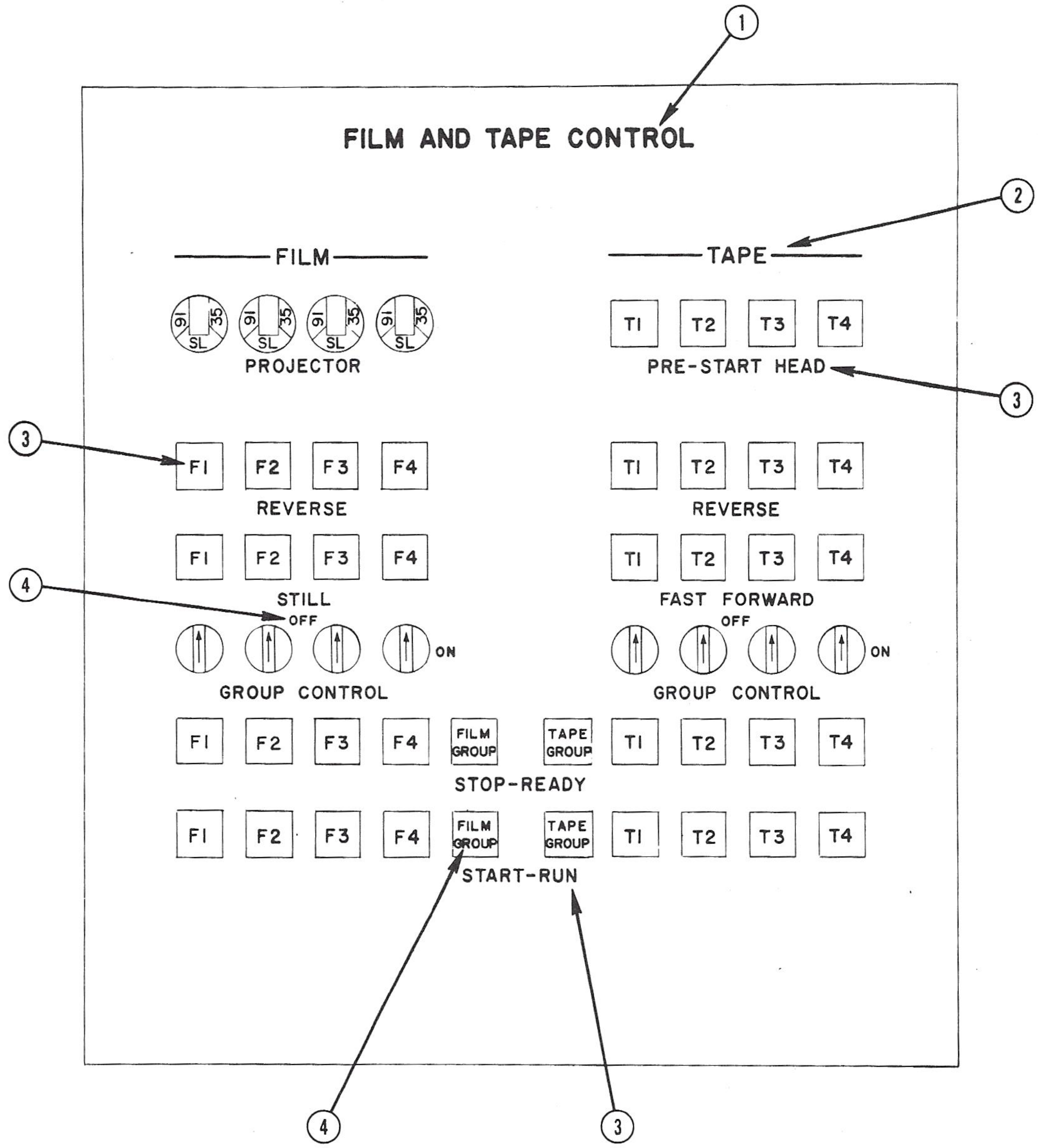
**PANELS WHICH ARE TO HAVE A BAKED ENAMEL FINISH ARE FREQUENTLY ENGRAVED PRIOR TO ENAMELLING TO AVOID THE POSSIBILITY OF CRACKING THE ENAMEL COATING DURING ENGRAVING. TO PRODUCE THE SPECIFIED LINE WIDTH WHEN THIS IS DONE, ALLOWANCE MUST BE MADE FOR THE FILLING EFFECT OF THE ENAMEL IN THE ENGRAVED CUTS. THIS CAN BE DONE BY ENGRAVING A SUITABLY WIDER LINE.

NOTE: ALTHOUGH NOT ILLUSTRATED, CHARACTERS LARGER THAN 3/4-INCH MAY BE USED WHEN NEEDED. KEEP FACE WIDTH PROPORTIONAL TO 1/2-INCH CHARACTER, I.E., 1-INCH, 1-1/2-INCH, AND 2-INCH HIGH CHARACTERS SHOULD HAVE FACE WIDTHS OF 0.130, 0.195, AND, 0.260 INCHES RESPECTIVELY.

If you have ever wondered why engraving sometimes seems slightly larger than expected, the explanation can be seen in Figure 5-18. Engravers measure the height of an engraved character as the distance between cutting tool centers; see "nominal height" in Figure 5-18. As can be seen, this results in an engraved character that has an actual "total height" that is the nominal height plus the face width.

It is important that appropriate size engraving for the application at hand be employed. The engraved characters must be clearly readable at the normal viewing distance and under the normal lighting conditions. Major information should employ slightly larger characters than minor information. Figure 5-19 gives examples of good design practice in the selection of appropriate engraving size for control panels. Of course, if engraving is being added to an existing installation, it should conform in size to that already in use.

FIGURE 5-18. The "nominal height" of an engraved character is the distance between the center lines of the top and bottom engraving tool cuts. The "total height" is the actual overall height of the engraved character (nominal height plus "face width"). To an engraver, the height of a character is the "nominal height".



ENGRAVING HEIGHT

(1) USE 3/16-INCH CHARACTERS FOR CONTROL PANEL IDENTIFICATION.

(2) USE 5/32-INCH CHARACTERS FOR WORDS TO BE EMPHASIZED (IMPORTANT CONTROL GROUPINGS OR MAJOR EQUIPMENT CONTROL).

(3) USE 1/8-INCH CHARACTERS FOR ALL NORMAL PANEL ENGRAVING, INCLUDING ENGRAVING ON FACE OF PUSHBUTTONS.

(4) USE 3/32-INCH CHARACTERS FOR SECONDARY INFORMATION OR WHERE SPACE IS LIMITED. (NOT RECOMMENDED FOR PANELS WITH BAKED ENAMEL OR PAINT FINISH).

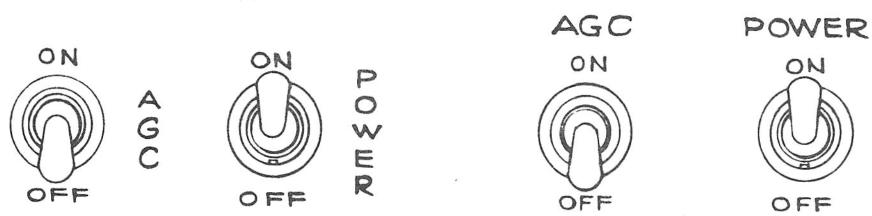
FIGURE 5-19. Recommended character height for control panel engraving, one-half full size.

The general rules given below should be followed in the layout of panel engraving:

(a) Use only capital letters.

(b) Engraving should be brief, but as clear and unambiguous as possible. It should indicate what is being controlled or measured rather than state the name of the component. For example, STUDIO CUE, not CUE SELECTOR.

(c) Orient engraving horizontally, not vertically.

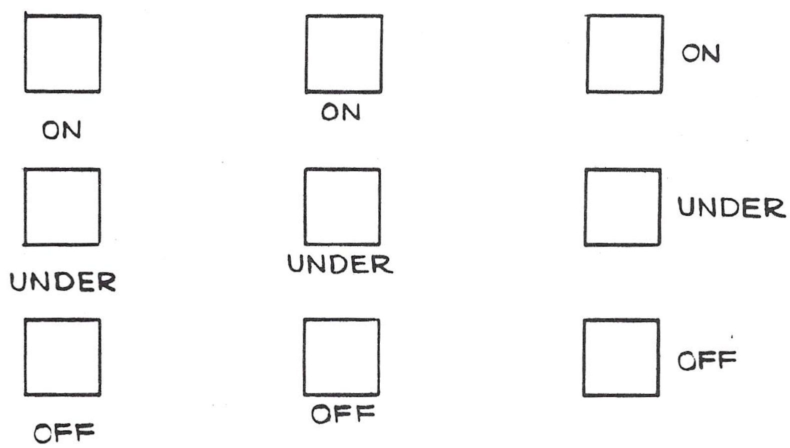


POOR GOOD

(d) Avoid abbreviations that may be confusing. If space permits, words should be spelled out. For example, MULTIPLE spelled out is best, MULT is good, MT is poor. When abbreviations must be used, use standard CBS abbreviations from Chapter 11.

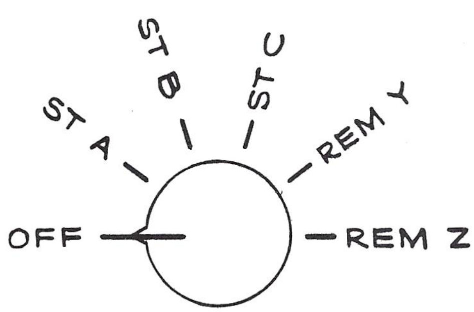
(e) Put engraving consistently either above or below controls. Above the control is preferred on equipment rack panels (provided it is clearly visible), but it is usually necessary to put engraving below the controls on a horizontal desk-top control panel for good visibility.

(f) Avoid placing engraving between two controls in such a manner that the control to which the engraving refers may not be clear.

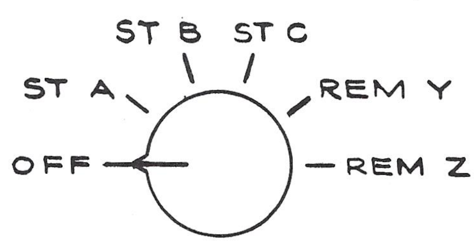


POOR BETTER GOOD

(g) Engraving for the positions of a rotary selector switch should be placed alongside the switch positions, horizontally oriented.

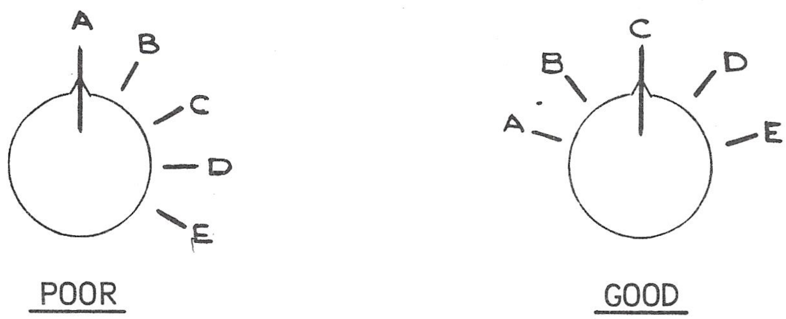


WRONG



RIGHT

(h) Maintain symmetry in arranging letters or numerals around a selector knob, for example:



(i) Engraved lines on control panels to indicate signal paths or circuitry are useful only if well done. Plan carefully and use sparingly. An example is shown in Figure 5-20.

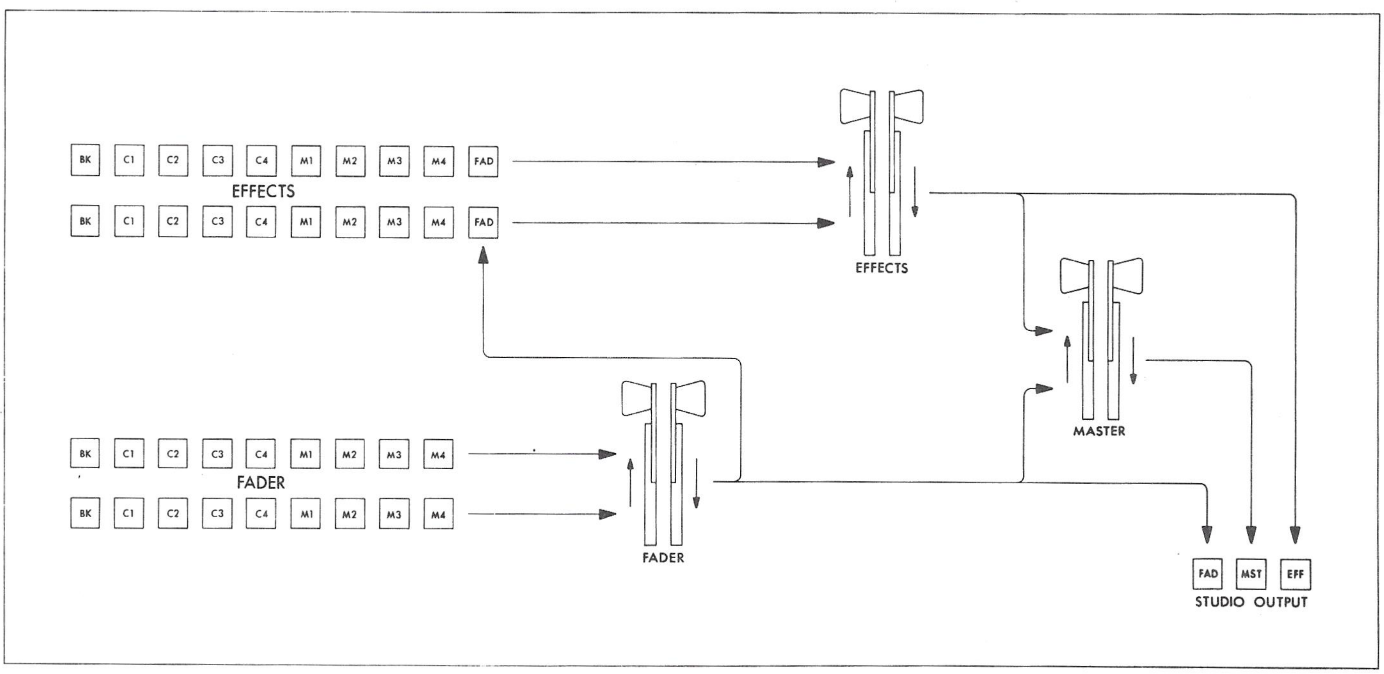


FIGURE 5-20. Example of use of engraved lines on control panel to indicate signal paths.

(j) Avoid stamped, decal, silk-screened, or stenciled letters on control panels (but these are satisfactory on chassis, circuit boards, terminal blocks, and similar applications).

III. AV OUTLETS

Receptacles for cameras, microphones, floor monitors, headsets, and other audio-video gear must be provided in every television studio, as well as in other areas of a television plant where programs originate; such as a News Room. Receptacles must also be provided for studio-to-control-room tie lines, sound effects circuits, and ac power.

The methods by which these audio-video outlets are installed in CBS television plants, and the hardware used, are described below.

A. CBS Type 7 AV Outlets

In CBS television installations, studio outlets are installed in CBS type 7 AV outlet boxes and plates. In order to meet the differing outlet requirements of television studios, which vary with the scope of the studio's audio-video installation, CBS type 7 AV outlet boxes come in different sizes, and CBS type 7 AV plates come with a variety of outlet arrangements. These CBS type 7 boxes and plates constitute building blocks from which studio AV outlets suitable for the job at hand can be assembled.

To make engineering drawings of the CBS type 7 boxes and plates readily available, this information has been documented on CBS Standard Drawings (see "Reference Drawings" listed at end of this chapter).

An example of a CBS type 7 AV outlet box assembly is shown in Figure 5-21. As can be seen, the assembly consists of a metal box, several color-coded outlet plates, and a suitable outlet-identifying designation card above each outlet. The plates are hinged along the bottom edge to provide convenient access to the wiring and receptacle terminals for servicing.

CBS type 7 AV outlet boxes are usually mounted on the studio walls at a convenient height for easy access (20 inches from centerline to floor) but, on occasions when operating practices warrant it, they are mounted aloft on the studio lighting overhead structure.

In order that a receptacle will always be near at hand, it is the usual practice, in all but the smallest studios, to install several AV outlet box assemblies, distributing them throughout the performing area of the studio.

A description of the CBS type 7 boxes, plates, and associated hardware is given below:

1. Boxes. The CBS type 7 AV outlet box (actually a family of outlet boxes) shown in Figure 5-22, is 7-inches high, 5-inches deep, and comes in lengths from 7 inches to 105 inches in increments of 7 inches. (There is also a 10 1/2-inch long size that is not a 7-inch increment). These boxes are made of steel and, unless otherwise specified, are finished with CBS light gray baking enamel (see Chapter 11).

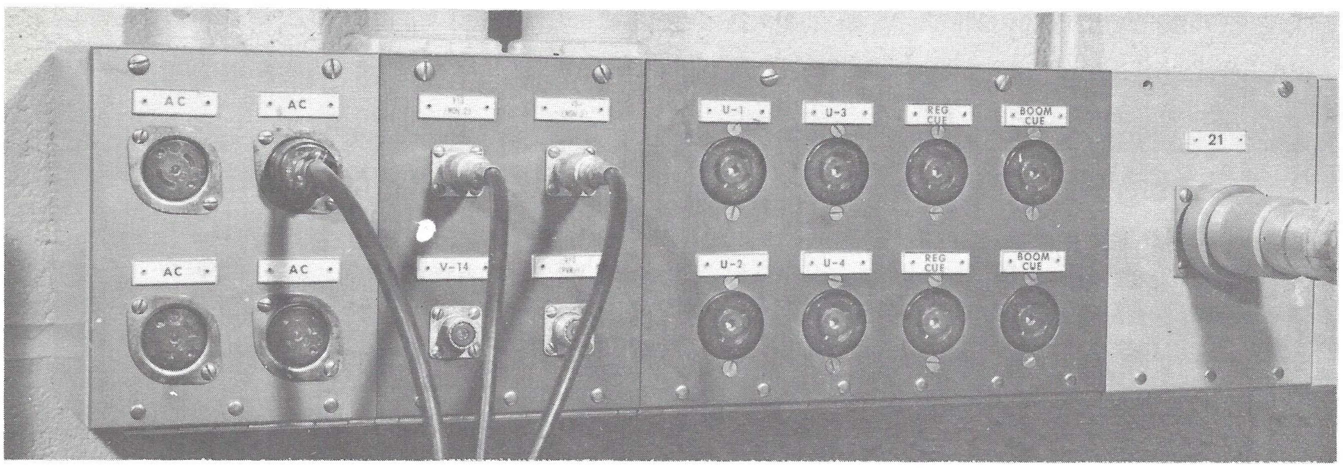
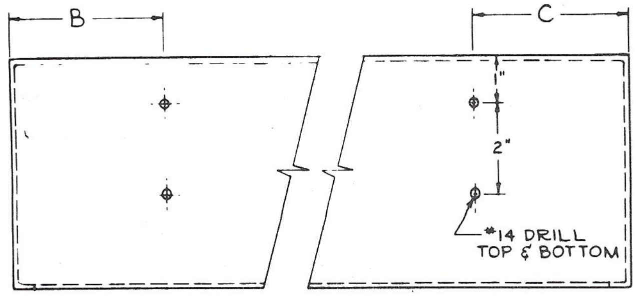
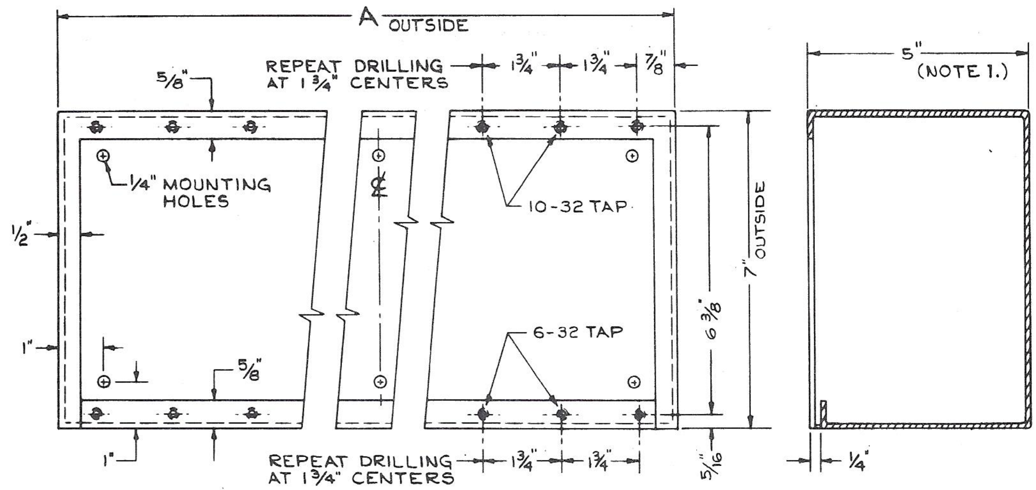


FIGURE 5-21. A CBS type 7 AV outlet assembly.



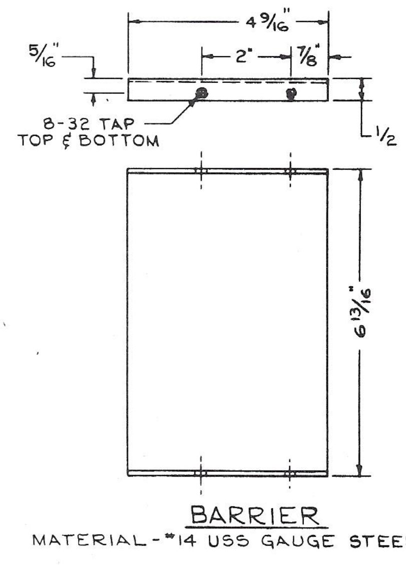
NOTES:
1. BOX DEPTH AS SHOWN UNLESS OTHERWISE SPECIFIED.
2. TOLERANCE ON ALL DIMENSIONS PLUS OR MINUS 1/32".



BOX
MATERIAL - #14 USS GAUGE STEEL
FINISH - PRIME COAT ZINC CHROMATE, THEN CBS LIGHT GRAY BAKING ENAMEL (UNLESS OTHERWISE SPECIFIED).

BOX TYPE	DIM A	DIM B	DIM C
CBS 7-7	7"	3 1/2"	—
CBS 7-10 1/2	10 1/2"	3 1/2"	3 1/2"
CBS 7-14	14"	3 1/2"	3 1/2"
CBS 7-21	21"	3 1/2"	7"
CBS 7-28	28"	5 1/4"	7"
CBS 7-35	35"	5 1/4"	10 1/2"
CBS 7-42	42"	5 1/4"	10 1/2"
CBS 7-49	49"	5 1/4"	10 1/2"
CBS 7-56	56"	5 1/4"	10 1/2"
CBS 7-63	63"	5 1/4"	10 1/2"
CBS 7-70	70"	*	*
CBS 7-77	77"	*	*
CBS 7-84	84"	*	*
CBS 7-91	91"	*	*
CBS 7-98	98"	*	*
CBS 7-105	105"	*	*

* LOCATION OF HOLES FOR MOUNTING STEEL BARRIER TO BE SPECIFIED ON JOB DWG. (OUTLET BOX LAYOUTS)



BARRIER
MATERIAL - #14 USS GAUGE STEEL
FINISH - PRIME COAT ZINC CHROMATE, THEN CBS LIGHT GRAY BAKING ENAMEL (UNLESS OTHERWISE SPECIFIED).

FIGURE 5-22. CBS type 7 AV outlet box.

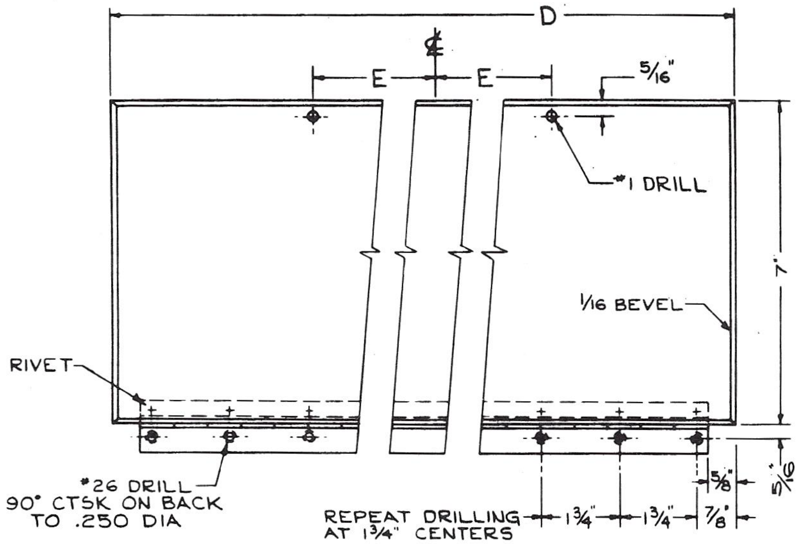
2. Plates. CBS type 7 plates (panels) are 7-inches high, and come in lengths ranging from 3-1/2 inches to 21 inches in increments of 1-3/4 inches. A typical undrilled plate is shown in Figure 5-23, together with a section view showing the panel and box. The plates are made of 1/8-inch thick 2024-T3 aluminum. They have a fine-grained, horizontally-oriented, hand-rubbed, satin finish with a colored anodize (or alumilite) treatment. The plates are colored according to function, as shown below, to aid studio operating personnel in quickly locating a desired outlet.

Plate Function	Plate Color
Camera	Clear
Microphone	Green
Monitoring*	Blue
AC Power	Gold
Sound Effects	Purple
Utility Control**	Red

To assure receiving the CBS standard color finish (many shades of each color are available), a color sample should be made available to the supplier of the plates. Color samples of the CBS standard plate finishes are available from the CTN Engineering and Development Drafting Room.

*Monitoring plates include outlets for loudspeakers, headphones, utility circuits, tie lines, and picture monitors.

**Utility control circuits are control-room-to-studio tie lines for handling control circuits of special equipment such as prompting and timing devices which might cause interference if fed through the audio tie lines.

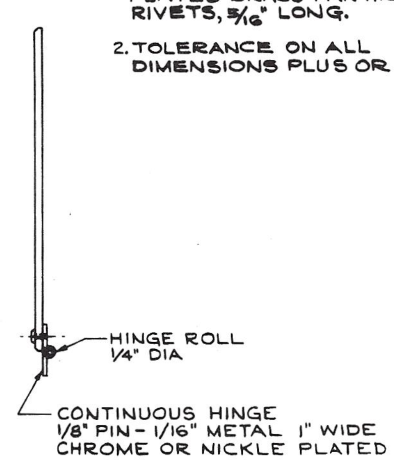


PLATE

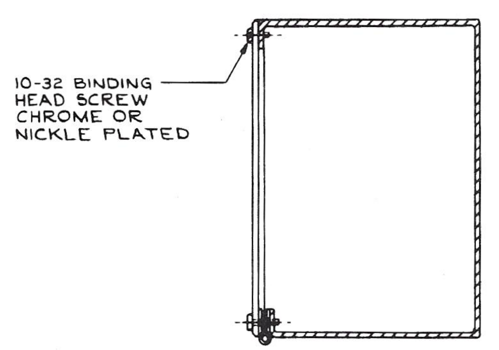
MATERIAL-1/8" THK 2024-T3 ALUMINUM
FINISH-ANODIZE, COLOR TO BE SPECIFIED
(SEE NOTE 1.)

NOTES:

1. AFTER FINISHING FASTEN HINGE TO PLATE WITH 1/8" NICKLE PLATED BRASS PAN HEAD RIVETS, 5/16" LONG.
2. TOLERANCE ON ALL DIMENSIONS PLUS OR MINUS 1/32".



BLANK PLATE TYPE	DIM D	DIM E
CBS 7-3 1/2	3 15/32"	7/8"
CBS 7-5 1/4	5 7/32"	1 3/4"
CBS 7-7	6 31/32"	2 5/8"
CBS 7-8 3/4	8 23/32"	3 1/2"
CBS 7-10 1/2	10 15/32"	2 5/8"
CBS 7-12 1/4	12 7/32"	3 1/2"
CBS 7-14	13 31/32"	4 3/8"
CBS 7-15 3/4	15 23/32"	5 1/4"
CBS 7-17 1/2	17 15/32"	6 1/8"
CBS 7-19 1/4	19 7/32"	7"
CBS 7-21	20 31/32"	7 7/8"



REFERENCE LIST	
PLATE	DWG NO.
AUDIO, TYPE 7	S5-2
VIDEO, TYPE 7	S5-3
UTILITY, TYPE 7	S5-4

ASSEMBLY BOX AND PLATE
SECTION

FIGURE 5-23. CBS type 7 outlet plate.

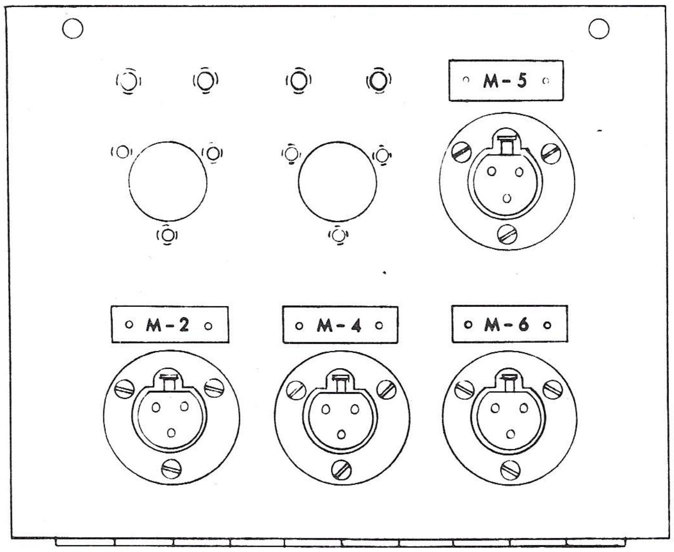
Two typical AV plate receptacle arrangements are illustrated in Figure 5-24. The full complement of standard AV outlet plate receptacle arrangements can be found on the CBS Standard Drawings covering these plates (see "Reference Drawings" listed at the end of this chapter).

3. Designations. The function of each outlet on a CBS type 7 AV outlet box must be clearly identified. For this purpose a plastic-protected paper designation card is provided above each outlet. These plastic-protected designation cards can be seen on the AV outlet box of Figure 5-21. Centered above each outlet are two tip jacks (H.H. Smith No. 147 or equivalent). These tip jacks hold in place a CBS 1F 7/16 by 1-1/2-inch clear plastic, plug-in, designation cover strip. This plug-in designation cover strip, in turn, supports and protects the outlet-identifying paper designation card.

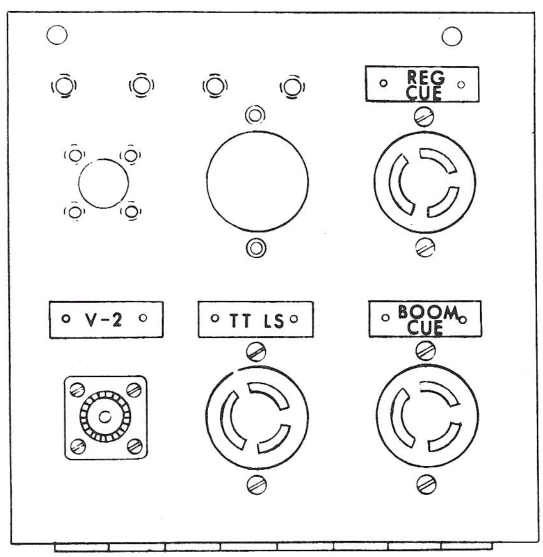
4. Connectors. The CBS standard connectors to be used on CBS Type 7 AV outlet plates are listed below:

Service	Connector	Cable
Low-Level Audio (microphones, turntables).	Cannon UA-3-13	CBS 2FA
Medium- & High-Level Audio (headphones, loudspeakers, utility lines, tie lines, interphone).	Hubbell 7586 (Hubbell 7556 at sending end such as at sound effects console).	CBS 2FA
Utility Control (prompting control, timing control).	Hubbell 7586 (Hubbell 7556 at control room end).	14/3 lead-covered power cable
Video (picture monitors, pulses, tie lines).	Amphenol 83-1R	CBS 1CA
AC Power	Hubbell 7487	No. 12 TW copper conductors

There are no industry standards for television camera connectors or cable at this time. Until standardization has been achieved, the camera receptacles to be used on the AV outlet boxes in a given installation will be determined by the type of camera being used.



A. MICROPHONE PLATE



B. MONITORING PLATE

FIGURE 5-24. Typical CBS type outlet plates, showing some receptacles in place and drilling for others.

5. Barrier. It is CBS standard practice (and an electrical code requirement) to isolate the ac compartment of an AV outlet box from adjacent compartments with a metal barrier. It is also CBS standard practice to isolate the microphone (or any low-level audio) compartment of an AV outlet box from adjacent compartments with a metal barrier. Details of this metal barrier are given in Figure 5-22.

With the exception of ac power cables and microphone cables, all cables enter an AV outlet box through a common wireway; usually a 4- by 4-inch metal duct. The ac power cables and the microphone cables enter their isolated AV outlet box compartments through separate electrical conduits.

As it is desirable to provide the maximum possible isolation between ac power and microphone circuits, the conduits carrying these two services, as well as the two AV box compartments themselves, should be physically separated as much as possible. The arrangement shown in Figure 5-25, where the ac power compartment and the microphone compartment are at opposite ends of the AV box, is recommended.

6. Wiring. Wiring details of typical AV outlet plates are shown in Figure 5-26 through 5-35. In each of these wiring details, the panel is viewed in the open position, that is, as it would be seen when viewed from the front with the panel in the hinged-down position.

Although not essential, a terminal block is sometimes quite convenient for handling the wiring associated with audio and communication circuits (regular cue, boom cue, talkback loudspeakers, turntable loudspeakers, audio utility lines, and sound effects lines). In some AV boxes, the audio cable after connecting to the appropriate outlet, must continue on to another AV box. A terminal block, such as the CBS 2006 (see Chapter 4, page 4-5), is a convenient way of handling these loop-thru connections. A further advantage of a terminal block is that it permits a substantial portion of the AV outlet wiring to be done in the shop prior to the installation of the box.

Wiring associated with other AV outlets (AC, microphone, camera, utility control) do not employ terminal blocks.

7. Unused Plate Holes. Because of the use of standard plates, it often happens that one or more of the receptacle mounting holes will not be required. To produce a finished professional-appearing installation, it is desirable that these unused holes be covered. Although, in the past, special colored blank plates have been installed over these unused holes, it has been found more expedient, neater in appearance, and no more expensive to install actual receptacles. This should be done and blank designation cards installed above these outlets.

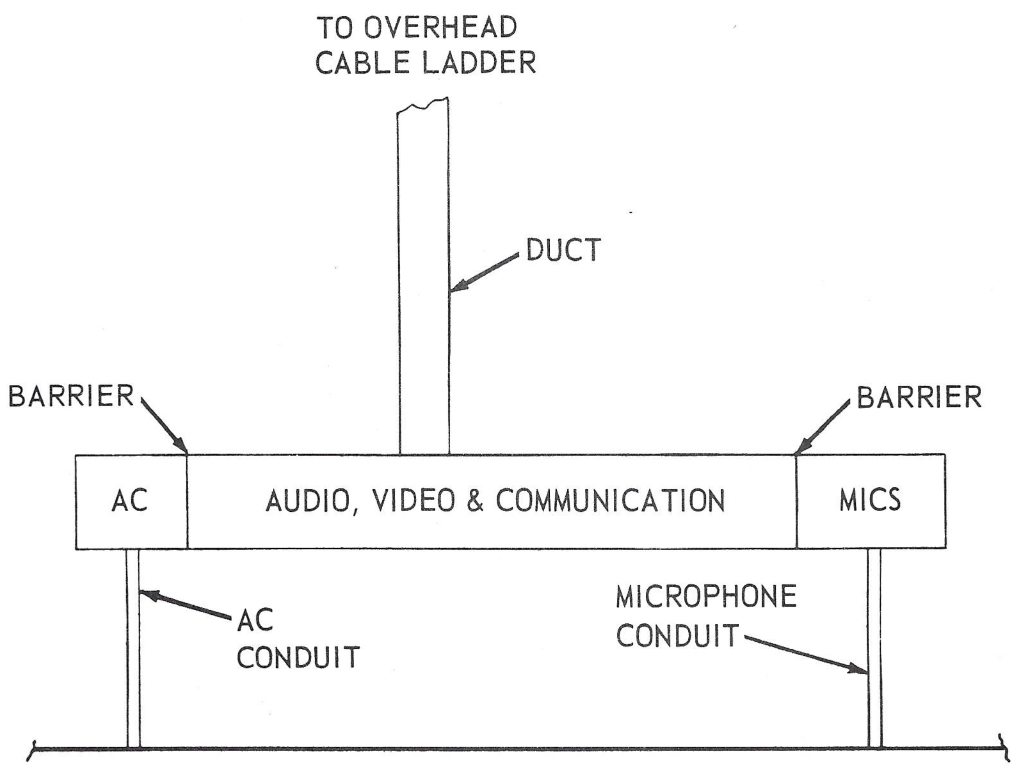


FIGURE 5-25. It is standard practice to locate the ac and microphone compartments of a studio AV outlet at opposite ends of the box. The cables feeding these two compartments are carried to these end compartments through separate conduits. The remaining outlets in the center area of the box are fed through a common duct or conduit.

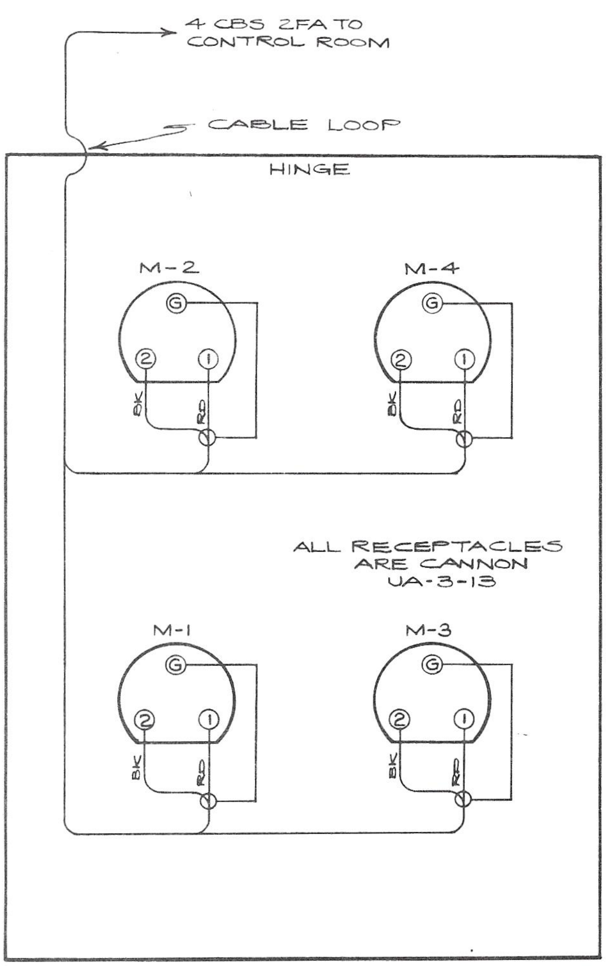


FIGURE 5-26. Wiring details of microphone AV plate.

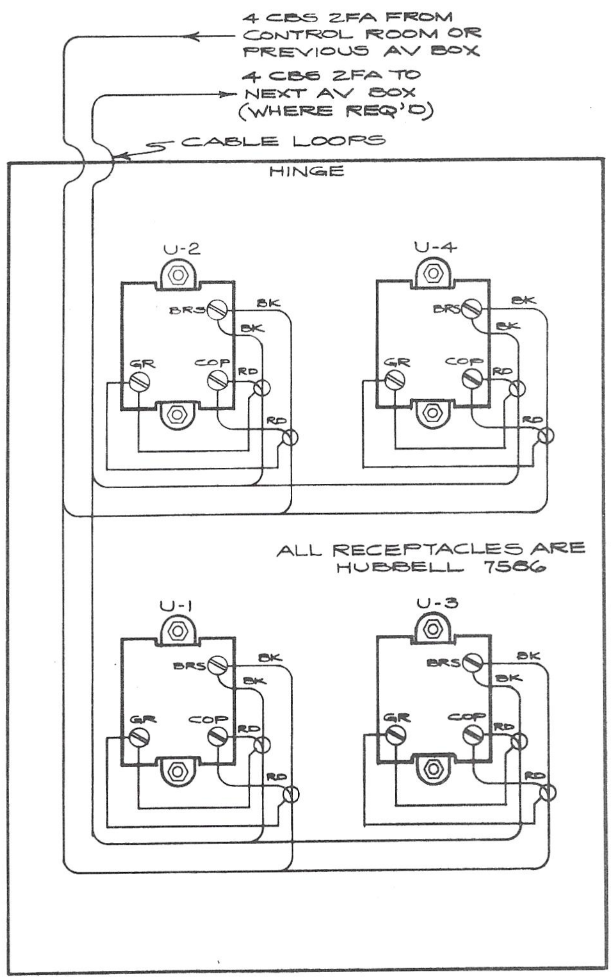


FIGURE 5-27. Wiring details of audio utility AV plate.

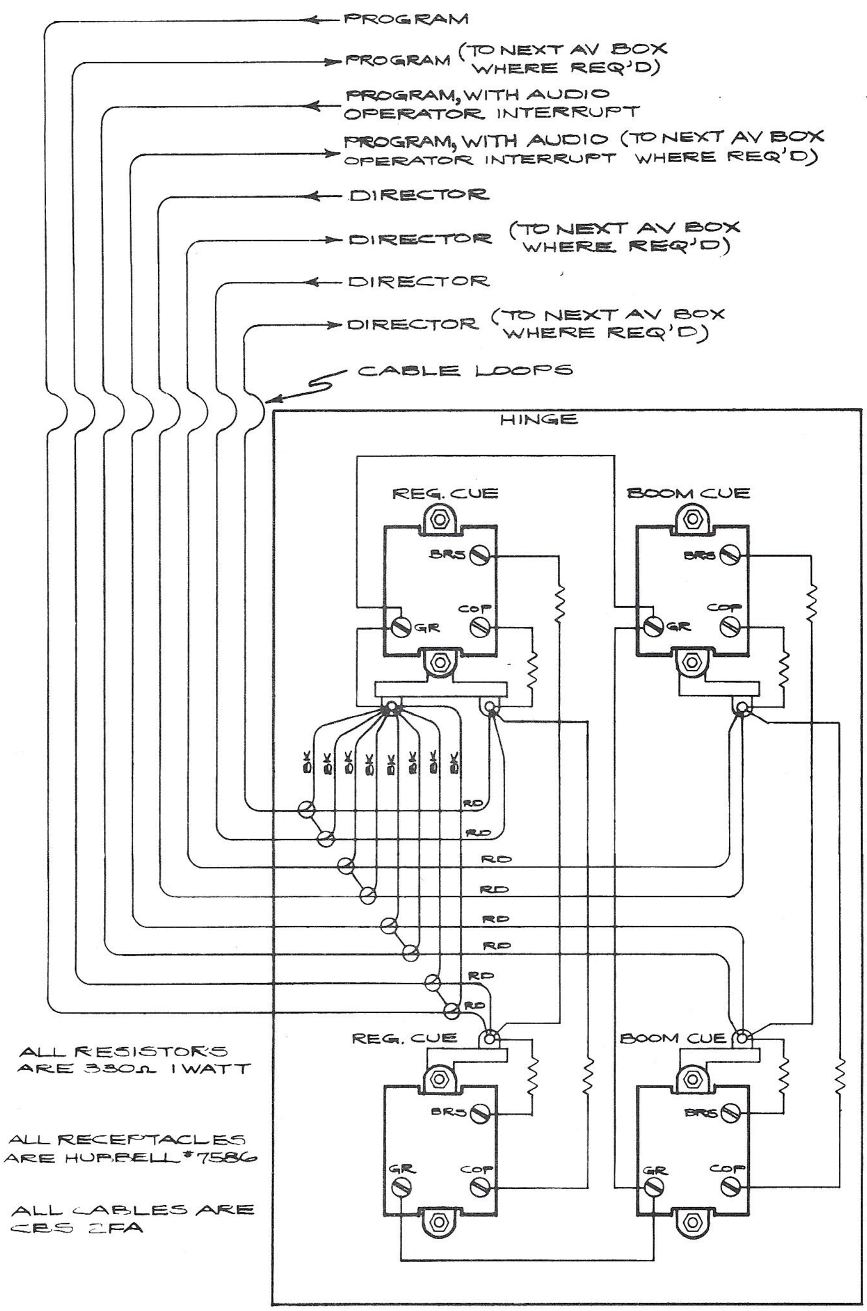
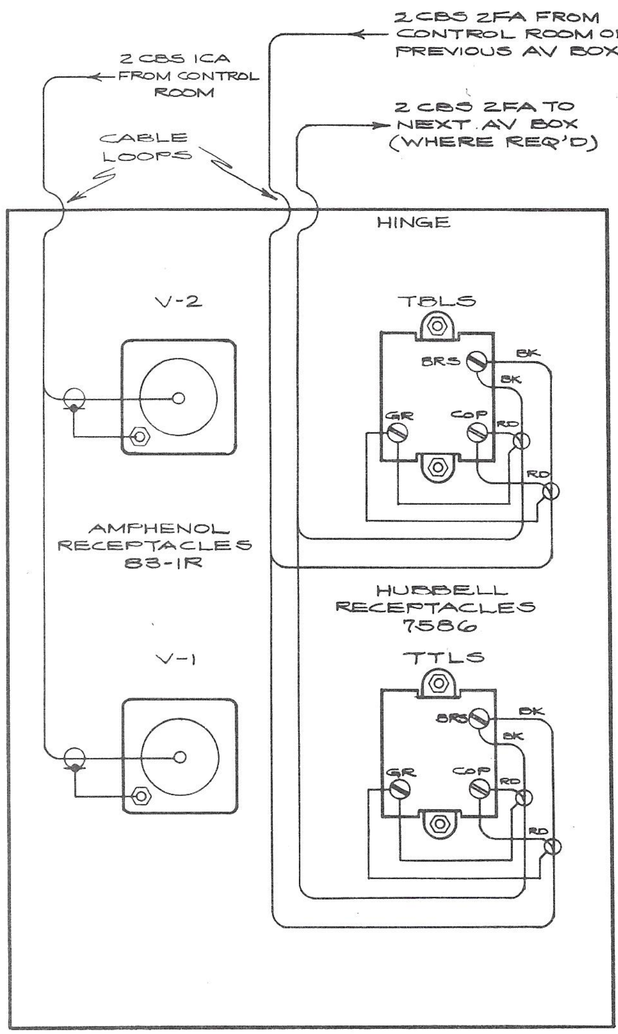


FIGURE 5-28. Wiring details of headphone cue AV outlet plate.



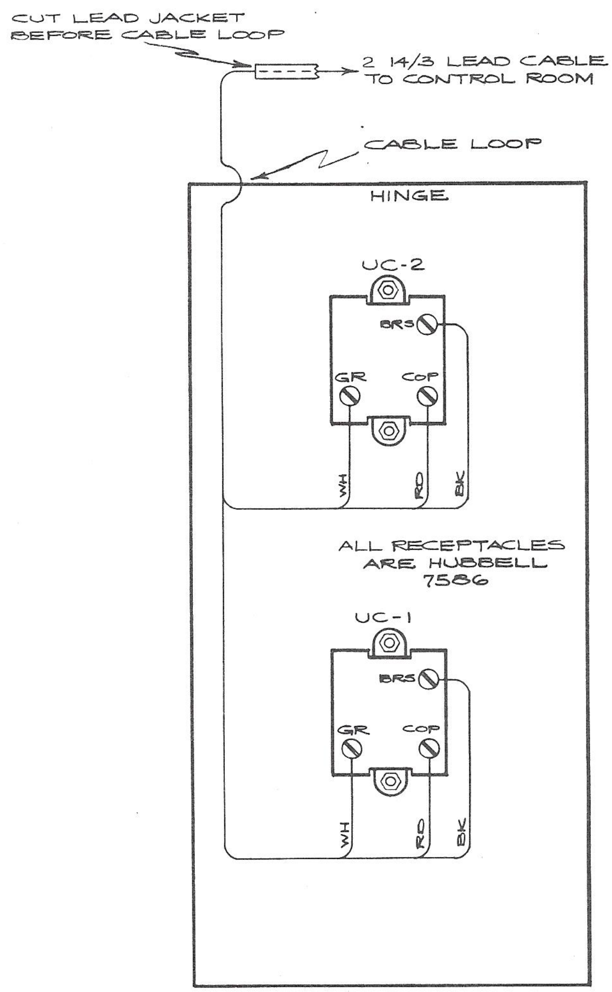


FIGURE 5-29. Wiring details of AV outlet plate containing two video outlets, one talkback loudspeaker outlet, and one turntable loudspeaker outlet.

FIGURE 5-30. Wiring details of utility control AV plate.

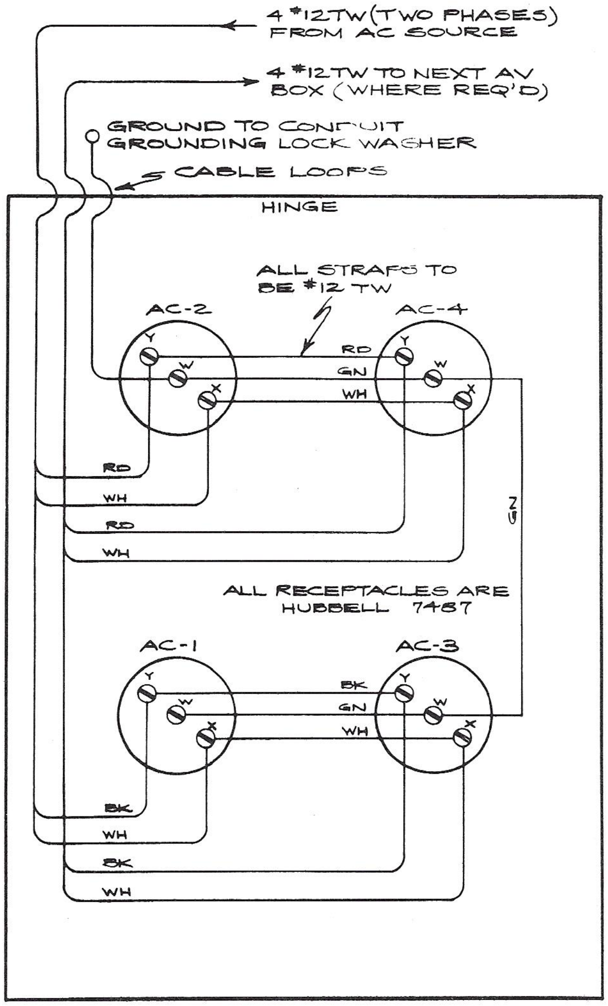


FIGURE 5-31. Wiring details of AV outlet plate with four ac outlets.

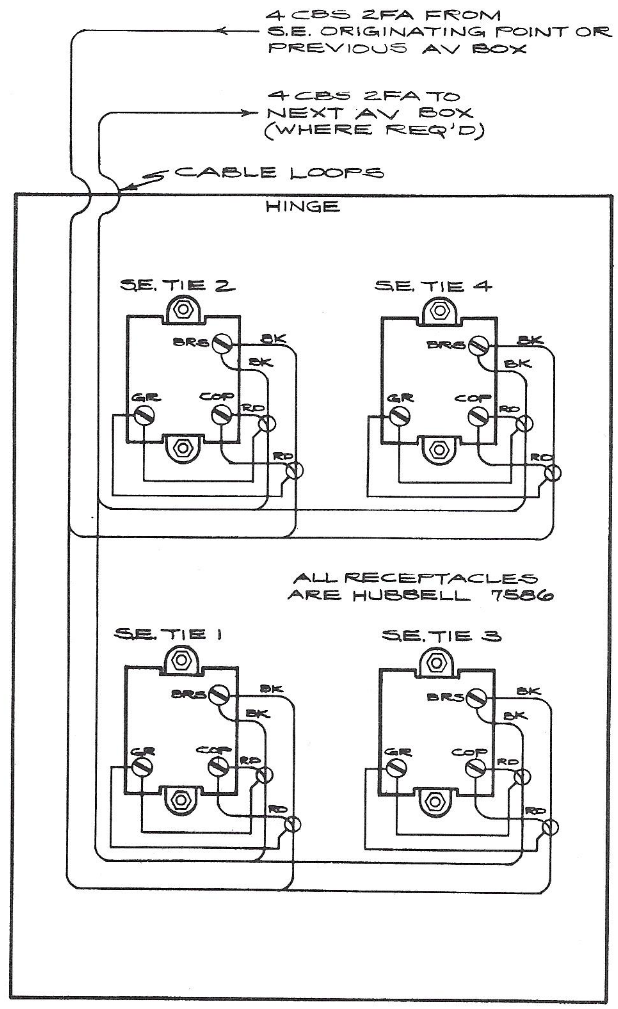


FIGURE 5-32. Wiring details of sound effects "tie" AV plate used in studio AV outlet boxes for connection of sound effects loudspeakers.

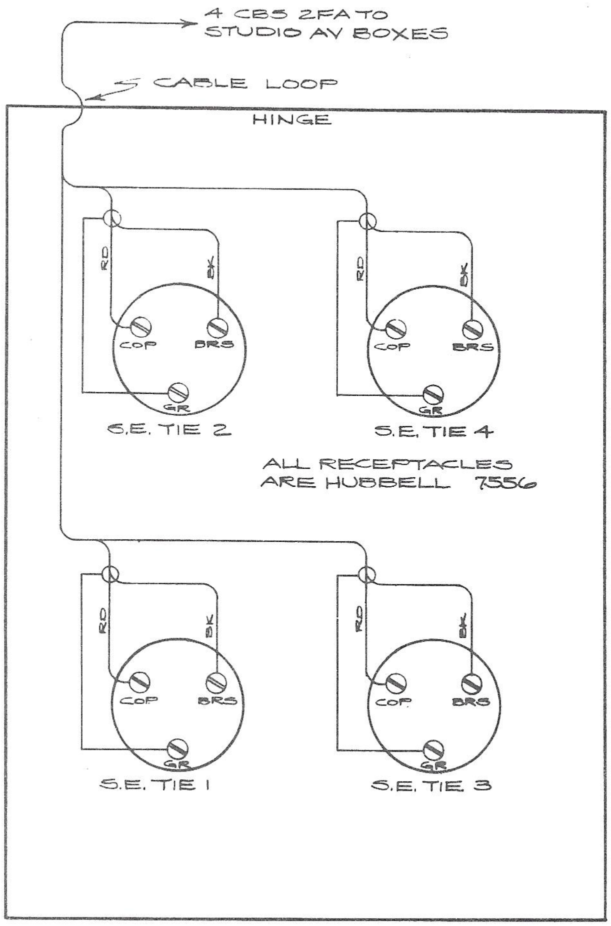


FIGURE 5-33. Wiring details of sound effects "tie" AV plate used at sound effects originating point. Sound effects ties are used to transmit high-level sound effects program material to portable loudspeakers on the studio floor.

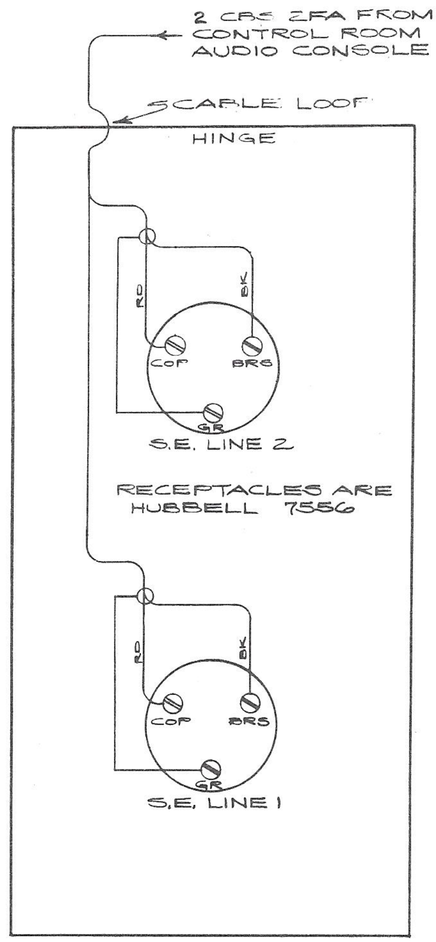


FIGURE 5-34, Wiring details of sound effects "line" AV plate used at sound effects originating point. These lines are used to transmit medium-level sound effects program material to control room audio console.

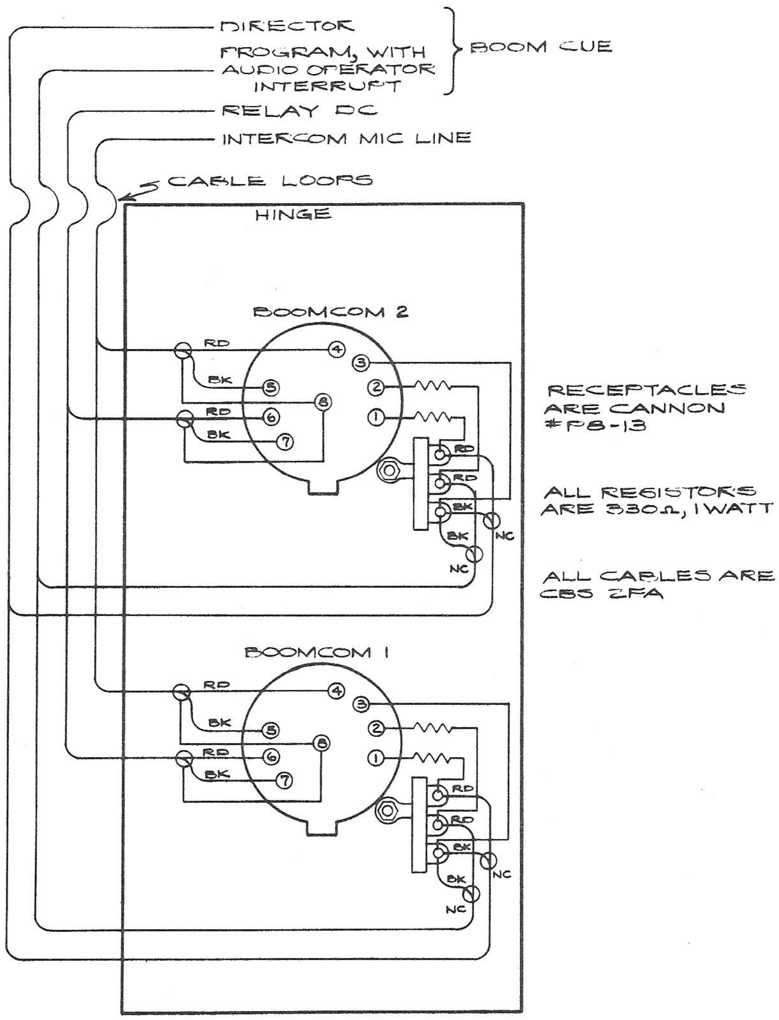


FIGURE 5-35. Wiring details of boomcom AV plate.

B. Economy AV Outlets

The need often arises for a small number of outlets in a location where appearance is unimportant, such as in a shaftway, a utility closet, or inside built-in office or viewing room cabinet work.

When such outlets are needed, it would be difficult to justify economically the use of CBS type 7 boxes and plates. A less expensive alternate, and the recommended hardware to use in such applications, is the AV outlet illustrated in Figure 5-36. This economy AV outlet employs the electrical-industry standard 4-11/16-inch square outlet box, surface-mounted with exposed conduit, with the receptacles mounted on an aluminum cover plate. Two possible cover plate outlet arrangements are shown in Figure 5-36. Additional panel outlet arrangements are given on the CBS Standard Drawing covering these economy-type AV outlets (see "Reference Drawings" listed at end of this chapter).

The same economy-type AV outlet principle described above can also be applied to installations where appearance is important (such as offices or conference rooms) by using concealed-in-wall conduit, an electrical-industry standard flush-mounting wall box, and an electrical-industry standard blank cover plate. The blank cover plate is suitably drilled to accommodate the required outlets using the same drilling details employed for the surface-mounted units described above.

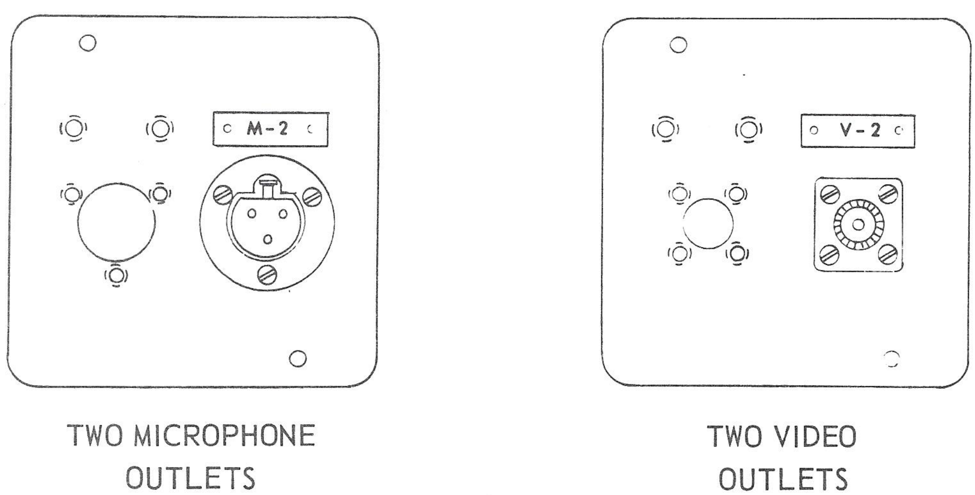


FIGURE 5-36. An AV outlet for use in areas where appearance is not important may employ a surface-mounted 4-11/16-inch electrical outlet box with a suitably-drilled, 1/8-inch thick aluminum cover plate. Two cover plate arrangements are shown above. In each case, drilling only is shown for one of the two receptacles.

REFERENCES

1. Henry Dreyfuss, THE MEASURE OF MAN, 2nd ed., Whitney Library of Design, New York, N.Y., (1967).

2. Wesley E. Woodson and Donald W. Conover, HUMAN ENGINEERING GUIDE FOR EQUIPMENT DESIGNERS, 2nd ed., University of California Press, Berkeley, Calif., (1966).

REFERENCE DRAWINGS

CBS DWG. NO.	TITLE
S2 SERIES	TYPE B MONITOR RACK AND ASSOCIATED HARDWARE
S2-1	Assembly
S2-2	Base, Side Plate, Top and Slide Mounting Angle, Mechanical Details
S2-3	Doors, Mechanical Details (Solid and Vented)
S2-4	Terminal Block Mounting Hardware, Mechanical Details
S2-5	Grounding Bus, Mechanical Details
S4 SERIES	CBS RACK PANELS, CHASSIS, AND SHELVES
S4-2	Standard Panels
S5 SERIES	AV BOXES AND PLATES
S5-1	CBS Type 7 Outlet Boxes and Blank Plates
S5-2	CBS Type 7 Audio Plates
S5-3	CBS Type 7 Video Plates
S5-4	CBS Type 7 Utility Plates
S5-5	AV Outlet Plates for One- and Two- Gang Electrical Boxes
S5-6	AV Plates, Typical Wiring Details

6. Grounding Practices

CHAPTER 6

GROUNDING PRACTICES

6 GROUNDING PRACTICES

It is well known that a television broadcasting system, to perform correctly, must be properly grounded. If it is not, hum, cross talk, and unstable operation can be expected. Despite the importance of good grounding, little has been written on this subject. As a result of the lack of authoritative information, the subject of system grounding has, to some extent, become surrounded with mystery. It is the purpose of this chapter to clarify this situation by describing CBS principles of good grounding practice for television broadcasting systems.

I. AUDIO-VIDEO GROUNDING SYSTEMS

Grounds in a television broadcasting system are made by connecting each rack, console, and other equipment unit requiring a ground to the "system ground bus". The system ground bus is a network of low-impedance copper busses and conductors carried throughout a television plant by means of conduits, cable ducts, overhead cable ladders, and underfloor wiring ducts. The system ground bus, in turn, is connected to earth through a "main ground bus" to a "main ground". In larger plants, a "ground distribution point" may be involved in the grounding system. Each of the above-mentioned elements of a grounding system for a television broadcasting plant are described more fully in the following paragraphs.

A. Main Ground

The point in a television broadcasting installation where the connection to earth is made is known as the "main ground". The grounding conductor that connects to the main ground is known as the "main ground bus".

It is the usual practice in television broadcasting installations to make the main ground connection to an incoming metallic cold-water supply pipe. This connection should be made as close as possible to the point where the pipe enters the building from underground. Further, the ground connection should always be made on the ground side of the first pipe joint. Figure 6-1 shows a main ground connection made in this manner.

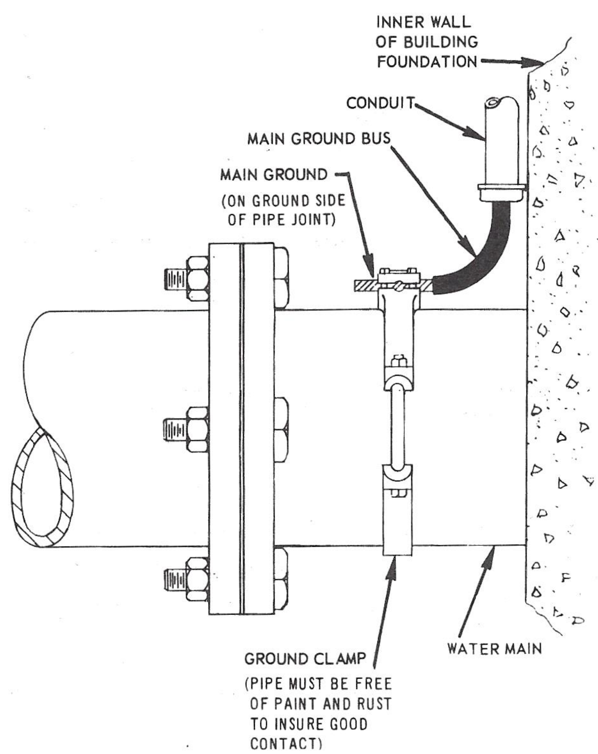
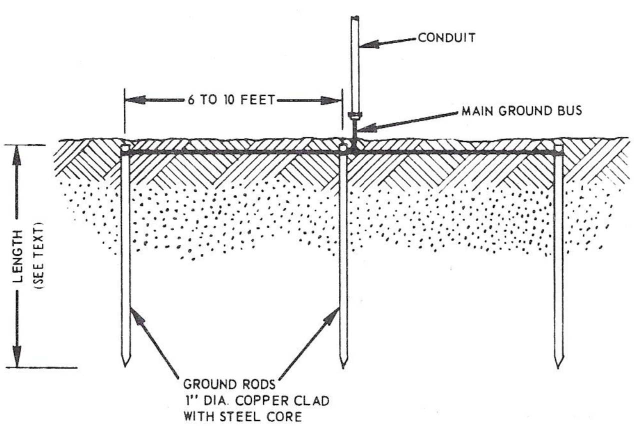


FIGURE 6-1. A water main at the point where it enters the building from underground makes a good main ground.

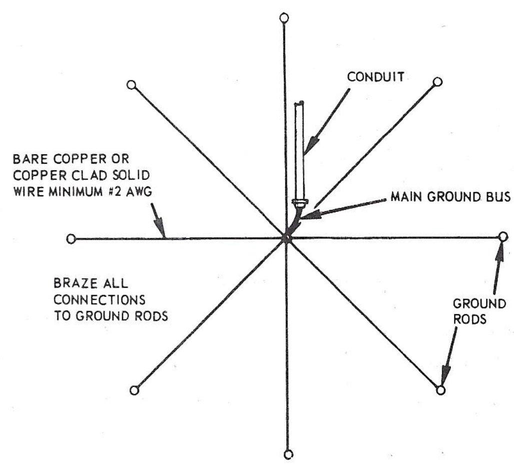
GROUNDING PRACTICES

When a building is being especially constructed for broadcasting purposes, it is often possible to create a main ground specifically for the electronic equipment. The multiple ground rod structure shown in Figure 6-2 has proven an effective main ground. The nine copper-clad steel grounding rods should be at least eight feet in length. In areas where the soil is dry, their length should be increased enough to penetrate at least three feet into permanently moist earth. A ground system such as this would prove desirable when the water supply pipe is a considerable distance away from the electronic facilities to be grounded and a long main ground bus run would be required. An ideal application would be in an on-grade television plant installation with the ground system installed directly below the plant's central technical area.

The ac power system must not use the main ground bus or the main ground for its ground connection. However, when the main ground connection is made to a cold-water supply pipe, it is permissible for the ac power system ground connection to be made to a second ground strap adjacent to the television system ground strap. When two such ground connections are made to the same cold-water pipe, the television system ground strap should be the one nearest to the entry point of the pipe.



SECTION



PLAN

FIGURE 6-2. The array of grounding rods shown above makes an effective earth connection for the electronic equipment. The ground rods must be of sufficient length to penetrate into moist earth.

In cases where television facilities are located high in a tall building (a television transmitting plant, for example), it may not be practical to run a ground bus to earth because of the excessive length of the run. In these instances an alternate, although less desirable, arrangement is to make the ground connection to both the cold-water main and to the steel structure of the building at the floor where the equipment is installed.

B. System Ground Bus

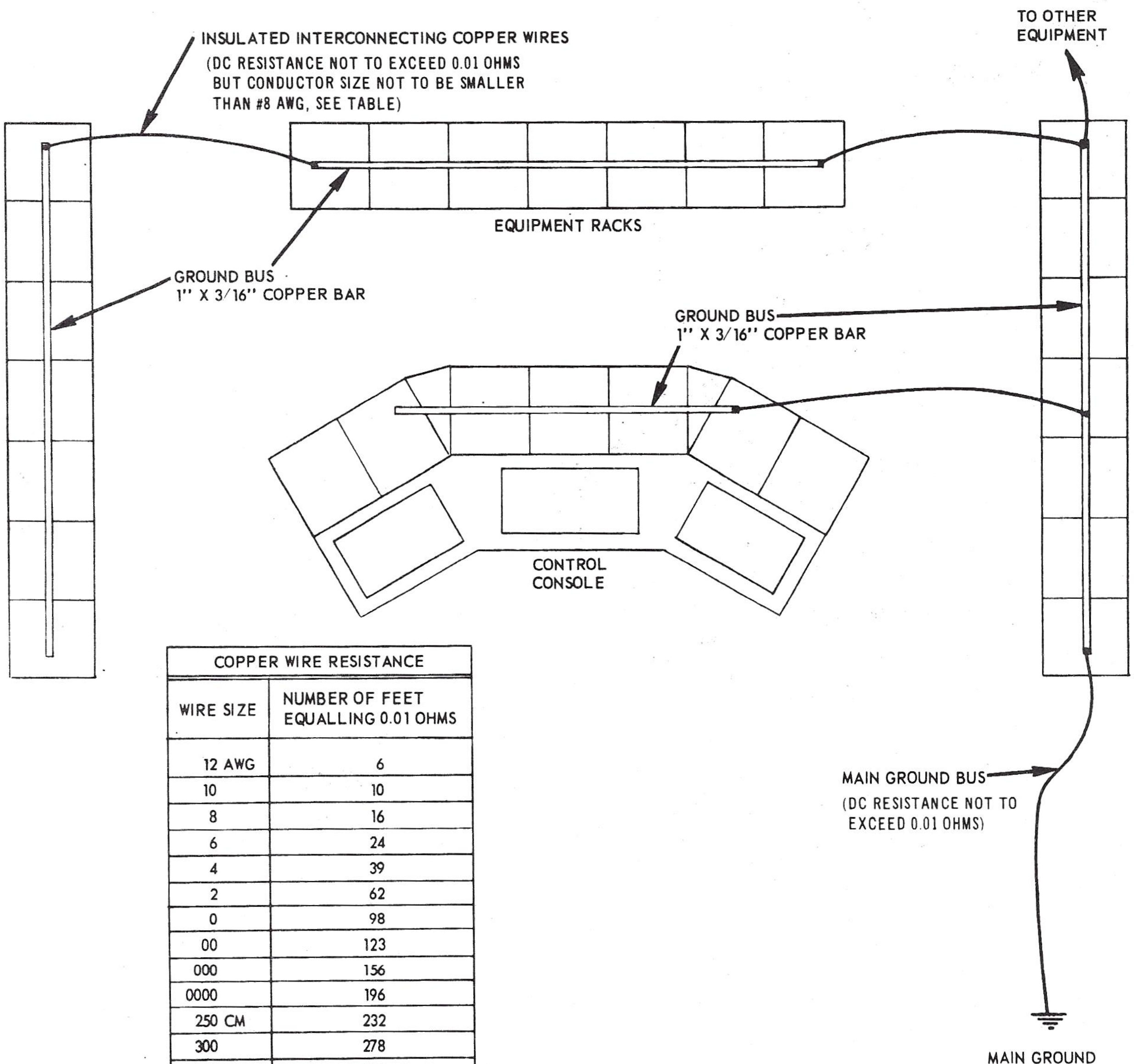
The ground is distributed throughout a television broadcasting plant by means of a system of copper busses and heavy interconnecting copper conductors jointly known as the "system ground bus".

The copper busses (usually 1-inch by 3/16-inch copper bars of bus bar temper) are mounted over the equipment racks and equipment assemblies on the overhead cable ladder, or, if cables enter the equipment from underfloor wiring ducts, the copper busses are mounted in these ducts under the equipment racks and equipment assemblies. The various 1-inch by 3/16-inch ground busses are interconnected by low-impedance copper conductors, which are routed through the plant's audio-video wireways and conduits, as shown in Figure 6-3.

The 1-inch by 3/16-inch copper ground bars are bolted directly to the overhead cable ladders (at least twice for every section of ladder) using 1/4-20 bolts, nuts, and lock washers; see Figure 6-4. When rectangular ladder hangers (such as Unistrut) are used, the copper ground bars may be supported on the hangers as shown in Figure 6-5. This arrangement gets the copper ground bars into the clear; away from the cables in the ladder. In the case of underfloor cable ducts, the copper ground bars should be bolted to the side or bottom of the duct (at least once every six feet) using 1/2-inch metal standoff bushings; see Figure 6-6. The type of fastening device in this case will depend on the surface of the floor duct involved which may be sheet metal, steel channel, steel angle, or concrete. When two sections of copper ground bus meet, the joint should be made as shown in Figure 6-7.

Ground wires are connected to the copper bar grounding bus by means of either solder-type or solderless crimp-type lugs fastened to the bus by means of 1/4-20 machine screws, lock washers, and 1/4-20 tapped holes in the ground bus. The surface of the bus at the point of contact must be clean to insure a good electrical connection. As an alternate to ground bus connections with lugs and screws, the ground wires can be soldered (rosin flux only) or brazed to the ground bus.

In designing a plant ground system, the number of interconnecting copper wire jumpers in series in the path between any rack or console ground bus (or the equipment ground terminal of a film projector, video tape machine, or similar assemblies) and the main ground bus should be kept to a minimum. As a general rule, it should never exceed three.



COPPER WIRE RESISTANCE	
WIRE SIZE	NUMBER OF FEET EQUALLING 0.01 OHMS
12 AWG	6
10	10
8	16
6	24
4	39
2	62
0	98
00	123
000	156
0000	196
250 CM	232
300	278
350	325
400	370
500	463

FIGURE 6-3. In a small compact plant, the "system ground bus" connects directly to the "main ground" through the "main ground bus".

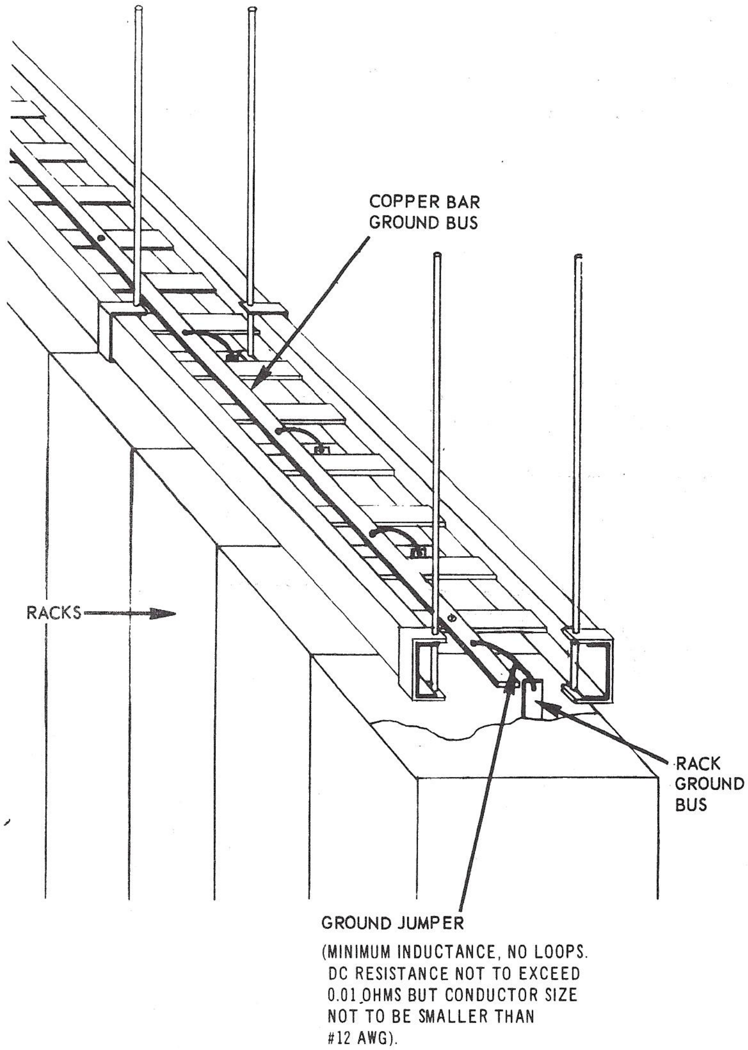


FIGURE 6-4. Copper bar ground bus mounted on overhead cable ladder.

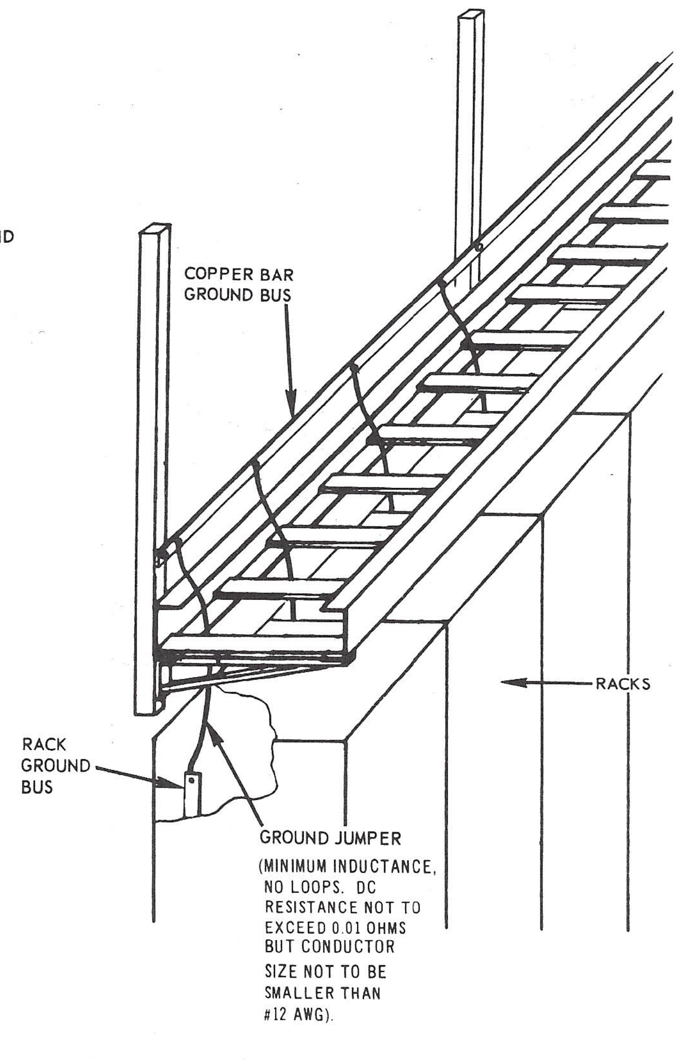


FIGURE 6-5. Copper bar ground bus mounted on rectangular cable ladder hangers.

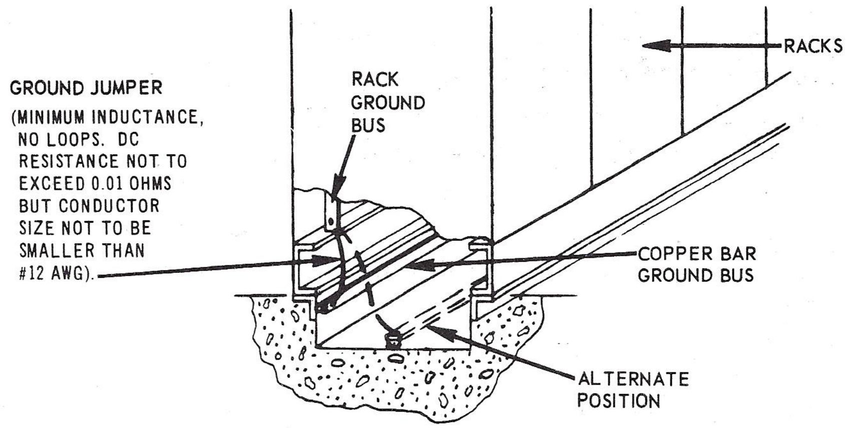


FIGURE 6-6. Copper bar ground bus mounted in underfloor cable duct.

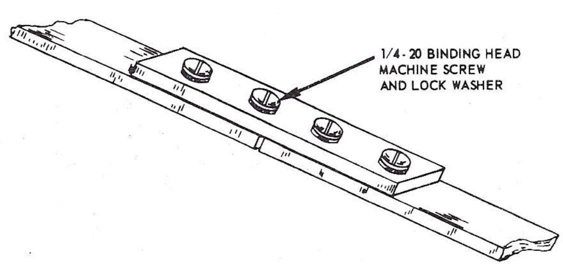


FIGURE 6-7. Detail of joint of two sections of copper bar ground bus.

The metal structure of all equipment racks, control consoles, and other equipment components in a broadcast plant are physically and electrically in contact with electrical conduits, ducts, and cable ladders that are grounded. It might be contended that a system ground bus such as that described above merely duplicates the connection to ground that exists through these grounded electrical conduits, ducts, and cable ladders. However, the audio-video ground system is a low-impedance, all-copper path directly to the best available earth connection. In contrast, the conduit-duct-ladder path to ground, while unquestionably massive, involves a path through conduit and duct joints of questionable contact integrity, to an earth connection that is rarely under control of the television system designer. The all-copper audio-video ground system insures the best possible connection to earth at all times.

C. Ground Distribution Point

In a small compact plant, the system ground bus connects directly to the main ground through the main ground bus. This has been illustrated in Figure 6-3. In a larger multi-studio plant it is sometimes necessary to establish a "ground distribution point", centrally located with respect to the equipment, as shown in Figure 6-8. From this centrally located ground distribution point, ground distribution busses are run to system ground busses in each area of the plant.

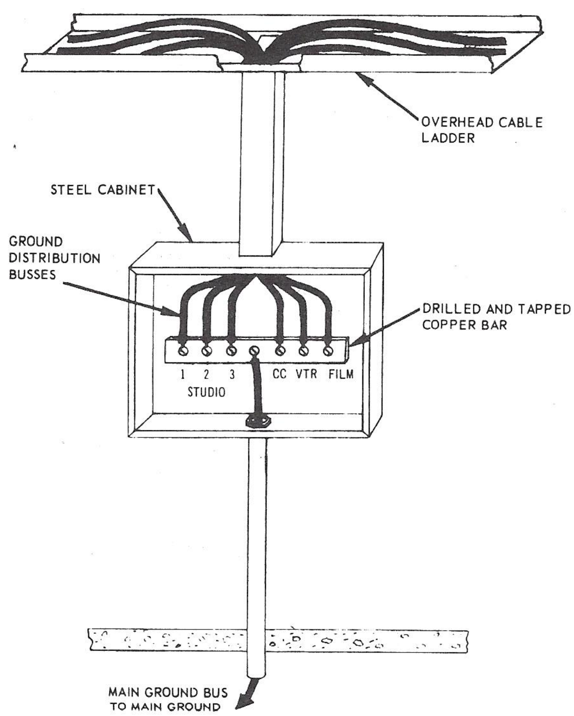


FIGURE 6-8. In a large multi-studio television plant, it is often necessary to establish a ground distribution point centrally located with respect to the equipment. From this ground distribution point, ground distribution busses are run to system ground busses in different technical areas of the plant.

D. Rack, Console, and Equipment Grounds

The system ground bus brings a 1-inch by 3/16-inch copper grounding bus in close proximity to each rack, console, and other equipment assembly in a television plant. In Chapters 2 and 5, it has been described how each rack and console is provided with a copper ground bus known as the "rack ground bus" or "console ground bus" to which ground wires from the various components and circuits within the assembly are connected. Other equipment units, such as film projectors and video tape machines, are also equipped with a ground terminal, known as an "equipment ground terminal". All that remains then, to complete the grounding system, is to make a suitable connection from these rack and console ground busses and equipment ground terminals to the system ground bus. These connections are illustrated for racks in Figure 6-4 through 6-6. The connecting jumpers are green-insulated copper wires as short and direct as possible. Each should have a dc resistance of 0.01 ohms or less but, in no case, should be smaller in size than #12 AWG. A table of wire lengths equal to 0.01 ohms is given in Figure 6-3. As described earlier, the grounding jumpers are connected to the system ground bus by means of either solder-type or solderless-type lugs fastened to the bus by means of 1/4-20 machine screws and 1/4-20 tapped holes in the bus. As an alternate, the ground wires can be soldered (rosin flux only) or brazed to the ground bus.

E. Grounding Equipment Assemblies and Components

In general, grounding of equipment assemblies and components in a television broadcasting system should be handled in the manner outlined below:

(a) The metal structure of every equipment rack, control console, equipment cabinet, and other major equipment component (such as film projectors, VTR machines) should be grounded. This is accomplished when the rack ground bus, console ground bus, or equipment ground terminal is connected to the system ground bus.

(b) All equipment chassis, equipment panels, and equipment mounting shelves within an equipment rack, control console, or other equipment assembly should be grounded. A grounding wire should be installed for the grounding connection even though a particular unit might already be grounded by virtue of a bolted contact to the frame of a rack, console, or cabinet. Reliance should not be placed upon a ground circuit formed by a non-electric mounting contact since such contacts may have, or may acquire, relatively high electrical resistance. The only positive method of assuring a good ground connection at all times is to short-circuit these chance ground circuits with a grounding conductor.

(c) The cases of components such as transformers, attenuators, pads, equalizers, and filters should be grounded. Experience has shown that it is unnecessary to employ grounding wires to ground the cases of small components such as transformers, pads, and similar-sized units provided they are bolted securely to a clean metal surface (free of paint, anodizing, or any other treatment that would interfere with obtaining a good electrical contact) of an equipment chassis, equipment panel, or equipment shelf that is properly grounded; see (b) above.

(d) Audio and video circuits and cable shields should be grounded as described in the following sections of this chapter.

(e) The electrostatic shield of transformers, when provided, should be grounded to the ground bus of the rack or console.

A commonly-used wire for individual ground leads of single small components is CBS 1FG, a #18 AWG green-plastic insulated, stranded copper wire. Considerably heavier grounding conductors (#12 AWG green-insulated copper wire is usually used) should be used to ground panels, chassis, or shelves to which more than one ground connection is made as, for example, a jack field panel (see Section II, Paragraph A-2 below).

II. AUDIO SYSTEM GROUNDING

When it is recalled that government regulations covering the aural portion of a television broadcasting system parallel the more exacting FM rather than AM standards, it becomes evident that every reasonable installation precaution should be observed in order to insure the best possible performance of the audio facilities.

These government regulations (FCC Rules and Regulations Section 73.687, Paragraph b4) require that the noise level (which includes noise, hum and cross talk) for the entire transmission system from microphone terminals to transmitter output be at least 55 dB below the audio level representing 100 per cent modulation. CBS performance requirements for the studio portion of the system specify a signal-to-noise ratio of at least 70 dB*. Careful grounding procedure must be observed to meet these signal-to-noise requirements.

*When measured in the usual manner using a measurement reference test tone 10 dB higher than the normal program level.

A. Audio Circuit and Audio Cable Shield Grounding

The cable used in interconnecting audio systems (CBS 2FA and 2FB; see Chapter 11) consists of a pair of twisted, insulated, color-coded (red and black) conductors enclosed in a shield. A third uninsulated conductor, which is immediately under and in continuous contact with the shield, is included to provide a convenient means of making a connection to the shield. The shield is covered with an insulating black vinyl outer jacket.

Unless care is taken to control audio circuit grounds and audio cable shield grounds, cross talk, hum, and unstable operation most surely will result. Perhaps the most important practice to prevent such problems is avoiding multiple grounds on audio circuits and audio cable shields. Where a ground is required on an audio circuit, the ground connection should be made at one point only and not at both ends of the circuit. This same principle holds true for audio cable shields which should be grounded at one end of the cable run and not at both ends. The use of audio cable that has the shield covered with an insulating jacket, combined with careful installation practices to avoid accidental grounding of the shield, goes a long way toward avoiding hum, cross talk, and instability.

1. Audio Circuit Grounding. An important consideration in an audio system is the correct grounding of system elements. In general, the center-tap of balanced-to-ground system elements should be grounded. Likewise, the low side of unbalanced-to-ground system elements should be grounded. In doing this, it is important that the ground be applied at only one point in the circuit.

Several examples of proper audio grounding are given below:

(a) A recommended method of avoiding multiple grounds in an audio system is to place the ground on the system element requiring the ground rather than on an amplifier preceding it and/or following it. This procedure makes it possible to patch the amplifier (whose input and output windings should be left floating with respect to ground*) interchangeably to either balanced- or unbalanced-to-ground circuits; see Figure 6-9.

*An exception is the input of a microphone preamplifier which always has its center tap grounded.

(b) If two (or more) one-side-grounded system elements are cascaded, the ground should be placed on only one; the element contributing the greater attenuation. The common side of the circuit will carry the ground through to the other element; see Figure 6-10.

(c) An unbalanced-to-ground variable audio attenuator (mixer controls, master gain controls, etc.) may not cut off completely in the "off" position unless a good low-impedance ground connection is made directly to the common side of the attenuator. Therefore, ground connections should always be made directly to the common side of the attenuator; not to a circuit element that precedes or follows it; see Figure 6-11.

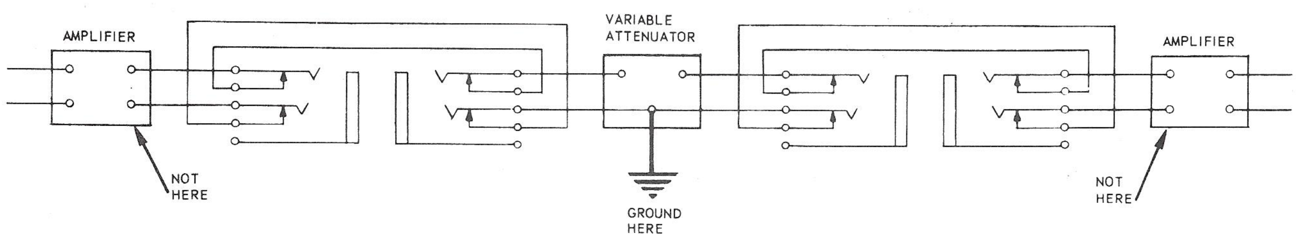


FIGURE 6-9. The ground connection should be made to the system element requiring the ground; not to an amplifier preceding or following it.

(d) If two balanced-to-ground system elements that are not isolated from each other by a transformer* are cascaded, only one of them should be grounded. If one of the elements is a variable audio attenuator such as a master gain control where complete cut-off is essential, it should be the element that is grounded. Otherwise, the ground should be made to the system element that is contributing the most attenuation. If the nature of the equipment is such that both system elements must be grounded, a transformer should be installed between them to prevent the flow of longitudinal currents in the program circuit because of a difference in potential of the two grounds. In the case of a long transmission circuit, the ground must be made to the circuit element at the receiving end of the circuit (usually a transformer), the foregoing notwithstanding.

As already discussed, a ground bus is provided in each rack, console, and other equipment assembly requiring ground connections. Audio circuits and equipment requiring a connection to ground are connected to this equipment ground bus.

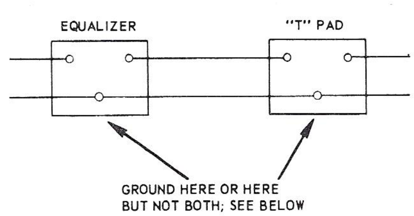


FIGURE 6-10. When two one-side-grounded system elements are cascaded, the ground connection should be made to the system element that contributes the greater attenuation.

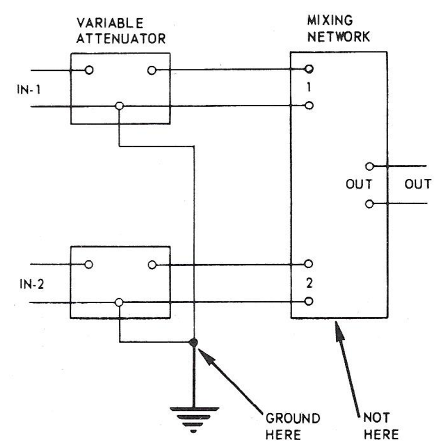


FIGURE 6-11. A ground connection should always be made directly to the common side of one-side-grounded variable audio attenuators to insure cutoff.

*This transformer may be built into one (or both) of the system elements. This is often the case with an amplifier.

The connection from equipment to ground bus can take one of two forms:

(a) In areas where relatively few ground connections are involved, the connection to ground can be made by means of a #18 AWG or larger green-insulated grounding conductor (CBS 1FG) connecting the equipment to be grounded to the ground bus. A separate grounding wire should be used for each ground connection.

(b) In areas where a substantial number of ground connections are involved (such as a mounting shelf of plug-in amplifiers, or a panel containing a large grouping of audio components), it is usually more desirable to establish a local ground bus directly on the shelf, panel, or chassis to which all ground connections are made. The local ground bus is usually a heavy copper wire or bar fastened directly, and without insulation, to the shelf, panel, or chassis. All equipment and circuits to be grounded are connected to this local ground bus with #18 AWG green-insulated wire (CBS 1FG). This local ground bus is then connected to the rack or console ground bus with a #12 AWG copper green-insulated conductor. Another method (often used on mounting shelves containing a grouping of plug-in amplifiers) establishes a grounding lug, fastened by a machine screw directly through the metal shelf, directly behind each amplifier. Ground connections are made by short jumpers of #18 AWG green-insulated wire (CBS 1FG) from each amplifier receptacle to its associated ground lug. All ground lugs are then connected by a heavy copper conductor which, in turn, is grounded to the rack ground bus.

2. Grounding Audio Cable Shields. The shield of every audio cable must be grounded. Further, the shield ground must be made at only one end of the cable to prevent ground loops and the resulting flow of current through the shield. The hum, noise, and other disturbances in these ground currents may cross over into the program-carrying conductors, particularly in unbalanced-to-ground and low level circuits.

The rules given below should be followed in grounding cable shields:

(a) The preferred point to ground audio cable shields is at the audio jack field; see Chapter 3. At this point, the shield of each cable is automatically grounded when the shield grounding wire of the cable is connected to the grounded sleeve lug of its associated jack; see Figure 6-12.

(b) Method (a) above will only ground the shield of cables that connect to the jack field. The shields of some other cables can be grounded by tieing them to the shields of associated cables that are already grounded in this manner; see Figure 6-13. In doing this, the following precautions must be observed; (1) the shield to be grounded should be tied only to the shield of another cable in the same program circuit, (2) the level difference in the two cables should be no more than 20 dB.

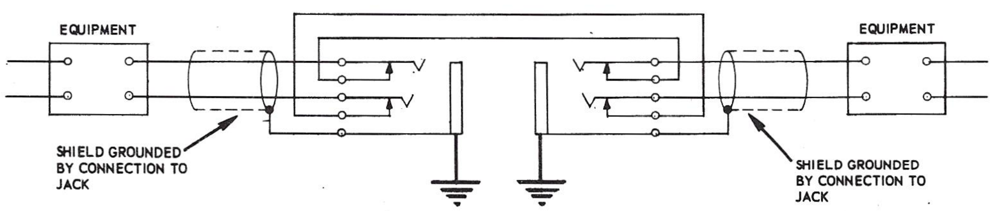


FIGURE 6-12. Audio cable shields grounded at jack field.

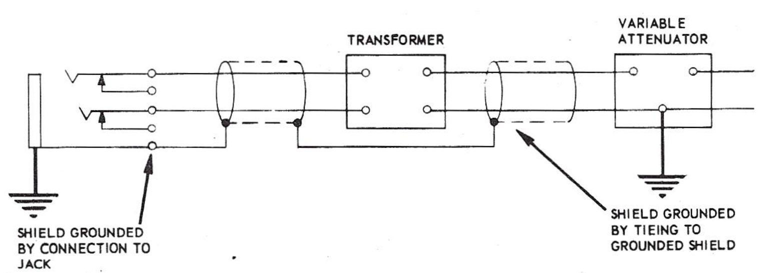


FIGURE 6-13. Audio cable shield grounded by tieing to an already-grounded shield.

(c) A terminal block is a good point to ground the shields of cables that connect to it but whose shields cannot be grounded by the methods outlined above; see Figure 6-14. Grounding of a cable shield at a terminal block is easily specified on the audio terminal block wiring and cross-connection form by wiring the letter G in the appropriate box; see Chapter 4, Figure 4-7.

(d) If a cable shield cannot be grounded by the methods outlined in (a), (b), and (c), the shield of that cable should be picked up with a CBS 1FG grounding wire and connected to the rack or console ground bus; see Figure 6-15.

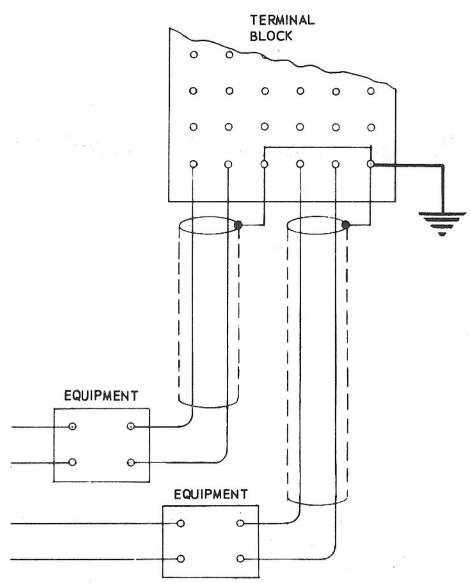


FIGURE 6-14. Audio cable shield grounded at terminal block. Separate ground busses should be used for low-level (below −20 vu), medium-level (−20 vu to +20 vu), and high level (above +20 vu) cables.

B. Microphone and Microphone Cable Shield Grounding

The correct grounding of microphones and microphone cable shields is of particular importance because of the extremely low output level of most present-day microphones, coupled with their portability which makes them especially susceptible to interference when operated close to ac lighting boards, cables carrying large lighting loads, RF cue transmitter antennas, and similar sources of audio interference.

Standard microphone cable (CBS 3FA; see Chapter 11) consists of three flexible, twisted, insulated, color-coded (red, black, green) conductors enclosed in a shield. The shield is covered with an insulating brown neoprene jacket.

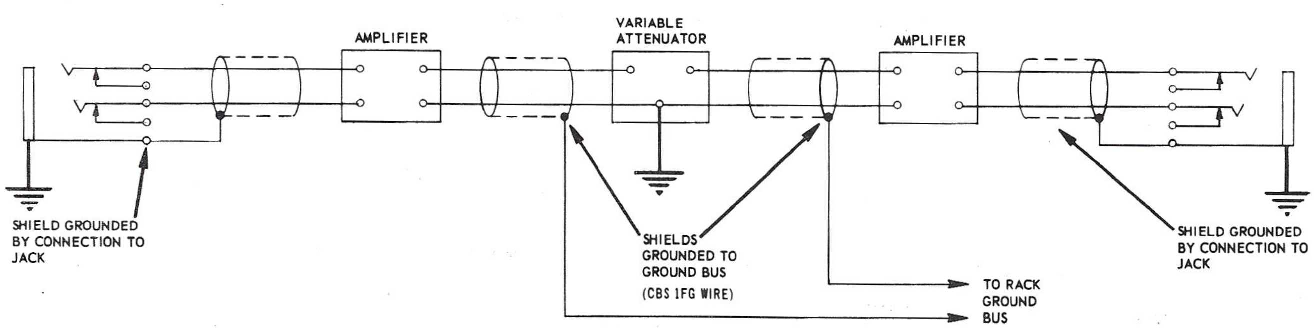


FIGURE 6-15. Audio cable shields grounded to rack or console ground bus.

The basic rules for the grounding of microphones and microphone cable shields are illustrated in Figure 6-16 and may be summarized as follows:

(a) All microphone cable shields must be grounded. The ground connection must be made at only one end of each cable length; the end farthest from the microphone.

(b) The frame of the microphone must be grounded by the green grounding conductor carried to it through the microphone cable.

(c) The ground connections for both the shield and the microphone frame must be made at the receiving end of the circuit; that is, at the rack or console in which the microphone run terminates.

(d) No connection is made to the metal shell of the microphone connectors.

(e) Standard audio cable (CBS 2FA or 2FB; see Chapter 11) should be used for portions of the microphone cable run that are carried in conduit.

III. VIDEO SYSTEM GROUNDING

The use of one-side-grounded cables and equipment in broadcast video systems does not provide the opportunity to control video circuit grounds as in the case of audio systems. Multiple grounds on the coaxial cable shields are unavoidable since connection to both ends of the coaxial cable shields must be made, inasmuch as the shield is actually one side of the video circuit.

A. Video Cable

The cable used in interconnecting CBS video systems (CBS 1CA; see Chapter 11) is a coaxial cable with a #20 AWG solid-copper inner conductor which is insulated from the two tinned-copper braided shields by a solid polyethylene dielectric. The cable has an overall black polyethylene outer jacket.

B. Grounding Precautions

In arranging the grounding for a video system, the following precautions should be observed:

(a) Carefully ground all components of the video system and their associated racks, consoles, and other mounting hardware as outlined in Section I, Part E, above.

(b) Be sure that all video components have a low-impedance (minimum inductance) path to ground at all frequencies throughout the video frequency range. Unless this is done, the voltage drop across the grounding circuit may introduce unnecessary interference in the video signals.

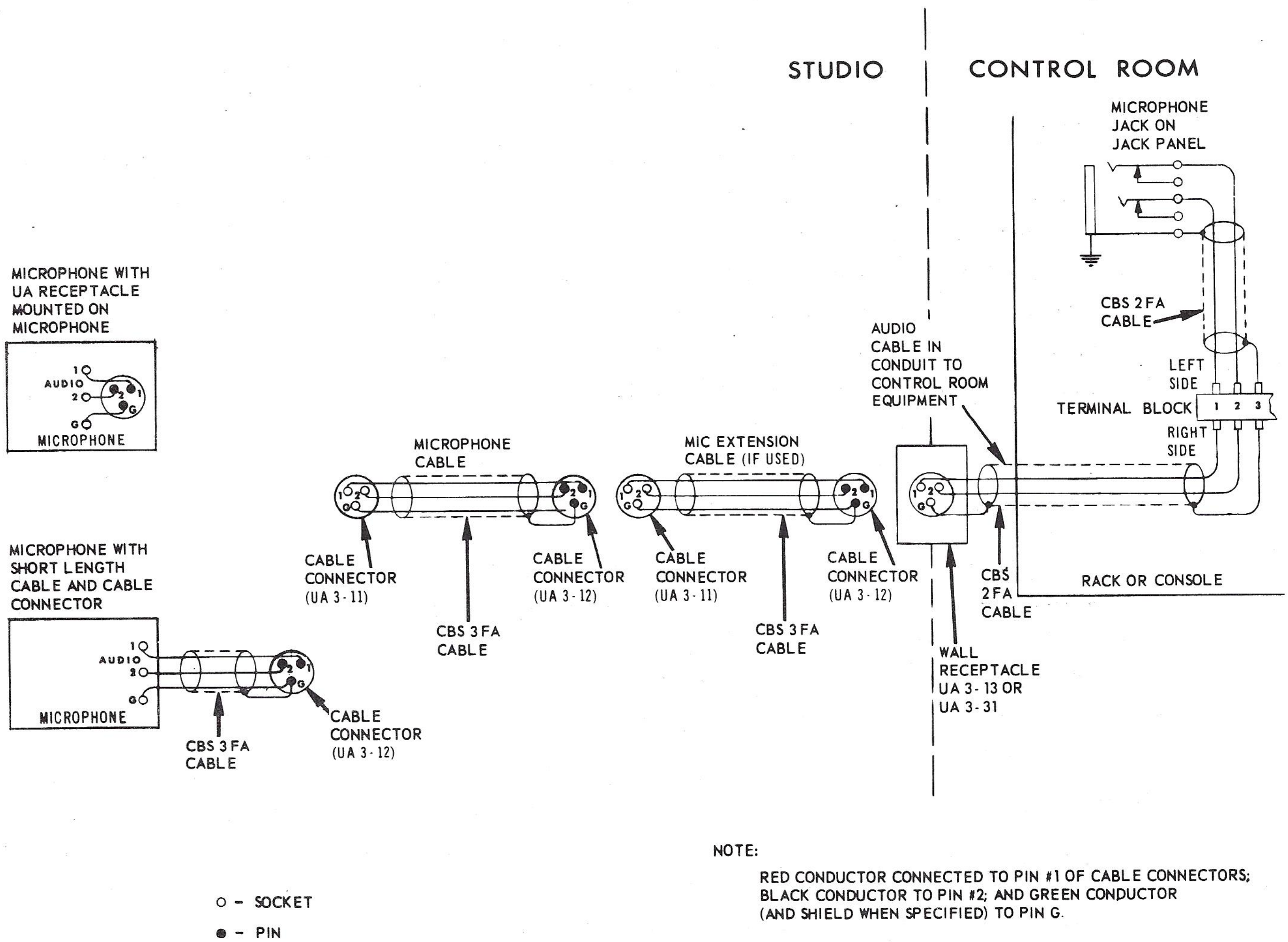


FIGURE 6-16. Microphone cable wiring details. Both the microphone connector and the microphone cable used have been standardized by the Electronic Industries Association (EIA) as industry standards.

C. Camera Cables

Camera cables and camera cable connectors do not enjoy the status of being industry standards as is the case with microphone cable and microphone cable connectors. As a matter of fact, different types of cable and connectors are presently used by various manufacturers of television cameras.

As industry standards have not yet been formulated or adopted, it is not possible to set forth standard wiring procedures for camera cables. However, as a result of CBS experience, some general rules of good design practice for camera cables have evolved. For example, the metal shell of a camera cable connector should never connect to the cable shield. If it does, an undesired ground will be made to the cable shield every time the connector shell is grounded. This would occur at studio AV outlet boxes, camera patch panels, and at any other point where the cable connector makes contact with ground. In an outdoor pick up, such a ground may be created merely by the fact that the connector is lying on the ground. Such multiple grounds are, of course, undesirable as they cause currents to flow in the cable shield as a result of the differences in potential at the various ground points. No connection should be made to the metal shell of the connector. The cable shield should be carried through from cable to cable on one of the largest sized contacts available within the connector.

General rules of good design practice for camera cables, including the one in the example discussed above, are given in the following paragraphs:

(a) The metal shell of camera cable connectors should not connect to the camera cable shield or to any other circuit in the camera cable.

(b) A suitable insulating material should line the entire interior surface of the metal shell of the camera cable connector. This is to prevent the possibility of a short circuit from the internal wiring of the connector to the metal shell.

(c) The number of electrical contacts in camera cable circuits (such as camera cable connectors and terminal blocks) should be kept to a minimum as they introduce additional resistance, as well as discontinuities, in the camera circuits.

(d) Double-shielded camera cable is preferred since it will be affected less by extraneous interference than the single-shielded type. It also provides a lower resistance ground path from camera to camera control than the single-shielded type.

(e) The outer conductor of each coaxial cable within the camera cable must be provided with an exclusive circuit through the camera cable connector, i.e., two or more coaxial cable outer conductors should never feed through a single connector contact.

IV. MISCELLANEOUS GROUNDING PRACTICES

Several grounding practices that have been found to be useful in the design of television broadcasting systems are given in the following paragraphs.

A. Common Coupling in Power Supply Circuits

In many cases, it is not only important to ground a circuit, it is even more important to ground it in the right place. For example, in Figure 6-17A, current leaving the power supply to all three amplifiers flows through a common circuit. Common coupling exists. Cross talk and oscillation can result. Rearranging grounds as shown in Figure 6-17B or 6-17C removes the common coupling to signals that flow to ground. Further, the addition of capacitor C in Figure 6-17C by-passes the common coupling formed by the leads from the power supply to the distribution point.

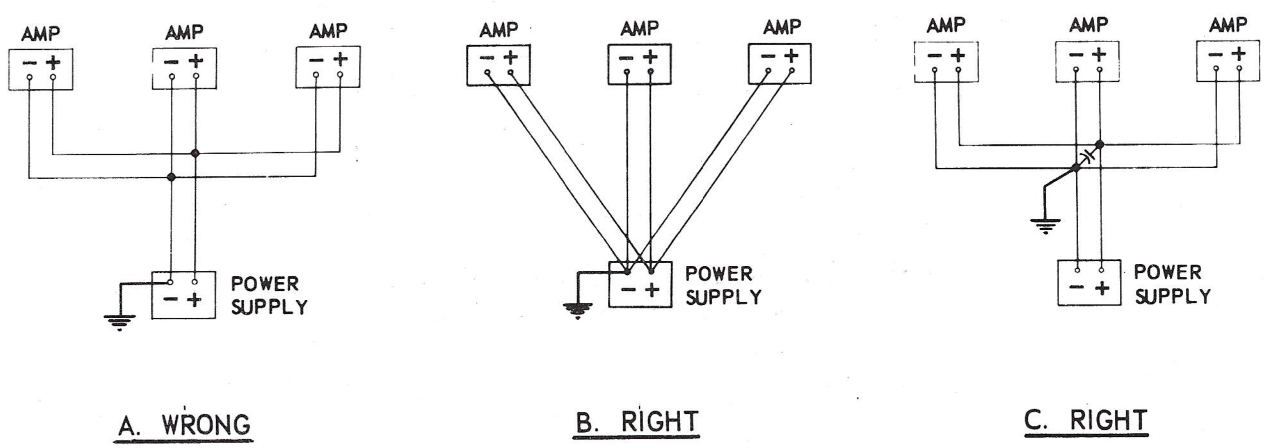


FIGURE 6-17. Common coupling in power supply wiring can cause cross talk and oscillation. In C, a by-pass capacitor must be provided at the distribution point, as shown, to prevent common coupling in the portion of the power supply circuitry that is common to all amplifiers.

B. Component Elements as Shields

Cross talk can often be reduced significantly by placing a grounded shield between two circuits. This can be accomplished on system components, at times, simply by grounding an element or elements of the component itself, for example:

(a) Cross talk between circuits on the springs of a key switch or relay can be reduced by grounding an intervening relay spring and thereby reducing the capacitive coupling between the two circuits. Figure 6-18 shows an example of such an arrangement that was used in a studio audio console. The audio circuit is isolated from the noise-producing contacts of the control circuit by the grounded key switch spring which, in this particular case, is actually an active spring of the control circuit.

(b) Similarly, cross talk can be reduced on a terminal block by providing a row of grounded terminals between the circuits to be isolated.

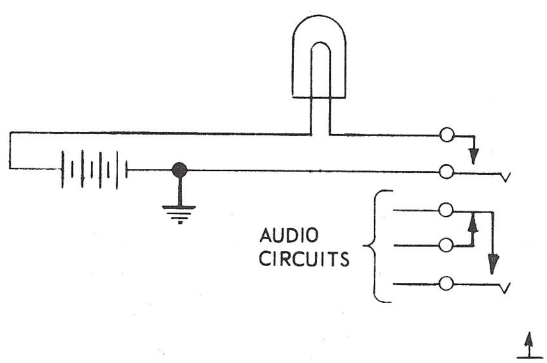


FIGURE 6-18. The grounded control circuit spring on the key switch isolates the audio and control circuitry.

REFERENCES

1. Frank Stetka and Merwin M. Brandon, NFPA HANDBOOK OF THE NATIONAL ELECTRICAL CODE, McGraw-Hill Book Co., Inc., New York, N.Y., pp. 100-132 (1966).

2. USA Standard C1-1965 (NFPA 70-1965), NATIONAL ELECTRICAL CODE 1965, pp. 64-83.

3. EIA Standard RS-297, CABLE CONNECTORS FOR AUDIO FACILITIES FOR RADIO BROADCASTING, (April, 1964).

4. EIA Standard RS-221, POLARIZATION OR PHASING OF BROADCAST MICROPHONES, (April, 1959).

5. EIA Standard RS-215, BASIC REQUIREMENTS FOR BROADCAST MICROPHONE CABLES, (November, 1958).

6. Howard A. Chinn, TELEVISION BROADCASTING, McGraw-Hill Book Co., Inc., New York, N.Y., pp. 602-606 (1953).

7. Arthur Davis, GROUNDING, SHIELDING, AND ISOLATION, Jour. AES, 1:1:103 (January, 1953).

7. Wiring Diagrams

CHAPTER 7

WIRING DIAGRAMS

7 WIRING DIAGRAMS

Two methods in general use for presenting the wiring information for an electrical or electronic device are the circuit schematic diagram and the wiring diagram. Both methods are used in CBS engineering drawings. This chapter describes the practices and standards to be followed in preparing both types of drawings. A third type of diagram used in television broadcast system design is the block or single-line diagram which was described in Chapter 1. The block diagram serves to graphically portray the equipment complement and signal flow of an entire system or portion of a system without regard to the wiring details of the systems components.

I. THE CIRCUIT SCHEMATIC

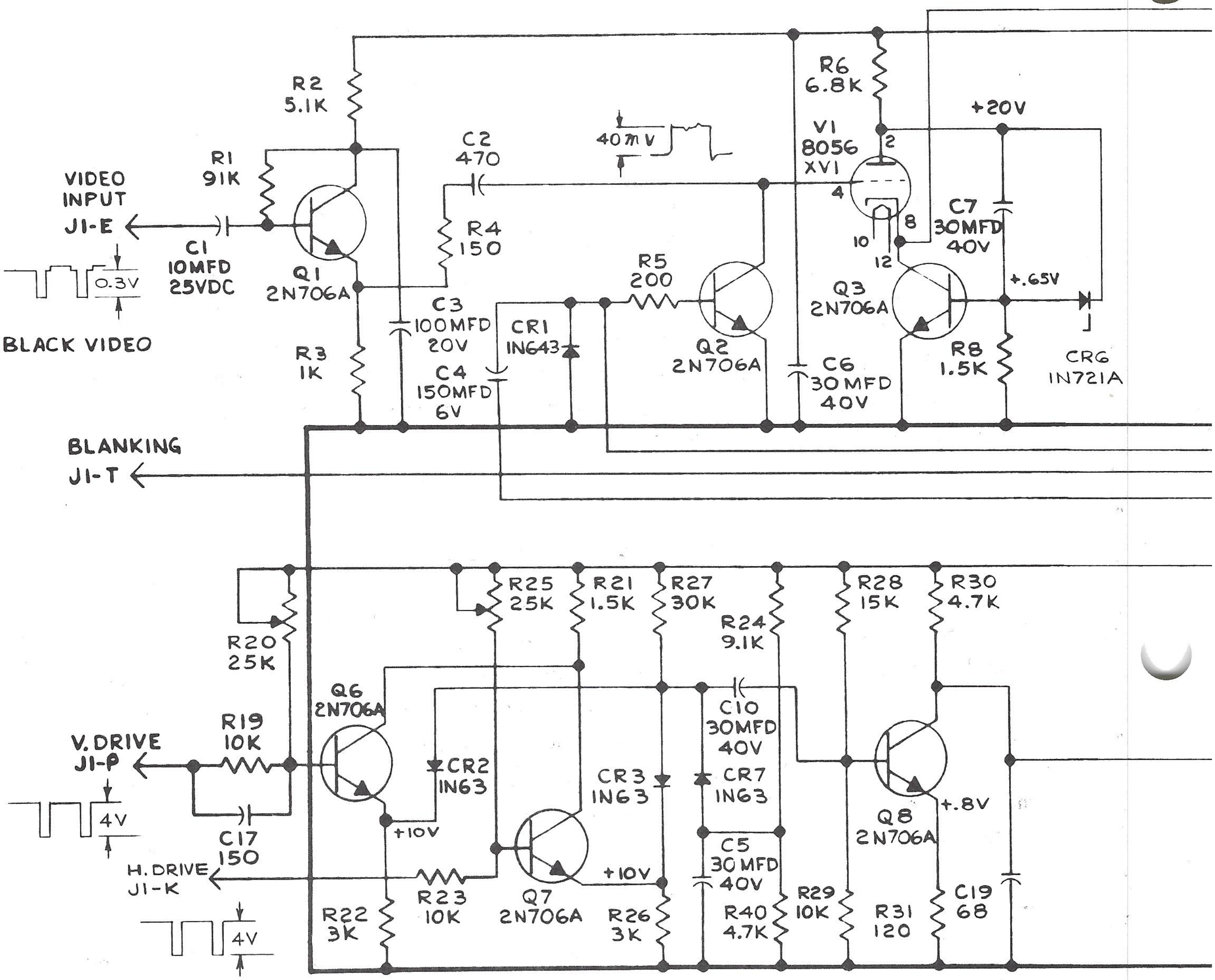
The circuit schematic shows, by means of graphic symbols and interconnecting lines, the circuit of an electrical or electronic device or system without regard to the actual physical size, shape, or location of the parts used. Equipment-identifying information and explanatory notes are an essential part of the circuit schematic. Additional information such as waveforms, voltages, and wire colors is often included on a circuit schematic, and this added information makes the drawing considerably more useful in maintenance of the equipment. The circuit schematic is widely used by equipment manufacturers and is frequently used by CBS to show the circuitry of system components.

A. Symbols

Graphic symbols for circuit schematics have been standardized by the USA Standards Institute in USA Standard Y32.2. The graphic symbols used in CBS circuit schematics should conform to this standard wherever possible. If there is a need for a symbol that is not given in the above USA Standard, refer to the record book of circuit schematic symbols maintained by the CTN Engineering and Development Drafting Room which records previously-used CBS-developed symbols. If the need for such a symbol has not arisen before, and the symbol is not given in the record book, a carefully-considered symbol may be created. This new symbol should be used to complete the drawing in progress and simultaneously be submitted for approval and inclusion in the Drafting Room record book.

B. Typical Circuit Schematic

A typical circuit schematic using USA Standard symbols is shown in Figure 7-1.

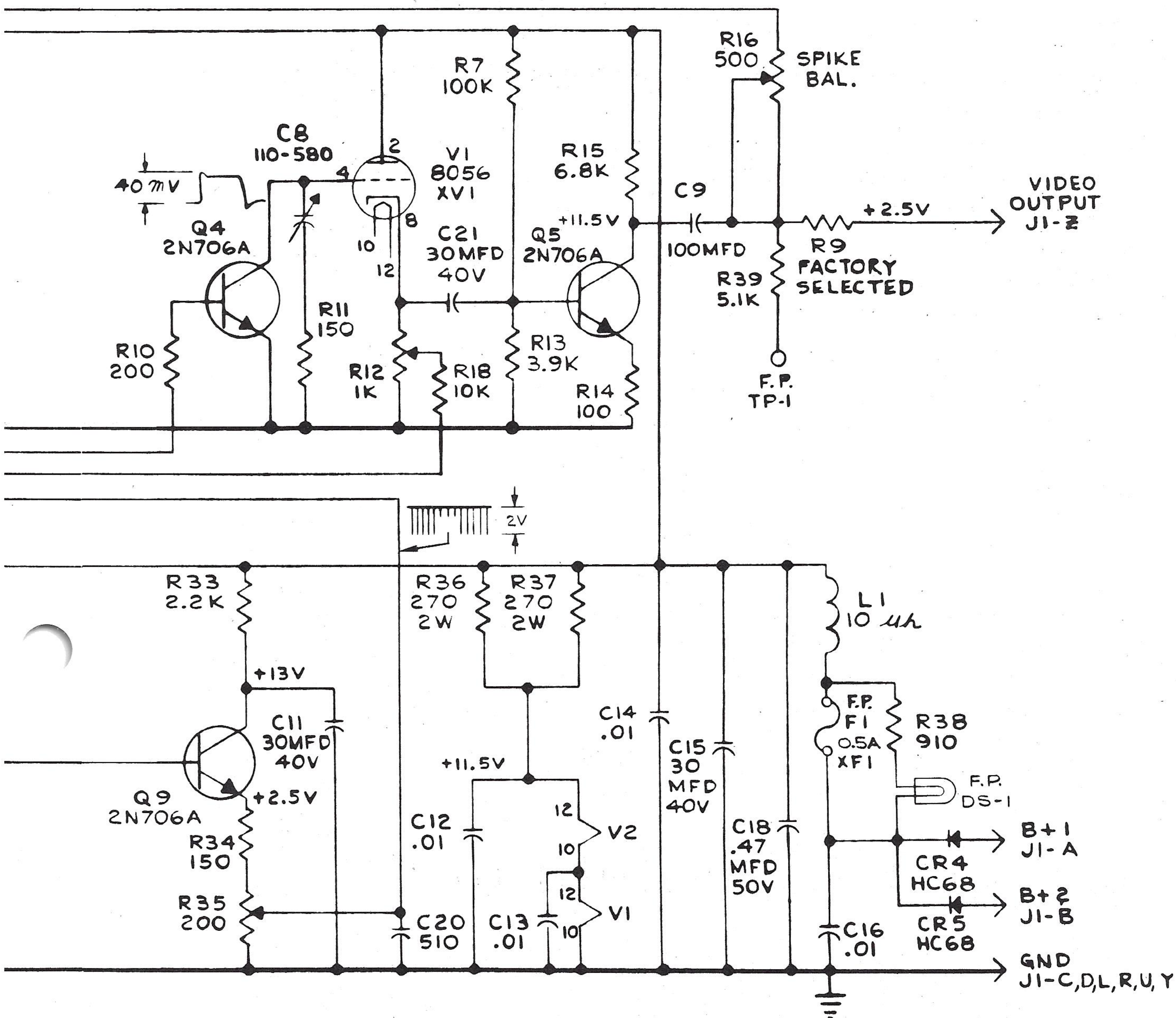


NOTES:

UNLESS OTHERWISE SPECIFIED

1. ALL RESISTOR VALUES ARE IN OHMS UNLESS FOLLOWED BY K = 1,000 OHMS OR MEG. = 1,000,000 OHMS, 1/2 WATT.
2. CAPACITOR VALUES IN MICROMICROFARADS UNLESS FOLLOWED BY MFD MICROFARADS.
3. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH = MILLIHENRYS OR H = HENRYS.
4. F.P. = FRONT PANEL

FIGURE 7-1. A TYPICAL CIRCUIT



SCHEMATIC USING USA STANDARD SYMBOLS.

II. THE WIRING DIAGRAM

The wiring diagram differs from the circuit schematic in that, in addition to presenting circuit wiring information, it also shows the physical arrangement of the components and wiring. It presents a picture-like view of the components and wiring of a device or system using symbols pictorially resembling the actual components. Wiring is drawn to show the placement and routing of the cables and the connection of each conductor. As a result, a considerable uniformity in the finished product is possible through the use of the wiring diagram and, for this reason, it is used more often than the circuit schematic in CBS drawings covering broadcast equipment.

Printed or etched circuit boards are actually a specialized form of wiring diagram. The preparation and processing of the special artwork required in their production is not covered here.

A. Symbols

With a few exceptions, there are no national or industry standards for symbols used in wiring diagrams (electron-tube terminals are an exception). The symbols used in CBS wiring diagrams are, in most cases, two-dimensional pictorial representation of the terminal or connection portion of the device. In some cases, such as relays and switches, the spring and contact arrangements are shown in detail* along with the pictorial representation of the terminals.

Examples of equipment symbols used in CBS wiring diagrams are given in Figure 7-2.

On wiring diagrams, a single interconnecting conductor is represented by a line. However, multi-conductor cables are also shown as a single line except at the ends of the cable where the single line branches out to show each of the individual conductors in the cable, as well as the cable shield if one is involved. Furthermore, in wiring diagrams, a group of single conductors and/or multi-conductor cables that are grouped together and are following the same route are also drawn as a single line.

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*It is standard practice to draw the contacts of a relay as they are in the unenergized position. Similarly, the contacts of a telephone-type key switch are shown as they are when the switch is in the center position.

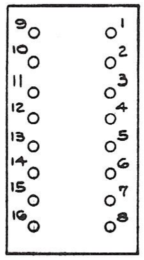
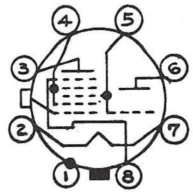
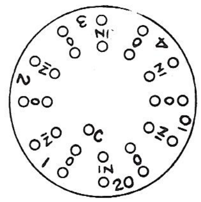
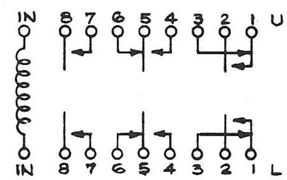
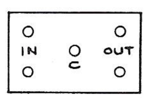
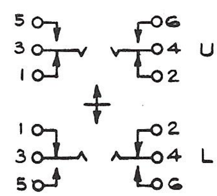
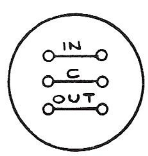
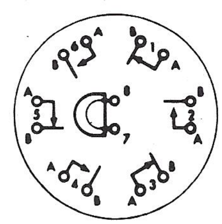
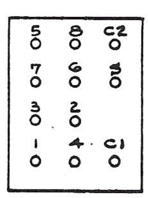
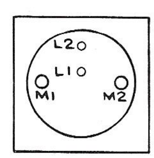
UNIT	WIRING DIAGRAM SYMBOL	UNIT	WIRING DIAGRAM SYMBOL
Amplifier, preliminary, plug-in (View of receptacle terminals)	 PRELIMINARY AMP BATES MG313	Tube, electron	 CONVERTER 6J8-G
Attenuator, adjustable	 MON CH. PAD SMITH 1230	Relay	 LINE/AIR RELAY JONES U-1017
Attenuator, fixed	 LINE PAD-2 SMITH H154	Switch, key	 MON SEL KEY JONES 2GR
Attenuator, variable	 MICROPHONE-1 MIXER SMITH T730	Switch, pushbutton	 CAMERA-1 SWITCH PORTER 1022
Transformer, line	 LINE TRANSFORMER ABC A14420	Volume indicator	 VOLUME INDICATOR BROWN 14L

FIGURE 7-2. Examples of typical symbols used in wiring diagrams. The symbol should include a notation identifying the function of the unit as well as its manufacturer and type number, as shown. Other examples are given in Figures 7-10, 7-11, and 7-12.

Examples of cable symbols used in wiring diagrams are given in Figure 7-3.

B. Cable Destination Indicators

To be useful in the initial wiring of an equipment assembly, as well as in its subsequent maintenance or modification, a wiring diagram must include information identifying the far end, or "destination", connection of each wire and cable. This identification, known as the "cable destination indicator", is accomplished by an alphameric notation at each end of every conductor or cable on the diagram except short jumpers and straps.

Cable destination indicators have been shown on the examples of cable symbols in Figure 7-3. The meaning of the notation is discussed in the following paragraphs.

1. Terminal Blocks. If the equipment to which the far end of a wire or cable connects is a terminal block in the same rack, the cable destination indicator consists of a notation containing (a) the terminal block designation letter or letters; (b) the terminal block row number; and (c) the terminal number. As an example, the notation DD17/3 indicates that the destination of a cable is terminal block DD, row 17, terminal 3.

If the terminal block to which the cable connects is in another rack, and the cable runs directly to that rack without connection to a terminal block in its own rack (which could be the case when two or more bolted-together racks are wired as a single unit with cables running directly between them), the cable destination indicator must be prefixed with the number of the destination rack. If the destination rack is Rack 12, the above cable destination indicator would become 12DD17/3.

2. Jacks. If the far end of a cable connects to the tip terminals of a jack in the same rack, the cable destination indicator consists of a notation containing (a) the jack row number, and (b) the jack's number on the row. As an example, the notation R3J5 indicates that the destination of a cable is jack row 3, jack number 5. Should the cable connect to the normal terminals of the jack instead of the tip terminals, the letter N is added; for example, R3J5N.

If the jack to which the cable connects is in another rack, and the cable runs directly to that rack without connection to a terminal block in its own rack, the cable destination indicator must be prefixed with the number of the destination rack as described in Section 1 above.

3. Equipment Rack Mounting Shelf or Frame. A frequently-used equipment mounting device for rack-mounted equipment is the mounting shelf (sometimes known as a mounting frame) in which plug-in modular units (such as amplifiers, power supplies, and pulse generator modules) mount in a horizontal row across the shelf.

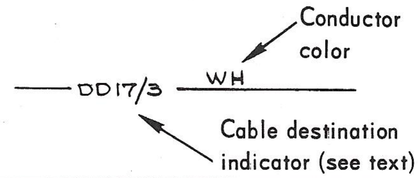
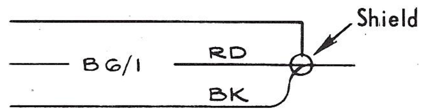
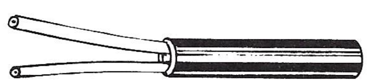
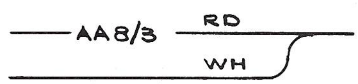
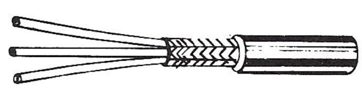
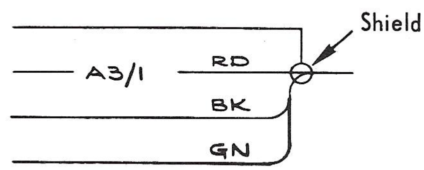
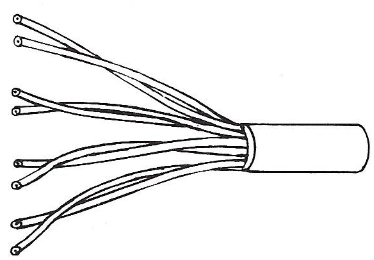
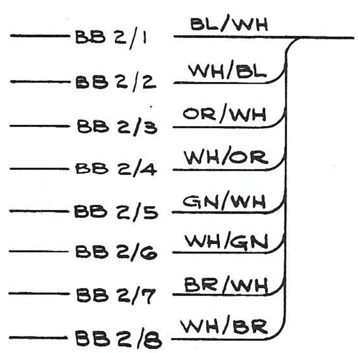
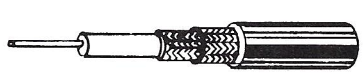
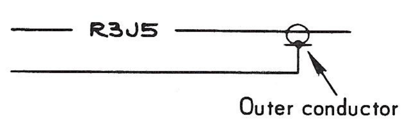
<table>
<tr><th>CABLE</th><th>WIRING DIAGRAM
CABLE SYMBOL</th></tr>
<tr><td>
CBS 1FA Conductor</td><td>
</td></tr>
<tr><td>
CBS 2FA Audio cable</td><td>
</td></tr>
<tr><td>
CBS 2FP Power cable</td><td>
</td></tr>
<tr><td>
CBS 3FA Microphone cable</td><td>
</td></tr>
<tr><td>
CBS 8FA Multi-conductor cable</td><td>
</td></tr>
<tr><td>
CBS 1CA Coaxial cable</td><td>
</td></tr>
</table>

FIGURE 7-3. Examples of cable symbols used in wiring diagrams. The color of each conductor must be specified as shown (see Table 7-1 for standard color abbreviations). In addition, a cable destination indicator must be given at each end of the cable. Cable destination indicators are discussed in Part II, Section B of the text.

As already described in Chapter 2, an equipment rack mounting shelf, like a rack panel, is identified by a number which is determined by the rack unit at the top edge of the mounting shelf's front panel when in place on the equipment rack; see Figure 7-4. Components on a mounting shelf are identified by the letters A, B, C, etc., starting at the left as viewed from the front of the rack as is also shown in Figure 7-4. The letters I and O should not be used for component identification.

If the equipment to which the far end of a conductor or cable connects is on an equipment rack mounting shelf in the same rack, the cable destination indicator consists of a notation containing (a) the number of the mounting shelf where the equipment is mounted, (b) a letter indicating the position of the equipment on the mounting shelf and (c) the number (or letter or word; see Section 7 below) identifying the terminal to which the connection is to be made. As an example, the cable destination indicator 21C/7 indicates that the destination of a conductor is a rack mounting shelf at rack unit 21, equipment unit C (third from left) as viewed from the front of the rack, terminal 7.

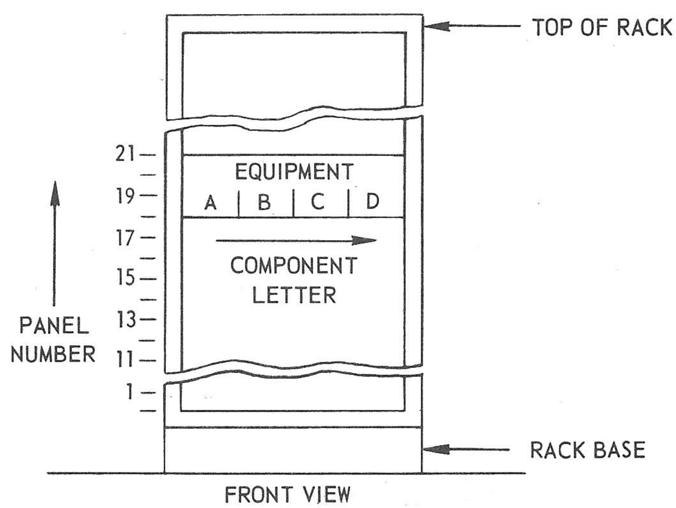


FIGURE 7-4. The location of shelf-mounted rack equipment is specified by the panel number and component letter. The panel number in the above example is 21.

Two special cases sometimes arise in cable destination indicators to mounting shelves.

(a) Shelf-mounted equipment components are sometimes equipped with two (or more) connectors or terminal boards. When this is the case, this additional information must be included in the cable destination indicator. This is done by including the connector number or terminal board number along with the terminal information as illustrated in the following examples. The cable destination indicator 21C/J2-7 indicates a destination at mounting shelf 21, equipment unit C, receptacle J2, terminal 7. The cable destination indicator 21C/TB2-7 indicates a destination at mounting shelf 21, equipment unit C, terminal board 2, terminal 7.

(b) At times, an additional associated component is installed on a mounting shelf along with the regular component; for example, it is common practice to install a gain-adjusting pad behind an amplifier receptacle on a mounting shelf. When a cable or conductor is to connect to this additional (or extra) component, the same cable destination indicator is used that would be used for the regular component but an X (indicating extra component) is added to the equipment position indicator. For example, the cable destination indicator 21CX/3 indicates that the destination of a conductor is a mounting shelf at rack unit 21, that it is an extra component associated with equipment unit C, and the connection is to be made to terminal 3 of the extra component.

If the rack mounting shelf to which the conductor or cable connects is in another rack, and the cable runs directly to that rack without connection to a terminal block in its own rack, the cable destination indicator must be prefixed with the number of the destination rack as described in Section 1 above.

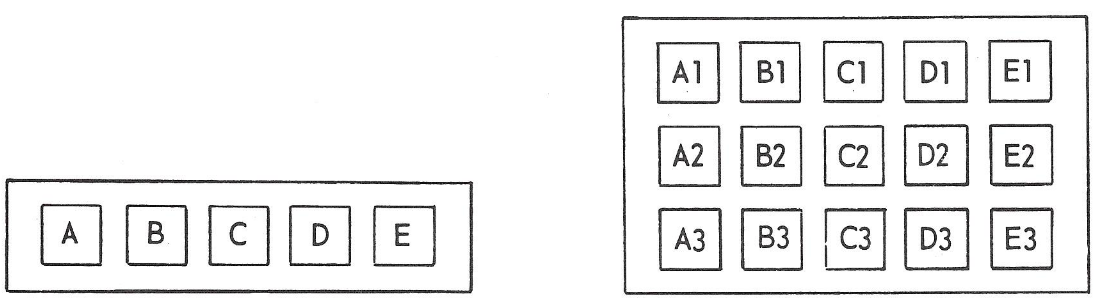
4. Equipment Rack Panels. System components such as level controls, meters, transformers, pads, equalizers, relays, and connectors are, in most cases, mounted on equipment rack panels. These panels may fall into the category of front-of-rack panels (such as control panels), or recessed panels (such as equipment mounting panels).

As already described in Chapter 2 (and in Section 3 above), an equipment rack mounting panel is identified by a number which is determined by the rack unit at the top edge of the panel when it is mounted on the equipment rack. If the panel is recessed (recessed or sub-panels are frequently employed for mounting small system components) and the wiring side of the panel faces toward the rear of the rack, the panel number should include the suffix R (for example, panel 17R). On the other hand, if the wiring side of the panel faces toward the front of the rack, the panel number should include the suffix F (for example, panel 17F). Note that either suffix (R or F) indicates a recessed panel. In the rather unusual case of a panel mounted on the rear (back) surface of a rack, the panel number should include the suffix B (for example, panel 17B).

Components mounted on a panel are identified by a letter, and in the case of panels with more than one row of components, by a letter and a number as described below:

(a) When the components mounted on a panel are arranged in a single horizontal row as in Figure 7-5A, they are identified by the letters A, B, C, etc., starting at the left as viewed from the front of the rack.

(b) When the components mounted on a panel are arranged in two or more horizontal rows, as in Figure 7-5B, they are identified by a letter and number. The letter indicates the vertical column in which the component is located (starting with A at the left as viewed from the front of the rack). The number indicates the position of the component in its vertical column starting with 1 at the top of the panel and working down.



(as viewed from front of rack)
A

(as viewed from front of rack)
B

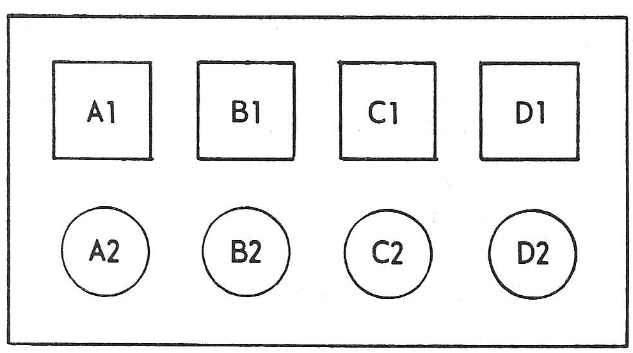
FIGURE 7-5. A single letter identifies a component on a panel with one horizontal row of components as in A. A letter and a number identify a component on a panel with multiple horizontal rows of components as in B. The letters always start with A at the left as viewed from the front of the rack.

Other examples of panels with multiple rows of components (including unsymmetrical equipment arrangements which are often encountered) and the methods by which the individual components are identified, are shown in Figures 7-6, 7-7 and 7-8.

When the equipment to which the far end of a conductor or cable connects is an equipment rack panel in the same rack (either front-of-rack or recessed), the cable destination indicator consists of a notation containing (a) the number of the panel where the equipment is mounted, (b) a letter (if the panel has one horizontal row of components), or a letter and a number (if the panel has two or more horizontal rows of components) indicating the position of the component on the panel, and (c) the number (or letter or word; see Section 7 below) identifying the terminal to which the connection is to be made.

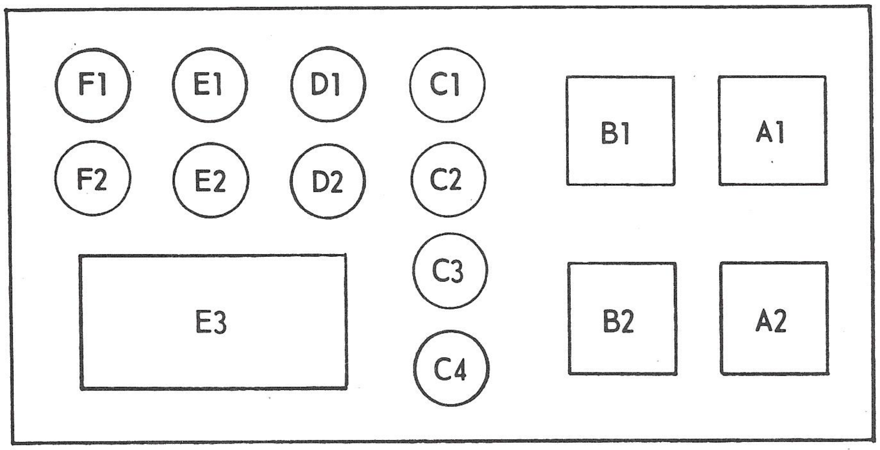
As an example, the cable destination indicator 21E/3 indicates that the destination of a conductor is an equipment rack panel at rack unit 21, equipment unit E (fifth from left as viewed from the front of the rack), terminal 3. Two other facts can also be deduced from this notation. First, the omission of suffix R or F on the panel number indicates that the panel is mounted on the front surface of the rack, i.e., it is not a recessed panel. Second, the fact that the equipment unit is identified by the letter E without an added number indicates that the panel contains only a single horizontal row of components.

As a second example, the cable destination indicator 19R-C3/4 indicates that the destination of a conductor is a recessed equipment rack panel at rack unit 19, equipment unit C3 (vertical column C, 3rd component down, see Figures 7-5B and 7-7), terminal 4. This cable destination indicator further tells us by means of the suffix R on the panel number that the wiring side of this recessed panel faces toward the rear of the rack.



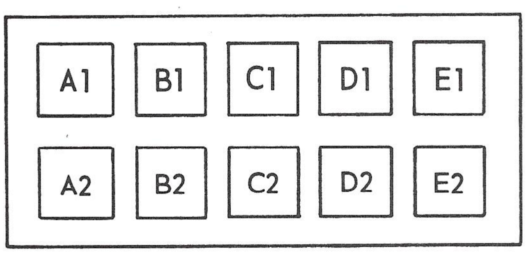
(as viewed from front of rack)

FIGURE 7-6. In a symmetrical panel layout, such as this control panel containing four meters and four variable attenuators, the method of component identification is clearly evident.

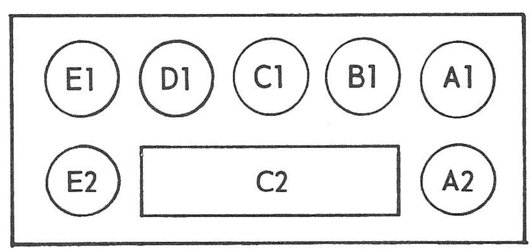


(as viewed from rear of rack)

FIGURE 7-7. In an unsymmetrical panel layout such as this recessed equipment mounting panel, a vertical (lettered) column is established for each vertical column of components. Components sharing a common vertical center line are considered to be in the same column. The components in each of these vertical columns are then numbered starting with 1 at the top as indicated. Note that the number of components in the vertical columns can vary, but the numbering in each column must remain consecutive. If a component is omitted, but the panel has been drilled for its inclusion at a later date, its number must be reserved.



PANEL 19F
(as viewed from front of rack)



PANEL 19R
(as viewed from rear of rack)

FIGURE 7-8. Should a recessed panel have equipment mounted on both front and rear, component numbering should start with A1 for each side as shown above. The letter F or R on the panel number in the cable destination indicator will clearly indicate to which side of the panel a conductor is to be connected. Note that component A is always at the left when viewed from the front of the rack.

At times, an additional component is mounted directly on a panel mounted component, for example, a tapped volume indicator attenuator network is often mounted directly on a volume indicator meter. When a cable is to connect to such an additional component, the same cable destination indicator is used that would be used for the regular component but an X (indicating extra component) is added to the component position indicator. For example, the cable destination indicator 36C1X/IN indicates that the destination of a conductor is a panel at rack unit 36, that it is an extra component associated with equipment unit C1, and the connection is to be made to the terminal marked IN on the extra component.

If the rack panel to which the conductor or cable connects is in another rack, and the cable runs directly to that rack without connection to a terminal block in its own rack, the cable destination indicator must be prefixed with the number of the destination rack as described in Section 1 above.

5. Control Consoles. In the discussion of cable destination indicators thus far, we have been concerned with cable destination indicators for use on cables destined to components mounted in equipment racks. When the destination of a cable is a component in a control console, the same general rules are used. To do this, however, the control console must first be broken down into numbered compartments and a simple sketch of the console, identifying each compartment, included on the wiring diagram. An example of such a sketch is given in Figure 7-9.

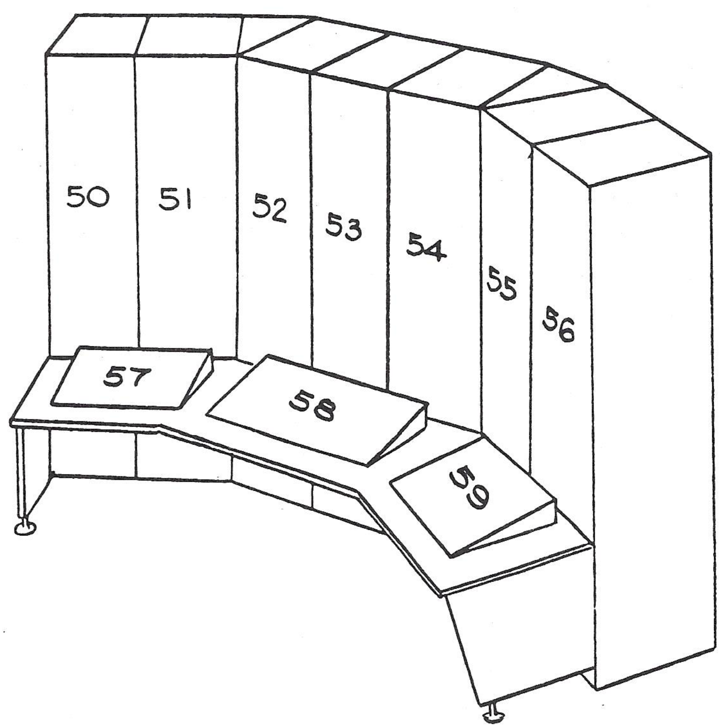


FIGURE 7-9. A sketch identifying each console compartment, such as shown in this example, must be included on the control console wiring diagrams.

When this has been done, the same cable destination indicator system that is used for racks (and is described in considerable detail above) may now be used. In the cable destination indicator, the console compartment number is equivalent to the rack number in a rack cable destination indicator and should be used in the same manner. It will be noted that, as is the case with a rack cable destination indicator, the compartment number need be used only when the destination of a cable is in another compartment of the console.

6. Equipment Assemblies not Mounted in Racks or Consoles. Wiring diagrams and cable destination indicators are also needed for equipment assemblies that do not involve an equipment rack or console; at least at the time they are built. An example would be a relay switching chassis. Such a unit may be installed in a rack or console at some later date, or it may be packaged in a carrying case for use in field pickups. The wiring diagram for such a unit involves only the wiring of the switching chassis itself.

In such cases, the same cable destination indicator is shortened to show only the component identifying letter (or letter and number) and the terminal number (or letter or word, see Section 7).

An example of such a shortened cable destination indicator would be C3/4 which indicates that the destination of a conductor is equipment unit C3 (vertical column C, 3rd component down, see Figure 7-5B and 7-7), terminal 4.

7. Terminal Identification. The terminal identification used in a cable destination indicator, which may be a number, letter, or word (in some instances, it may be a combination of these) must be clear and unmistakable. It should be, whenever possible, the terminal identification marked on the terminal of the component by the manufacturer. If the terminals of the component are not marked, then the terminal identification should be obtained from the manufacturer's drawing or instruction manual.

If the terminal information is not available in either of the above ways, refer to the record book of wiring diagram symbols maintained by the CTN Engineering & Development Drafting Room. Should the component in question be new, and not yet included in this record book, a carefully-considered terminal identifying system should be created. This new terminal identifying system should be used to complete the work in progress and simultaneously be submitted for approval and inclusion in the Drafting Room record book.

8. Punctuation in Cable Destination Indicators. To keep wiring diagrams from becoming cluttered, it is desirable to keep cable destination indicators as short and concise as possible. Therefore, when clarity is not impaired, the characters that make up the destination indicator should not have spaces or punctuation marks between them but, rather, should be run tightly together. One exception; a virgule (/) should always be used to separate the terminal identification from the preceding part of the indicator. An example of this would be DD17/3.*

In cases where ambiguity could result, a hyphen should be used to separate the appropriate characters, for example; 27R-G/4.

9. Avoiding Redundancy. When CBS 2FA, 2FB, 2FP, 3FA, or similar cables connect to a terminal block or jack field in the normal manner, it is necessary to give a destination indicator only on the red conductor of the cable as shown on Figure 7-3. Similarly, in the case of a coaxial cable, such as CBS 1CA, a destination indicator need be given only for the center conductor. When the cable connects to equipment other than a terminal block or jack field, and the terminals to be used might not be clear, a destination indicator should be given for all conductors in the cable.

10. Summary. For convenient reference, there is given below a summary of typical cable destination indicators together with their meanings. These are examples that were discussed in the preceding paragraphs.

*As discussed in Section 3 above, the terminal portion of the cable destination indicator should include the receptacle number or terminal board number of a component when one is involved, for example, 21C/TB2-7.

Destination Indicator	Far End of Cable Connects To:
DD17/3	Terminal block DD, row 17, terminal 3
R3J5	Jack row 3, jack 5 tip
R3J5N	Jack row 3, jack 5 normal
21C/7	Panel or shelf 21, equipment unit C, terminal 7.
21C/J2-7	Panel or shelf 21, equipment unit C, receptacle J2, terminal 7.
21C/TB2-7	Panel or shelf 21, equipment unit C, terminal board 2, terminal 7.
21CX/3	Panel or shelf 21, extra component associated with equipment unit C, terminal 3 of the extra component.
21E/3	Panel or shelf 21, equipment unit E, terminal 3.
19R-C3/4	Recessed panel 19 (with wiring facing toward rear), equipment unit C3, terminal 4.
36C1X/IN	Panel or shelf 36, extra component associated with equipment unit C1, terminal marked IN.
C3/4	Equipment chassis, equipment unit C3, terminal 4.

In the above examples, the cable runs would be to equipment in the same equipment rack or console compartment. If the cable destination was in another rack or another console compartment, the cable destination indicator should be prefixed with the number of the destination rack or destination console compartment, for example; 12DD17/3, 23R3J5, 18-21C/7, 37-19R-C3/4, 52-36C1X/IN.

Abbreviations used in cable destination indicators are summarized below:

Abbreviation	Meaning
B	When used following a panel number (for example, panel 17B), indicates panel is flush-mounted on rear of rack or console compartment.
F	When used following a panel number (for example, panel 17F), indicates panel is recessed with wiring facing toward front of rack or console compartment.
J	Receptacle for a plug-in component (when so designated by the manufacturer of the component).
N	Normal or normals (of jack).
R	When used following a rack panel number (for example, panel 17R), indicates panel is recessed with wiring facing towards rear of rack or console compartment.
R J	When R and J appear in the same expression, (for example, R3J9) indicates row and jack.
TB	Terminal board on a component.
X	When used following a component identifying letter (for example, CX), indicates an extra component associated with the component.

C. Orientation of Drawing

Wiring diagrams should always be drawn so they are oriented in the way the wireman or maintenance man will see the actual equipment.

D. Typical Wiring Diagrams

Examples of typical wiring diagrams using the symbols and methods discussed above are given in Figures 7-10, 7-11, and 7-12.

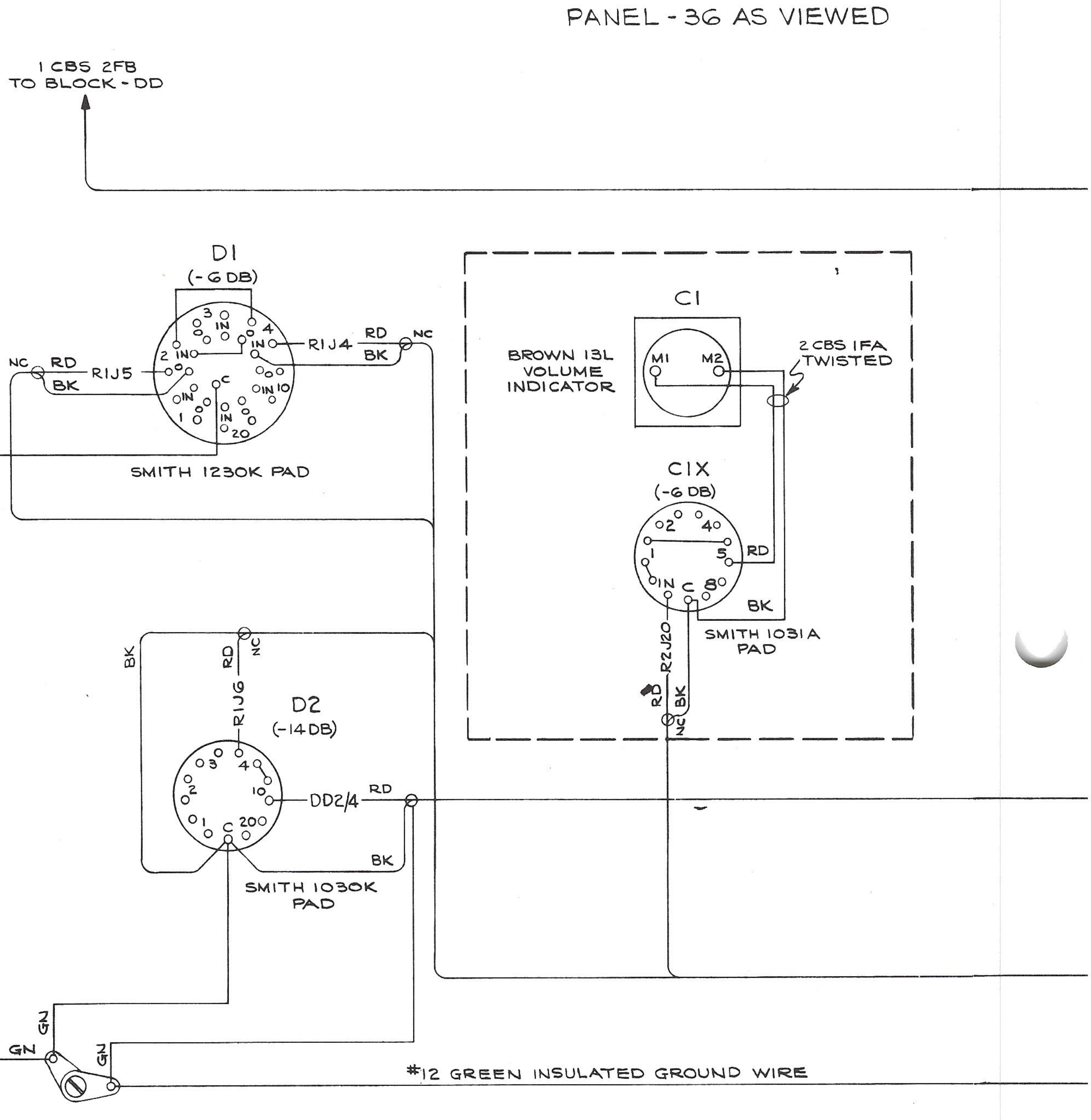
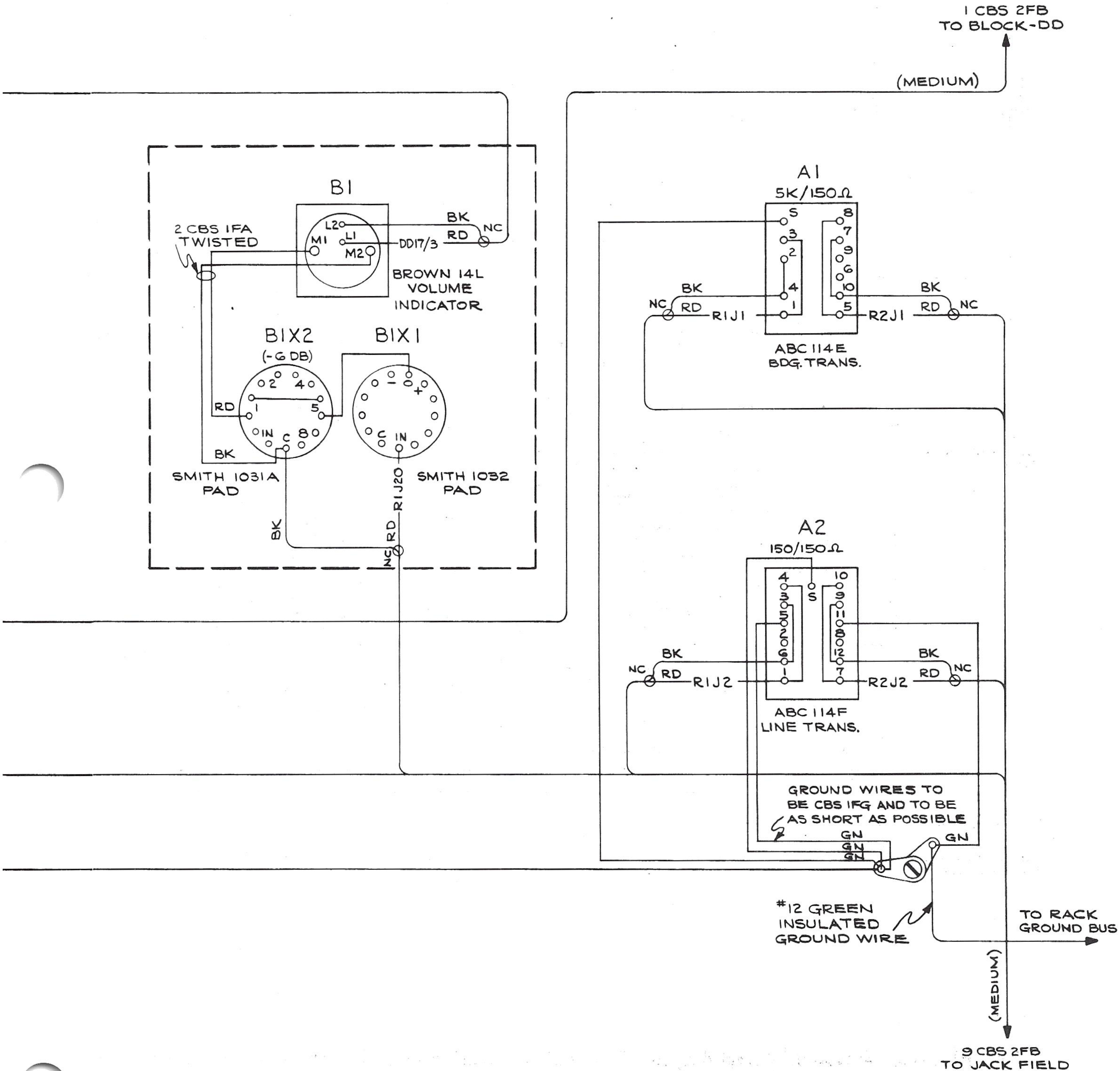


FIGURE 7-10. A typical wiring diagram of a panel of miscellaneous audio components illustrating the use of CBS cable and component symbols, cable destination indicators, cable color coding, and component-identifying designations.

FROM REAR OF RACK



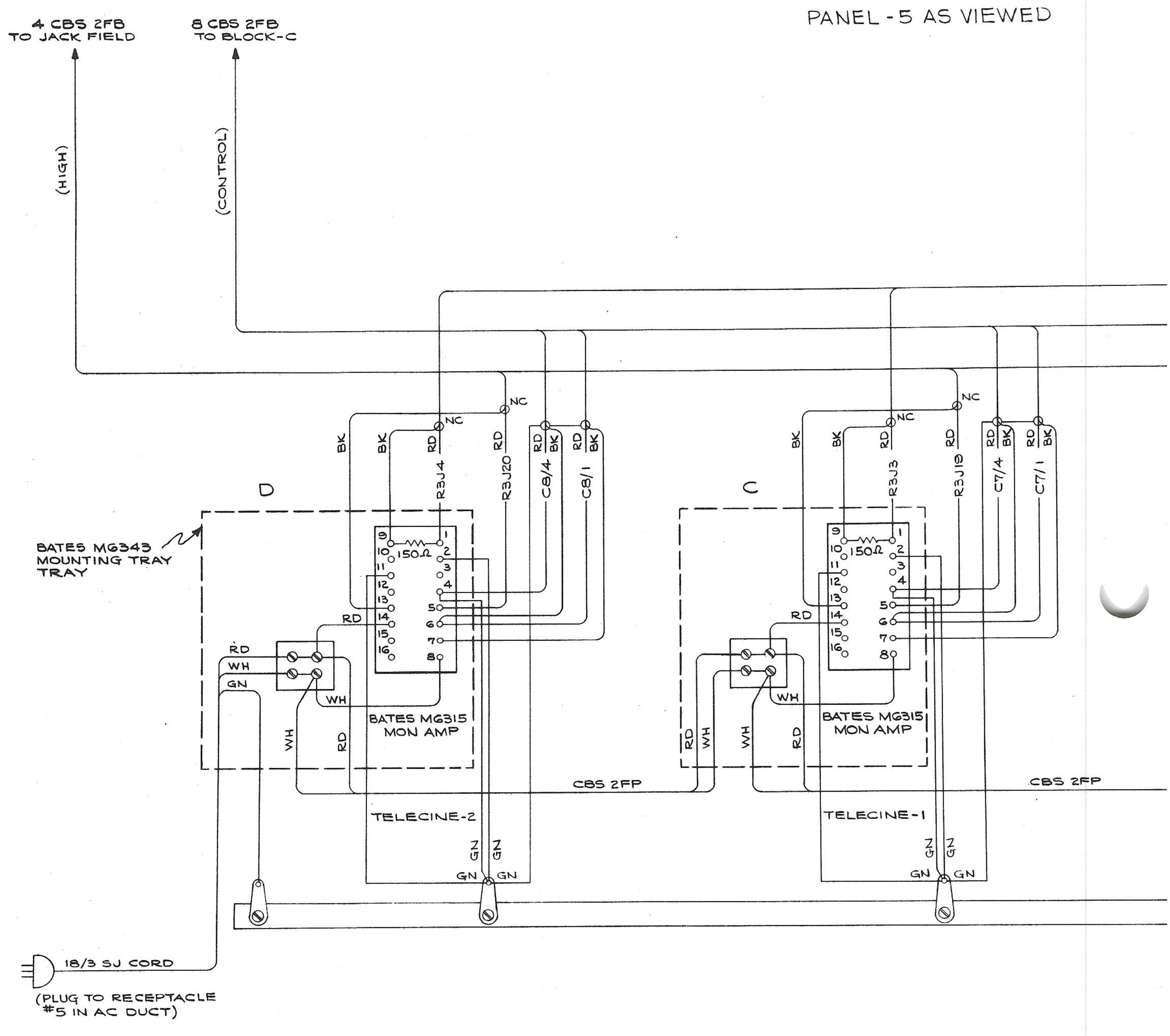
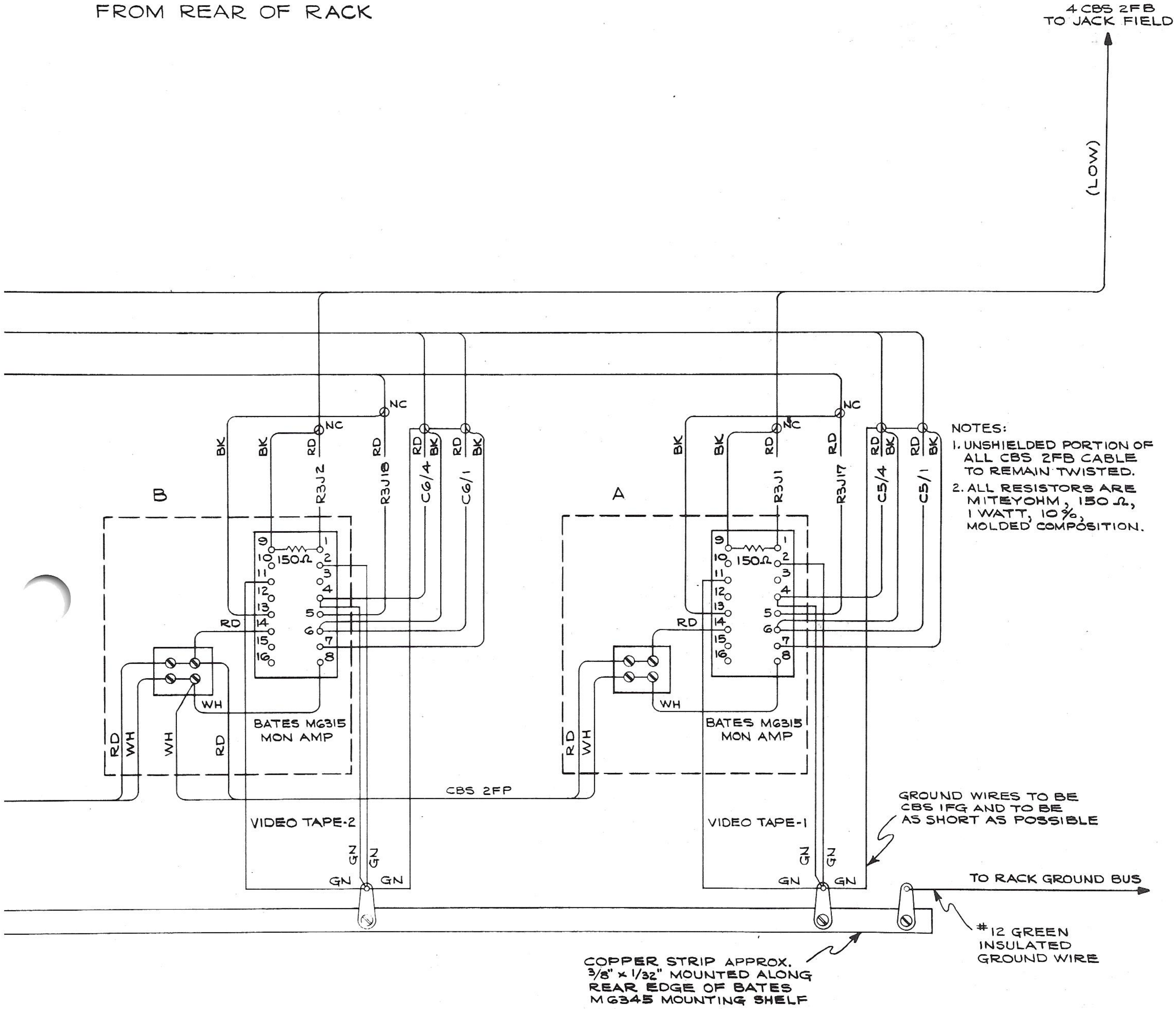


FIGURE 7-11. A typical wiring diagram of an audio monitoring amplifier mounting shelf illustrating method of showing individual mounting trays and identifying amplifier type and function. Grounding is in accordance with method discussed in Chapter 6.

FROM REAR OF RACK



NOTES:
1. UNSHIELDED PORTION OF ALL CBS 2FB CABLE TO REMAIN TWISTED.
2. ALL RESISTORS ARE MITEYOHM, 150 Ω, 1 WATT, 10%, MOLDED COMPOSITION.

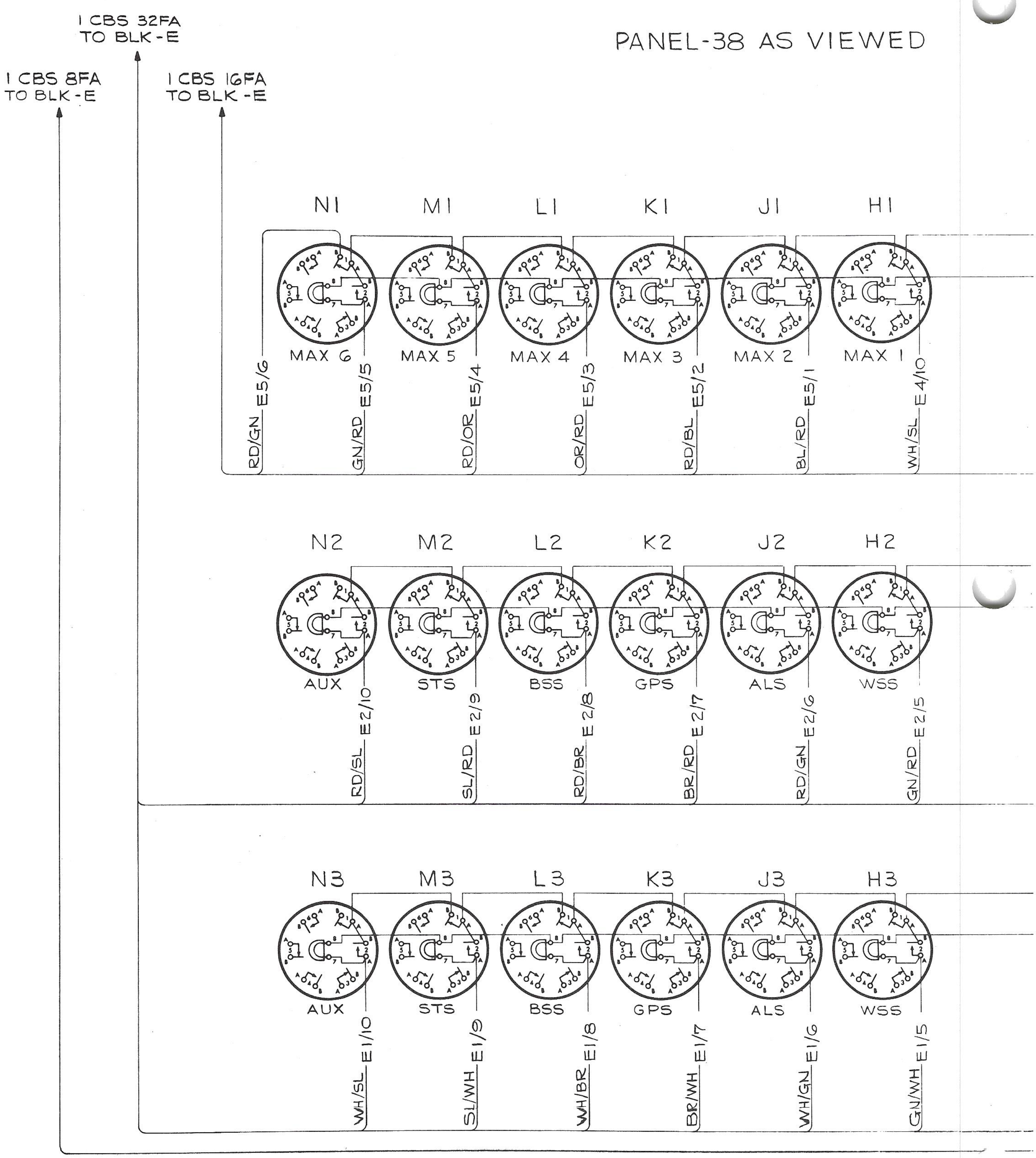
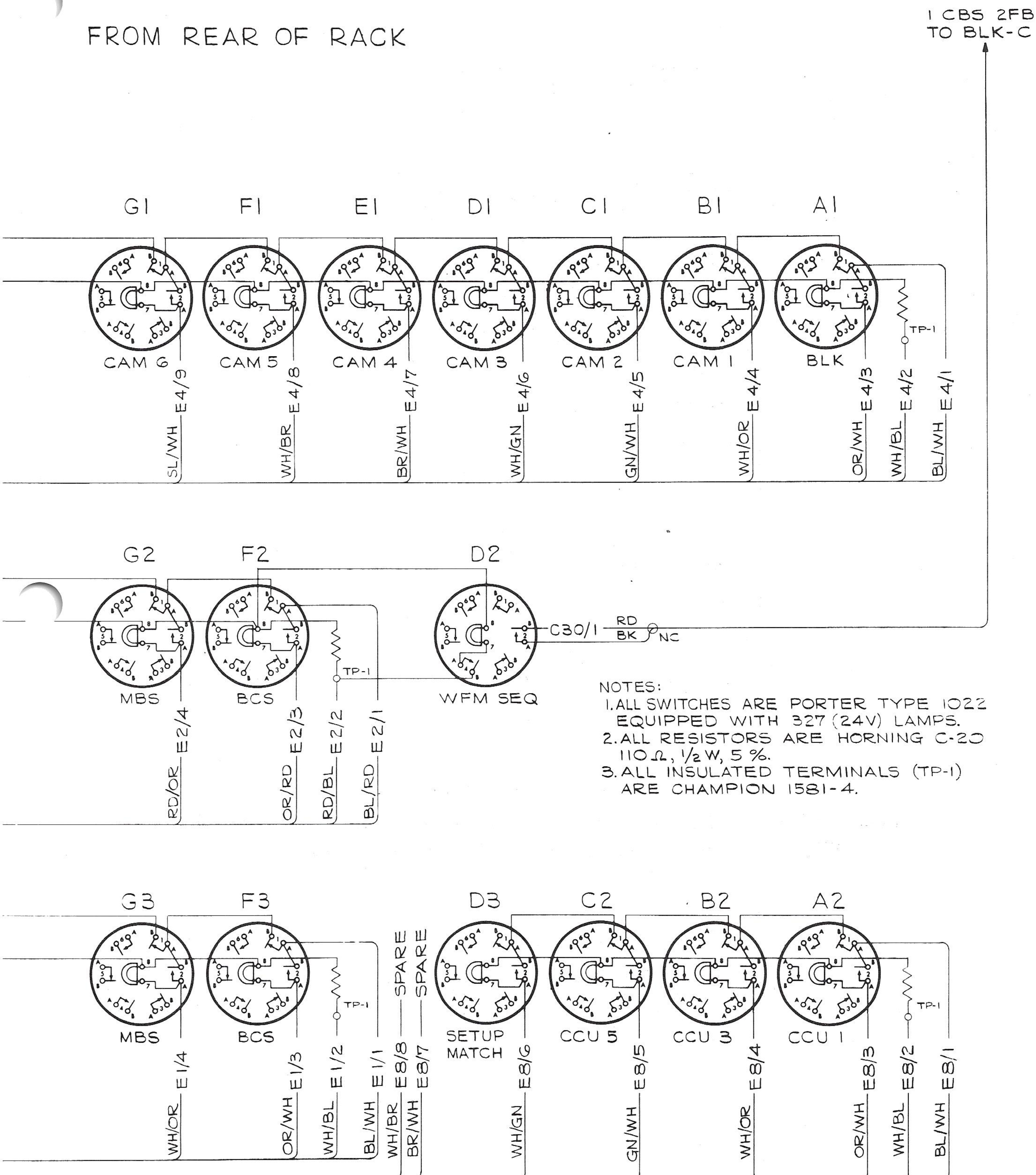


FIGURE 7-12. A typical wiring diagram of a push button control panel illustrating the breaking out of individual conductors from multi-conductor control cables. The component identifying designation is given above each push button; the circuit being controlled is given below.



NOTES:
1. ALL SWITCHES ARE PORTER TYPE 1022 EQUIPPED WITH 327 (24V) LAMPS.
2. ALL RESISTORS ARE HORNING C-20 110 Ω, 1/2 W, 5 %.
3. ALL INSULATED TERMINALS (TP-1) ARE CHAMPION 1581-4.

Table 7-1. ABBREVIATIONS FOR COLORS OF CABLE AND WIRE

COLOR	ABBREVIATION
Black	BK
Blue	BL
Brown	BR
Gray	GY
Green	GN
Orange	OR
Pink	PK
Purple	PP
Red	RD
Slate	SL
Tan	TN
Violet	VI
White	WH
Yellow	YL

Note: WH/BL indicates a white insulated wire with a blue tracer.
BL/WH indicates a blue insulated wire with a white tracer.

REFERENCES

1. USA Standard Y32.2 - 1962, GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONICS DIAGRAMS.

2. USA Standard Y32.2a - 1964, Supplement No. 1 to Y32.2 - 1962, GRAPHIC SYMBOLS FOR ELECTRICAL AND ELECTRONICS DIAGRAMS.

3. USA Standard Y14.15 - 1966, ELECTRICAL AND ELECTRONICS DIAGRAMS.

8. Electrical Contractor

CHAPTER 8

ELECTRICAL CONTRACTOR SPECIFICATIONS AND DRAWINGS

8

ELECTRICAL CONTRACTOR SPECIFICATIONS AND DRAWINGS

An electrical contractor is almost always involved in the installation of broadcasting equipment in a CBS television plant. The electrical contractor installs ductwork, conduits, electrical power panels, outlet boxes, and cable runs. On some jobs he also moves broadcasting system equipment units into the building, fastens them in place, and makes the necessary electrical connections to each unit.

The electrical contractor must be provided with complete information covering the work he is to do. Accordingly, complete and well-detailed job drawings and well-prepared job specifications covering the electrical work must be prepared. These drawings and specifications form the foundation upon which a contract between CBS and the contractor is based.

It must be kept in mind that essentially all the contractor knows about a job when estimating its cost is the information given to him on the drawings and in the specifications, supplemented in some cases by an inspection visit to the site. Completeness and clarity in both the drawings and in the specifications cannot be stressed too strongly because, once a contract has been awarded, any work not covered in the drawings or specifications becomes a job extra.

It is the purpose of this chapter to review the methods employed in the preparation of electrical contractor drawings and specifications.

I. ELECTRICAL CONTRACTOR DRAWINGS

The electrical contractor drawings must include the following information:

(a) An accurate floor plan. This floor plan should show the exact location of each unit of technical equipment. Inasmuch as it will be used during equipment installation for the placement of equipment, key dimensions must be given on the floor plan. In addition, the floor plan must be drawn to a scale that permits other dimensions to be scaled from it with acceptable accuracy. A scale not smaller than 1/4-inch to the foot is recommended. A typical floor plan drawing is shown in Figure 8-1.

(b) Conduit, duct, and outlet details. Conduit, duct, and outlet requirements for a television plant are usually shown on a floor plan of the area of the plant involved, with the conduits, ducts, and outlets superimposed using the symbols shown in Figure 8-2. AC power conductors to be installed in conduit runs are usually included on this drawing. A typical conduit, duct, and outlet drawing is shown in Figure 8-3. In areas where the density of conduit and ductwork is high, it may be necessary to make two separate drawings; one for the conduit runs, the other for the duct runs.

(c) Installation details. Inasmuch as the plan-view conduit, duct, and outlet drawing cannot make clear all details of the installation, it should be supplemented, as required, with explanatory elevations, sections, and details to clarify particular portions of an installation. Typical installation details are shown in Figure 8-4.

(d) AV outlets. AV outlet drawings must include all information that the contractor will need to assemble, wire, and install the AV outlets in the studios and other areas of the plant. A typical AV outlet layout drawing of the type supplied to a contractor is shown in Figure 8-5. If the contractor is to supply the AV boxes and plates, he will also need drawings giving constructional details. CBS standard drawings covering the mechanical construction of the box and plates (as well as wiring details of typical plates) are listed under Reference Drawings at the end of this chapter.

(e) The ground system. Plant grounding systems have been discussed in considerable detail in Chapter 6. A typical electrical contractor ground system drawing for a television broadcasting plant is shown in Figure 8-6.

(f) Equipment power (EP) panelboard details. Circuit breaker equipped equipment power panelboards are installed in technical areas of a television plant for the distribution of power to the various units of technical equipment. A typical EP panelboard drawing of the type supplied to an electrical contractor is shown in Figure 8-7.

(g) Cable pulls. The electrical contractor must be supplied with information detailing all cable runs that are to be pulled in conduits and installed in ducts and cable ladders for the interconnection of racks, consoles, projectors, tape machines, outlet boxes, and other equipment units that form the plant system.

On relatively simple projects, this can be done by indicating cable pulls on the conduit, duct, and outlet drawing (see Section b above) using the notation shown in Figure 8-2. On more complex projects, cable runs should be indicated on "cable pull" sheets illustrated in Figure 8-8.

(h) Interconnection data (if contractor is to do this work). When the cable connections to racks, consoles, projectors, tape machines, outlet boxes, and other equipment units are to be made by the electrical contractor, it is necessary to provide him with terminal block and cross-connect data sheets (see Chapter 4) for each terminal block in the installation.

While the terminal block and cross-connect data sheets contain all information needed for making the cable connections, the fact that they also contain other information not pertinent to this phase of a project tend to make them appear relatively complex. Furthermore, some terminal block and cross-connect data sheets are large and therefore difficult to handle by an electrician working in cramped quarters at the base of a rack or on a ladder at the top of a rack. For these reasons, it has been found that an installation will often proceed faster if, instead of the regular terminal block and cross-connect data sheet, the contractor is provided with small-size (8-1/2 by 11 inch) sheets (one for each terminal block) that give only the terminal block external connections.

FLOOR

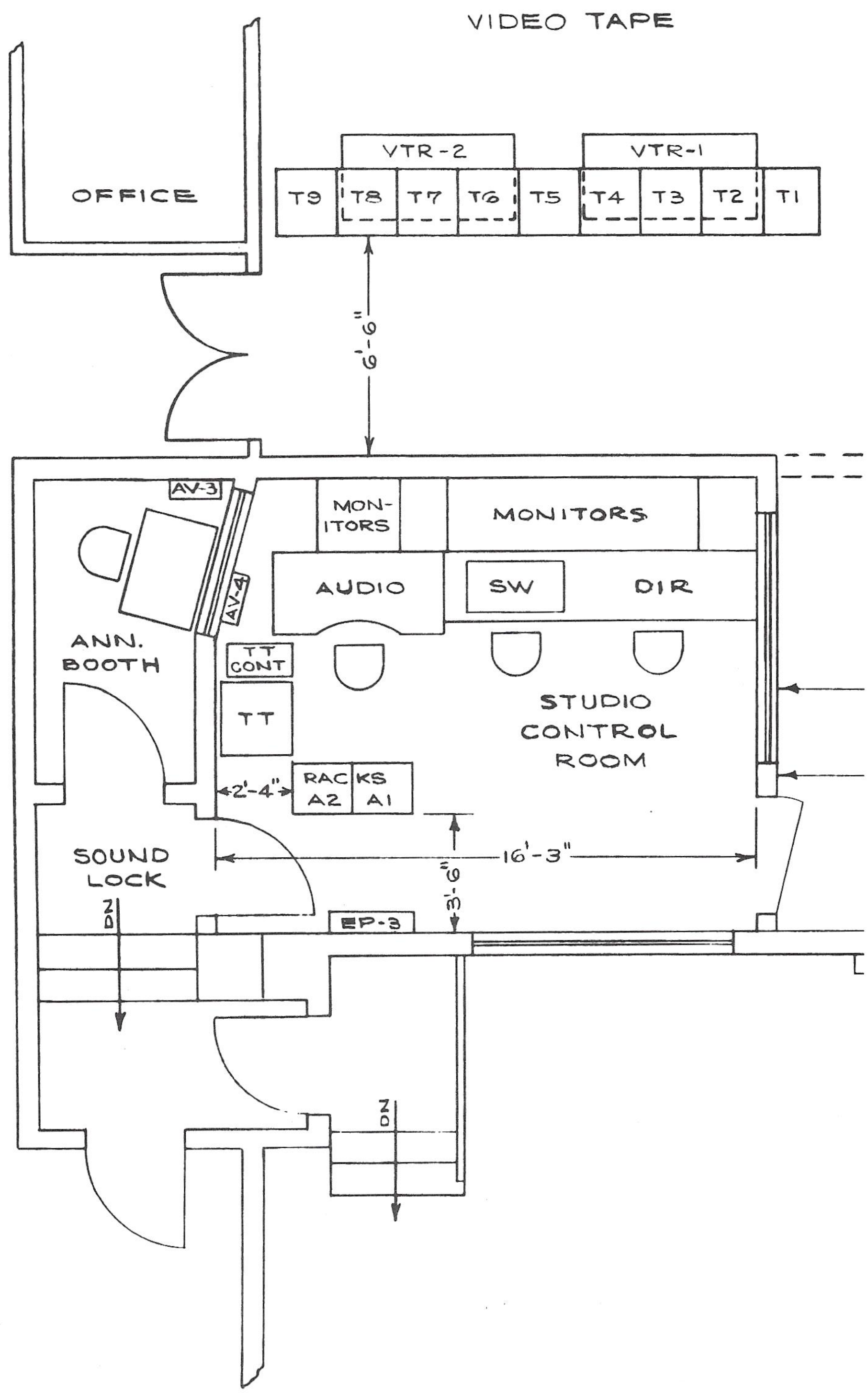
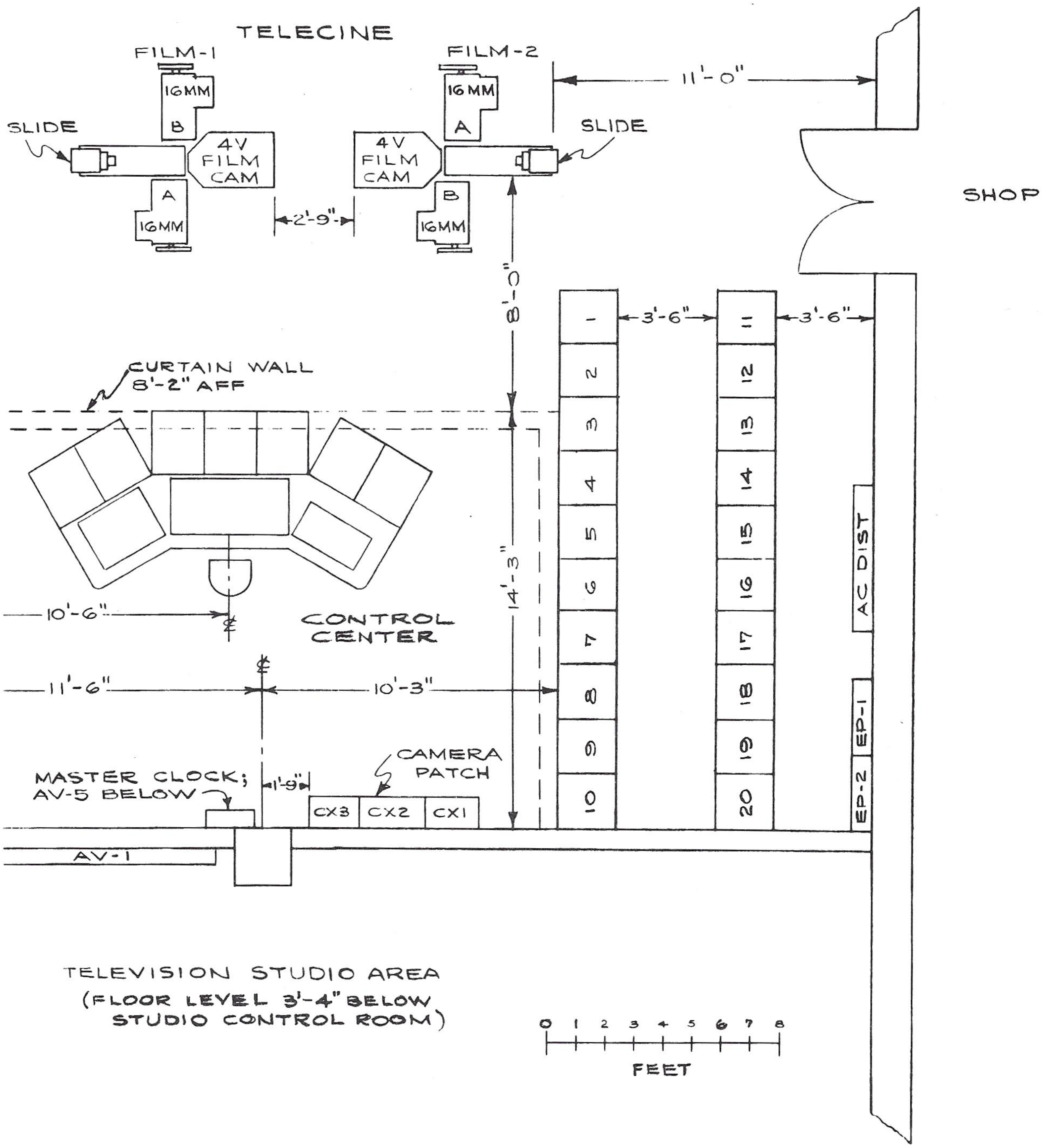


FIGURE 8-1. Typical floor plan of a portion of the technical area of a television plant.

PLAN


TELECINE
FILM-1
FILM-2
16MM
B
A
SLIDE
4V FILM CAM
2'-9"
11'-0"
SHOP
8'-0"
3'-6"
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
CURTAIN WALL
8'-2" AFF
14'-3"
AC DIST
10'-6"
CONTROL CENTER
11'-6"
10'-3"
EP-1
EP-2
CAMERA PATCH
MASTER CLOCK; AV-5 BELOW
1'-9"
CX3
CX2
CX1
AV-1
TELEVISION STUDIO AREA
(FLOOR LEVEL 3'-4" BELOW
STUDIO CONTROL ROOM)
0 1 2 3 4 5 6 7 8
FEET

SYMBOLS AND

OUTLET SYMBOLS

A	AUDIO
AC	AC POWER
AV	AUDIO-VIDEO (MULTI-PURPOSE AUDIO, VIDEO, COMM. & POWER)
C	CLOCK
COM	COMMUNICATION
DC	DC POWER
HM	HOUSE MONITORING
LS	LOUDSPEAKER
M	MICROPHONE
RF	RADIO FREQUENCY
V	VIDEO
G	DUPLEX CONVENIENCE OUTLET (LETTER G INDICATES OUTLET WITH SAFETY GROUNDING ELEMENT)

EQUIPMENT SYMBOLS

CX	CAMERA PATCH UNIT
EP	EQUIPMENT POWER PANELBOARD
PX	PATCH CROSS UNIT
TB	TERMINAL BLOCK CABINET OR BOX
IU	IN-USE SIGN
OA	ON-AIR SIGN
GEN	GENERATOR
MOT	MOTOR

CONDUIT SYMBOLS

———	CONDUIT RUN (SEE NOTE 7)
1½"C ———	NOTATION INDICATES SIZE OF CONDUIT
2 CBS 2 FA ———	NOTATION INDICATES NUMBER & TYPE OF CABLE IN CONDUIT
20 // 16 /// ———	CROSS LINES INDICATE NUMBER OF AC BRANCH CIRCUIT CONDUCTORS IN CONDUIT, (ONE 2-WIRE & ONE 3-WIRE CIRCUIT IS INDICATED) NUMBERS INDICATE CIRCUIT BREAKERS FEEDING CIRCUITS (IN EXAMPLE, BREAKER 16 FEEDS 3-WIRE CIRCUIT, BREAKER 20 FEEDS 2-WIRE CIRCUIT) CONDUCTOR SIZE & TYPE ARE TO BE SPECIFIED ON JOB DRAWINGS
———→ EP-1	ARROWHEAD ON CONDUIT RUN INDICATES CONDUIT HOME RUN NOTATION INDICATES DESTINATION OF CONDUIT HOME RUN; EQUIPMENT POWER PANELBOARD EP-1 IN THIS EXAMPLE

FIGURE 8-2. Symbols and abbreviations used on electrical contractor conduit and duct layout drawings.

ABBREVIATIONS

BOX SYMBOLS

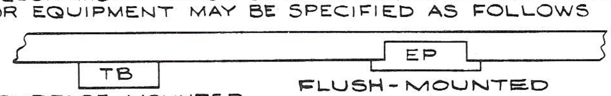
J	JUNCTION BOX
PB	PULL BOX

ABBREVIATIONS

AFF	ABOVE FINISHED FLOOR
CL	CABLE LADDER
FC	FLEXIBLE CONDUIT
NIC	NOT IN CONTRACT
OC	ON CENTERS
OH	OVERHEAD

NOTES:

1. ADDITION OF NUMBER TO BASIC SYMBOL INDICATES SPECIFIC OUTLET, FOR INSTANCE $\boxed{\text{AV4}}$
2. TYPE OF BOXES, COVERS, & RECEPTACLES ARE TO BE SPECIFIED ON JOB DRAWINGS.
3. RECEPTACLE ARRANGEMENTS ON BOX COVERS OR PLATES ARE TO BE SPECIFIED ON JOB DRAWINGS.
4. FLUSH-MOUNTED OR SURFACE MOUNTED OUTLETS OR EQUIPMENT MAY BE SPECIFIED AS FOLLOWS

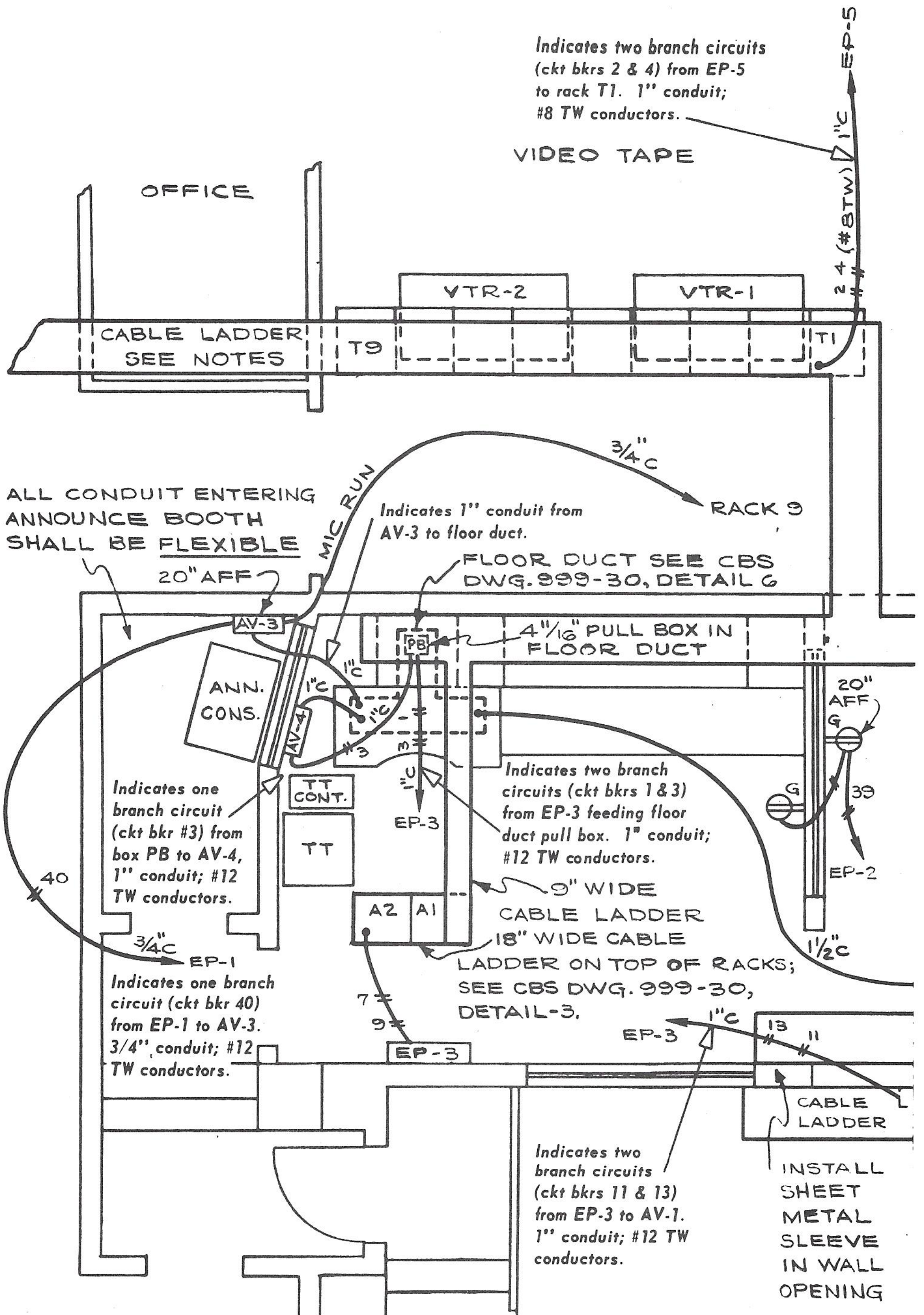


SURFACE-MOUNTED TERMINAL CABINET

FLUSH-MOUNTED EQUIPMENT POWER PANELBOARD

5. AV OUTLET BOXES ARE NORMALLY DIVIDED INTO THREE SECTIONS; AC, GENERAL, AND MICROPHONE. AC AND MICROPHONE CONDUIT RUNS GO TO END SECTIONS OF BOX AS INDICATED ON JOB DRAWINGS; ALL OTHER CONDUITS OR DUCTS GO TO CENTER SECTION OF BOX.
6. BOX LOCATION DIMENSIONS REFER TO THE BOX CENTER LINE UNLESS OTHERWISE SPECIFIED. HEIGHT DIMENSIONS ARE FROM THE FINISHED FLOOR.
7. CONDUIT RUNS MAY BE EXPOSED OR CONCEALED, WHICHEVER IS ARCHITECTURALLY (AND AESTHETICALLY) APPROPRIATE FOR THE AREA INVOLVED UNLESS SPECIFIED OTHERWISE ON JOB DRAWINGS.

CONDUIT, DUCT,

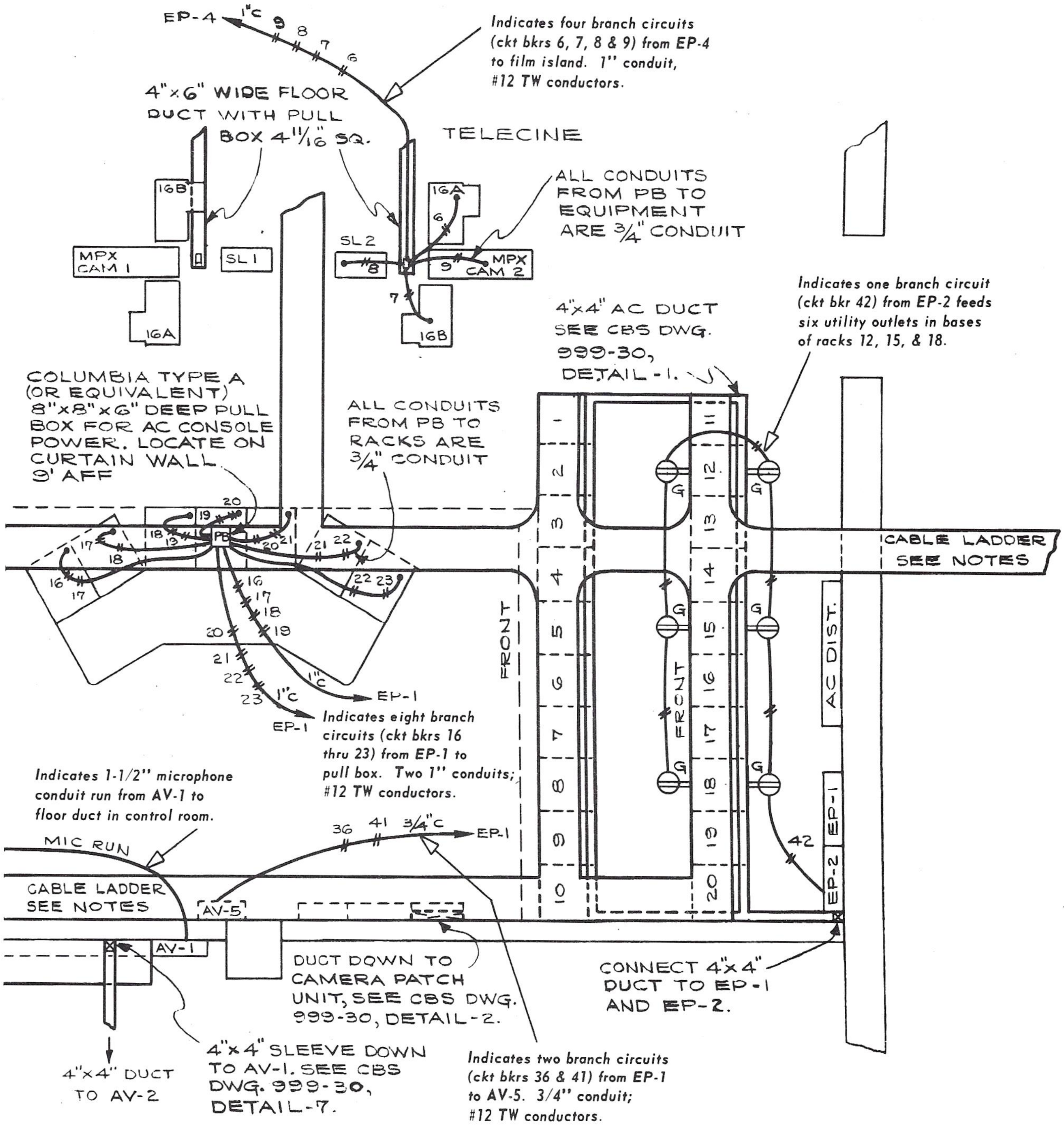


NOTES:

1. SEE CBS DWG. 999-25 FOR LEGEND OF SYMBOLS.
2. AC CONDUCTORS SHALL BE #12TW UNLESS OTHERWISE SPECIFIED.
3. SEE CBS DWG. 999-34,35,36, & 37 FOR ADDITIONAL CABLE RUNS.
4. OVERHEAD CABLE LADDER SHALL BE HUSKY/BURNDY VENTRAY LADDER S9H-18 (OR EQUIVALENT).

FIGURE 8-3. Conduit, duct, and outlet layout of a portion of the technical area of a television plant. To avoid conflicts, right-of-way for overhead cable ladders and ductwork must be coordinated with installations of air-conditioning ducts, water pipes, and similar installations.

AND OUTLETS



5. USE HUSKY/BURNDY VENTRIB HORIZONTAL CROSS SH-18X-12 (OR EQUIVALENT) FOR INTERSECTIONS ABOVE RACKS 3/4 AND 13/14.

6. ALL OVERHEAD CABLE LADDER IN CENTRAL TECHNICAL AREA SHALL BE 8'-9" AFF; IN STUDIO 10' AFF.

7. CABLE LADDER HANGERS SHALL BE LOCATED A MAXIMUM OF 5' OC.

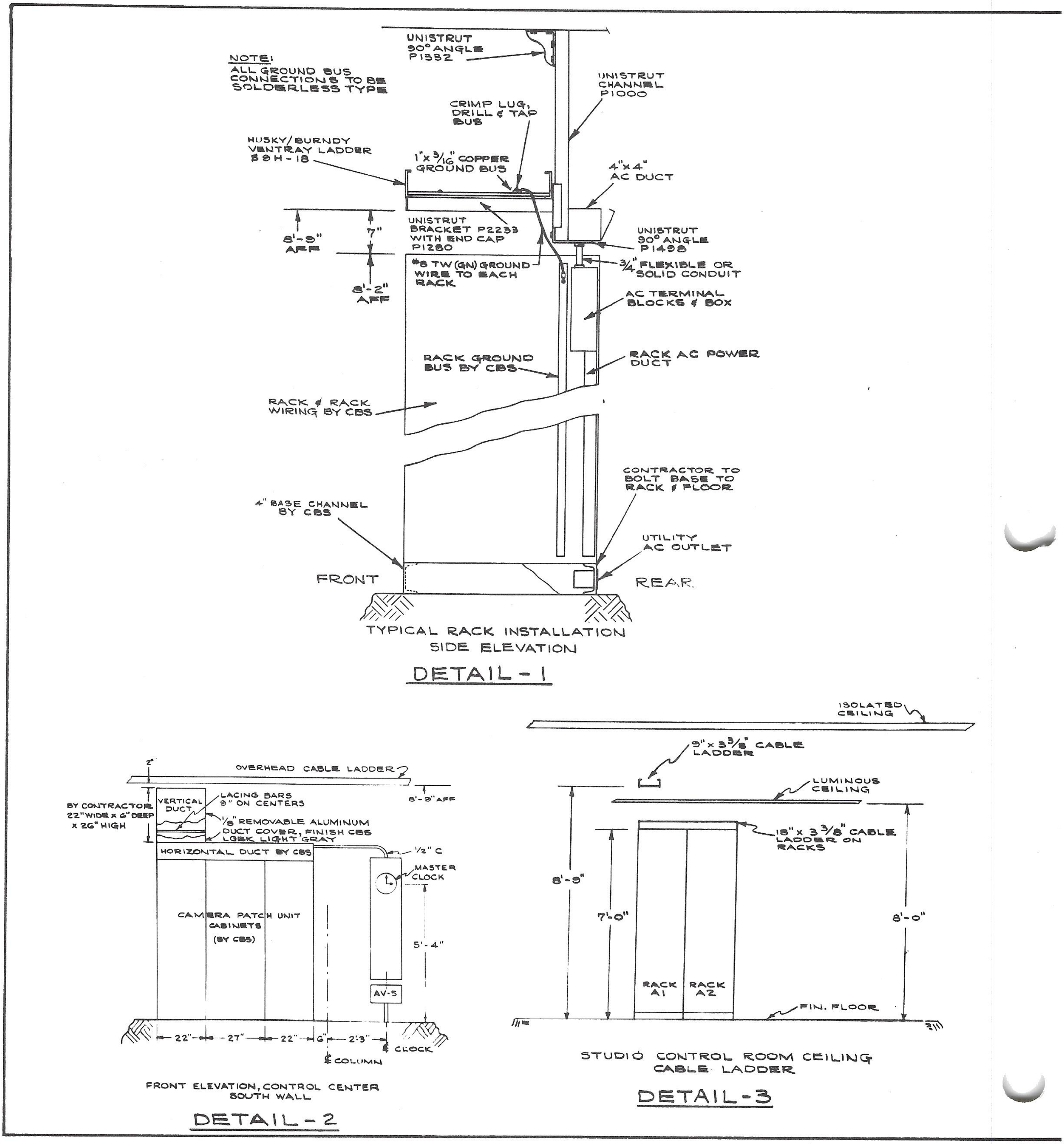
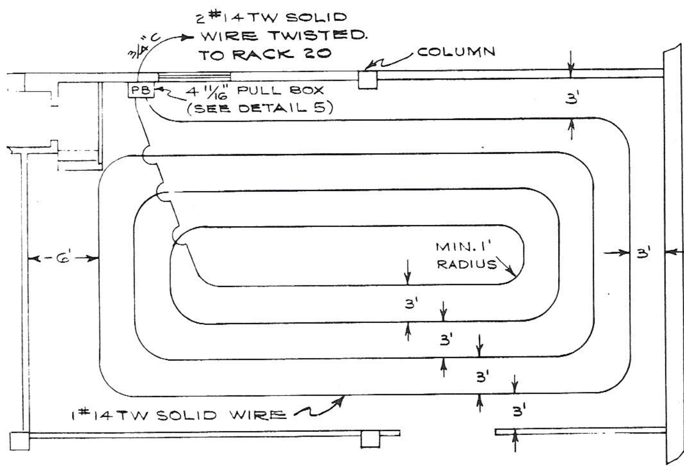


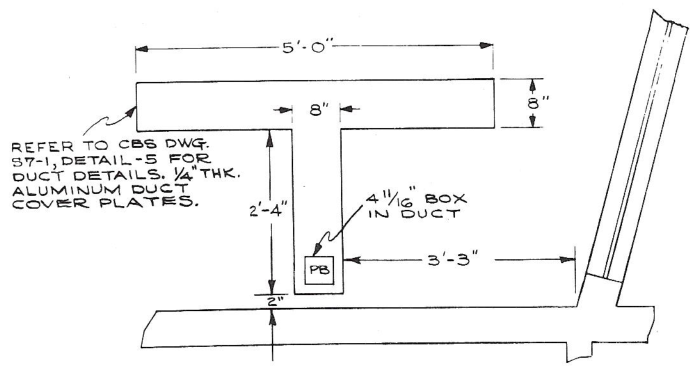
FIGURE 8-4. Installation details of a portion of the technical area of a television plant.

DETAILS



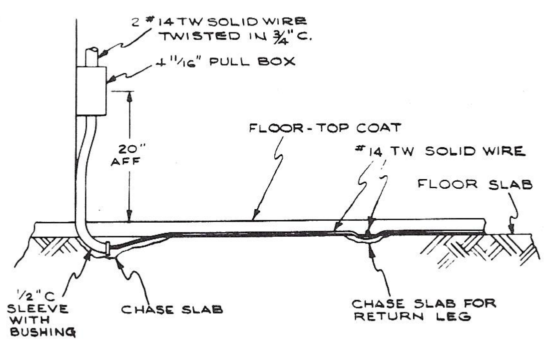
STUDIO CUE LOOP

DETAIL - 4



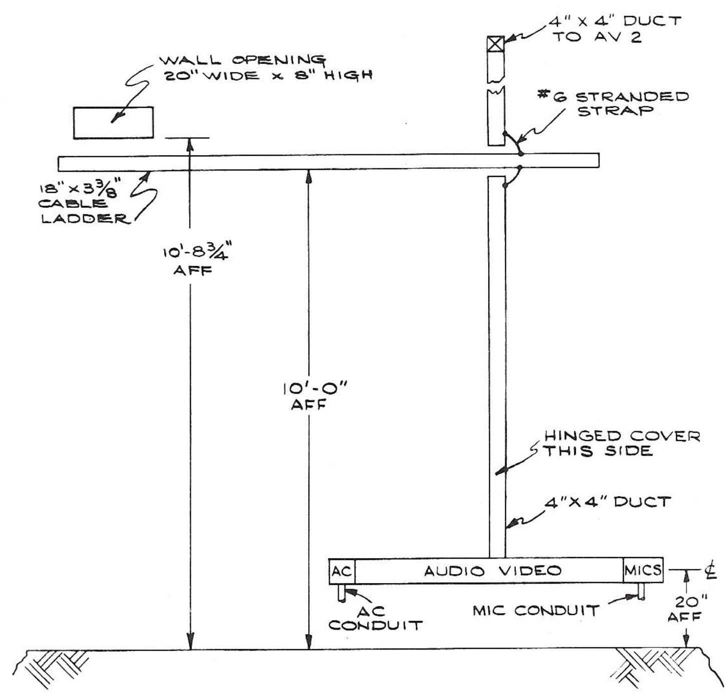
STUDIO CONTROL ROOM FLOOR DUCT LAYOUT

DETAIL - 6



STUDIO CUE LOOP - INSTALLATION DETAIL

DETAIL - 5



STUDIO AV BOX & DUCT INSTALLATION DETAIL

DETAIL - 7

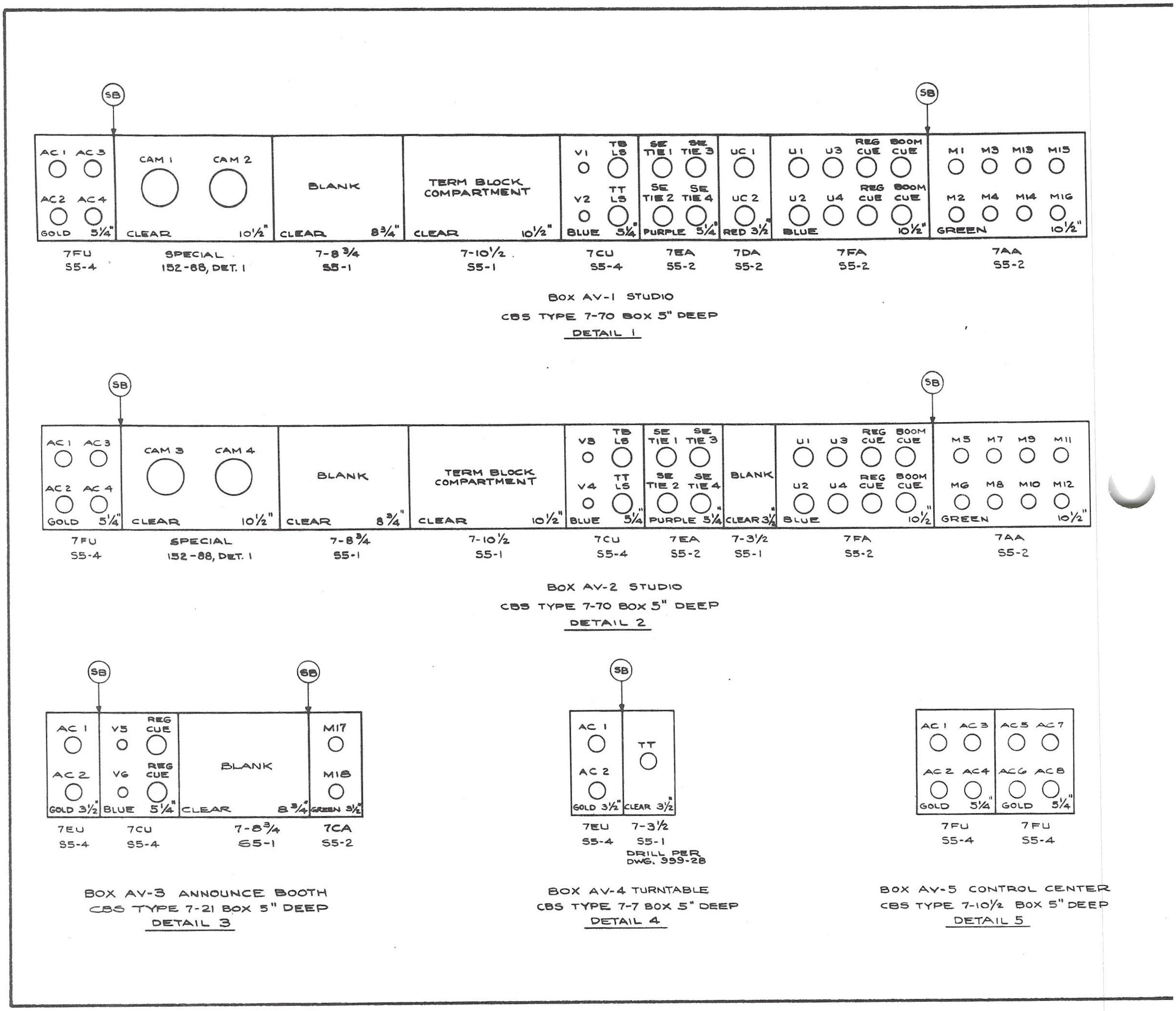


FIGURE 8-5. A typical electrical contractor AV outlet drawing.

OUTLETS

EQUIPMENT NOTES:

1. CONTRACTOR TO SUPPLY AV BOXES, PLATES, BARRIERS; CBS TO SUPPLY RECEPTACLES & RECEPTACLE DESIGNATIONS.
2. ALL PLATES TO HAVE ALUMILITE FINISH IN COLOR SPECIFIED. COLOR TO BE IN ACCORDANCE WITH COLOR SAMPLES TO BE SUPPLIED.
3. FOR PANEL DRILLING & FINISHING DETAILS REFER TO CBS DWGS. S5-1, S5-2, S5-3, S5-4, S5-5 & 152-88.
4. FOR BOX DETAILS REFER TO CBS DWG. S5-1.
5. FOR TYPICAL RECEPTACLE WIRING DETAILS, SEE CBS DWG. S5-6.
6. SB INSERT STEEL BARRIER IN BOX. REFER TO CBS DWG. S5-1, DETAIL 2.

RECEPTACLE LEGEND	
CODE	MANUFACTURER
AC	HUBBELL 7487 OR EQUIVALENT
CAM	BIW TV101C OR EQUIVALENT
M	CANNON UA3-13 OR EQUIVALENT
TT	CANNON SK-D12-31SL OR EQUIVALENT
BOOM CUE	HUBBELL 7586 OR EQUIVALENT
REG CUE	HUBBELL 7586 OR EQUIVALENT
SE TIE	HUBBELL 7586 OR EQUIVALENT
TB LS	HUBBELL 7586 OR EQUIVALENT
TT LS	HUBBELL 7586 OR EQUIVALENT
U	HUBBELL 7586 OR EQUIVALENT
UC	HUBBELL 7586 OR EQUIVALENT
V	AMPHENOL 83-1R OR EQUIVALENT

GROUND

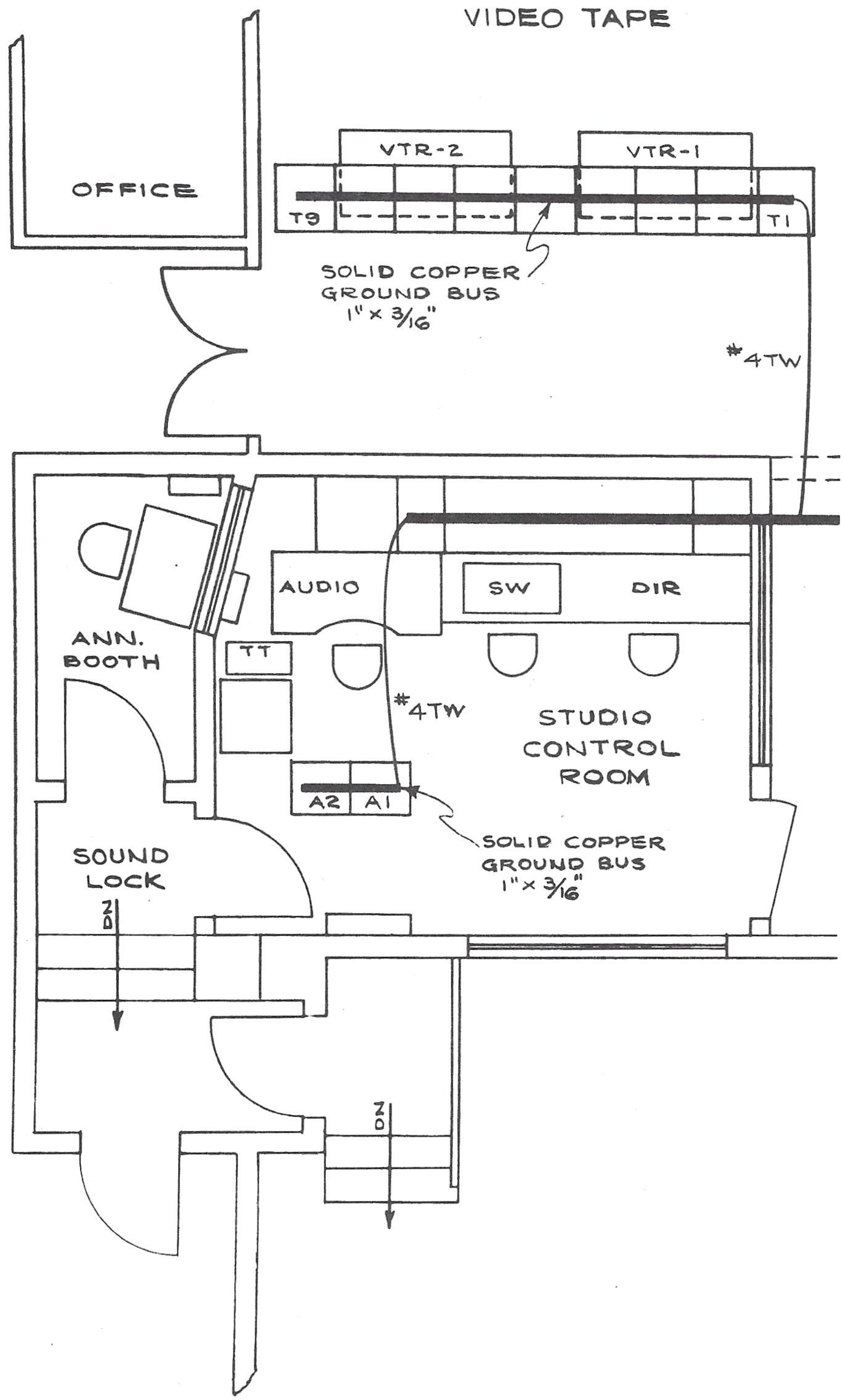
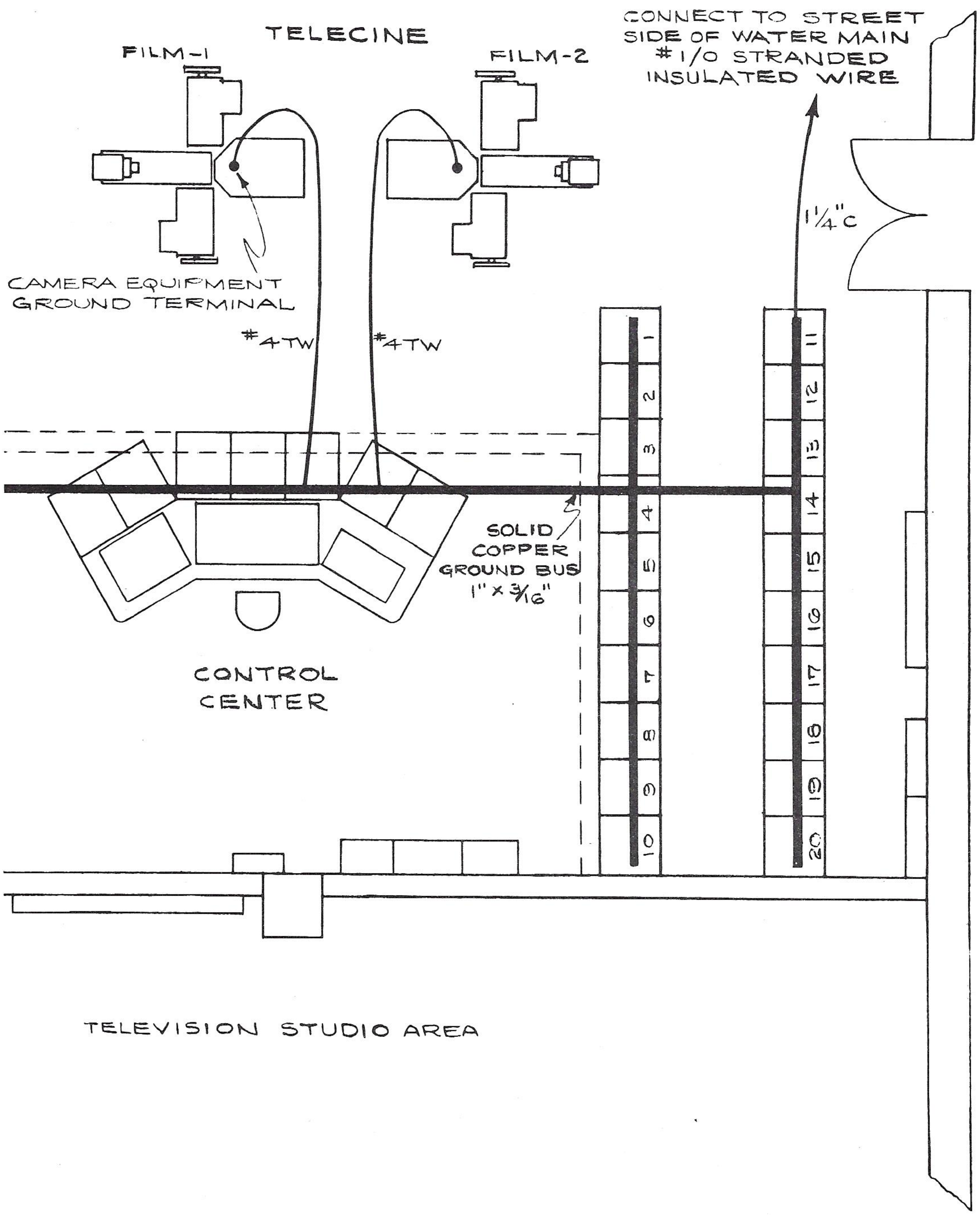


FIGURE 8-6. Ground system layout drawing of a portion of the technical area of a television plant.

SYSTEM


TELECINE
FILM-1
FILM-2
CONNECT TO STREET SIDE OF WATER MAIN #1/0 STRANDED INSULATED WIRE
1¼"C
CAMERA EQUIPMENT GROUND TERMINAL
#4TW
#4TW
SOLID COPPER GROUND BUS 1" x 3/16"
CONTROL CENTER
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
TELEVISION STUDIO AREA

EQUIPMENT POWER

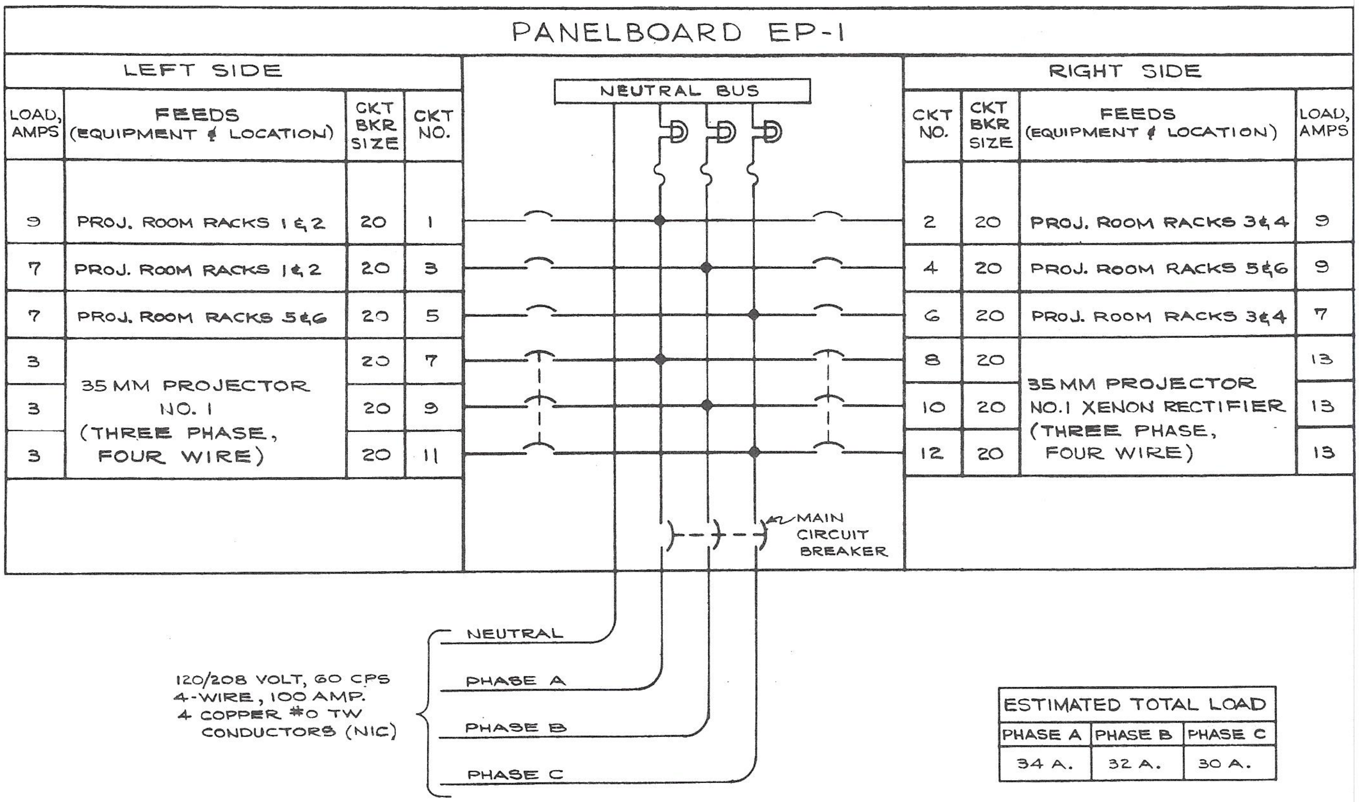


FIGURE 8-7. A typical engineering drawing of a 12-circuit EP panelboard. Not more than 42 overcurrent devices (other than those provided for the mains) should be installed in any one panelboard cabinet. In counting the overcurrent devices, a two-pole circuit breaker shall be considered two overcurrent devices; a three-pole breaker shall be considered three overcurrent devices.

To avoid the need for throwing all branch circuit breakers in an EP panelboard each time the equipment is turned on or off, a master on-off switch, or equivalent means for controlling power to all branch circuits simultaneously, is often included. This can be accomplished (a) by incorporating a multiple-pole main switch or multiple-pole main circuit breaker in the panelboard or (b) by means of remotely-located mains power-controlling relays operated from a switch or push buttons on the panelboard.

(EP) PANELBOARD

EQUIPMENT NOTES:

1. PANELBOARD SHALL BE SURFACE MOUNTED TYPE; CBS LIGHT GRAY BAKED ENAMEL (LGBK) FINISH.
2. SINGLE-POLE BRANCH CIRCUIT BREAKERS SHALL BE HEINEMANN TYPE 0411, FULLY MAGNETIC TYPE, STANDARD TIME DELAY CURVE, OR EQUIVALENT.
3. THREE-POLE BRANCH CIRCUIT BREAKERS SHALL BE HEINEMANN TYPE 3363, FULLY MAGNETIC TYPE, STANDARD TIME DELAY CURVE, OR EQUIVALENT.
4. MAIN CIRCUIT BREAKER SHALL BE HEINEMANN TYPE CJ3, 100 AMPERE, STANDARD TIME DELAY CURVE, OR EQUIVALENT.
5. INDICATOR LAMPS SHALL BE DIALCO TYPE 91408-935 SOCKET, OR EQUIVALENT, WITH NE-51 LAMP.
6. FUSEHOLDERS SHALL BE BUSSMAN TYPE HKP, OR EQUIVALENT, WITH TYPE 3AG FUSES.
7. PANELBOARD SHALL INCLUDE CIRCUIT DIRECTORY ON INSIDE OF FRONT DOOR ON WHICH CIRCUITS SHALL BE CLEARLY IDENTIFIED.

FIGURE 8-7 (continued)

The first method is simple and usually less expensive. The latter method may prove necessary in large installations where the number of panelboards receiving power must be automatically limited when the plant is switched over to operate from an emergency generator of limited capacity. With either system, fused indicator lamps (one for each phase) should be provided on the panelboard to indicate when power is on. In some cases, it may be desirable to include a second set of indicator lamps to indicate that power is available.

CABLE PULL SHEET

CABLE		FROM			TO			NOTES
MARKER	TYPE	AREA	EQUIPMENT	✓	✓	AREA	EQUIPMENT	
A101	2FA	EQUIP RM	RACK 1			CONT RM	PROD CONS	MED. LEVEL
A102								↓
A103			↓				↓	SPARE CABLE
A104			RACK 7			↓	VIDEO CONS	MED. LEVEL
A105			RACK 21			EQUIP RM	RACK 28	
A106			↓				RACK 31	
A107			RACK 22				RACK 28	
A108			↓			↓	RACK 31	↓
A109		↓	RACK 31			CLIENT'S ROOM	BOX AV-10	HIGH LEVEL
A110		SE RM	BOX AV-22			STUDIO	BOX AV-5	MED. LEVEL
A111		↓	↓			↓	BOX AV-7	↓
A112		CONT RM	RACK A1			CONT RM	PROD CONS LS	HIGH LE
A113							VID CONS LS	
A114							AUD CONS	
A115							LS	
A116						BTH	ANN BOOTH LS	
A117			↓			STUDIO	TB LS-1	
		STUDIO	TB LS-1				TB LS-2	↓

NOTE: PLACE CHECK IN ✓ COLUMNS WHEN CABLE MARKERS ARE RECORDED ON TERMINAL BLOCK DRAWINGS.

FIGURE 8-8. Cable runs that are to be installed between racks, consoles, and other equipment units that constitute a television broadcasting installation are indicated on cable pull sheets (Engineering Department Form 3) an example of which is shown above. It is customary to use separate sheets for audio, video, control, communication, and dc power cables. Cable markers should carry the prefix A for audio cables; V for video; C for control; K for communication; and P for dc power. Ac power cables are customarily indicated on the conduit, duct, and outlet drawing and require no identifying prefix.

II. ELECTRICAL CONTRACTOR SPECIFICATIONS

Specifications for the work to be performed must accompany the electrical contractor drawings to make clear any aspect of the job not covered by the drawings. As a guide to the general form and content of electrical contractor specifications, a typical specification is reproduced on the following nine pages. However, it should be remem- that no two jobs are alike; therefore, a specification must always be written specifically to fit the job at hand. For this reason, the example specification on the following pages should be used only as a general guide, and not as a standard form, in preparing an electrical contractor specification.

EXAMPLE

ELECTRICAL CONTRACTOR SPECIFICATIONS

These specifications, together with accompanying drawings, plans, schedules, and other data are intended to describe the work to be performed by an electrical contractor in the installation of such audio, video, film or communication facilities, together with associated low-tension control and signal system, as are required for the television broadcasting studio, video tape, or other technical areas indicated.

The following designations shall apply in these specifications and on accompanying drawings:

"CBS"	CBS Television Network, a division of Columbia Broadcasting System, Inc.
"Engineers"	CBS Television Network Engineering and Development Department personnel.
"Contractor"	The party to perform the work called for in these Specifications under a contract to be prepared after receipt by CBS of bid proposals.

I. SCOPE OF WORK

This Contractor shall furnish and install all ductwork, conduit, electrical boxes, hardware, devices, and wiring as called for on the Specifications and Drawings in accordance with the Engineers' requirement and approval.

II. GENERAL CONDITIONS

A. Laws, Ordinances, and Permits

This Contractor shall comply with all National Electrical Code regulations, as well as all local rules, regulations, laws, and ordinances which are applicable. Anything necessary to make the work comply with the above requirements shall be provided and installed by the contractor without additional cost to CBS.

This Contractor shall procure and pay for all permits and certificates required for the complete installation of the work specified.

EXAMPLE

B. Substitutions

Other makes of items than specified may be used if, in the opinion of the Engineers, same are equal and if specifically approved in writing by the Engineers.

C. Shop Drawings

Before proceeding with the work, this Contractor shall submit for approval of the Engineers drawings of the service switches, panelboards, ducts, and any other specially-constructed equipment furnished as part of the Contract.

D. Interpretation of Drawings and Specifications

Should there be any conflict between the Drawings and Specifications as to their interpretation for audio, video, and film installations, the same shall be referred to the Engineers, who shall give their decision, which decision shall be final and accepted as such by this Contractor.

E. Approval of Materials

This Contractor shall, upon request, submit samples of all materials and appliances to the Engineers for approval.

F. Visit to the Site and Examination of Drawings

This Contractor shall visit the site and carefully compare the plans with existing conditions and inform himself as to the nature and extent of the work to be done, and no extra compensation will be allowed him because of his failure to inform himself fully and to include in his work all items of labor and material to be furnished.

G. Drilling and Cutting

This Contractor shall do all drilling and cutting of ceilings, walls, and floors required for the installation of this work and shall do all patching, plastering, and finishing of walls, floors, and ceilings disturbed by this work.

H. Layout of Work

The arrangement and location of equipment racks, control consoles, wall boxes, outlets, ductwork, clocks, and like equipment shown on the drawings shall be followed explicitly. The responsiblity for accurately following the plans rests with the Contractor. The right is reserved by the Engineers to change the locations to accommodate any conditions which may arise during the progress of the work without additional compensation to this Contractor for such changes. Should it be found that any such work is laid out in a manner that interference will occur, this Contractor shall so report to the Engineers. The ductwork, conduits, outlets, and equipment shall be installed so that they will not interfere with the work of the other trades.

EXAMPLE

I. Coordination of Work With Other Trades

This Contractor shall assume full responsibility for coordinating his work with the work of other trades and other contractors working on the job.

J. Cleaning Up

This Contractor shall collect on a daily basis all waste and rubbish accumulating from his work and shall remove same from the premises at his expense.

K. Guarantee

This Contractor shall guarantee all work to be sound in every particular and shall make for a period of one year after date of final acceptance of the installation, without charge to CBS, any repairs that may be required owing to defective workmanship and materials, replacing same at his own expense, and all other work disturbed by such repairs, to the entire satisfaction of CBS.

L. Coordinating Engineer

A coordinating engineer will be assigned by CBS to answer any questions or clarify any problems that may arise during the progress of this work.

III. MATERIALS

A. Ductwork

1. Specially constructed ductwork, raceways, wireways, and troughs fabricated and installed in accordance with specifications of the Engineers shall incorporate only high quality materials and workmanship. Same must carefully and accurately follow the Specifications and Drawings of the Engineers.

2. Standard types of manufactured metal ductwork, raceways, wireways, and troughs shall be installed by the Contractor as specified on the Drawings and Specifications supplied by the Engineers.

3. Proper and adequate hangers and supports for ductwork, raceways, wireways, and troughs shall be furnished and installed by the Contractor.

EXAMPLE

B. Conduit and Fittings

1. Conduit and fittings shall be steel and shall be installed in accordance with the Specifications and Drawings supplied by the Engineers.

2. Conduit shall be concealed or run exposed, depending on the nature of the area of the installation. It shall be concealed except when it is specified by the engineers that it is to be exposed.

3. Concealed conduits shall be installed in floor slabs, floor fill, hung or furred ceilings, walls, or partitions.

4. When conduit is embedded in a concrete slab, standard wall-thickness rigid conduit shall be used. Other concealed or exposed conduit work may employ standard wall-thickness or thin-wall steel conduit.

5. Conduit and fittings shall be thoroughly and evenly protected against corrosion with cadmium plating or zinc applied by the electro-galvanizing, the hot-dipping, or the Sheradizing process. Make of conduit shall be General Electric, Westinghouse, National Electric, Youngstown, or equivalent.

6. Proper and sufficient hangers and supports for conduit work shall be furnished and installed as required.

7. When conduits extend from unisolated floors or walls to sound-isolated studio or control room walls, or to any other sound-isolated walls, the extension shall be made with flexible conduit. The flexible conduit shall be galvanized, single strip General Electric, Westinghouse, National Electric, Youngstown or equivalent.

C. Boxes

1. Specially constructed boxes and panels shall incorporate high quality workmanship and materials and shall follow accurately the Specifications and Drawings of the Engineers.

2. Standard types of manufactured boxes shall be installed by the Contractor when specified on the Drawings and Specifications. Make of boxes shall be General Electric, Westinghouse, National Electric, Appleton, or equivalent.

3. Junction and pull boxes shall be installed where found necessary and as directed by the Engineers.

4. Boxes shall be rigidly fastened to wall or ceiling.

EXAMPLE

D. Panelboards

1. Panelboard boxes and fronts shall be constructed of Code gauge steel. The box shall be galvanized sheet steel. The front shall be sheet steel finished with CBS light gray baking enamel. The front shall have a single door, flush hinges and catch, and a circuit directory on the inside surface of the door.

2. Mains shall be 4 wire, 3 phase, 120/208 volts ac with neutral bus unless otherwise specified on job drawings.

3. Main breakers, where specified, shall be moulded-case circuit breakers.

4. Single-pole branch circuit breakers shall be Heinemann type 0411, or equivalent, fully magnetic breakers, standard time delay curve, current rating as specified on job drawing. Three-pole branch circuit breakers shall be Heinemann type 3363, or equivalent, fully magnetic breakers, standard time delay curve, current rating as specified on job drawing.

5. Pilot light assemblies, where specified, shall be installed across the top of the panelboard. Associated fuse holders shall be front-mounted below each pilot light assembly. Pilot lamps shall be neon and the indicator jewels milk-white.

6. Panelboard layouts shall be in accordance with job drawings.

7. Panelboard shall be General Electric, Heinemann, Westinghouse, or equivalent.

8. Panelboards shall be flush or surface mounted as specified on job drawings.

E. Connectors

1. Connectors for audio, video, camera, communication, control, and ac circuits will be supplied by CBS.

2. Connectors shall be installed by the Contractor at locations and in the manner directed by the Engineers.

EXAMPLE

F. Wire and Cable

1. Wire of the size and type specified on the drawings and specifications shall be installed by the Contractor.

2. CBS shall supply all audio, video, camera, communication, and control cable. The Contractor shall supply all cable and wire for the distribution of ac electrical power.

3. There shall be no splices in audio, video, camera, communications, or control cables. Splices in other cables and wires are to be eliminated wherever possible. When necessary, a splice is to be made only in an accessible pull, junction, outlet, switch, or receptacle box.

G. Fuses

Upon completion of the work, this Contractor shall leave all panelboards and safety switches properly fused and, in addition, shall furnish one complete set of spare fuses for the entire job.

IV. GROUNDS

This Contractor shall properly ground the entire ac power system as required by the local Code authorities. The audio-video ground system shall be installed in accordance with CBS job drawings.

V. JOB SPECIFICATIONS

A. Job Details

1. General All conduit, duct, boxes, grounding systems, construction materials, wire and cable pulling, ac power connections, and audio, video, communications, and control connections indicated on the CBS job drawings listed in Addendum I shall be included in this contract unless otherwise indicated on the drawings.

Specific location of studio control room floor ducts shall be approved by the Engineers on the job.

Avoid running low-level audio conduits parallel to ac power circuits. When such parallel runs cannot be avoided, a minimum spacing of one foot must be provided.

EXAMPLE

2. Wire and Cable Installation All wire and cable specified on the job drawings shall be pulled between the units indicated and shall be connected at each end to terminal blocks or connectors in accordance with CBS practices. Detailed information pertaining to the exact destination of wire and cable pulls and specific terminal connections shall be furnished by the Engineers as the job progresses. No charge shall be made by the Contractor where wire- and cable-pull information is changed previous to installation, providing the scope of the pulls is comparable.

Wire and cable routing shall be specified on the job by the Engineers. Wire and cable shall be laced or spot-tied in accordance with CBS practices. Cables in ducts shall be grouped according to function (audio, video, communications, control) and groups shall be spot-tied approximately every two feet with Thomas & Betts Ty-Raps, or equivalent. The color of the Ty-Raps shall be black. Ty-Raps and associated tools shall be supplied by the Contractor. Furthermore, the Contractor shall clearly identify each end of the cable with a wrap-around cable marker, the type and specific location of which shall be approved by the Engineers. Markers shall remain on the cables for future reference. Cable markers and identification code shall be supplied by the Engineers.

Care shall be exercised to provide an adequate radius for bends in coaxial cable runs. Minimum radius bend data for the coaxial cables used will be supplied by the Engineers.

Suitable and adequate cable supports shall be provided on vertical cable runs to relieve the cables from strain due to cable weight.

3. Wiring Connections Crimping tools, terminals, lacing cord, and jigs required for the prewiring and connection of wires to CBS solderless terminal blocks shall be specified by CBS and supplied by the Contractor.

Prewiring shall be defined as the breaking out of wires and the installation of solderless lugs on each wire previous to plugging the wires into designated terminal blocks.

4. Equipment and Materials Supplied by CBS This Contractor shall move into the area, locate, and install all equipment and materials supplied by CBS which are indicated on the job drawings, unless otherwise stated on the drawings. Equipment and materials shall include consoles, equipment racks, film projectors, video and audio tape machines, loudspeaker baffles, AV outlet boxes, special boxes and hardware, wire and cable, and other equipment and materials supplied by CBS.

EXAMPLE

- 8 -

5. AC Power This Contractor shall supply all EP panelboards indicated on the job drawings and shall install and connect all branch circuit wiring for circuits listed on the EP panelboard layouts. Main feeders to the EP panelboards and associated equipment and hardware shall not be included in this contract.

B. Job Schedule

1. Start job - January 15, 19XX
2. Roughing and ductwork to be completed - April 15, 19XX
3. Start cable pulling - April 15, 19XX
4. Start prewiring and equipment installation - June 1, 19XX
5. Complete wiring and equipment installation - August 15, 19XX

EXAMPLE

- 9 -

ADDENDUM I

ELECTRICAL CONTRACTOR JOB DRAWINGS

A. Layout Drawings

999-9	First and second floor plan.	Revision A
999-10	Central Technical Area floor plan.	

B. Electrical Construction Drawings

999-25	Symbols and Abbreviations.	
999-26	Central Technical Area conduit and duct layout.	
999-27	First and second floor conduit and ground system layouts.	
999-28	AV box layouts.	
999-29	EP power distribution.	
999-30	Installation details.	
999-34	Area to area cable schedule.	
999-35	Video cable schedule.	
999-36	Audio & communications cable schedule.	
999-37	Plant utility and low-level audio cable schedule.	
999-56	Floor ducts and covers.	Revision C

III. OTHER CONSIDERATIONS

Other considerations involved in electrical contractor work are discussed in this section.

A. Electrical Codes

CBS installations shall meet all requirements of the National Electrical Code (USA Standard C1-1968; National Fire Protection Association Standard No. 70-1968). Installations must also meet the requirements of local codes or other rules, regulations, laws, or ordinances that apply in the community where the installation is being made.

B. Segregation of Cables

To minimize crosstalk in a television system, cable runs are divided into four general categories; (a) audio, (b) video and pulse, (c) control and dc power, and (d) ac power. Audio cable runs, in turn, are further divided into low level (below −20 vu), medium level (−20 vu to +20 vu), and high level (+20 vu and higher).

Ideally, to keep crosstalk as low as possible, cables in each of the above categories would be run in separate ducts or conduits. In practice, this is seldom possible as cable runs must share common cable ladders. Nor is it necessary if proper precautions are taken in separating the cables of different categories on the cable ladder as discussed below. Exceptions are (a) ac power circuits always are run in separate conduit or duct to meet electrical code requirements and (b) low-level audio circuits are protected from crosstalk by running them in separate conduit and keeping this conduit separated from ac power circuits by at least one foot.

It has been determined that crosstalk can be made to meet CBS performance requirements if cables in each of the above categories (except ac power and low-level audio) are laced or tied into separate bundles and these cable bundles then carefully arranged on the cable ladders to provide adequate spacing between cables of different categories or different levels. Figure 8-9 shows one possible arrangement of cables on a cable ladder.

Special attention is necessary in transmitter plants to protect interplant cable runs from the strong rf fields that exist at such installations.

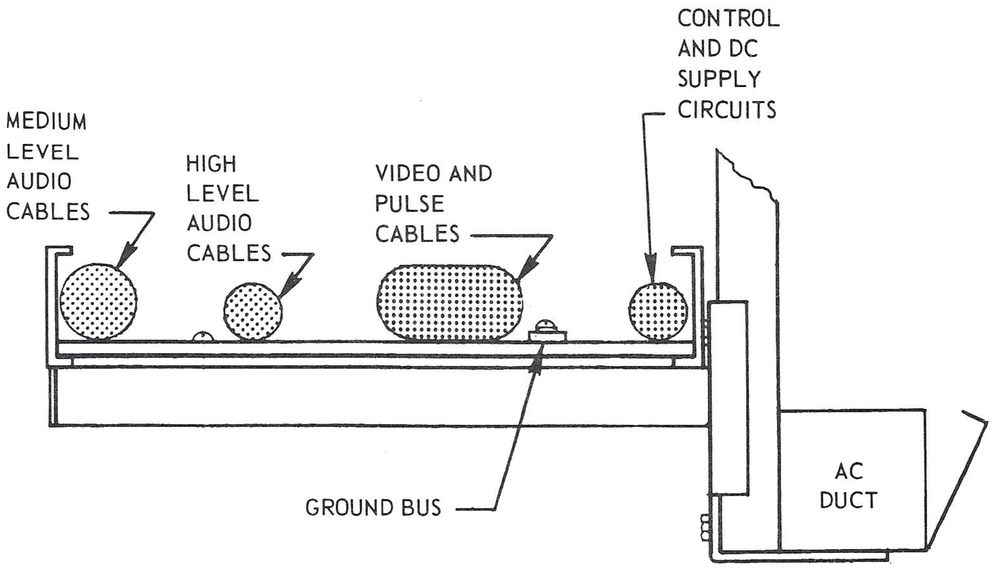


FIGURE 8-9. Example of cable segregation on a cable ladder. Low level audio cables are run in separate conduit.

C. Conduit Capacity

The National Electrical Code, as well as various local electrical codes, limits the number of ac power conductors that can be installed in a conduit. When specifying conduit sizes for an installation, be sure to refer to conduit capacity charts in the appropriate code.

On the other hand, limits are not specified by code for the number of audio, video, or control cables that can be installed in a conduit. However, CBS has adopted a recommended practice of limiting the conduit fill for these cables to 40% of the interior cross-sectional area of the conduit. Table 8-1 shows the maximum number of frequently-used audio, video, and control cables that can be installed in various size conduits in accordance with this 40% fill recommendation. Inasmuch as two or more different types of cables are frequently installed in the same conduit, the data on conduit dimensions in Table 8-2, and cable dimensions in Table 8-3, will permit easy determination of the maximum number of cables that can be accommodated by a conduit in these circumstances.

Table 8-1. CONDUIT CAPACITY

CBS CABLE TYPE*	TRADE SIZE OF CONDUIT (INCHES)							
	1/2	3/4	1	1-1/4	1-1/2	2	2-1/2	3
1CA	1	2	4	8	10	17	25	39
2FA	3	5	9	15	21	35	50	77
2FP	1	3	5	9	13	21	31	48
3FA	1	3	5	9	13	21	31	48
8FA	1	2	4	7	9	15	22	34
16FA	0	1	2	4	6	10	15	23
32FA	0	0	1	2	3	6	8	13

*See Chapter 11 for description of cables.

Table 8-2. CONDUIT DIMENSIONS

TRADE SIZE (IN.)	ACTUAL I.D. (IN.)	CROSS-SECTIONAL AREA (SQ. IN.)	40% AREA (SQ. IN.)
1/2	0.622	0.30	0.12
3/4	0.824	0.53	0.21
1	1.049	0.86	0.34
1-1/4	1.380	1.50	0.60
1-1/2	1.610	2.04	0.82
2	2.067	3.36	1.34
2-1/2	2.469	4.79	1.92
3	3.068	7.38	2.95

Table 8-3. CABLE DIMENSIONS

CBS CABLE TYPE	CABLE O.D. (IN.)	CROSS-SECTIONAL AREA (SQ. IN.)
1CA	0.31	0.075
2FA	0.22	0.038
2FP	0.28	0.061
3FA	0.28	0.061
8FA	0.33	0.085
16FA	0.40	0.126
32FA	0.53	0.220

IV. OTHER ELECTRICAL WORK

In addition to the electrical work involved in installing the television technical facilities, a television plant almost always involves other electrical contractor work for general building power, lighting, and air-conditioning. This building electrical work is not included in the CTN Engineering & Development Department contract with the electrical contractor but, rather, is the subject of a separate contract between the CBS Facilities Engineering Department and the electrical contractor.

The electrical work itemized below is normally covered by the CBS Facilities Engineering Department's budget, contract, drawings, and specifications.

(a) Primary ac power.

(b) Ductwork, conduit, and wiring to carry primary power from the power vault or other point of origin to the equipment power (EP) panelboards in technical areas (in accordance with requirements established by CTN Engineering & Development).

(c) General lighting (lighting levels required in technical areas, as well as locations and/or types of lighting equipment in areas where the requirements are special, are specified by CTN Engineering & Development).

(d) Convenience outlets (types and locations of outlets in technical areas are specified by CTN Engineering and Development).

In addition to the electrical work listed above, the CBS Facilities Engineering Department also provides the studio overhead lighting suspension system (in accordance with requirements established by CTN Engineering and Development). However, CTN Engineering and Development provides the studio lighting system mounted on the studio overhead suspension system.

REFERENCES

1. USA Standard C1-1968 (NFPA Standard 70-1968) NATIONAL ELECTRICAL CODE 1968.

2. ELECTRICAL CODE OF THE CITY OF NEW YORK, City Record Office, New York, N.Y., (February, 1968)

3. USA Standard Y32.9-1962, GRAPHIC ELECTRICAL WIRING SYMBOLS FOR ARCHITECTURAL AND ELECTRICAL LAYOUT DRAWINGS.

REFERENCE DRAWINGS

CBS DWG. NO.	TITLE
S5 SERIES	AV BOXES AND PLATES
S5-1	CBS Type 7 Outlet Boxes and Blank Plates
S5-2	CBS Type 7 Audio Plates
S5-3	CBS Type 7 Video Plates
S5-4	CBS Type 7 Utility Plates
S5-5	AV Outlet Plates for One- and Two- Gang Electrical Boxes
S5-6	AV Plates, Typical Wiring Details
S7 SERIES	ELECTRICAL CONTRACTOR
S7-1	Floor Ducts and Covers, Mechanical Details

CHAPTER 9

ARCHITECTURAL CONSIDERATIONS

9 ARCHITECTURAL CONSIDERATIONS

Prior to the installation of technical facilities in a television plant, building construction work is almost always required to prepare the technical areas architecturally for the operation they are to house. This building construction work includes not only the erection of suitably structured and finished walls, doors, and floors, but also includes the installation of necessary services such as general lighting, air conditioning, power feeds and distribution, compressed air, central vacuum cleaning system, and water supply. To provide a suitable acoustical environment, it is often necessary to acoustically isolate certain areas and to acoustically treat wall, ceiling, and even floor surfaces.

Because of the specialized nature of architectural planning and design, it is the usual practice to have this work handled by a group of architectural design specialists.* The CTN Engineering & Development Department must provide the architectural design group with drawings and other data showing the arrangement of equipment in the technical areas of a plant, together with facts and figures concerning the building space and building services required. From this data, and the requirements of other groups who will use the area, the architectural design group produces the architectural plans and specifications for the project.

Close collaboration and a continuing exchange of information is essential between the engineers and the architects throughout the duration of a project. An even greater effort is necessary in the early formative stages of a project when the basic layout philosophy for the plant is evolving. This chapter reviews the general nature of the information needed by the architectural design group and methods that have been used in supplying this information. This chapter also reviews recommended architectural practices and procedures that should be used in the layout and installation of technical areas of CBS television plants.

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*At CBS, all architectural design work and building construction work for television projects, from the preparation of architectural drawings and specifications at the start of a project through to the final completion of the actual building construction work, is the responsibility of the CBS Facilities Engineering Department.

I. DEFINITIONS

The terms "technical facilities" and "technical areas" are used frequently in this chapter. These terms may be defined as follows:

(a) The term "technical facilities" includes audio, video, communication, control, closed-circuit, studio lighting, special effects, sound effects, video tape recording and playback, film, photographic, television film recording, magnetic and optical sound recording, transmitter, transmission line, antenna, and similar facilities used in technical areas of television plants or in the field.

(b) The term "technical areas" includes television studios, studio control rooms, program control rooms, control centers, transmission centers, equipment centers, telecine rooms, video tape rooms, sound and picture recording rooms, television and film viewing rooms, film and tape handling areas, film production studios, news department technical areas, technical offices, transmitting plants, mobile units, and similar areas wherein technical facilities are installed.

II. ARCHITECTURAL DATA

An architect cannot start designing a private residence, or even estimate its cost, until he obtains the basic functional requirements for the structure from his client. The same is true in the architectural design and planning of a television plant. The architectural design group must be given accurate and adequate architectural requirements for the technical areas before design work or accurate cost estimating can begin. The information and data needed by the architectural design group is discussed in this section.

A. Floor Plan

A floor plan showing the layout of the technical facilities in the technical areas of a television broadcasting plant is a fundamental architectural drawing and one needed by the architectural design group as early in a project as possible. The floor plan should show the location of both existing and new walls, doors, and windows. It should also show other construction work that must be taken care of by the architectural design group such as concrete bases for equipment, electrical ducts formed in the concrete floor slab, cueing antennas embedded in a studio floor, as well as penetrations and accesses through walls, floors, and ceilings.

The floor plan drawing should show the exact location of each rack, console, and other unit of technical equipment that is to be installed in the completed plant. Key dimensions should be given on the drawing. In addition, the floor plan should be drawn to a scale that permits other dimensions to be scaled from it with acceptable accuracy. A scale not smaller than 1/4-inch to the foot is recommended. A typical floor plan drawing is shown in Figure 9-1. Good practices in the layout of television technical areas are discussed in Section III.

In preparing architectural requirements for the technical areas of a television plant, it has been found that the floor plan drawing is a convenient document on which to transmit to the architectural design group a considerable amount of supplementary architectural information and data. Supplemental information that is usually transmitted in this way includes:

(a) Equipment Weight. The weight of the technical equipment to be installed in a plant is needed by the architects for floor loading determination. It is the usual practice to indicate equipment weights (a carefully-considered estimate if the actual weight is not known) by a notation on each equipment unit (or equipment grouping) on the floor plan. Such notations have been shown in Figure 9-1.

(b) Equipment Heat Dissipation. Heat dissipation data in watts for the technical facilities is needed by the architects in the design of the air-conditioning and ventilating system. Like equipment weights, this data is usually noted on each equipment unit (or equipment grouping) on the floor plan as shown in Figure 9-1. In noting equipment heat loads, consideration must be given to whether the equipment operates continuously or intermittently. For example, in a film island comprised of one film camera and three projectors, only one of the projectors operates at a time. It is not necessary to specify temperature (or humidity) ranges for the television studios or technical areas for each individual project as this information has been documented elsewhere.[1]

(c) Number of Occupants. An estimate of the number of persons who will normally occupy each technical area of a television plant is also needed by the architects in designing the air-conditioning and ventilating system. This information can be indicated by a notation on the floor plan as shown in Figure 9-1

FLOOR

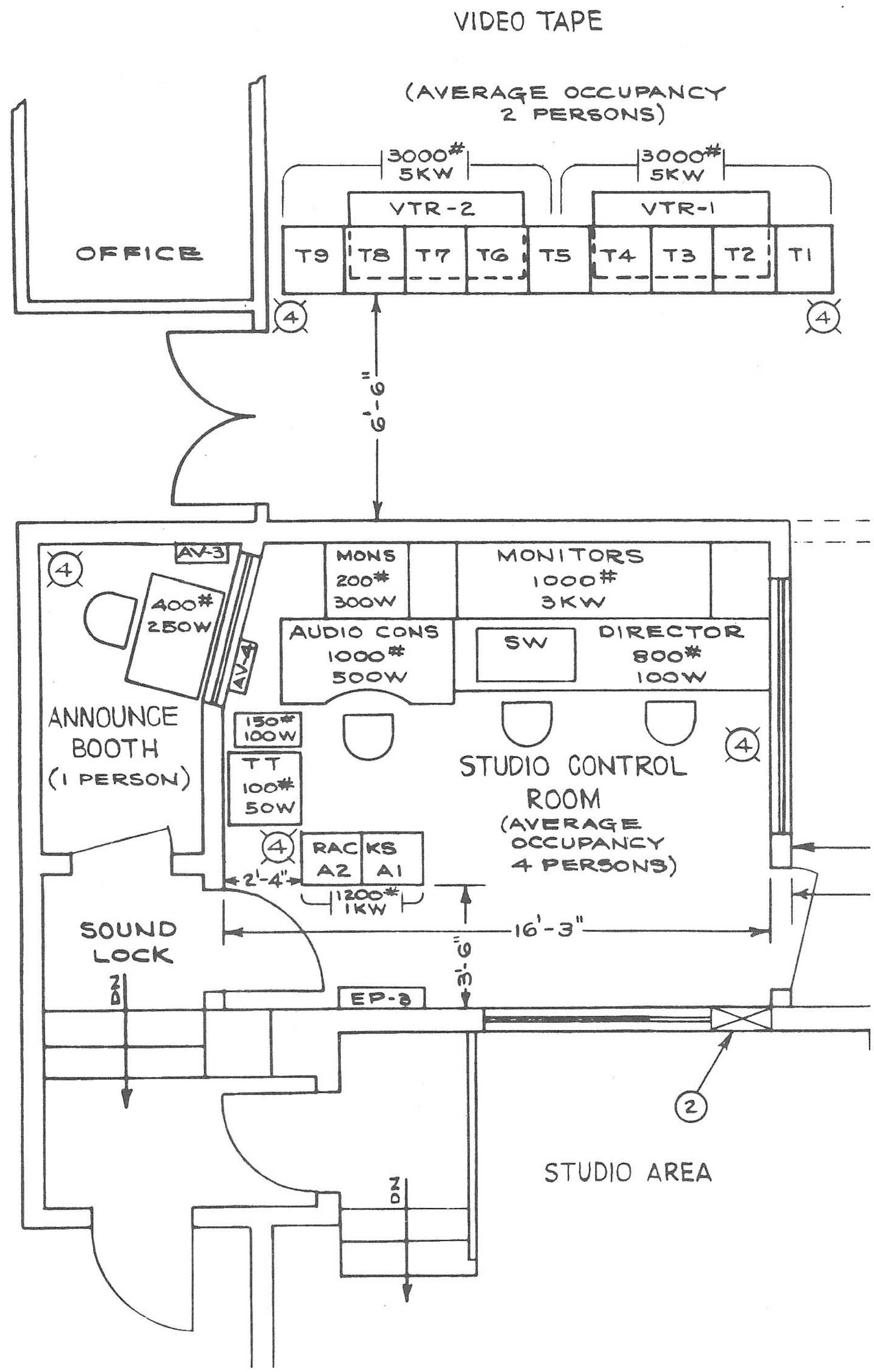
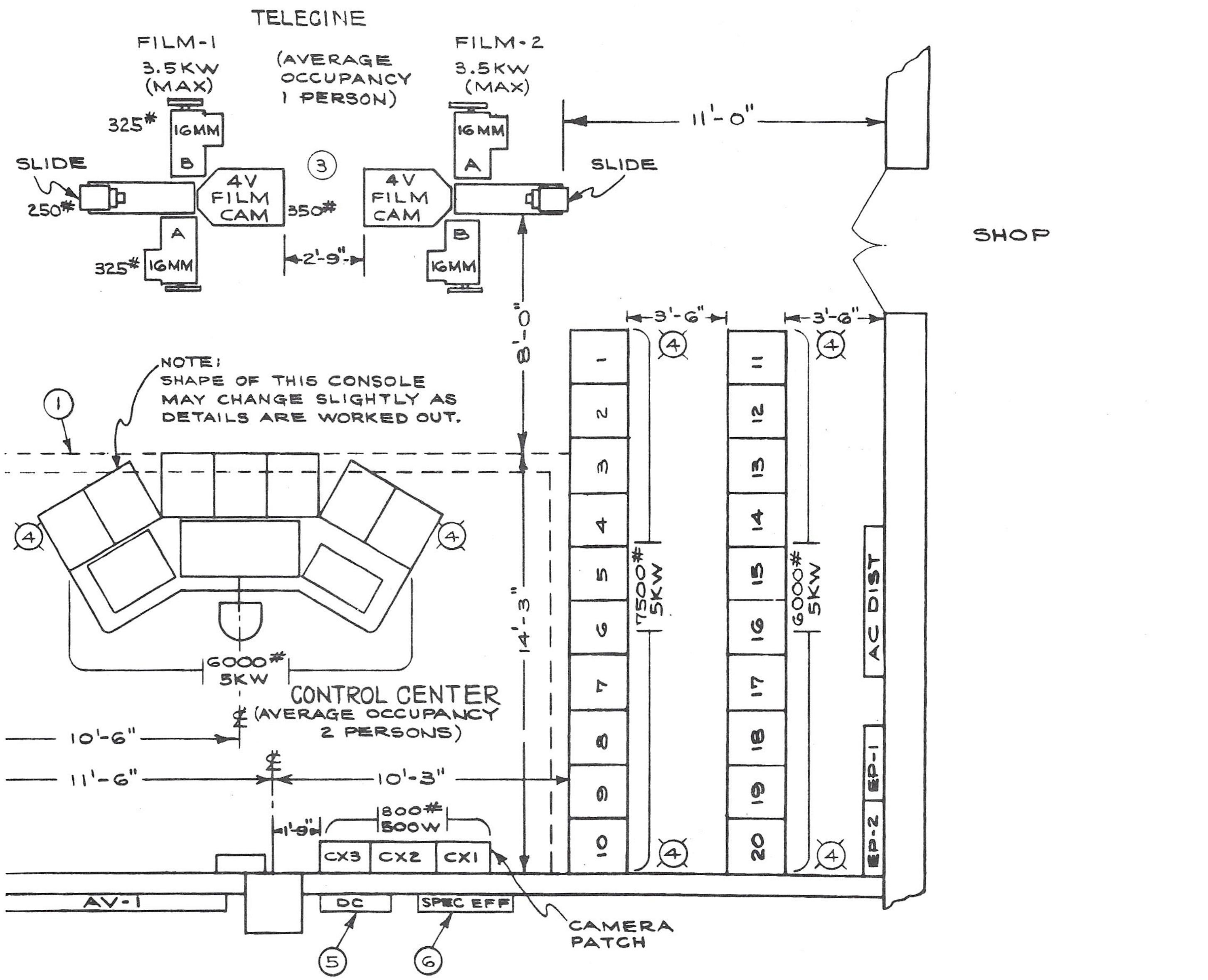


FIGURE 9-1. A floor plan drawing of the type prepared for use by an architectural design group.

PLAN



ARCHITECTURAL REQUIREMENTS:

1. PROVIDE SOUND-ABSORBING CURTAIN WALL (1) EXTENDING FROM CEILING TO 8' 2" AFF.
2. CABLE OPENING IN STUDIO WALL (2) TO BE ACOUSTICALLY SEALED AFTER CABLES ARE INSTALLED.
3. PROVIDE COMPRESSED AIR OUTLET (3) WITH 25 FOOT HOSE, RETRACTABLE HOSE REEL, AND HAND NOZZLE. PRESSURE 35 POUNDS. INCLUDE AIR DRYER TO REMOVE MOISTURE.
4. PROVIDE CABLE-RETRACTING MAINTENANCE REEL-LIGHTS AT ELEVEN LOCATIONS MARKED (4).
5. PROVIDE HUBBELL 3770 OR EQUIVALENT 120 VOLT, 30 AMPERE DC WALL OUTLET (5) 20-INCHES AFF FOR OPERATION OF MOTOR-DRIVEN CAMERA CRANES.
6. INSTALL 120 VOLT AC WALL OUTLETS (6) 20-INCHES AFF FOR STUDIO SPECIAL EFFECTS EQUIPMENT.
7. GENERAL LIGHTING LEVEL IN STUDIO CONTROL ROOM, CONTROL CENTER, TELECINE, AND VIDEO TAPE AREAS TO BE ADJUSTABLE. PROVIDE SEPARATE CONTROL FOR EACH AREA.
8. STUDIO CONTROL CONSOLE AND CONTROL CENTER CONSOLE ARE EQUIPPED WITH BUILT-IN DOWNLIGHTS.

(d) Acoustical Requirements. It is not necessary to specify general acoustical design requirements for television studios, control rooms, announce booths, rehearsal halls, viewing rooms, or other technical areas for each individual project as this information has been documented elsewhere.[1]

However, it is necessary to inform the architects of any special acoustical requirement or problem in the technical areas requiring their attention. Two such examples can be seen in Figure 9-1, (i) the requirement for a sound-isolating curtain wall in the Control Center area, and (ii) the need for acoustically sealing a cable opening in the studio wall.

(e) Special Lighting Requirements. Requirements for general lighting in the technical areas of a television plant have been documented[1] and need not be repeated for each individual project. However, special lighting problems, conditions, or requirements that must be handled or taken into consideration by the architects must be called to their attention. In many cases, this information can be transmitted to them on the floor plan drawing. As examples, in Figure 9-1, it is pointed out in the notes that (i) lighting levels in all technical areas are to be adjustable, (ii) reel-type trouble lights are to be provided at the points indicated, and (iii) the control consoles are provided with built-in downlights.

(f) Special-Purpose Power Outlets. Special-purpose power outlets that are to be provided by the architects should be noted on the floor plan. Two examples are given on Figure 9-1; (i) the requirement for a 120 volt dc studio outlet for powering a camera crane and (ii) 120 volt ac studio outlets for special-effects studio equipment.

(g) Other Requirements. Other building services or accommodations are occasionally required in the technical areas of television plants. Examples are (i) water, with suitable drains; (ii) drains for chemical solutions, often required in film processing areas; (iii) compressed air, often provided in technical areas for cleaning equipment (such as film projector gates) of dust and dirt; (iv) vacuum cleaning systems, also sometimes used to keep equipment free of dust and dirt; (v) an rf ground plane, often embedded in the floor of transmitter plants. Special arrangements for removing heat from equipment racks into ventilating system or air-conditioning ducts must also be called to the attention of the architectural design group. The floor plan drawing is an ideal place to indicate any of these special requirements as the exact location can be indicated on the drawing.

B. Electrical Power for Technical Facilities.

In order to undertake the electrical system design, the architectural design group must be provided with complete information concerning the power requirements for the technical facilities. Figure 9-2 is a single-line power diagram of the type used at CBS to transmit equipment power requirements to the architectural design group. The architectural design group, in turn, combines these equipment power requirements with other power requirements for the plant (such as general lighting, elevators, and air-conditioning) and produces a complete electrical power plan for the overall project.*

Points to consider in preparing a single-line electrical power diagram for the architectural design group include (a) all meters, indicators, and warning devices that must be integrated in the power system; (b) the need for voltage regulators on power feeds to the audio-video facilities and switchgear to by-pass a defective regulator; (c) the need for an emergency power generator for use in the event of a power failure; (d) the length of time an emergency power source be capable of operating.

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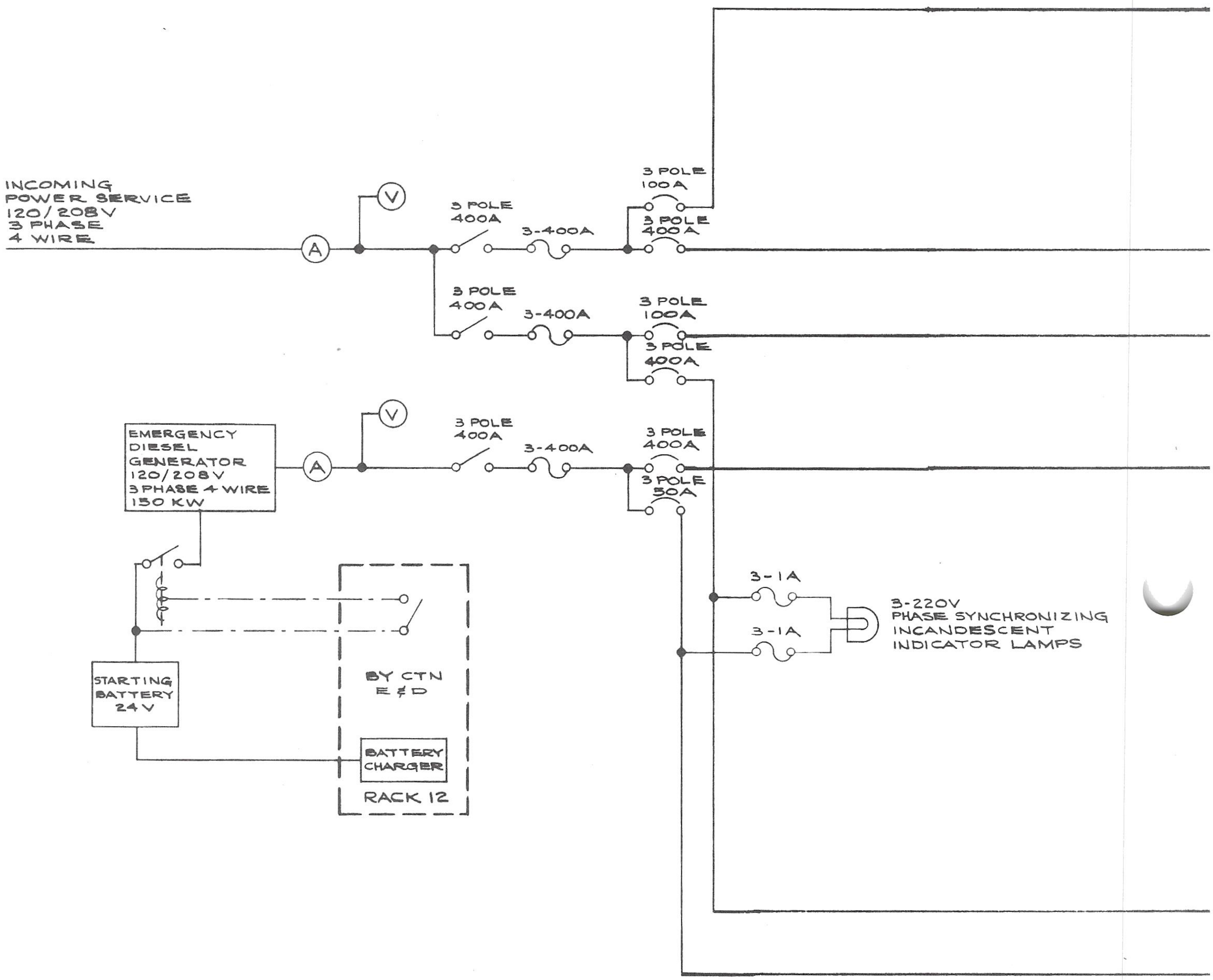
*The dividing line for the responsibility of budgeting and contracting for technical equipment power on CBS television projects is, in most cases, at the equipment power (EP) panelboards. CBS Facilities Engineering Department budgets and contracts cover all equipment power work from the point where power is delivered to a building by the power company (usually the power vault) to the inputs of the EP panelboards including voltage regulators (and by-passing switchgear) specified by CTN Engineering and Development. CTN Engineering and Development budgets and contracts cover the EP panelboards and all electrical work between these panelboards and the technical facilities. A possible exception to the above division of responsibility may occur in plants which incorporate a power distribution system wherein power to the EP panelboards is controlled by remotely-located power relays. In such installations, these power-controlling relays usually are grouped in a power-distribution cabinet which feeds power to each EP panelboard in the plant when appropriate relays are energized by power on-off controls on the EP panelboards. In plants so equipped, this relay-equipped power-distribution cabinet, rather than the EP panelboards, serves as the dividing line for electrical system responsibility. Under these circumstances, CTN Engineering and Development budgets and contracts include the power-distribution relay cabinet as well as conduit, ductwork, and wiring between it and the EP panelboards.

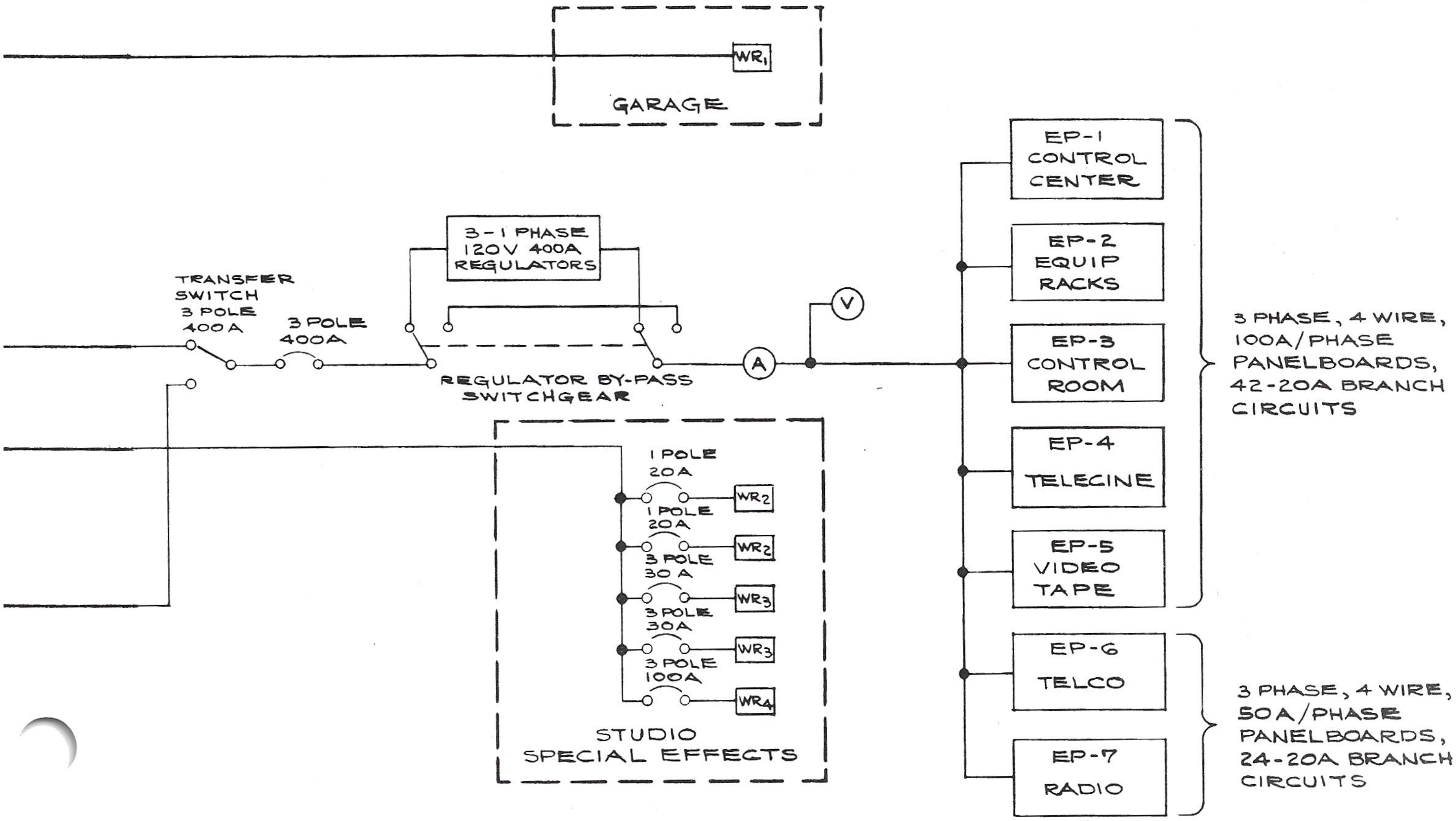
SINGLE-LINE

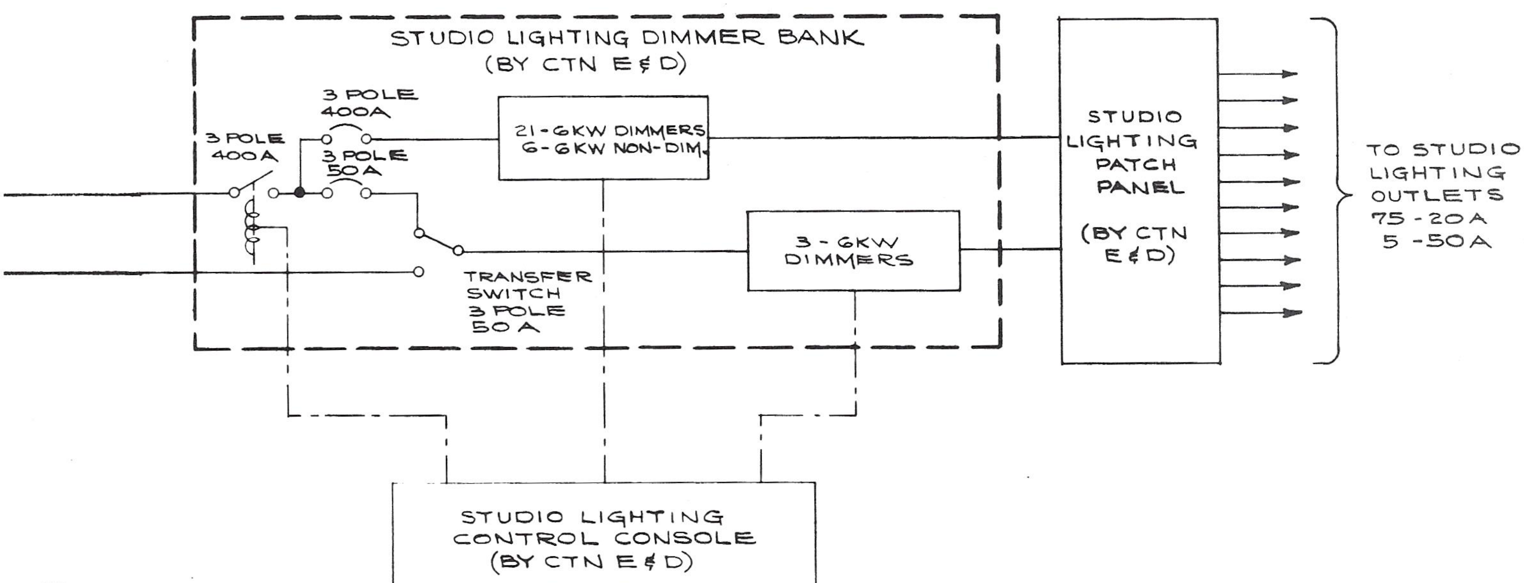


LEGEND		
CODE	DESCRIPTION	MANUFACTURER
WR_1	4 POLE, 250V, 100A WALL RECEPT	RUSSELL & STOLL #JRFA1034H
WR_2	3 POLE 250V, 20A WALL RECEPT	HUBBELL #7328G
WR_3	3 POLE 600V, 30A WALL RECEPT	HUBBELL #25250
WR_4	4 POLE 250V, 100A WALL RECEPT	RUSSELL & STOLL #HSB842H

FIGURE 9-2. A single-line power diagram of the type prepared for use by an architectural design group.

POWER DIAGRAM





C. Telephones

In designing a television plant, telephones must not be overlooked. It is the responsibility of the project engineer to specify telephones in technical areas of the plant.

In arranging a telephone installation, the project engineer is a coordinator. On one hand, he works closely with operations personnel to determine the telephone system that will best serve their method of operating. On the other hand, the project engineer arranges for the ordering of the telephone installation (this is usually done through the business office at the plant or station involved that normally places telephone orders). Later, he works with telephone company installation personnel to resolve any problems that arise during the installation of the facilities.

In working with the operations group, the project engineer must use his knowledge of standard telephone equipment and practices to insure the use of the best possible equipment for the intended purpose. More important, he must concern himself with basic economics to avoid an installation excessive in complexity or in cost. It must be kept in mind that the plant or station must continue to pay monthly telephone service charges for the life of the telephone installation.

In addition, the project engineer must arrange, where necessary, for the installation of suitable conduits or ducts for the telephone cables. As a rule, telephone companies are reluctant to run their cables in a conduit or duct carrying other services. The project engineer must also be sure that adequate and suitable space is provided for telephone racks and other equipment.

Telephone requirements must be prepared in writing, using supplementary drawings when necessary. This permits the information to be conveniently forwarded to the telephone company.

In preparing telephone requirements, be sure to give adequate data. This should include:

(a) The location of each telephone instrument. When the instruments must be precisely located, include a suitably-marked floor plan or other suitable drawing.

(b) Type of instrument.

(c) Color of instrument.

(d) Special mounting details, if any. If necessary, include a mounting drawing or sketch; for examples, see Figures 5-3 and 5-14.

(e) The type of service to be provided by each instrument.

(f) Any special requirement (such as a signal light, chime, or buzzer instead of the usual bell).

Should one or more private-line telephone systems be required, such as the 1- or 2-digit dialing private exchanges frequently used for internal communication, a written specification stating detailed requirements should be prepared.

III. TECHNICAL AREA LAYOUT AND INSTALLATION PRACTICES

Thus far this chapter has been concerned with information that must be supplied to an architectural design group to permit them to undertake architectural planning, cost estimating, and design detailing of the technical areas of a television broadcasting facility. This section covers architectural practices and procedures that should be observed in the layout and installation of television technical facilities.

It is beyond the scope of this chapter to deal with CBS design standards and design targets for construction work. CBS design standards and design targets for technical areas have been documented elsewhere[1] and will not be repeated here.

A. Technical Area Layout

Planning an effective television plant requires a good understanding of the operations to be performed, the problems and needs of the operating personnel, and the capabilities and limitations of the equipment to be installed.

In preparing a technical area layout, the first arrangement that comes to mind may not necessarily be the best; as a matter of fact, it would be most unusual if it were. For this reason, it is recommended that a number of different arrangements be considered and, by a process of elimination, the best features of each of these arrangements be adopted for the final layout. Give careful consideration to this layout work. Well-directed effort spent in studying the requirements and problems in each area, and in providing a layout that most effectively serves the needs of the operation, will be repaid many times over by the increased operating efficiency it will produce.

The guidelines given below may prove useful in laying out technical areas:

(a) Use Proven Layouts. Improved equipment arrangements should always be a major goal in designing television plants. It is always a challenge to try to create a plant layout that is more efficient, neater in appearance, more flexible, or lower in cost than existing plant layouts. On the other hand, change does not necessarily represent improvement. It is good practice to approach the layout of a new plant by reviewing past practices, particularly those past CBS equipment arrangements that have proven particularly efficient and effective. Do not hesitate to copy from these existing plants; most equipment arrangements in CBS plants have had careful thought and study. Depart from successful past layouts only when sure that the proposed new layout actually is an improvement.

Furthermore, a uniformity of plant design at all CBS television plants is desirable as it simplifies engineering, reduces cost, and avoids operating confusion.

In cases where proven-layout guidelines do not exist, plant layout design decisions should give operational considerations and maintenance considerations (in that order) the highest weighting. Normally, all other considerations follow these in importance.

(b) Provide for Future Expansion. Be sure to allow adequate space in technical areas for anticipated future expansion.

(c) Conserve Space. In laying out the technical areas of a television plant, keep in mind the high cost of building space and use it efficiently and effectively. The equipment arrangement should allow adequate space for the activities that take place in an area. To allow more space (except for anticipated expansion) is wasteful; to allow less will result in crowding and inefficiency. On the other hand, be sure to provide adequate space in the aisles behind rows of racks for access with dolly-mounted measuring equipment.

(d) Confirm Actual Dimensions. Prior to making the final layout of a technical area, it is a good idea to visit the site and confirm all technical area dimensions by actual measurement.

(e) Space Conflicts. Although usually worked out on a two-dimensional drawing, the layout of a technical area is a three-dimensional problem. Invariably, air-conditioning ducts, cable ladders, power wiring and, in a transmitter plant, the coaxial lines, all compete for the limited overhead space. Failure to consider potential conflicts in this overhead area may result in costly field changes or compromise the operating efficiency of the plant. Close coordination with the architectural design group is essential to avoid such problems. The architects must be advised of all services that are required for the technical facilities installation in the overhead area.

(f) Equipment Access. In laying out a television technical area, keep in mind problems that may arise when equipment is moved into the area. Be sure that all door openings and passageways (and elevators) through which the equipment must pass are adequate in size to accommodate the equipment.

(g) Detour Traffic. Layouts should be arranged in such a manner that traffic does not pass through active operating areas of the plant.

(h) Maintenance Requirements. Specify adequate and conveniently-placed utility ac power outlets (for test equipment and soldering irons) as well as strategically-placed reel-type cable-retracting trouble lights for maintenance work.

(i) Storage Space. Provide suitable storage space in technical areas for supplies, spare parts, as well as the coats and hats of operating personnel. In video tape and telecine areas, suitable storage arrangements must be provided for the short-term storage of active tapes and films.

B. Installation Problems

During the installation phase of a project, problems of many different kinds inevitably arise that must be dealt with. Although it is not possible to predict beforehand what these problems will be, certain problems have arisen often enough in the past that it is wise to anticipate they probably will occur again and be prepared for them. The best way of handling such recurring problems is to take suitable measures to prevent them from happening. Two such problems, and the methods of dealing with them, are discussed below.

1. Start of Equipment Installation. Do not move technical facilities into a technical area until building construction work in that area is completed. Otherwise, the equipment will be exposed to the dust and dirt of construction. This has proven particularly damaging to jacks, connectors, and equipment slides, as well as relays and switches with exposed contacts. In addition to equipment damage that may result, difficulties may arise when two or more trades try to work in the same space at the same time.

2. Initial Operation of Air-Conditioning or Ventilating System. When an air-conditioning or ventilating system is started for the first time, dust and dirt that has accumulated in the air ducts is ejected through the orifices of the system into the rooms that are to be served by the system. Unless suitable precautions are taken, this dust and dirt will get into the contacts of the electronic equipment and may result in faulty operation for the life of the equipment.

Ideally, of course, technical equipment should not be installed until the air-conditioning or ventilation installation is completed and is in regular operation, but, in practice, this is not always possible.

Two steps should be taken to protect the technical facilities. First, filter bags should be placed over all air duct openings in technical areas during the initial start-up of the air-conditioning or ventilating system. These filter bags should be installed by those responsible for the air-conditioning installation. Second, all technical equipment should be protected with dust covers until the system is operating free of dust and dirt. These dust covers should be installed by those responsible for the technical equipment installation.

To provide adequate preparation time to cover the equipment, the air system subcontractor, the general contractor, and the CBS construction project engineer should be requested in writing to give 24 hours advance notice before starting up the system.

A word of warning -- never become complacent and assume this air duct problem is under control. Despite careful precautions, dust and dirt from air ducts has gotten into equipment during air conditioning start-up many times.

REFERENCES

1. CBS Engineering Report E578M, DESIGN TARGETS FOR TELEVISION TECHNICAL AREA CONSTRUCTION.

2. CBS Engineering Report E578N, INTERDEPARTMENTAL PROJECT PROCEDURES.

REFERENCE DRAWINGS

CBS DWG. NO.	TITLE
S7 SERIES	ELECTRICAL CONTRACTOR
S7-1	Floor Ducts and Covers, Mechanical Details

10. System Performance

11. Miscellaneous

CHAPTER 11

MISCELLANEOUS DESIGN AND CONSTRUCTION PRACTICES

Page

11

MISCELLANEOUS DESIGN AND CONSTRUCTION PRACTICES

Assembled in this chapter are miscellaneous standards and other data covering CBS television design and construction practices that have evolved through the years. Included are standards for cables, connectors, cable assemblies, equipment finishes, and machine screws. Standard abbreviations as well as design data for audio resistance networks are also included.

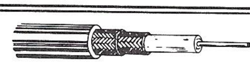
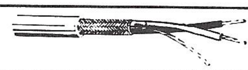
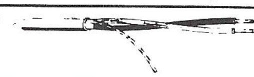
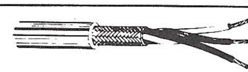
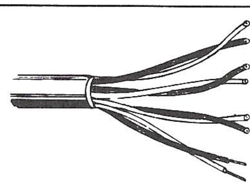
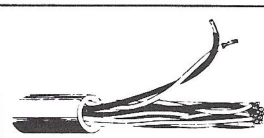
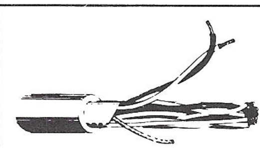
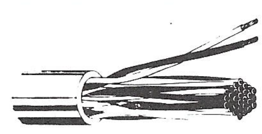
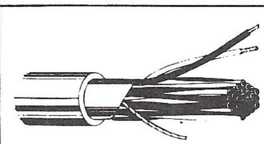
I. PREFERRED CABLE

At the present time cable manufacturers can supply a virtually unlimited variety of cable and wire for the interconnection of electronic components and systems. However, from the viewpoint of standardization, it is desirable to minimize the number of different cable types used in a television broadcasting system. By so doing, the preferred cable types can be purchased in larger quantities with a consequent reduction in cost. Furthermore, when a relatively small number of preferred cables are used, each type of cable will be more readily available as the preferred cables can all be stocked.

Experience has shown that the cable types listed on Table 11-1 and 11-2 will, with the exception of camera cables, handle the majority of the cable requirements of CBS television installations. These cables, therefore, are considered preferred types and should be used insofar as possible. Cable types other than these should be employed only when one of the preferred cables is not suitable for the job.

The cables listed on Table 11-1, which are identified by CBS type numbers, are custom-built for CBS. Detailed specifications for each of these custom-built cables are given on cable specification sheets on pages 11-6 through 11-18. The cables of Table 11-2 are industry-standard cables and are, in most cases, available from a number of suppliers. Detailed specifications are not given for these industry-standard cables as they are available in manufacturers catalogs.

Table 11-1. CBS CABLE AND WIRE TYPES

TYPE	ILLUSTRATION	USES	CONDUCTORS	
			NUMBER	DESCRIPTION
CBS 1CA		Video and Pulse Circuits	1	#20 AWG Solid Copper
CBS 1FA		General Purpose Hook-up Wire	1	#22 AWG Stranded (7 x 30) Tinned Copper
CBS 1FB		General Purpose Hook-up Wire	1	#18 AWG Stranded (16 x 30) Tinned Copper
CBS 1FG		Equipment Grounds	1	#18 AWG Stranded (16 x 30) Tinned Copper
CBS 2FA		General Purpose Audio Cable	2 Plus 1 Uninsulated Shield Wire	#22 AWG Stranded (16 x 34) Tinned Copper
CBS 2FB		Small-Size Audio Cable	2 Plus 1 Uninsulated Shield Wire	#22 AWG Stranded (7 x 30) Tinned Copper
CBS 2FP		Power Cable	2	#16 AWG Stranded (19 x 29) Tinned Copper
CBS 3FA		Microphone and Microphone Extension Cable	3	#20 AWG Stranded (26 x 34) Tinned Copper
CBS 8FA		Interphone and Control Circuits	8 (4 Pair)	#22 AWG Stranded (7 x 30) Tinned Copper
CBS 16FA		Interphone and Control Circuits	16 (8 Pair)	#22 AWG Stranded (7 x 30) Tinned Copper
CBS 16FB		Communication Circuits	16 (8 Pair) Plus 1 Uninsulated Shield Wire	#22 AWG Stranded (7 x 30) Tinned Copper
CBS 32FA		Interphone and Control Circuits	32 (16 Pair)	#22 AWG Stranded (7 x 30) Tinned Copper
CBS 32FB		Communication Circuits	32 (16 Pair) Plus 1 Uninsulated Shield Wire	#22 AWG Stranded (7 x 30) Tinned Copper

INSULATION COLORS

Group 1		Group 2		Group 3		Group 4	Group 5	
Blue-White	White-Blue	Blue-Red	Red-Blue	Blue-Black	Black-Blue	Red	Black	Blue
Orange-White	White-Orange	Orange-Red	Red-Orange	Orange-Black	Black-Orange	White	Brown	Violet
Green-White	White-Green	Green-Red	Red-Green	Green-Black	Black-Green		Orange	Gray
Brown-White	White-Brown	Brown-Red	Red-Brown	Brown-Black	Black-Brown		Yellow	
Slate-White	White-Slate	Slate-Red	Red-Slate	Slate-Black	Black-Slate			

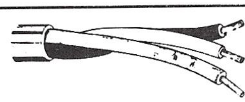
MISCELLANEOUS

INSULATION		SHIELD		OUTER JACKET			NOTES
MATERIAL	COLORS	NO.	TYPE	MATERIAL	COLOR	OD (IN.)	
Polyethylene	Natural	2	Tinned Copper Wire Braid	Polyethylene	Black	0.31	Nominal Impedance 75 Ohms
Polyvinyl Chloride	Groups 1, 2, 3, 4, 5 and Green	None	—	—	—	—	
Polyvinyl Chloride	Groups 4 and 5	None	—	—	—	—	
Polyvinyl Chloride	Green	None	—	—	—	—	
Polyvinyl Chloride	Red, Black	1	Tinned Copper Wire Braid	Polyvinyl Chloride	Black	0.22	
Polypropylene	Red, Black	1	Mylar-Aluminum Wrap	Polyvinyl Chloride	Black	0.14	2FB cable should be restricted to internal wiring in consoles, racks, and boxes. Do not use where flexibility is required, as in the case of wiring to a hinged panel.
Polyvinyl Chloride	Red, White	None	—	Polyvinyl Chloride	Black	0.28	2FP cable should not be used for 120 volt ac applications.
Synthetic or Natural Rubber	Red, Black, Green	1	Tinned Copper Wire Braid	Neoprene	Brown	0.28	
Polyvinyl Chloride	Group 1 (First 8 Colors)	None	—	Polyvinyl Chloride	Brown	0.33	
Polyvinyl Chloride	Groups 1 and 2	None	—	Polyvinyl Chloride	Brown	0.40	
Polyvinyl Chloride	Groups 1 and 2	1	Mylar-Aluminum Wrap	Polyvinyl Chloride	Gray	0.43	Similar to 16FA, but shielded.
Polyvinyl Chloride	Groups 1, 2, 3 and 4	None	—	Polyvinyl Chloride	Brown	0.525	
Polyvinyl Chloride	Groups 1, 2, 3 and 4	1	Mylar-Aluminum Wrap	Polyvinyl Chloride	Gray	0.58	Similar to 32FA, but shielded.

Not included in the above cable tabulation is special-purpose CBS 19-2FB which consists of 19 CBS 2FB cables enclosed in a gray-colored, polyvinyl chloride 0.75" OD jacket (0.060" wall thickness).

Also not included is special-purpose CBS 12-3FA cable, which consists of 12 CBS 3FA microphone cables enclosed in a gray-colored, polyvinyl chloride 0.74" OD jacket (0.060" wall thickness).

Table 11-2. FREQUENTLY-USED CABLE AND WIRE

TYPE	ILLUSTRATION	USES	CONDUCTORS	
			NUMBER	DESCRIPTION
JT408D		Building RF Distribution Systems – Main Bus	1	#12 AWG Solid Copper
Double-Shielded RG59/U		Building RF Distribution Systems – Branch Circuits	1	#22 Copperweld
#12 TW Wire		AC & DC Power Wiring	1	#12 Solid Copper
#14 TW Wire		AC & DC Power Wiring	1	#14 Solid Copper
#16/3 SJ Cord		Flexible Power Cord	3	#16 Stranded (26 x 30) Copper
#18/3 SJ Cord		Flexible Power Cord	3	#18 Stranded (16 x 30) Copper
#18/3 SVT Cord		AC Power Wiring Within Racks & Cabinets	3	#18 Stranded (41 x 34) Copper

INSULATION		SHIELD		OUTER JACKET			NOTES
MATERIAL	COLORS	NO.	TYPE	MATERIAL	COLOR	OD (IN.)	
Cellular Polyethylene	Natural	2	Copper Ribbon Braid	Polyethelene	Black	0.46	Nominal Impedance 75 Ohms
Cellular Polyethylene	Natural	2	Copper Wire Braid	Polyvinyl Chloride	Black (Also Available White)	0.25	Nominal Impedance 75 Ohms
Thermoplastic	Black, Red, Green, Blue, White	None	—	—	—	—	
Thermoplastic	Black, Red, Green, Blue, White	None	—	—	—	—	
Rubber	Black, White, Green	None	—	Rubber	Black	0.36	Available with neoprene outer jacket as type SJO Cord
Rubber	Black, White, Green	None	—	Rubber	Black	0.33	Available with neoprene outer jacket as type SJO Cord
Vinyl	Black, White, Green	None	—	Vinyl	Black	0.253	

CABLE SPECIFICATION

Type: CBS 1CA.

Uses: Video and pulse circuits.

Description: Single solid-conductor double-shielded cable.

Inner Conductor: #20 AWG solid copper.

Dielectric: Solid, stabilized polyethylene, diameter 0.193 inch to 0.207 inch.

Outer Conductor: Two shields as follows:

	Inner Shield	Outer Shield
Braid	tinned copper	tinned copper
Wire	#34 AWG	#34 AWG
Carriers	16	16
Ends	10	9
Picks/inch	7	11

Jacket: Black, stabilized polyethylene, outside diameter 0.312 inch maximum.

Concentricity: The inner conductor shall not be off center in the dielectric at any point by more than 0.0025 inch.

Nominal Capacitance: 21 picofarads per foot.

Impedance: 75 ohms ±1.5 ohms to 50 MHz.

Nominal Attenuation per 100 ft:

1 kHz - 0.022 dB	30 kHz - 0.06 dB	1 MHz - 0.23 dB
3 kHz - 0.036 dB	100 kHz - 0.077 dB	3 MHz - 0.43 dB
10 kHz - 0.052 dB	300 kHz - 0.132 dB	6 MHz - 0.6 dB
		10 MHz - 0.8 dB

Return Loss: The return loss of a 100 foot length of cable shall be greater than 35 dB when measured with a multiburst signal using the method of measurement described in the paper, "The Video Return-Loss Bridge", by E.H. Friedman and Frank Davidoff, JSMPTE, August 1968, Vol. 77.

CABLE SPECIFICATION

Type: CBS 1FA.

Use: General purpose hook-up wire.

Description: Single conductor stranded hook-up wire. CBS 1FA hook-up wire shall meet all requirements for type MW wire, which is included under Specification MIL-W-76B.

Conductor: 7 strands of #30 AWG (equivalent to #22 AWG) tinned soft copper.

Insulation: Polyvinyl chloride (80°C compound), color coded, 0.064 inch nominal OD, 0.017 inch nominal wall thickness.

Insulation Voltage Rating: 1000 volts rms.

Color Code: CBS 1FA hook-up wire shall be available in the following colors:

Body-Tracer*	Body-Tracer*	Body-Tracer*	Body-Tracer*
Blue-White	White-Blue	Blue-Red	Red-Blue
Orange-White	White-Orange	Orange-Red	Red-Orange
Green-White	White-Green	Green-Red	Red-Green
Brown-White	White-Brown	Brown-Red	Red-Brown
Slate-White	White-Slate	Slate-Red	Red-Slate

Body-Tracer*	Body-Tracer*		
Blue-Black	Black-Blue	Red	White
Orange-Black	Black-Orange	Black	Green
Green-Black	Black-Green	Brown	Blue
Brown-Black	Black-Brown	Orange	Violet
Slate-Black	Black-Slate	Yellow	Gray

Note: This wire is available as a stock item (type MW) from a number of manufacturers.

*Spiral tracer.

CABLE SPECIFICATION

Type: CBS 1FB.

Use: General purpose hook-up wire.

Description: Single conductor stranded hook-up wire. CBS 1FB hook-up wire shall meet all requirements for type MW wire, which is included under Specification MIL-W-76B.

Conductor: 16 strands of #30 AWG (equivalent #18 AWG) tinned soft copper.

Insulation: Polyvinyl chloride (80°C compound), color coded, 0.081 inch nominal OD, 0.017 inch nominal wall thickness.

Insulation Voltage Rating: 1000 volts rms.

Color Code: CBS 1FB hook-up wire shall be available in the following colors:

Black	Blue
Brown	Violet
Red	Grey
Orange	White
Yellow	

Note: This wire is available as a stock item (type MW) from a number of manufacturers.

CABLE SPECIFICATION

Type: CBS 1FG.

Use: Equipment grounds.

Description: Single conductor stranded ground wire. CBS 1FG ground wire shall meet all requirements for type MW wire, which is included under Specification MIL-W-76B.

Conductor: 16 strands of #30 AWG (equivalent to #18 AWG) tinned soft copper.

Insulation: Polyvinyl chloride (80°C compound), color coded, 0.081 inch nominal OD, 0.017 inch nominal wall thickness.

Insulation Voltage Rating: 1000 volts rms.

Color Code: Green

Note: This wire is available as a stock item (type MW) from a number of manufacturers.

CABLE SPECIFICATION

Type: CBS 2FA.

Use: General purpose audio cable.

Description: Single pair shielded cable with uninsulated shield drain wire.

Conductor: 16 strands of #34 AWG (equivalent #22 AWG) tinned soft copper.

Insulation: Semi-rigid polyvinyl chloride color coded, 0.065 inch nominal OD, 0.015 inch nominal wall thickness.

Twist: Nominal lay 2 inches.

Shield:

Braid	tinned soft copper
Wire	#36 AWG
Carriers	16
Ends	5
Coverage	80% minimum

Shield Drain Wire: 16 strands of #34 AWG (equivalent #22 AWG) tinned soft copper wire, uninsulated, run parallel to axis under shield.

Wrap: Mylar tape, 0.00085 inch thick over shield.

Jacket: Black polyvinyl chloride, nominal diameter 0.215 inch, nominal wall thickness 0.025 inch.

Mutual Capacitance:* 67.5 picofarads per foot nominal.
Grounded Capacitance:* 86.0 picofarads per foot nominal.

Color Code: Red
Black

*For definition see Pender and McIlwain "Electrical Engineers Handbook - Electric Communication and Electronics", fourth edition, John Wiley and Sons, Inc., New York, 1967, page 11-24.

CABLE SPECIFICATION

Type: CBS 2FB.

Use: Small-size audio cable.

Description: Single pair shielded cable with uninsulated shield drain wire.

Conductor: 7 strands of #30 AWG (equivalent to #22 AWG) tinned soft copper.

Insulation: Polypropylene 0.046 inch nominal OD, 0.008 inch nominal wall thickness.

Twist: Nominal lay 1.75 inches.

Shield: Mylar-aluminum laminate wrap.

Shield Drain Wire: 7 strands of #30 AWG (equivalent to #22 AWG) tinned copper wire, uninsulated, run parallel to axis over shield.

Wrap: Paper tape, 0.00085 inch thick over shield.

Jacket: Black polyvinyl chloride, nominal diameter 0.135 inch, nominal wall thickness 0.020 inch.

Mutual Capacitance:* 50.5 picofarads per foot nominal.
Grounded Capacitance:* 67.0 picofarads per foot nominal.

Color Code: Red
Black

*For definition see Pender and McIlwain "Electrical Engineers Handbook - Electric Communication and Electronics", fourth edition, John Wiley and Sons, Inc., New York, 1967, page 11-24.

CABLE SPECIFICATION

Type: CBS 2FP.

Use: Power cable (not to be used for 120 volt ac applications).

Description: Single-pair unshielded cable.

Conductor: 19 strands of #29 AWG (equivalent to #16 AWG) tinned soft copper.

Insulation: Polyvinyl chloride (105°C compound), color coded, 0.093 inch nominal OD, 0.016 inch nominal wall thickness.

Twist: Nominal lay 2.5 inches.

Fillers: Use suitable plastic fillers to produce cable of uniform diameter.

Jacket: Black polyvinyl chloride, nominal diameter 0.275 ± 5%, nominal wall thickness 0.040 inch.

Maximum Operating Potential: 300 volts dc.

Color Code: Red
White

CABLE SPECIFICATION

Type: CBS 3FA.

Use: Microphone and microphone extension cables.

Description: Three conductor shielded cable. CBS 3FA shall be in accordance with EIA Standard RS-215, "Basic requirements for broadcast microphone cable".

Conductor: 26 strands of #34 AWG (equivalent to #20 AWG) tinned soft copper.

Insulation: Serve of cotton, color coded rubber wall, 0.09 inch nominal OD, 0.020 inch nominal wall thickness.

Twist: Nominal lay 2 inches.

Braid: White cotton braid over conductors.

Shield:

Braid	tinned soft copper
Wire	#34 AWG
Carriers	24
Ends	5
Picks/inch	19.3 Approx.

Wrap: White cotton wrap over shield.

Jacket: Brown neoprene jacket, color in accordance with EIA Standard GEN-101A, OD 0.28 inch +0, -0.030 inch, minimum 0.015 inch wall thickness.

Color Code: Red
Black
Green

CABLE SPECIFICATION

Type: CBS 8FA.

Use: Control circuits.

Description: 4 pair cable.

Conductor: 7 strands of #30 AWG (equivalent to #22 AWG) tinned soft copper.

Insulation: Polyvinyl chloride (80°C compound), color coded, 0.012 inch nominal wall thickness.

Twist: Nominal lay 2.5 inches, 4 twisted pairs.

Jacket: Brown polyvinyl chloride, nominal diameter 0.33 inch, nominal thickness 0.047 inch.

Insulation Voltage Rating: 1000 volts rms.

Maximum Operating Potential: 300 volts dc.

Color Code:

Pair No.	Conductor No. 1 Body-Tracer*	Conductor No. 2 Body-Tracer*
1	Blue-White	White-Blue
2	Orange-White	White-Orange
3	Green-White	White-Green
4	Brown-White	White-Brown

*Spiral tracer.

CABLE SPECIFICATION

Type: CBS 16FA.

Use: Control circuits.

Description: 8 pair cable.

Conductor: 7 strands of #30 AWG (equivalent to #22 AWG) tinned soft copper.

Insulation: Polyvinyl chloride (80°C compound), color coded, 0.012 inch nominal wall thickness.

Twist: Nominal lay 2.5 inches, 8 twisted pairs.

Jacket: Brown polyvinyl chloride, nominal diameter 0.40 inch, nominal thickness .047 inch.

Insulation Voltage Rating: 1000 volts rms.

Maximum Operating Potential: 300 volts dc.

Color Code:

Pair No.	Conductor No. 1 Body-Tracer*	Conductor No. 2 Body-Tracer*
1	Blue-White	White-Blue
2	Orange-White	White-Orange
3	Green-White	White-Green
4	Brown-White	White-Brown
5	Slate-White	White-Slate
6	Blue-Red	Red-Blue
7	Orange-Red	Red-Orange
8	Green-Red	Red-Green

*Spiral tracer.

CABLE SPECIFICATION

Type: CBS 16FB

Use: Communication circuits.

Description: 8 pair cable.

Conductor: 7 strands of #30 AWG (equivalent to #22 AWG) tinned soft copper.

Insulation: Polyvinyl chloride (80°C compound), color coded, 0.012 inch nominal wall thickness.

Shield: Mylar-aluminum laminate spiral wrap.

Shield Drain Wire: 7 strands of #30 AWG (equivalent #22 AWG) tinned soft copper wire, uninsulated, run parallel to axis under shield.

Twist: Nominal lay 2.5 inches, 8 twisted pairs.

Jacket: Gray polyvinyl chloride, nominal diameter 0.43 inch, nominal thickness 0.060 inch.

Insulation Voltage Rating: 1000 volts rms.

Color Code:

Pair No.	Conductor No. 1 Body-Tracer*	Conductor No. 2 Body-Tracer*
1	Blue-White	White-Blue
2	Orange-White	White-Orange
3	Green-White	White-Green
4	Brown-White	White-Brown
5	Slate-White	White-Slate
6	Blue-Red	Red-Blue
7	Orange-Red	Red-Orange
8	Green-Red	Red-Green

*Spiral tracer.

CABLE SPECIFICATION

Type: CBS 32FA.

Use: Control circuits.

Description: 16 pair cable.

Conductor: 7 strands of #30 AWG (equivalent to #22 AWG) tinned soft copper.

Insulation: Polyvinyl chloride (80°C compound), color coded, 0.012 inch nominal wall thickness.

Twist: Nominal lay 2.5 inches, 16 twisted pairs.

Jacket: Brown polyvinyl chloride, nominal diameter 0.525 inch, nominal thickness 0.060 inch.

Insulation Voltage Rating: 1000 volts rms.

Maximum Operating Potential: 300 volts dc.

Color Code:

Position	Pair No.	Conductor No. 1 Body-Tracer*	Conductor No. 2 Body-Tracer*
Core	1	Blue-White	White-Blue
Core	2	Orange-White	White-Orange
Core	3	Green-White	White-Green
Core	4	Brown-White	White-Brown
Core	5	Slate-White	White-Slate
Outer Layer	6	Blue-Red	Red-Blue
Outer Layer	7	Orange-Red	Red-Orange
Outer Layer	8	Green-Red	Red-Green
Outer Layer	9	Brown-Red	Red-Brown
Outer Layer	10	Slate-Red	Red-Slate
Outer Layer	11	Blue-Black	Black-Blue
Outer Layer	12	Orange-Black	Black-Orange
Outer Layer	13	Green-Black	Black-Green
Outer Layer	14	Brown-Black	Black-Brown
Outer Layer	15	Slate-Black	Black-Slate
Outer Layer	16	Red	White

*Spiral tracer.

CABLE SPECIFICATION

Type: CBS 32FB.

Use: Communication circuits.

Description: 16 pair shielded cable.

Conductor: 7 strands of #30 AWG (equivalent to #22 AWG) tinned soft copper.

Insulation: Polyvinyl chloride, color coded, 0.012 inch nominal wall thickness.

Shield: Mylar-aluminum laminate spiral wrap.

Shield Drain Wire: 7 strands of #30 AWG (equivalent to #22 AWG) tinned soft copper wire, uninsulated, run parallel to axis under shield.

Twist: Nominal lay 2.5 inches, 16 twisted pairs.

Jacket: Gray polyvinyl chloride, nominal diameter 0.575 inch, nominal thickness 0.060 inch.

Insulation Voltage Rating: 1000 volts rms.

Color Code:

Position	Pair No.	Conductor No. 1 Body-Tracer*	Conductor No. 2 Body-Tracer*
Core	1	Blue-White	White-Blue
Core	2	Orange-White	White-Orange
Core	3	Green-White	White-Green
Core	4	Brown-White	White-Brown
Core	5	Slate-White	White-Slate
Outer Layer	6	Blue-Red	Red-Blue
Outer Layer	7	Orange-Red	Red-Orange
Outer Layer	8	Green-Red	Red-Green
Outer Layer	9	Brown-Red	Red-Brown
Outer Layer	10	Slate-Red	Red-Slate
Outer Layer	11	Blue-Black	Black-Blue
Outer Layer	12	Orange-Black	Black-Orange
Outer Layer	13	Green-Black	Black-Green
Outer Layer	14	Brown-Black	Black-Brown
Outer Layer	15	Slate-Black	Black-Slate
Outer Layer	16	Red	White

*Spiral tracer.

II. STANDARD ELECTRICAL CONNECTORS

In television broadcasting, standardization of the electrical connectors used in day-to-day operation is essential. For example, unless the same type of microphone connector is used in all studios, as well as in the field, interchangeability of microphones between studios, or between studios and field, will be severely limited. The same applies to the electrical connectors used for video, rf, and ac power. For this reason, CBS standards have been established for the types of electrical connectors to be used for each of the various services. Exceptions are camera connectors and lighting connectors, standards for which have not yet evolved.

Equally important in connector standardization is the polarity of the connector (male or female) that is used at the source end and at the load end of a circuit. The practice followed by CBS in this respect is:

(a) Power or signal sources appear on female connectors.

(b) Power or signal loads appear on male connectors.

In CBS installations, two exceptions are made to the above connector polarity convention. First, CBS conforms with the long-standing industry practice of employing male coaxial connectors at both ends of a coaxial cable run. Second, CBS follows the long-established industry standard that specifies a male connector on microphones and other low-level audio program sources, see paragraph A1 below.

CBS standard electrical connectors and connector practices are described in this section.

A. Audio Connectors

Three audio connector types have been standardized for use in CBS audio and communication systems; one for use on low-level audio circuits, the second for use on medium- and high-level audio and communication circuits, and the third for microphone boom communication circuits.

1. Low-level Audio Connector. The connector used for microphones and other low-level (below -20 vu) audio applications enjoys the distinction of being an industry standard. This family of low-level audio connectors, Figure 11-1, was developed by representatives of the broadcasting industry (including CBS) and is covered by an Electronics Industry Association (EIA) standard*. In addition to covering the basic connector design, the EIA standard also specifies the type of connector to be used for a given application. Table 11-3 details the standard manner in which these connectors are used with microphones or other low-level program sources and with associated circuitry. It will be noted that the program source connects to the male connector; the reverse of standard practice in other connector applications. An illustration showing wiring details in a typical application of these connectors is given in Chapter 6, Figure 6-16. Wiring details of an AV microphone plate using these standard connectors is given in Chapter 5, Figure 5-26.

Table 11-3. LOW-LEVEL AUDIO CONNECTOR APPLICATION

CIRCUIT	TYPE CONNECTOR
Microphone or other low-level program source	Male
Cable, end toward microphone or other low-level program source	Female
Cable, end toward preamplifier input	Male
Wall or panel receptacle connected to preamplifier input	Female
Wall or panel receptacle connected to microphone or other low-level program source	Male

*EIA Standard RS-297, "Cable Connectors for Audio Facilities in Radio Broadcasting", April 1964.

2. General-Purpose Audio Connector. The three-wire locking-type family of connectors, Figure 11-2, is the CBS standard for medium-level (-20 to +20 vu) and high-level (above +20 vu) audio applications. These connectors are used on studio AV outlets (see Chapter 5, Figures 5-27 through 5-34) as well as on audio, communication, and sound-effects equipment and cables*.

3. Communication Connector. The eight-wire locking-type family of connectors, Figure 11-3, is employed in CBS studio communication systems; specifically for communications between control room and microphone booms. These connectors are used on studio AV outlets; see Chapter 5, Figure 5-35.

B. Video Connectors

Two different types of coaxial cable video connectors are presently employed in CBS television installations. The first has been in use for many years. The second is a more recent (and smaller) type that is being supplied on many present-day video components such as amplifiers and video jacks.

1. UHF Connector. The UHF coaxial connector, Figure 11-4, has been used in video systems since the earliest days of television broadcasting. These rugged, non-constant impedance connectors are the CBS standard video connector for AV outlet plates and associated studio and field video cables.

An illustration of a typical application of the UHF connector on an AV outlet plate can be seen in Chapter 5, Figure 5-21. Wiring details of an AV video outlet plate is shown in Figure 5-29.

*It will be noted that these general-purpose standard audio connectors are relatively large. While every effort should always be made to use these standard connectors in all applications, considerations may occasionally arise that dictate the substitution of a smaller connector. Although not a CBS standard, the type XLR connector series is used on many commercially-available items of audio equipment and has, on occasion, been authorized as a substitute for the standard connector. In any installation where the XLR family of connectors is used as a substitute for the CBS standard general-purpose audio connector series in medium- and high-level audio circuit applications, the source-female, load-male CBS connector polarity practice must be followed. Furthermore, pin connections to the XLR connectors shall be as follows: pin 1, shield; pin 2, red conductor; pin 3, black conductor. The XLR connector series is not an approved substitute for the CBS standard low-level audio connector series in CBS systems.

2. BNC Connector. The BNC coaxial connector, Figure 11-5, is being used increasingly by manufacturers on video system components such as switching systems, amplifiers, and video jacks and therefore must be used in CBS video systems as a means of making connection to these components. The BNC connector is a constant-impedance 50 ohm connector and should not be used in applications where frequencies higher than video frequencies are involved.

3. BNC to UHF Adapters. When interconnection between a BNC and a UHF connector is necessary, the adapters shown in Figure 11-6 may be used.

C. AC Power Connectors

Two different types of ac power connectors are used in CBS television installations. Guidelines are included in the description of each of these connector series below giving the applications to which its use should be limited.

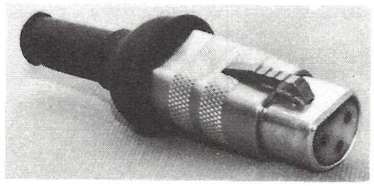
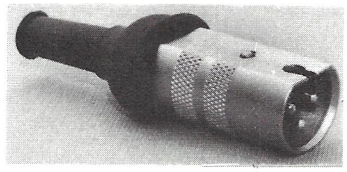
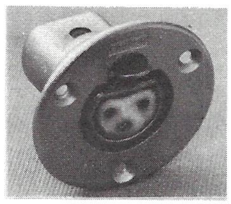
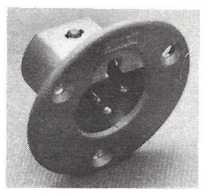
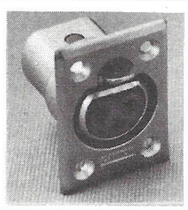
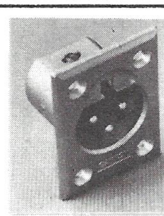
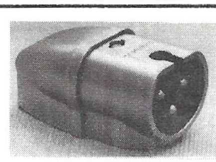
It is recognized that special applications arise from time to time that cannot be solved with either of the power connector types described here. In such cases, a non-standard connector may, of course, be used, care being exercised not to use a connector already standardized for another service. For example, the general-purpose audio connector (see Section A2 above), which is actually a locking-type power connector, should never be used for ac power.

1. General-Purpose AC Connector. The three-wire, locking-type family of power connectors, Figure 11-7, is a general-purpose ac power connector. These connectors are used on studio AV outlets (see Chapter 5, Figure 5-21 and 5-31), on system components, and on interconnection cables used in studios and in the field (within their power-handling capability), as well as for internal power distribution within equipment rack assemblies (see Chapter 2, Figure 2-6) or similar equipment assemblies.

2. Utility AC Connector. The three-wire, non-locking family of ac connectors, Figure 11-8, finds a limited application in the technical facilities in CBS plants. The fact that it is non-locking (and therefore susceptable to accidential disconnection) precludes it from use in equipment involved in program production. However, this connector does enjoy the status of being an almost universal standard as a general-purpose utility ac outlet. It is used for this purpose throughout all areas of television plants and office buildings. In technical areas it is installed in the base of equipment racks and on workbenches to provide ac power for measuring equipment, trouble lamps, and soldering irons.

D. RF Connectors

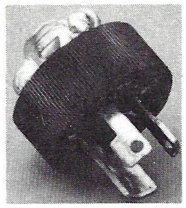
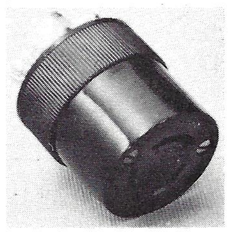
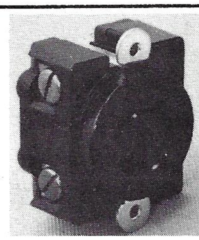
The family of coaxial cable connectors commonly referred to as type F is used in rf distribution systems associated with CBS building monitoring installations. In this application, these connectors, shown in Figure 11-9, are normally used with double-shielded RG59-U and JT408D coaxial cable.

TYPE	ILLUSTRATION	DESCRIPTION
Cannon UA-3-11		Cable connector, female contacts
Cannon UA-3-12		Cable connector, male contacts
Cannon UA-3-13		Panel or chassis mounting receptacle, round mounting flange, female contacts
Cannon UA-3-14		Panel or chassis mounting receptacle, round mounting flange, male contacts
Cannon UA-3-31		Same as UA-3-13 except rectangular mounting flange
Cannon UA-3-32		Same as UA-3-14 except rectangular mounting flange
Cannon UA-3-42		Microphone-mounting connector, male contacts

NOTES

Material: Connector casing - Steel
Receptacle casing - Zinc
Microphone-mounting connector casing - Zinc
Male contacts - Brass, gold plated
Female contacts - Beryllium copper, gold plated

FIGURE 11-1. CBS standard low-level audio connectors

TYPE	ILLUSTRATION	DESCRIPTION
Hubbell 7554 or equivalent		Cable connector, male contacts
Hubbell 7555 or equivalent		Cable connector, female contacts
Hubbell 7556 or equivalent		Panel or chassis mounting receptacle, male contacts
Hubbell 7557 or equivalent		Panel or chassis mounting receptacle, female contacts
Hubbell 7586 or equivalent		Panel or chassis mounting receptacle, female contacts

NOTES

Material: Connector body - Phenolic
Receptacle body - Phenolic
Receptacle mounting flange - brass, nickel plated
Male contacts - Brass
Female contacts - Beryllium copper

FIGURE 11-2. CBS standard general-purpose connectors for medium-level and high-level audio applications

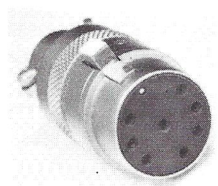
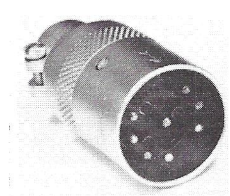
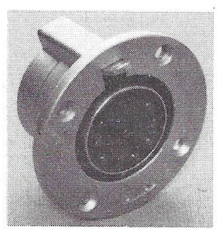
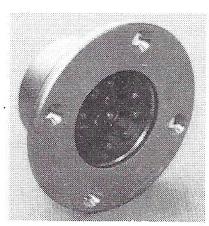
TYPE	ILLUSTRATION	DESCRIPTION
Cannon P8-CG-11S		Cable connector, female contacts
Cannon P8-CG-12S		Cable connector, male contacts
Cannon P8-13		Panel or chassis mounting receptacle, female contacts
Cannon P8-14		Panel or chassis mounting receptacle, male contacts
NOTES	Material: Connector casing - Steel, satin chrome finish Receptacle casing - Zinc, satin chrome finish Male contacts - Brass, silver plated Female contacts - Beryllium copper, silver plated	

FIGURE 11-3. CBS standard communication connector for microphone boom communication circuits

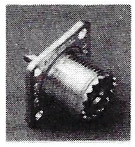
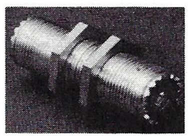
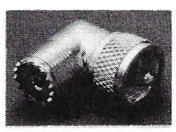
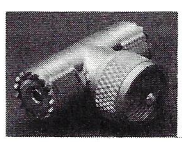
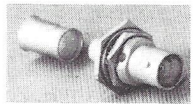
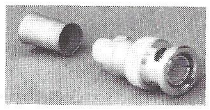
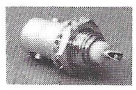
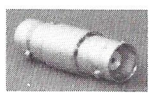
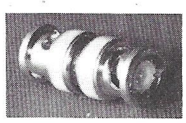
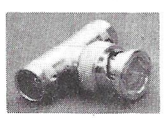
TYPE	ILLUSTRATION	DESCRIPTION
AMP 2-330830-2 or equivalent		Cable connector, adapter and crimping ring for use with CBS 1CA cable, male contact
Amphenol 83-1R (MIL SO-239) or equivalent		Panel or chassis receptacle, female contact
Amphenol 83-1F (MIL 363) or equivalent		Panel or chassis mounting adapter, female contacts
Amphenol 83-1J (MIL PL-258) or equivalent		Straight adapter, female contacts
Amphenol 83-1AP (MIL UG-646/U) or equivalent		Angle adapter, one male contact, one female contact
Amphenol 83-1T (MIL M-358) or equivalent		Tee adapter, one male contact, two female contacts
<u>NOTES</u>	Material: Casing - Brass, silver plated Male contacts - Brass, silver plated Female contacts - Beryllium copper, silver plated	

FIGURE 11-4. The UHF series of video connector

TYPE	ILLUSTRATION	DESCRIPTION
AMP 330878 or Equivalent		Cable connector and crimping ring, male contact, for CBS 1CA cable.
AMP 331300 or Equivalent		Panel or chassis receptacle and crimping ring, female contact, crimp type shield connection. For CBS 1CA cable.
Amphenol 31-236 (MIL 625B) or equivalent		Panel or chassis receptacle, female contact. Use Amphenol 31-759 lug or equivalent for cable shield connection.
Amphenol 31-220 (MIL 492A) or equivalent		Panel or chassis adapter, female contacts.
Amphenol 31-219 (MIL 914) or equivalent		Adapter, female contacts.
Amphenol 31-218 (MIL 491A) or equivalent		Adapter, male contacts.
Amphenol 31-009 (MIL 306) or equivalent		Angle adapter, one male contact, one female contact.
Amphenol 31-008 (MIL 274) or equivalent		Tee adapter, one male contact, two female contacts.

NOTES

1. Material: Casing - Brass, silver plated
   Male contacts - Brass, gold plated
   Female contacts - Beryllium copper, gold plated
2. The BNC is a 50-ohm connector series and should not be used in 75-ohm circuit applications where frequencies higher than video frequencies are involved.

FIGURE 11-5. The BNC series of video connector

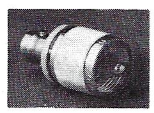
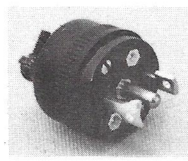
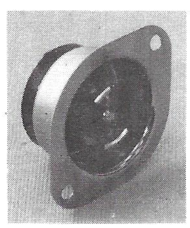
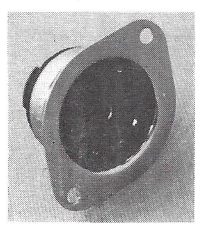
TYPE	ILLUSTRATION	DESCRIPTION
Amphenol 31-028 (MIL 273) or equivalent		BNC to UHF adapter, UHF male contact, BNC female contact
Amphenol 2900 (MIL 255) or equivalent		BNC to UHF adapter, UHF female contact, BNC male contact
NOTES	Material: Casing - Brass, silver plated Male contacts - Brass, silver plated Female contacts - Beryllium copper, silver plated	

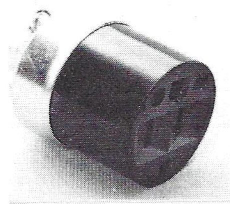
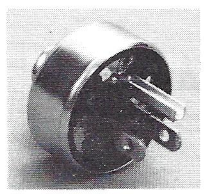
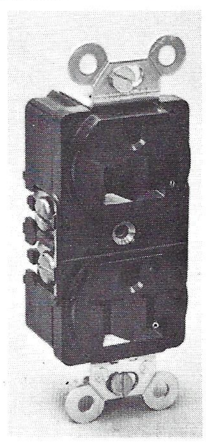
FIGURE 11-6. Adapters for interconnecting BNC and UHF connectors

TYPE	ILLUSTRATION	DESCRIPTION
Hubbell 7484 or equivalent		Cable connector, female contacts
Hubbell 7485 or equivalent		Cable connector, male contacts
Hubbell 7486 or equivalent		Panel or chassis mounting receptacle, male contacts
Hubbell 7487 or equivalent		Panel or chassis mounting receptacle, female contacts

NOTES

1. Material: Connector body - Phenolic and Nylon
   Receptacle body - Phenolic
   Connector mounting flange - Brass, nickel plated
   Male contacts - Brass
   Female contacts - Beryllium copper
2. Rating: 15 amperes, 125 volts ac

FIGURE 11-7. CBS standard general-purpose ac connector

TYPE	ILLUSTRATION	DESCRIPTION
Hubbell 5269 or equivalent		Cable connector, female contacts
Hubbell 5264 or equivalent		Cable connector, male contacts
Hubbell 5262 or equivalent		Duplex receptacle, female contacts

NOTES

1. Material: Receptacle body - Phenolic
   Connector body - Phenolic armored
   Male contacts - Brass
   Female contacts - Beryllium copper
2. Rating: 15 amperes, 125 volts ac

FIGURE 11-8. CBS standard utility ac connector

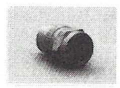
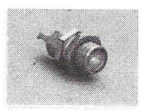
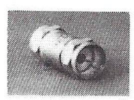
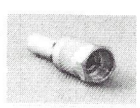
TYPE	ILLUSTRATION	DESCRIPTION
Jerrold F-59 or equivalent		Cable connector, male contact, for RG59/U cable
Gilbert G-AF-408 or equivalent		Cable connector, male contact, for JT408D cable
Jerrold F-61 or equivalent		Panel or chassis connector, female contact
Jerrold F-71 or equivalent		Coupling, male contacts
Jerrold F-81 or equivalent		Panel or chassis mounting coupling, female contacts
Jerrold TR-72F or equivalent		Terminating resistor, male contact, 72 ohms
NOTES	Material:	Connector & coupling bodies - Brass, silver plated Male contacts - Brass, silver plated Female contacts - Beryllium copper, silver plated

FIGURE 11-9. RF connectors for use in building-monitoring rf distribution systems

III. STANDARD CABLE ASSEMBLIES AND PATCHCORDS

For many years CBS standards have covered cable assemblies (a cable complete with connectors) used in the day-to-day operation of CBS television plants (and in the field) for microphones, audio, video, rf, and ac power. Specifications for these standard cable assemblies are given on the following pages. Included with these cable specifications are specifications for audio and video patchcords.

It will be noted that a standard camera cable is not covered in these specifications. Until industry standardization has been achieved on camera cable and camera connectors, the camera cables used in a given installation will be determined largely by the type of camera being used.

CABLE ASSEMBLY SPECIFICATION

Type: CBS 1A audio patchcord.

Uses: Patchcord for audio jackfields.

Description:

Cable: CBS 2FJ* cord.

Connectors: Western Electric 291B or equivalent** audio plug at each end.

Cable Length: As required. Recommended lengths are 1, 2, 4, and 6 feet.

Connections:

Plug	Conductor
Tip	Black
Ring	White
Sleeve	Shield (shield must connect to sleeve of plug at one end only)

*Use Runzel type CBS 2FJ cord available from Runzel Cord and Wire Co., 4727 West Montrose, Chicago, Illinois. CBS 2FJ is a two-conductor shielded cable, No. 18 AWG conductors (42 strands of #34 AWG tinned copper wire), rubber insulation, tinsel shield, slate-colored nylon-braided jacket, shield tab at one end only. Length must be specified when ordering.

**The Western Electric 310 audio plug is not equivalent to the WE 291B audio plug and should not be used. Although appearing equivalent, a WE 310 audio plug produces a momentary short circuit when inserted into a WE 239E audio jack.

CABLE ASSEMBLY SPECIFICATION

Type: CBS 1U AC cable.

Uses: General purpose extension cable.

Description:

Cable: 16/3 SJ cord.

Connectors: Hubbell 7484 or equivalent cable receptacle.
Hubbell 7485 or equivalent cable plug.

Cable Length: As required. Recommended lengths are 25, 50, and 100 feet.

Connections:

Connector Contacts	Conductor Color
Y	Black
X	White
W (ground)	Green

CABLE ASSEMBLY SPECIFICATION

Type: CBS 1V video patchcord.

Uses: Patchcord for video jackfields.

Description:

Cable: CBS 1CA.

Connectors: Western Electric 358A, Superior TV-30P, or equivalent video plug at each end.

Cable Length: As required. Recommended lengths are 2½, 4, and 6 feet.

CABLE ASSEMBLY SPECIFICATION

Type: CBS 2A microphone extension cable.

Uses: Microphone and microphone extension cables.

Description:

Cable: CBS 3FA.

Connectors: Cannon UA-3-11 cable connector, socket contacts.

Cannon UA-3-12 cable connector, pin contacts.

Cable Length: As required. Recommended lengths are 25, 50, and 100 feet.

Connections:

Connector Pin Number	Conductor Color
1	Red
2	Black
G	Green*

*Connect shield to green conductor at UA-3-12 (pin contacts) end only. Insulate shield at UA-3-11 end.

CABLE ASSEMBLY SPECIFICATION

Type: CBS 2V video cable.

Uses: General purpose video extension cable.

Description:

Cable: CBS 1CA.

Connectors: AMP, Inc., 331300 or equivalent UHF series plug at each end.

Cable Length: As required. Recommended lengths are 25, 50, and 100 feet.

CABLE ASSEMBLY SPECIFICATION

Type: CBS 3A audio utility cable.

Uses: General purpose audio extension cable.

Description:

Cable: CBS 3FA.

Connectors: Hubbell 7554 or equivalent cable plug.

Hubbell 7555 or equivalent cable receptacle.

Cable Length: As required. Recommended lengths are 25, 50, and 100 feet.

Connections:

Connector Contact	Conductor Color
X	Red
Y	Black
W	Green*

*Connect shield to green conductor at plug end only. Insulate shield at receptacle end.

CABLE ASSEMBLY SPECIFICATION

Type: CBS 3V video cable.

Uses: General purpose video extension cable.

Description:

Cable: CBS 1CA.

Connectors: AMP, Inc., 330878 or equivalent BNC connector at each end.

Cable Length: As required.

IV. STANDARD EQUIPMENT FINISHES

A distinguishing feature of a professional television broadcasting installation is a uniform finish on all equipment racks, consoles, and other system components.

At CBS, CBS light gray enamel is the standard finish. A darker finish, CBS dark gray is also a standard finish, but its use at present is limited to special applications such as providing a contrasting shade when a two-tone finish is desired. An important fact about both of these finishes is that they are neutral shades; that is, they possess no color*.

Both CBS light gray and CBS dark gray enamels are available in three different forms; a baking enamel, a spraying enamel, and a brushing enamel. These enamels are now supplied by Du Pont and are identified as shown in Table 11-4. Detailed preparation and application instructions for these enamels are given on the following pages.

Table 11-4. CBS GRAY ENAMELS

CBS DESIG	DU PONT DESIG	SHADE AND TYPE
LGBK	084-57045	Light gray baking enamel
LGSP	83-57045	Light gray spraying enamel
LGBR	88-57045	Light gray brushing enamel
DGBK	084-538	Dark gray baking enamel
DGSP	83-538	Dark gray spraying enamel
DGBR	88-538	Dark gray brushing enamel

*In areas where color programs are produced or controlled, it is important that the finish on the equipment, as well as the finish of the room and its furnishings, be neutral (colorless) to produce the proper environmental conditions for the critical evaluation of color program material on picture monitors.

ENAMEL SPECIFICATION

Type: CBS LGBK light gray baking enamel.

Uses: Baked enamel finish for metal surfaces.

Supplier's Code Number: Du Pont 084-57045 baking enamel.

Preparation: Thin CBS LGBK enamel up to 25% with Du Pont T-3810 thinner for spraying.

Application:

Steel Surfaces:

Clean surface, prime with Du Pont 65-3055 (light gray) primer, air-dry four hours for dry sanding or 16 hours for wet sanding. (For a fast dry, the primer can be baked for 45 minutes at 180°F, 35 minutes at 200°F, 25 minutes at 225°F, or 20 minutes at 250°F.) Finish with two coats of CBS LGBK enamel.

Aluminum Surfaces:

Wash surface with Du Pont T-3812 enamel reducer, treat with Du Pont VM5717 metal conditioner, rinse with hot water, dry thoroughly, and apply Du Pont 63-2085 zinc chromate primer immediately. (Reduce primer with two parts of Du Pont T-8837 thinner. Primer should be applied at a dry film thickness of approximately 1/2 mil. When applied at 1/2 mil, 63-2085 primer will have a semi-transparent greenish-yellow color.) Allow primer to dry for a minimum of 10 minutes and finish with two coats of CBS LGBK enamel.

Baking Procedures:

CBS LGBK enamel is formulated to cure after a 25 minute bake at 225°F. Alternate baking procedures are 15 minutes at 250°F, 45 minutes at 200°F, or 90 minutes at 180°F.

ENAMEL SPECIFICATION

Type: CBS LGSP light gray spraying enamel.

Uses: Sprayed, air-dry enamel finish for metal, wood, concrete, and plaster surfaces. Also, for touch-up of surfaces finished with CBS LGBK baking enamel.

Supplier's Code Number: Du Pont 83-57045 spraying enamel.

Preparation: Thin CBS LGSP enamel up to 25% with Du Pont T-3810 thinner.

Application:

Steel Surface:

Clean surface, prime with Du Pont 65-3055 (light gray) primer, air-dry four hours for dry sanding or 16 hours for wet sanding. Finish with two coats of CBS LGSP enamel*.

Aluminum Surfaces:

Wash surface with Du Pont T-3812 enamel reducer, treat with Du Pont VM5717 metal conditioner, rinse with hot water, dry thoroughly, and apply Du Pont 63-2085 zinc chromate primer immediately. (Reduce primer with two parts of Du Pont T-8837 thinner. Primer should be applied so as to provide a dry film thickness of approximately 1/2 mil.) Allow primer to dry for a minimum of 10 minutes and finish with two coats of CBS LGSP enamel*.

Non-metal Surfaces:

Clean surface, prime as required, and finish with two or more coats of CBS LGSP enamel*.

Remarks: CBS LGSP enamel covers approximately 550 square feet per gallon at a 1 mil dry film thickness.

*The second coat of CBS LGSP enamel must be applied within 1-1/2 hours after the first coat or it will be necessary to allow the first coat to dry 15 hours before applying the second coat. This procedure is necessary to prevent lifting.

ENAMEL SPECIFICATION

Type: CBS LGBR light gray brushing enamel.

Uses: Brushed enamel finish for wood, concrete, plaster, and metal surfaces.

Supplier's Code Number: Du Pont 88-57045 brushing enamel.

Preparation: Use CBS LGBR enamel at package viscosity or thin up to 5% with Du Pont T-3819 thinner if required.

Application: Clean surface, prime as required, and finish with two coats of CBS LGBR enamel. Allow 16 hours between coats.

Remarks: CBS LGBR enamel covers approximately 750 square feet per gallon at a 1 mil dry film thickness.

ENAMEL SPECIFICATION

Type: CBS DGBK dark gray baking enamel.

Uses: Baked enamel finish for metal surfaces.

Supplier's Code Number: Du Pont 084-538 baking enamel.

Preparation: Thin CBS DGBK enamel up to 25% with Du Pont T-3810 thinner for spraying.

Application:

Steel Surfaces:

Clean surface, prime with Du Pont 65-3011 (dark gray) primer, air-dry four hours for dry sanding or 16 hours for wet sanding. (For a fast dry, the primer can be baked for 45 minutes at 180°F, 35 minutes at 200°F, 25 minutes at 225°F, or 20 minutes at 250°F.) Finish with two coats of CBS DGBK enamel.

Aluminum Surfaces:

Wash surface with Du Pont T-3812 enamel reducer, treat with Du Pont VM5717 metal conditioner, rinse with hot water, dry thoroughly, and apply Du Pont 63-2085 zinc chromate primer immediately. (Reduce primer with two parts of Du Pont T-8837 thinner. Primer should be applied so as to provide a dry film thickness of approximately 1/2 mil. When applied at 1/2 mil, 63-2085 primer will have a semi-transparent greenish-yellow color.) Allow primer to dry for a minimum of 10 minutes and finish with two coats of CBS DGBK enamel.

Baking Procedures:

CBS DGBK enamel is formulated to cure after a 25 minute bake at 225°F. Alternate baking procedures are 15 minute at 250°F, 45 minutes at 200°F, or 90 minutes at 180°F.

ENAMEL SPECIFICATION

Type: CBS DGSP dark gray spraying enamel.

Uses: Sprayed, air-dry, enamel finish for metal, wood, concrete and plaster surfaces. Also, for touch-up of surfaces finished with CBS DGBK baking enamel.

Supplier's Code Number: Du Pont 83-538 spraying enamel.

Preparation: Thin CBS DGSP enamel up to 25% with Du Pont T-3810 thinner.

Application:

Steel Surface:

Clean surface, prime with Du Pont 65-3011 (dark gray) primer, air-dry four hours for dry sanding or 16 hours for wet sanding. Finish with two coats of CBS DGSP enamel*.

Aluminum Surfaces:

Wash surface with Du Pont T-3812 enamel reducer, treat with Du Pont VM5717 metal conditioner, rinse with hot water, dry thoroughly, and apply Du Pont 63-2085 zinc chromate primer immediately. (Reduce primer with two parts of Du Pont T-8837 thinner. Primer should be applied so as to provide a dry film thickness of approximately 1/2 mil.) Allow primer to dry for a minimum of 10 minutes and finish with two coats of CBS DGSP enamel*.

Non-metal Surfaces:

Clean surface, prime as required, and finish with two or more coats of CBS DGSP enamel*.

Remarks: CBS DGSP enamel covers approximately 550 square feet per gallon at a 1 mil dry film thickness.

*The second coat of CBS DGSP enamel must be applied within 1-1/2 hours after the first coat or it will be necessary to allow the first coat to dry 15 hours before applying the second coat. This procedure is necessary to prevent lifting.

ENAMEL SPECIFICATION

Type: CBS DGBR dark gray brushing enamel.

Uses: Brushed enamel finish for wood, concrete, plaster, and metal surfaces.

Supplier's Code Number: Du Pont 88-538 brushing enamel.

Preparation: Use CBS DGBR enamel at package viscosity or thin up to 5% with Du Pont T-3819 thinner if required.

Application: Clean surface, prime as required, and finish with two coats of CBS DGBR enamel. Allow 16 hours between coats.

Remarks: CBS DGBR enamel covers approximately 750 square feet per gallon at a 1 mil dry film thickness.

V. PREFERRED MACHINE SCREWS

There is a very large variety of industry-standard machine screws in general use at the present time.

In choosing a machine screw for a specific application, there are many factors to consider. First, there is the matter of screw thread. Screw threads are covered by American National Standard B1.1-1960 "Unified Screw Threads". There is a standard coarse thread (UNC) series and a standard fine thread (UNF) series. In the larger screw sizes, there is also an extra-fine thread (UNEF) series and several constant pitch (UN) series. All in all, there are 43 American National standard screw thread sizes between the small 0-80 size and the ½-32 size.

Second, the type of screw head to be used must be considered. Machine screws are available with flat, binding, oval, hexagon, round, pan, truss, and fillister heads. Setscrews are usually headless.

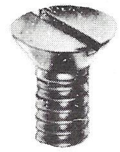
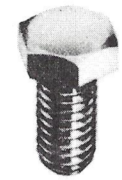
Third, there is the matter of the screwdriver or wrench slot in the screw head. In general use are screw heads with slotting for conventional screwdrivers, Phillips screwdrivers, hexagonal socket wrenches, and fluted socket wrenches.

Next is the matter of material. Machine screws are made of many materials including steel, stainless steel, brass, aluminum, and nylon.

Finally, machine screws are often plated or otherwise treated to improve their appearance or prevent rust. Finishes include nickel plating, chromium plating, cadmium plating, zinc plating, black-nickel plating, and baked enamelling.

With such an abundance of screw types, it is impractical for a shop to keep all on hand. Furthermore, only the largest supply houses stock all types and long delivery times may be encountered in procuring some of the less popular types. Accordingly, to simplify things somewhat, CBS has chosen a group of the most-frequently-used machine screw types and designated them as CBS preferred machine screws. These preferred types, shown in Table 11-5, should be used whenever possible in the design and construction of CBS equipment.

Table 11-5. CBS PREFERRED MACHINE SCREWS

SCREW SIZE	HEAD (See notes 1 & 2)			
	FLAT 	BINDING 	OVAL 	HEXAGON 
0-80	X	X		
2-56	X	X		
4-40	X	X	X	
6-32	X	X	X	
8-32	X	X	X	
10-32	X	X		
12-24		X		
1/4 -20	X	X		X
5/16-18	X			X
3/8 -16	X			X
1/2 -13	X			X

X - Indicates CBS preferred type

NOTES:

1. Head Slotting. Conventional screwdriver head slotting, as illustrated, is standard. (An exception is the hexagon head which normally is not slotted.) Phillips recessed slotting should be used where appearance is important, for example, on the front surface of control panels.

2. Other Head Types. Other industry-standard head types (such as round head, pan head, truss head, and fillister head) are not CBS preferred types and should be used only where a preferred type will not satisfactorily perform the job.

3. Material. Stainless steel machine screws are normally used. Special applications may require the use of other metals or non-metallic materials such as nylon.

4. Screw Length. Because of the wide variety of machine screw applications, no CBS standards for machine screw length have been established.

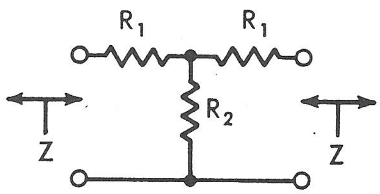
VI. RESISTANCE NETWORKS

Resistance networks are indispensible in television audio broadcasting systems. These simple, passive devices perform many useful functions in audio systems. These functions include (a) adjusting the program level or circuit impedance in a system to a desired value, (b) isolating system elements (as a line pad isolates an amplifier from a line), and (c) combining two or more program channels into a single program channel or, conversely, dividing the output of a single program channel into two or more program channels.

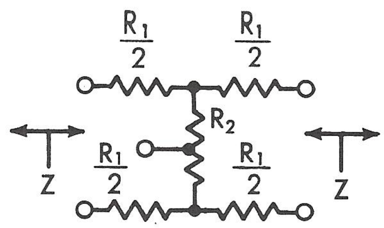
For the convenience of those having occasion to design such networks, there is given in Tables 11-6 through 11-12 a set of resistance network design charts. These design charts give network circuitry, network design data, as well as tables of actual resistor values for frequently-used resistance networks.

Although these design charts give complete design data for resistance networks, it should be kept in mind that it is not always the most economical procedure to design and custom-build a network. Considering the engineering, drafting, and shop time involved, it is often more economical, if time permits, to purchase a commercially-available unit.

Table 11-6. T AND H RESISTANCE ATTENUATION NETWORKS
operating between equal impedances.



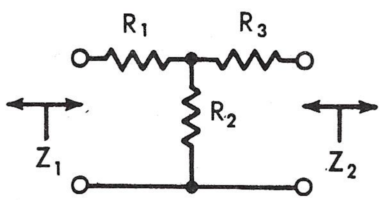
T PAD



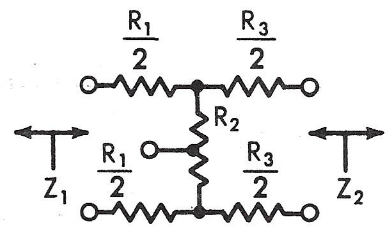
H PAD

RESISTOR VALUES, 150:150 AND 600:600 OHM NETWORKS					
NETWORK LOSS IN dB	POWER RATIO (N)	$R_1 = Z \frac{\sqrt{N}-1}{\sqrt{N}+1}$ OHMS		$R_2 = \frac{2Z\sqrt{N}}{N-1}$ OHMS	
		Z = 150 OHMS	Z = 600 OHMS	Z = 150 OHMS	Z = 600 OHMS
1	1.259	8.62 OHMS	34.5 OHMS	1302 OHMS	5208 OHMS
2	1.585	17.2	68.8	645	2582
3	1.995	25.7	103	426	1703
4	2.512	33.9	136	312	1249
5	3.162	42.0	168	247	988
6	3.981	49.8	199	201	803
7	5.012	57.4	230	171	685
8	6.310	64.6	258	142	568
9	7.943	71.4	286	122	487
10	10.00	78.0	312	105	422
11	12.59	84.1	336	92	367
12	15.85	89.8	359	80	322
13	19.95	95.1	381	71	283
14	25.12	100	400	62	249
15	31.62	105	419	55	221
16	39.81	109	436	49	195
17	50.12	113	452	43	173
18	63.10	116	466	38	152
19	79.43	120	479	34	136
20	100.0	123	490	30	121
22	158.5	128	512	24	96
24	251.2	132	529	19	76
26	398.1	136	543	15	60
28	631.0	138	554	12	48
30	1000	141	563	9.5	38
32	1585	143	571	7.5	30
34	2512	144	576	6	24
36	3981	145	581	4.7	19
38	6310	146	585	3.8	15.1
40	10000	147	588	3.0	12.0
50	100000	149	596	0.95	3.8

Table 11-7. T AND H RESISTANCE ATTENUATION NETWORKS operating between unequal impedances.



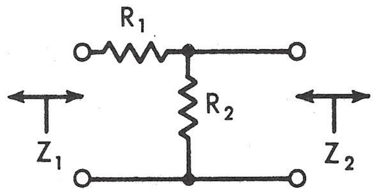
T PAD



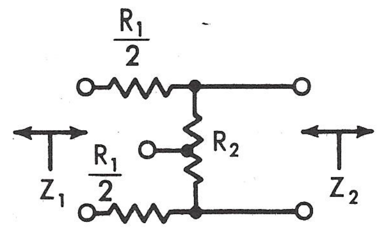
H PAD

RESISTOR VALUES, TYPICAL DISSYMMETRICAL NETWORKS						
Z_1	Z_2	NETWORK LOSS IN dB	POWER RATIO (N)	$R_1 = Z_1 \frac{(N+1)}{(N-1)} - R_2$	$R_2 = \frac{2\sqrt{NZ_1Z_2}}{N-1}$	$R_3 = Z_2 \frac{(N+1)}{(N-1)} - R_2$
600	150	11.4 (MIN LOSS)	13.8	520 OHMS	174 OHMS	0 OHMS
600	150	15	31.6	529	109	50.5
600	150	20	100	552	60	93
600	150	25	316.2	572	33.6	118
600	150	30	1000	581	18.8	131.2
600	150	40	10000	594	5.97	144
600	150	50	100000	598	1.88	148.1

Table 11-8. L AND U RESISTANCE ATTENUATION NETWORKS



L PAD

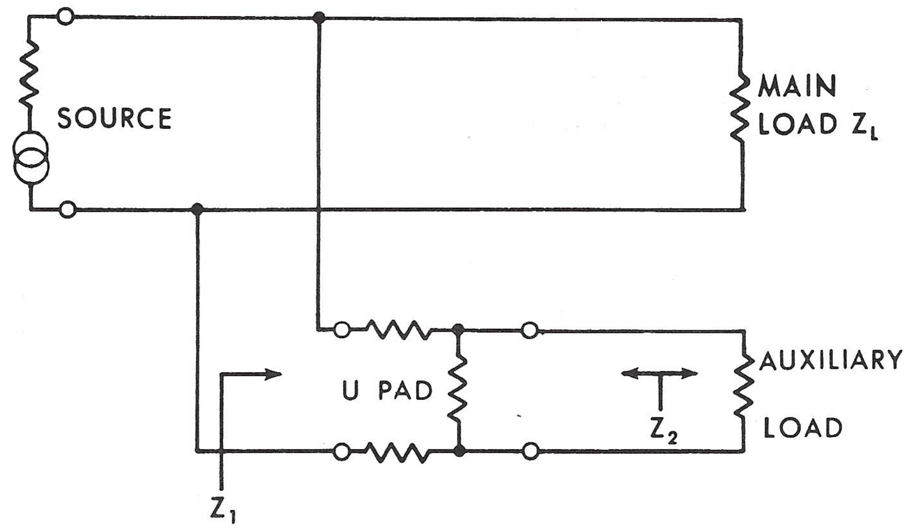


U PAD

RESISTOR VALUES, TYPICAL NETWORKS				
Z_1	Z_2	NETWORK LOSS* IN dB = $20 \log_{10}\left(\sqrt{\frac{Z_1}{Z_2}} + \sqrt{\frac{Z_1}{Z_2} - 1}\right)$	$R_1 = \sqrt{Z_1(Z_1 - Z_2)}$	$R_2 = \frac{Z_1 Z_2}{R_1}$
150	75	7.7 dB	106 OHMS	106 OHMS
150	50	10	122.5	61.2
600	150	11.4	520	174
1500	150	15.8	1425	158
3000	150	19.0	2925	153.8
5000	150	21.2	4925	152.3
6000	150	21.7	5925	152
12000	150	25.0	11925	151
15000	150	26.0	14925	150.7
20000	150	27.2	19925	150.5

*FOR LOSS WHEN L AND U NETWORKS ARE USED AS BRIDGING NETWORKS SEE TABLE 11-9

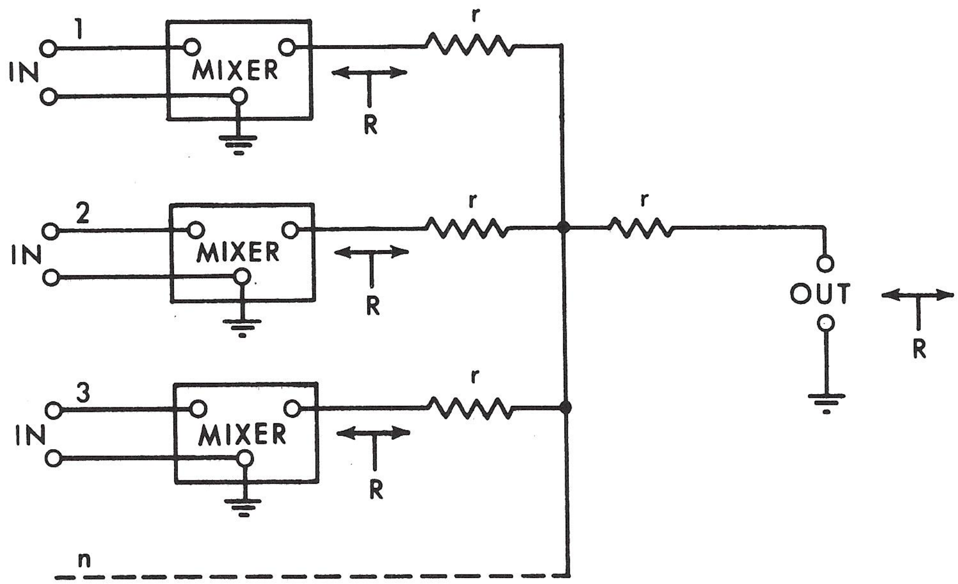
Table 11-9. RESISTANCE BRIDGING NETWORKS



WHEN L AND U NETWORKS ARE USED AS BRIDGING NETWORKS, THE TOTAL LOSS WILL BE EQUAL TO THE BRIDGING LOSS PLUS THE NETWORK LOSS ie:

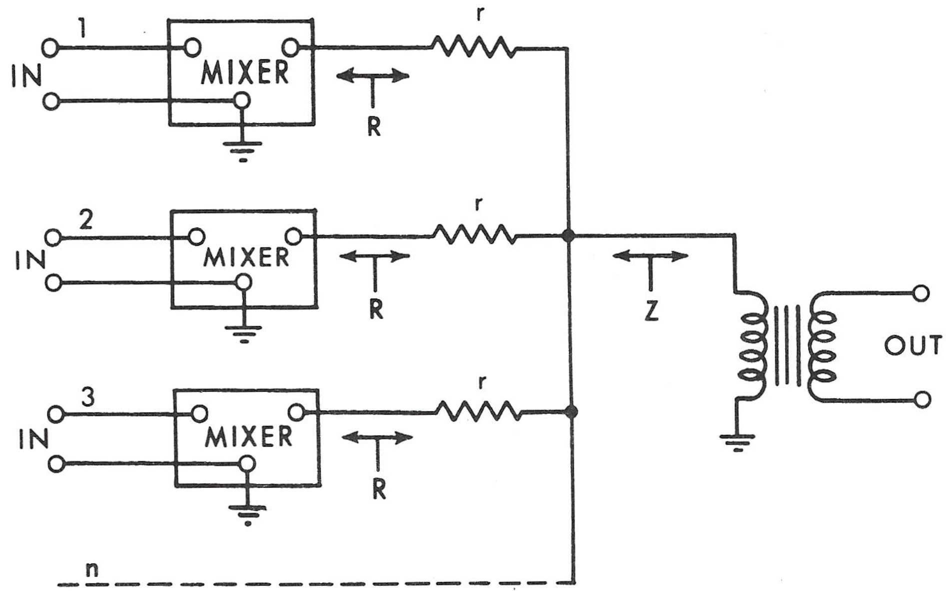
IMPEDANCE RATIO $\frac{Z_1}{Z_L}$	BRIDGING LOSS IN dB = $10 \log_{10} \frac{Z_1}{Z_L}$	NETWORK LOSS IN dB = $20 \log_{10} \left(\sqrt{\frac{Z_1}{Z_2}} + \sqrt{\frac{Z_1}{Z_2} - 1} \right)$	TOTAL LOSS
10	10 dB	15.8 dB	25.8 dB
20	13	19.0	32
33.3 (5000:150 Ω)	15.2	21.2	36.4
40	16	21.7	37.7
80	19	25.0	44
100	20	26.0	46
133.3 (20000:150 Ω)	21.2	27.2	48.4

Table 11-10. RESISTANCE MIXER MATCHING NETWORKS
General type - for use between same mixer and load impedances.



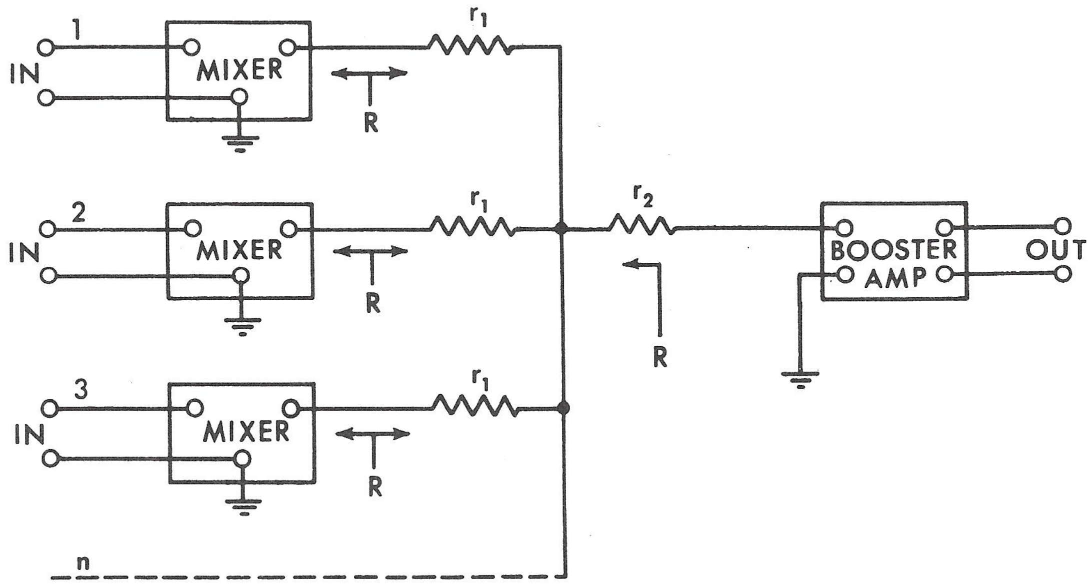
NUMBER OF CHANNELS, n	NETWORK LOSS IN dB = $20 \log_{10} n$	VALUE OF RESISTOR $r = \frac{R(n-1)}{n+1}$ OHMS	
		R = 150 OHMS	R = 600 OHMS
2	6.0 dB	50 OHMS	200 OHMS
3	9.5	75	300
4	12.0	90	360
5	14.0	100	400
6	15.6	107	429
7	16.9	112	450
8	18.1	117	466
9	19.1	120	480
10	20.0	123	492
11	20.8	125	500
12	21.6	127	508

Table 11-11. RESISTANCE MIXER MATCHING NETWORKS
Minimum loss type.



NUMBER OF CHANNELS, n	NETWORK LOSS IN dB = $10 \log_{10}(2n-1)$	MATCHING TRANSFORMER PRIMARY IMPEDANCE $Z = \frac{R(2n-1)}{n^2}$ OHMS		VALUE OF RESISTOR $r = \frac{R(n-1)}{n}$ OHMS	
		R = 150 OHMS	R = 600 OHMS	R = 150 OHMS	R = 600 OHMS
2	4.8 dB	112 OHMS	450 OHMS	75 OHMS	300 OHMS
3	7.0	83	333	100	400
4	8.4	66	262	112	450
5	9.5	54	216	120	480
6	10.4	46	183	125	500
7	11.1	40	159	129	514
8	11.8	35	141	131	525
9	12.3	31.5	126	133	532
10	12.8	28.5	114	135	540
11	13.2	26	104	136	544
12	13.6	24	96	137	548

Table 11-12. RESISTANCE MIXER MATCHING NETWORKS
Special type - for operation into high-input impedance booster amplifier.



NUMBER OF CHANNELS, n	NETWORK LOSS IN dB = $20 \log_{10} n$	$r_1 = \frac{R(n-2)}{n}$ OHMS		$r_2 = R - \left(\frac{R + r_1}{n}\right)$ OHMS	
		R = 150 OHMS	R = 600 OHMS	R = 150 OHMS	R = 600 OHMS
2	6.0 dB	0 OHMS	0 OHMS	75 OHMS	300 OHMS
3	9.5	50	200	83	334
4	12.0	75	300	94	375
5	14.0	90	360	102	408
6	15.6	100	400	108	433
7	16.9	107	429	113	453
8	18.1	112.5	450	117	469
9	19.1	117	468	120	482
10	20.0	120	480	123	492
11	20.8	123	492	125	500
12	21.6	125	500	127	508

VII. ABBREVIATIONS*

In the design and construction of the technical facilities for television broadcasting systems, abbreviations are used in a number of ways. One application is on engineering drawings where abbreviations are used to conserve both drawing space and drafting time. Other applications are in the designations on equipment, such as jack field designations, control panel designations, AV outlet designations, and EP panelboard designations. Although it has been recommended that equipment designations be spelled out, limited space sometimes makes the use of abbreviations unavoidable. When abbreviations must be used for equipment designations, keep in mind that their meaning must be unmistakably clear to those who will operate the equipment. For that reason, avoid the use of any abbreviation in these applications that may not be immediately understood by operating personnel.

It is customary to use all capital letters in the lettering on engineering drawings and equipment designations even though some abbreviations are normally written with lower case letters. As examples dB becomes DB; Hz becomes HZ.

A list of standard CBS abbreviations is given in Table 11-13. A list of frequently-used initials for the names of industry organizations is given in Table 11-14.

It should be noted that, in addition to the abbreviations listed here, the block diagram designations (Table 1-1), amplifier designations (Table 1-2), meter symbol designations (Table 1-3), signal abbreviations (Table 1-4), and miscellaneous abbreviations (Table 1-5) from Chapter 1 are also sometimes used as abbreviations on engineering drawings and equipment designations. Good judgment must be used when employing these block diagram designations and abbreviations as equipment designations to be certain their meaning will be clear.

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*Abbreviations given in this section are intended for use on engineering drawings and for equipment designations. See CBS Engineering and Development Department Office Procedure 221 for abbreviations to be used in written material.

Table 11-13. ABBREVIATIONS

TERM	ABBR	TERM	ABBR
Abbreviate	ABBR	Attenuator	ATT
Above Finished Floor	AFF	Audience	AUD
Acoustic	ACST	Audience Reaction	AR, AUD REAC
Adapter	ADPT	Audio Frequency	AF
Addendum	ADD	Audio Operator	AO, AUD OPR
Addition	ADD	Audio Recording	AR, AUD REC
Adjust	ADJ	Audio-Video	AV
Air Compressor	AIR COMP	Audition	AUD
Air Condition	AIR COND	Automatic	AUTO
Alarm	ALM	Automatic Brightness Control	ABC
Alloy	ALY	Automatic Frequency Control	AFC
Alternate	ALT	Automatic Gain Control	AGC
Alternating Current	AC	Automatic Noise Limiter	ANL
Alternator	ALT	Automatic Phase Control	APC
Altitude	ALT	Automatic Sensitivity Control	ASC
Aluminum	AL	Automatic Volume Control	AVC
Amber	AMB	Automatic Volume Expansion	AVE
Ambient	AMB	Auto Transformer	AUTO TR
American Wire Gauge	AWG	Auxilliary	AUX
Ampere	A, AMP	Average	AVG
Ampere Hour	AMP HR	Average Picture Level	APL
Amplifier	AMP	Azimuth	AZ
Amplitude Modulation	AM		
And	&	Back	BK
Angle	ANG	Backward-wave Oscillator	BWO
Angstrom	A	Baffle	BAF
Anneal	ANL	Balcony	BAL
Annunciator	ANN	Ball Bearing	BB
Announce	ANN	Barrel	BBL
Anode	A	Batten	BATT
Anodize	ANOD	Battery	BAT
Antenna	ANT	Beacon	BCN
Aperture	APERT	Beam	BM
Appendix	APPX	Bearing	BRG
Approved	APPD	Beat Frequency Oscillator	BFO
Approximate	APPROX	Bel	B
Area	A	Binary	BIN
Armature	ARM	Binding Head	BDGH
Arrester	ARR	Black	BK
Artificial	ART	Blank	BLK
Article	ART	Blanking Pulse	BL
Asbestos	ASB	Block	BLK
Asphalt	ASPH	Blocking Oscillator	BO, BLK OSC
Assemble	ASSEM	Blower	BLO
Assembly	ASSY	Blue	BL
Assistant	ASST	Bolt	BLT
Associate	ASSOC	Boom	BM

ABBREVIATIONS (Cont)

TERM	ABBR
Booster	BST
Booth	BTH
Bottom	BOT
Bracket	BRKT
Braid	BRD
Brass	BRS
Breaker	BKR
Bridging	BDG
Brightness	BRT
British Thermal Units	BTU
Broadcast	BC
Bronze	BRZ
Brown	BR
Brush	BR
Building	BLDG
Bushing	BUSH
Buzzer	BUZ
By-Pass	BYP
Cabinet	CAB
Cable	CA
Cable Television	CATV
Cable Ladder	CL
Cadmium Plate	CD PL
Calibrate	CAL
Calorie	CAL
Camera	CAM
Candela	CD
Candela per Square Foot	CD/FT^2
Candela per Square Meter	CD/M^2
Candlepower	CP
Capacitor	C, CAP
Capital	CAP
Cartridge	CTG
Case Harden	CH
Cassette	CST
Cast Iron	CI
Cast Iron Pipe	CIP
Cast Steel	CS
Casting	CSTG
Catalog	CAT
Cathode	C
Cathode Ray Oscilloscope	CRO
Cathode Ray Tube	CRT
Ceiling	CLG
Celsius	C

TERM	ABBR
Cement	CEM
Center Line	CL, ℄
Center Tap	CT
Centi (10^{-2})	C
Centigram	CG
Centiliter	CL
Centimeter	CM
Centimeter-gram-second	CGS
Central Technical Area	CTA
Central Terminal Frame	CTF
Centrifugal Force	CF
Ceramic	CER
Chain	CH
Chamber	CHBR
Chamfer	CHAM
Change	CHG
Channel	CH, CHAN
Charge	CHG
Chemical	CHEM
Chemically Pure	CP
Chilled Water	CHW
Choke	CH
Chrome Plate	CRPL
Circle	CIR
Circuit	CKT
Circuit Breaker	CKT BKR
Circular	CIR
Circular Mil	CM
Circular Mils, Thousands	MCM
Circulate	CIRC
Circulating Water Pump	CWP
Circumference	CIRC
Clamp	CLP
Clear	CLR
Clearance	CL
Clockwise	CW
Closed Circuit Television	CCTV
Closet	CLO
Clutch	CL
Coaxial	COAX
Coefficient	COEF
Coil	CL
Cold Drawn	CD
Cold Drawn Steel	CDS
Cold Rolled	CR
Cold Rolled Steel	CRS

ABBREVIATIONS (Cont)

TERM	ABBR
Collector	C, COLL
Column	COL
Combination	COMB
Combustion	COMB
Common	COM
Communication	COMM
Community Antenna Television	CATV
Commutator	COMM
Company	CO
Compartment	COMPT
Compensate	COMP
Complete	COMPL
Composite	CX
Composition	COMP
Compound	COMP
Compress	COMP
Compressor	COMPR
Concentric	CONC
Concrete	CONC
Condenser	C, COND
Conductor	COND
Conduit	C, CND
Conference	CONF
Connect	CONN
Connector	CONN
Console	CONS
Constant	CONST
Construction	CONST
Contact	CONT
Contact-Making Voltmeter	CMVM
Continue	CONT
Continuous Wave	CW
Contract	CONTR
Contractor	CONTR
Contractor Furnished Equipment	CFE
Contrast	CTRS
Control	CONT
Control Center	CC
Control Room	CR
Convert	CONV
Converter	CONV
Copper	COP
Copper Clad	COPCL
Cord	CD
Corporation	CORP
Correct	CORR
Correction	CORR

TERM	ABBR
Cotter	COT
Cotton	COT
Counter	CTR
Counter Clockwise	CCW
Counter Electromotive Force	CEMF
Counterbalance	CBAL
Counterbore	CBORE
Counterdrill	CDRILL
Counterpunch	CPUNCH
Countersink	CSK
Countersink Other Side	CSK-O
Counterweight	CTWT
Coupling	CPLG
Cover	COV
Cowling	COWL
Cross Connection	XCONN
Cross Section	XSECT
Crossbar	XBAR
Crystal	XTAL
Crystal Oscillator	XTLO
Cubic	CU
Cubic Centimeter	CC
Cubic Feet per Minute	CFM
Cubic Feet per Second	CFS
Cubic Foot	CU FT
Cubic Inch	CU IN
Cubic Meter	CU M
Cubic Micron	CUμ, CU MU
Cubic Yard	CU YD
Cue	Q, CUE
Current	CUR
Current Transformer	CT
Cycle	CY
Cycles per Second	HZ, CPS
Cylinder	CYL
Decibel	DB
Decibels referred to 1 Milliwatt, Sinewave	DBM
Deflect	DEFL
Degree	(o), DEG
Degrees Celsius	°C
Degrees Fahrenheit	°F
Degrees Kelvin	K
Delay Line or Delay Unit	DL
Delayed Automatic Volume Control	DAVC

ABBREVIATIONS (Cont)

TERM	ABBR	TERM	ABBR
Demodulator	DEM	Drive	DR
Density	D	Dry Bulb	DB
Department	DEPT	Duplicate	DUP
Depth	D	Dynamic	DYN
Design	DSGN	Dyne	DYN
Designation	DESIG		
Desk	DSK	Each	EA
Detail	DET	East	E
Detector	DET	Eccentric	ECC
Develop	DEV	Effective	EFF
Diagonal	DIAG	Effects	EFF
Diagram	DIAG	Effects-Fade	EFF-F
Diameter	DIA	Effects-Wipe	EFF-W
Diametrical Pitch	DP	Efficiency	EFF
Diaphragm	DIAPH	Elbow	ELL
Differential	DIFF	Electric	ELEC
Differential Time Relay	DIFF TR	Electrician	ELEC
Dimension	DIM	Electrolyte	ELECT
Dimmer	DIM	Electrolytic	ELECT
Dining Room	DR	Electromagnetic Unit	EMU
Diode	DIO	Electromotive Force	EMF
Direct Current	DC	Electron Beam Recording	EBR
Direction Finder	DF	Electronic Data Processing	EDP
Directional	DIR	Electronic Video Recording	EVR
Director	DIR	Electrostatic	ES
Discharge	DISCH	Elementary	ELEM
Disconnect	DISC	Elevate	EL
Discriminator	DISCR	Elevation	EL
Distance	DIST	Elongation	ELONG
Distribute	DISTR	Emergency	EMG
Distribution Unit	DU	Enamel	ENAM
Double Glass	DG	Enclose	ENCL
Double Sideband	DSB	Engine	ENG
Doubler	DBLR	Engineer	ENGR
Dovetail	DVTL	Engineering	ENGRG
Dowel	DWL	Entrance	ENT
Down	DN	Envelope	ENV
Dozen	DOZ	Equal	EQ
Drafting	DFTG	Equalizer	EQ
Draftsman	DFTSMN	Equation	EQ
Drain	DR	Equipment	EQUIP
Drawing	DWG	Equipment Power Panelboard	EP
Drawing List	DL	Equivalent	EQUIV
Dressing Room	DR	Escutcheon	ESC
Drill	DR	Estimate	EST
Drill Rod	DR	Excavate	EXC
Drinking Fountain	DF	Exchange	EXCH

ABBREVIATIONS (Cont)

TERM	ABBR	TERM	ABBR
Excitation	EXC	Fire Hose Cabinet	FHC
Exciter	EXC	Fire Hose Rack	FHR
Executive	EXEC	Fire Proof	FPRF
Exhaust	EXH	Fire Resistant	FRES
Existing	EXIST	Fire Retardant	FRET
Expand	EXP	Fixed	FXD
Expense	EXP	Fixture	FIX
Explosion Proof	EP	Flange	FLG
Extension	EXT	Flat Head	FLH
Exterior	EXT	Flexible	FLEX
External	EXT	Flexible Conduit	FC
Extra Fine (Threads)	EF	Floor	FL
Extremely High Frequency	EHF	Floor Drain	FD
Extremely Low Frequency	ELF	Floor Line	FL
Extrude	EXTR	Flooring	FLG
		Fluid	FL
Fabricate	FAB	Fluorescent	FLUOR
Facilities	FAX	Flush	FL
Facsimile	FAC	Focal	FCL
Fahrenheit	F	Focus	FOC
Farad	F	Foot	(′), FT
Feed	FD	Foot Candle	FC
Feeder	FDR	Foot Lambert	FL
Feet	(′), FT	Foot Pounds	FT LB
Feet per Minute	FPM	Foot Pounds per Second	FPS
Feet per Second	FPS	Footing	FTG
Female	FEM	Forged Steel	FST
Fiber	FBR	Forging	FORG
Field	FLD	Forward	FWD
Field-effect Transistor	FET	Foundation	FDN
Figure	FIG	Fractional	FRAC
Filament	FIL	Fractional Horsepower	FHP
Fillister	FIL	Frame	FR
Fillister Head	FILH	Framework	FRWK
Filter	FL	Frequency	FREQ
Filter, Band Elimination	FL-BE	Frequency Indicator	FREQ IND
Filter, Band Pass	FL-BP	Frequency Modulation	FM
Filter, High Pass	FL-HP	Front	FR
Filter, Low Pass	FL-LP	Furnish	FURN
Finish	FIN	Future	FUT
Finish All Over	FAO		
Fire Alarm	FA	Gallon	GAL
Fire Alarm Bell	FABL	Gallons per Hour	GPH
Fire Alarm Box	FABX	Gallons per Minute	GPM
Fire Door	FDR	Gallons per Second	GPS
Fire Extinguisher	FEXT	Galvanize	GALV
Fire Hose	FH	Galvanized Iron	GI

ABBREVIATIONS (Cont)

TERM	ABBR	TERM	ABBR
Galvanized Steel	GS	Horsepower	HP
Galvanometer	GALV	Hot Rolled	HR
Gasket	GSKT	Hot Rolled Steel	HRS
Gauge	GA	Hot Water	HW
Gauss	G	Hour	HR
General	GEN	Housing	HSG
Generator	GEN	Hydraulic	HYD
Giga (10^9)	G		
Gigahertz	GHZ	Illuminate	ILLUM
Glass	GL	Illustrate	ILLUS
Governor	GOV	Impedance	IMP
Grade	GR	Incandescent	INCAND
Gram	G	Inch	("), IN
Gray	GY	Inch Pound	("#), IN LB
Green	GN	Inches per Second	IPS
Grid	G	Include	INCL
Grommet	GROM	Incoming	INC
Groove	GRV	Incorporated	INC
Gross Weight	GRWT	Increase	INCR
Ground	GND	Indicate	IND
Group	GR	Indicator	IND
Guard	GD	Inductance or Induction	IND
		Induction-Capacitance	LC
Half-Hard	1/2H	Information	INFO
Half-Round	1/2RD	Infrared	IR
Hanging	HNG	Input	IN
Hard-Drawn	HD	Inside Diameter	ID
Hardware	HDW	Inside Radius	IR
Headphone	HDPH	Install	INSTL
Headquarters	HQ	Instantaneous	INST
Heat	HT	Instruction	INST
Heat Treat	HT TR	Instruction Book	IB
Heater	HTR	Instrument	INST
Heat Resisting	HR	Insulate	INS
Heat Sink	HTSK	Integrated Circuit	IC
Heavy	HVY	Intercommunication	IC, INTCM, INTERCOM
Hectolux	HLX		
Height	HT	Intermediate Frequency	IF
Henry	H	Interior	INT
Hertz	HZ	Interlock	INTLK
Hexagon	HEX	Intermediate	INTER
Hexagonal Head	HEXH	Intermediate Frequency	IF
High	H, HI	Intermittent	INTMT
High Frequency	HF	Internal	INT
High Frequency Oscillator	HFO	Interphone	IP, INTPH, INTERPH
High Voltage	HV		
Horizontal	HOR	Interrupt	INTER

ABBREVIATIONS (Cont)

TERM	ABBR
Interrupted Continuous Wave	ICW
Irregular	IRREG
Isolate	ISOL
Jack	J
Jack Field	JF
Joint	JT
Joule	J
Joule per Degree Kelvin	J/K
Journal	JNL
Junction	JCT
Kelvin	K
Keying	KEY
Kilo (10^3)	K
Kilocycle	KC
Kilogauss	KG
Kilogram	KG
Kilohertz	KHZ
Kilojoule	KJ
Kilometer	KM
Kilometer per Hour	KM/H
Kilohm	K Ω
Kilovolt	KV
Kilovolt-Ampere	KVA
Kilovolt-Ampere Hour	KVAH
Kilowatt	KW
Kilowatt Hour	KWH
Knocked Down	KD
Knockout	KO
Laboratory	LAB
Lacquer	LAQ
Ladder	LAD
Lambert	L
Laminate	LAM
Lateral	LAT
Latitude	LAT
Lavatory	LAV
Lead Covered	LC
Leader	LDR
Left	L
Left Hand	LH
Length	LG
Length Between Perpendiculars	LBP
Length Over All	LOA
Letter	LTR
Level	LEV
License	LIC
Light	LT
Lighting	LTG
Lights	LTS
Limit	LIM
Limit Switch	LS
Limited	LTD
Limiter	LIM
Line	LN, L
Linear	LIN
Liquid	LIQ
Liter	L
Local	LCL
Load	LD
Logarithm	LOG
Long	LG
Longitude	LONG
Long Playing	LP
Loop	LP
Loudspeaker	LS
Low	L, LO
Low Frequency	LF
Low Pressure	LP
Low Tension	LT
Low Voltage	LV
Lower	LWR
Luminaire	LUM
Lux	LX
Machine	MACH
Machine Screw	MSCR
Magazine	MAG
Magnet	MAG
Magnetic	MAG
Magnetomotive Force	MMF
Main	MN
Main Distributing Frame	MDF
Maintenance	MAINT
Malleable	MALL
Malleable Iron	MI
Manager	MGR
Manual	MAN
Manual Gain Control	MGC
Manual Volume Control	MVC
Manufacture	MFR
Manufactured	MFD

ABBREVIATIONS (Cont)

TERM	ABBR	TERM	ABBR
Manufacturer	MFR	Millilambert	ML
Manufacturing	MFG	Millimeter	MM
Mark	MK	Milliseconds	MS
Master	MA	Millivolt	MV
Master Assignment Exchange	MAX	Milliwatt	MW
Master Control	MC	Minimum	MIN
Master Exchange	MX	Minute	(′), MIN
Master Oscillator	MO	Miscellaneous	MISC
Material	MATL	Mixture	MIX
Material List	ML	Model	MOD
Maximum	MAX	Modify	MOD
Mechanical	MECH	Modulator	MOD
Median	MED	Molded	MLD
Medium	MED	Momentary Contact	MC
Medium Frequency	MF	Monitor	MON
Mega (10^6)	M	Monochrome	MONO
Megaelectronvolt	MEV	Month	MO
Megahertz	MHZ	Motor	MOT
Megavolt	MV	Motor Generator	MG
Megawatt	MW	Mount	MT
Megohm	MEG	Mounted	MTD
Memorandum	MEMO	Mounting	MTG
Metal	MET	Multiple	MULT
Metal-oxide Semiconductor	MOS	Multiple Unit	MU
Meter	M, MTR	Multiburst	MB
Meter-kilogram-second	MKS	Multiplex	MPX
Meters per Second	MTR/SEC	Multiplexer	MPX
Mezzanine	MEZZ		
Micro (10^{-6})	μ	Narrow Band	NB
Microampere	μA	National Electric Code	NEC
Microfarad	μF	Natural	NAT
Microhenry	μH	Negative	NEG
Microsecond	μS	Network	NET
Micron	μ	Neutral	NEUT
Microphone	MIC	Newton	N
Microvolt	μV	Newton per Square Meter	N/M^2
Microvolts per Meter	μV/M	Nickel Plated	NP
Microwatt	μW	Nipple	NIP
Microwave	μWAVE	No Connection	NC
Middle	MDL	Nomenclature	NOM
Miles	MI	Nominal	NOM
Miles per Gallon	MPG	Normal	NOR
Miles per Hour	MPH	Normally Closed	NC
Milliampere	MA	Normally Open	NO
Milligram	MG	North	N
Millihenry	MH	Not in Contract	NIC
		Not to Scale	NTS

ABBREVIATIONS (Cont)

TERM	ABBR	TERM	ABBR
Number	NO	Part	PT
		Partition	PTN
Observation	OBS	Patchcross	PX
Obsolete	OBS	Patent	PAT
Office	OFF	Peak to Peak	P-P
Ohm	Ω	Pedestal	PED
On Center	OC	Perforate	PERF
Opening	OPNG	Permanent	PERM
Operate	OPR	Permanent Magnet	PM
Operator	OPR	Perpendicular	PERP
Opposite	OPP	Phase	Φ, PH
Optical	OPT	Phase Alternation Line (European color system)	PAL
Orange	OR		
Orchestra	ORCH	Phase Modulation	PM
Orifice	ORF	Phenolic	PHEN
Original	ORIG	Phillips Head	PHH
Oscillate	OSC	Phones	PH
Oscillator	OSC	Phonograph	PHONO
Oscilloscope	CRO	Phosphor Bronze	PH BRZ
Ounce	OZ	Photograph	PHOTO
Ounce Foot	OZ FT	Physical	PHYS
Ounce Inch	OZ IN	Pickup	PU
Outgoing	OUT	Picture	PIX
Outlet	OUT	Piece	PC
Output	OUT	Pink	PK
Outside Diameter	OD	Pint	PT
Outside Radius	OR	Plant	PL
Oval Head	OVH	Plaster	PLAS
Over	OV	Plastic	PLSTC
Overall	OA	Plate	PL
Overcurrent	OC	Plate Glass	PLGL
Overhead	OH	Platform	PLATF
Overload	OVLD	Plug	P
		Plus or Minus	±
Painted	PDT	Pneumatic	PNEU
Pair	PR	Point	PT
Panel	PNL	Polar	POL
Pan Head	PNH	Polarized	POL
Panoramic	PAN	Portable	PORT
Pantograph	PANT	Position	POS
Paperboard	PBD	Positive	POS
Parabola	PRB	Potentiometer	POT
Parabolic	PRBLC	Pound	#, LB
Paraboloid	PRBD	Pounds per Cubic Foot	PCF
Paragraph	PARA	Pounds per Square Foot	PSF
Parallax	PRLX	Pounds per Square Inch	PSI
Parallel	PAR	Power	PWR

ABBREVIATIONS (Cont)

TERM	ABBR
Power Factor	PF
Power Factor Meter	PFM
Power Supply	PS
Preemphasis	PREEMP
Prefabricated	PREFAB
Preferred	PFD
Preliminary	PRE
Pressure	PRESS
Preview	PVW
Primary	PRI
Printed Circuit	PC
Private Automatic Exchange	PAX
Private Branch Exchange	PBX
Private Line	PL
Process	PROC
Production	PROD
Program	PGM
Program Control	PC
Project	PROJ
Projection	PROJ
Projector	PROJ.
Public Address	PA
Publication	PUB
Public Relations	PR
Pull Box	PB
Pulse-amplitude Modulation	PAM
Pulse-code Modulation	PCM
Pulse-count Modulation	PCM
Pulse-duration Modulation	PDM
Pulse Frequency	PF
Pulse Indicator	PI
Pulse-position Modulation	PPM
Pulse-repetition Frequency	PRF
Pulse-repetition Rate	PRR
Pulse-time Modulation	PTM
Pulse-width Modulation	PWM
Pulses per Second	PPS
Purple	PP
Push Button	PB
Push-Pull	P-P
Quadrant	QUAD
Quality	QUAL
Quantity	QTY
Quart	QT
Quarter	QTR

TERM	ABBR
Rack	RK
Radial	RAD
Radian	RAD
Radian per Second	RAD/S
Radian per Second Squared	RAD/S^2
Radio	RDO
Radio Frequency	RF
Radio Receiver or Tuner	RDO
Radius	R
Railing	RLG
Reactive Kilovolt-Ampere	KVAR
Reactive Volt-Ampere	VAR
Readout	RDOUT
Received	RECD
Receiver	RCVR
Receptacle	RECP
Record	REC
Rectifier	RECT
Rear	R
Red	RD
Reference	REF
Reflector	REFL
Refractory	REFR
Refrigerate	REFR
Regenerative	REGEN
Regular	REG
Regulator	REG
Rehearse	REH
Reinforce	REINF
Relay	K
Release	REL
Remote	REM
Remote Control	RC
Repeat	RPT
Reproduce	REPRO
Require	REQ
Required	REQD
Requisition	REQ
Resistance	RES
Resistance-Capacitance	RC
Resistance-Inductance Capacitance	RLC
Resistor	RES
Retard	RET
Return	RET
Reverberation	REV
Reversal	RVSL

ABBREVIATIONS (Cont)

TERM	ABBR	TERM	ABBR
Reverse	REV	Shelf	SHF
Revise	REV	Shield	SHLD
Revolution	REV	Short Wave	SW
Revolutions per Minute	RPM	Sign	SN
Revolutions per Second	RPS	Signal	SIG
Rheostat	RHEO	Signal to Noise	S/N
Right	R	Silence	SIL
Right Hand	RH	Silicon Controlled Rectifier	SCR
Room	RM	Similar	SIM
Root Mean Square	RMS	Simplex	SX
Rotary	ROT	Sine	SIN
Rotate	ROT	Single Sideband	SSB
Rough	RGH	Sink	SK
Round	RD	Sketch	SK
Round Head	RDH	Slate	SL
Round Robin	RR	Sleeve	SLV
Round Robin Return	RRR	Slide	SL
Rubber	RUB	Slotted	SLOT
		Slow Release	SR
Saddle	SDL	Small	SM
Satellite	SATL	Socket	SOC
Schedule	SCH	Solder	SLD
Schematic	SCHEM	Solenoid	SOL
Screen	SCRN	Sound	SND
Screw	SCR	Sound Effects	SE
Seamless	SMLS	Sound Effects Filter	SEF
Secant	SEC	Sound Reinforcement	SR
Second	("), SEC	South	S
Secondary	SEC	Spare	SP
Section	SECT	Speaker	LS
Segment	SEG	Special	SPL
Select	SEL	Specific	SP
Selector	SEL	Specific Gravity	SP GR
Self Tapping Screw	SLFTPGSCR	Specific Heat	SP HT
Selsyn	SELS	Specification	SPEC
Sensor	SENSR	Speed	SP
Separate	SEP	Split Phase	SP PH
Sequence	SEQ	Spring	SPG
Sequentiel Couleur a Memoire (French color system)	SECAM	Sprinkler Head	SPRHD
		Square	SQ
Serial	SER	Square Centimeter	SQ CM
Series	SER	Square Foot	SQ FT
Serrate	SERR	Square Inch	SQ IN
Service	SERV	Square Kilometer	SQ KM
Set Screw	SS	Square Meter	SQ M
Shaft	SFT	Square Yard	SQ YD
Sheet	SH	Stage	STG

ABBREVIATIONS (Cont)

TERM	ABBR
Stainless	STN
Stainless Steel	SST
Stairway	STWY
Standby	STBY
Standard	STD
Standards Converter	STD CON
Standing-wave ratio	SWR
Start	ST
Starting	STG
Station	STA
Stationary	STA
Steel	STL
Stiffener	STIFF
Stock	STK
Stop	STP
Storage	STG
Street	ST
Structural	STR
Studio	ST
Studio Transmitter Link	STL
Subcarrier	SC
Substation	SUBSTA
Substitute	SUB
Subsidiary Communications Authorization	SCA
Summary	SUM
Super High Frequency	SHF
Superintendent	SUPT
Supersede	SUPSD
Supervise	SUPV
Supplement	SUPP
Supply	SUP
Support	SUP
Surface	SUR
Suspend	SUSP
Switch	S
Switch and Relay Types	
Single-Pole, Single-Throw	SPST
Single-Pole, Double-Throw	SPDT
Double-Pole, Single-Throw	DPST
Double-Pole, Double-Throw	DPDT
Triple-Pole, Single-Throw	3PST
Triple-Pole, Double-Throw	3PDT
4-Pole, Single-Throw	4PST
4-Pole, Double-Throw	4PDT

TERM	ABBR
Switchboard	SWBD
Switcher	SW
Switch Gear	SWGR
Symbol	SYM
Symmetrical	SYM
Synchronous	SYN
System	SYS
Tabulate	TAB
Tachometer	TACH
Talk	TK
Talk Back	TB
Tan	TN
Tangent	TAN
Taper	TPR
Technical	TECH
Technical Director	TD
Teeth per Inch	TPI
Telecine	TC
Telegraph	TLG
Telemeter	TLM
Telephone	TEL
Telephone Company	TELCO
Teletypewriter Exchange	TWX
Television	TV
Television Interference	TVI
Television Recording	TVR
Temperature	TEMP
Template	TEMP
Temporary	TEMP
Tension	TENS
Tera (10^{12})	T
Terminal	TERM
Terminal Board	TB
Terminal Equipment Room	TER
Termination	TERM
Tertiary	TER
Tesla	T
Test	TST
Test Pattern	TP
Thermal	THRM
Thermocouple	TC
Thermometer	THERM
Thermostat	THERMO
Thick	THK
Thousand Circular Mils	MCM
Thousand Cubic Feet	MCF

ABBREVIATIONS (Cont)

TERM	ABBR	TERM	ABBR
Thread	THD	Vacuum	VAC
Threads per Inch	TPI	Vacuum Tube	VT
Through	THRU	Vacuum-Tube Voltmeter	VTVM
Tie Line	TL	Variable	VAR
Time Delay	TD	Variable Attenuator	ATT
Time Delay Closing	TDC	Variable Frequency Oscillator	VFO
Time Delay Opening	TDO	Velocity	V
Tinned	TD	Ventilate	VENT
Toggle	TGL	Versus	VS
Toilet	T	Vertical	VERT
Tolerance	TOL	Vertical Interval Test	VIT
Tool Steel	TS	Vertical Interval Test Signal	VITS
Total	TOT	Vertical Interval Reference	VIR
Tracer	TCR	Vertical Interval Reference Signal	VIRS
Track	TRK	Very High Frequency	VHF
Transceiver	XCVR	Very Low Frequency	VLF
Transfer	TRANS	Vestigial Sideband	VSB
Transformer	T	Vibrate	VIB
Transmission	XMSN	Video	VID
Transmission Exchange	TX	Video Tape	VT
Transmit-Receive	TR	Video Tape Recording	VTR
Transmitter	XMTR	Viewing Room	VR
Transmitter, Amplitude Modulated	AM XMTR	Violet	VI
Transmitter, Frequency Modulated	FM XMTR	Viscosity	VISC
		Vitreous	VIT
Transmitter, Phase Modulated	PH XMTR	Voice Frequency	VF
Transmitter, Pulse Modulated	PL XMTR	Volt	V
Transmitting	XMTG	Voltage standing-wave ratio	VSWR
Transverse	TRANSV	Voltampere	VA
Trimmer	TRIM	Volume	VOL
Trunk	TRK	Volume Control	VC
Tubing	TUB	Volume Indicator	VI
Tuned Radio Frequency	TRF		
Turntable	TT	Wall	W
Turntable Control Unit	TTCU	Wall Receptacle	WR
Twisted	TW	Washer	WASH
Typical	TYP	Water	W
		Waterproof	WTRPRF
Ultra High Frequency	UHF	Watt	W
Ultraviolet	UV	Watthour	WHR
Unequalized	UNEQ	Watthour Meter	WHM
Upper	UP	Wattmeter	WM
Utility	UTIL	Waveform Monitor	WFM
Utility Line	UTIL LN	Week	WK
		Weight	WT
		West	W

ABBREVIATIONS (Cont)

TERM	ABBR	TERM	ABBR
Wet Bulb	WB		
White	WH		
Width	W		
Winding	WDG		
Wire Way	WW		
Wire-Wound	WW		
Yard	YD		
Year	YR		
Yellow	YL		

Table 11-14. COMMONLY USED INITIALS OF INDUSTRY ORGANIZATIONS

INITIALS	INDUSTRY ORGANIZATION
AES	Audio Engineering Society
ANSI	American National Standards Institute
ASA	American Standards Association (Presently known as American National Standards Institute)
AT&T	American Telephone and Telegraph Company
CCIR	International Radio Consultative Committee
CIE	International Commission on Illumination
EBU	European Broadcasting Union
EIA	Electronic Industries Association
FCC	Federal Communications Commission
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IRE	Institute of Radio Engineers (Presently known as Institute of Electrical and Electronics Engineers)
NAB	National Association of Broadcasters
NBS	National Bureau of Standards
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
RETMA	Radio-Electronics-Television Manufacturers Association (Presently known as Electronic Industries Association)
RIAA	Record Industry Association of America
RMA	Radio Manufacturers Association (Presently known as Electronic Industries Association)
RTMA	Radio-Television Manufacturers Association (Presently known as Electronic Industries Association)
SMPTE	Society of Motion Picture and Television Engineers
UL	Underwriters Laboratories
USASI	United States of America Standards Institute (Presently known as American National Standards Institute)

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2. EIA Standard RS-279, CABLE CONNECTORS FOR AUDIO FACILITIES FOR RADIO BROADCASTING, (April, 1964).

3. EIA Standard RS-221, POLARIZATION OR PHASING OF BROADCAST MICROPHONES, (April, 1959).

4. EIA Standard RS-215, BASIC REQUIREMENTS FOR BROADCAST MICROPHONE CABLES, (November, 1958).

5. American National Standard B1.1-1960, UNIFIED SCREW THREADS.

6. American National Standard Z32.13-1950, ABBREVIATIONS FOR USE ON DRAWINGS.

7. American National Standard Z10.1-1941, ABBREVIATIONS FOR SCIENTIFIC AND ENGINEERING TERMS.

8. Military Standard MIL-STD-12C, ABBREVIATIONS FOR USE ON DRAWINGS, SPECIFICATIONS, STANDARDS, AND IN TECHNICAL DOCUMENTS, Department of Defense, Washington, D.C., (June, 1968).

REFERENCE DRAWINGS

CBS DWG. NO.		TITLE
S11	SERIES	FINISHING AND ENGRAVING STANDARDS
	S11-1	CBS Gray Paint Specifications
S12	SERIES	CABLE SPECIFICATION SHEETS
	S12-1	CBS 1CA
	S12-2	CBS 1FA
	S12-3	CBS 1FB
	S12-4	CBS 1FG
	S12-5	CBS 2FA
	S12-6	CBS 2FB
	S12-7	CBS 2FP
	S12-8	CBS 3FA
	S12-9	CBS 8FA
	S12-10	CBS 16FA
	S12-11	CBS 16FB
	S12-12	CBS 32FA
	S12-13	CBS 32FB
S13	SERIES	CABLE ASSEMBLY AND PATCHCORD SPECIFICATION SHEETS
	S13-1	CBS 1A audio patchcord
	S13-2	CBS 1U AC cable
	S13-3	CBS 1V video patchcord
	S13-4	CBS 2A microphone extension cable
	S13-5	CBS 2V video cable
	S13-6	CBS 3A audio utility cable
	S13-7	CBS 3V video cable

12. Index