ANNOUNCEMENT SYSTEMS

GENERAL TRANSMISSION DESIGN CONSIDERATIONS

CONTENTS PAGE

1. GENERAL

1.01 This section discusses the general transmission design of announcement systems. It also establishes objectives for transmission levels in all kinds of announcement systems. Details of specific announcement systems are covered in other sections.

1.02 This section is not intended to include telephone answering sets. Neither is it intended to cover private line systems. Although much of the information will apply, private line systems will generally require special treatment.

1.03 Announcement systems may be classified as general or special. General systems are those which any subscriber might have occasion to patronize, such as time, weather, stock quotations, etc. Special systems are those used for special occasions such as emergency or intercept service.

1.04 Systems may be classified as to sponsor telephone company or subscriber. They are also classified as manual and/or automatic, local and/or remote control.

1.05 General information about presently available systems is shown in Table I. For specific information on each system, refer to appropriate practices. These are shown in Table II.

1.06 Some existing announcement systems do not conform to the transmission design objectives stated in this section. It is recognized that such systems were developed at a time when telephone instruments were less sensitive and subscriber lines tended to have higher losses. As the occasion arises to revise or replace these systems, the transmission design should then be modified to conform with this practice.

2. DEFINITIONS

2.01 Announcement System—An equipment arrangement which permits a subscriber to obtain a recorded or live announcement through the switching system. The subscriber may reach the announcement system intentionally for such things as time or weather announcements or unintentionally as in the case of intercept announcements.

2.02 Sponsor—The controller of the system. This may be either the Telephone Company or a subscriber.

TABLE I

GENERAL INFORMATION ON ANNOUNCEMENT SYSTEMS

SYSTEM	CLASSIFICATION	SPONSOR	APPLICATION	SUB-CENTERS		BUS-BAR LEVEL (1)	REMOTE CONTROL	PROVISION FOR MANUAL ANNOUNCEMENT	CAPACITY
				PROVIDED	FED BY				
1A & 1B (3)	GENERAL	TEL. CO.	TIME OF DAY	YES	1 CA. PR.	+8 VU	YES	YES	UP TO 6400 TRUNKS
2 B & 2 C (3)	GENERAL	SUBSCRIBER	VARIOUS	NO	–	+4 VU	NO	YES	50 LINES
2 D	GENERAL	SUBSCRIBER	TIME OF DAY	NO	–	0 VU	YES (2)	ONLY ON SINGLE CHANNEL	30 LINES – ONE CHANNEL 100 LINES – DUAL CHANNEL
3 A	GENERAL	TEL. CO.	WEATHER	YES	2 CA. PR.	+9 VU +0 VU (MOD)	YES	NO	MAX. 600 TRKS PER CENTER
4 A	GENERAL	TEL. CO.	TIME OF DAY	YES	2 CA. PR.	+6 VU	YES	YES	300 TRKS PER CENTER
5 A	SPECIAL	TEL. CO.	INTERCEPT	NO	–	- 11 VU	YES	YES	100 TERM. PER CHANNEL
6 A	SPECIAL	TEL. CO.	INTERCEPT	YES	2 CA. PR.	+8 VU	YES	NO	600 TRKS. – DIST. CENTER 300 TRKS – SUB CENTER
7 A	SPECIAL	TEL. CO.	INTERCEPT	NO	–	- 8 VU	NO	NO	20 CALLS
8 A	GENERAL	SUBSCRIBER	VARIOUS	NO	–	0 VU	YES (2)	YES	20 LINES
9 A	GENERAL	SUBSCRIBER OR TEL. CO.	VARIOUS	YES	ONE OR TWO CA. PR.	0 VU	YES	NO	1100 TRKS PER CENTER
11 A	SPECIAL	TEL. CO.	INTERCEPT	NO	–	0 VU	NO	NO	20 CALLS
EMERGENCY	SPECIAL	TEL. CO.	INTERCEPT	YES	1 CA. PR.	+4 VU -3 VU (MOD)	NO	YES	ALMOST UNLIMITED

1. READING OBTAINED WITH VU METER. IT IS NOT VOLUME UNITS.
2. ANNOUNCEMENT EQUIPMENT LOCATED IN C.O.
3. A & M ONLY.

TABLE II

ASSOCIATED INFORMATION

SYSTEM	J SPEC. & KEY SHEETS	ORDERING INFORMATION	PRACTICES			NOTES
			TRANSMISSION	LINE-UP & MAINTENANCE	DESCRIPTIVE	
1 & 1 B	J95403 SD-90425-01 SD-98157-01	AA 388.035	AB 22.330 & ADD.	A204.451 A204.452 A204.455 A304.451 A804.451		TIME OF DAY (TEL. CO.)
2 B & 2 C	J95410	AA 388.040	AB 22.342	–	–	TIME OF DAY (SUBS.)
2 D	J95416	AA 388.088	AB 22.342	–	–	TIME OF DAY (SUBS.)
3 A	J95411 SD-96250-01	AA 388.044	AB 22.341	A204.503 A204.504 A204.505 A438.944 A509.944	–	WEATHER (TEL. CO.)
4 A	J95416 SD-95790-01	AA 388.075	AB 22.343	A204.457 A204.458 A204.473 A204.475	951-110-100	TIME OF DAY (TEL. CO.)
5 A	J67455	AA 443.001		A204.459	951-112-100	INTERCEPT (TEL. CO.)
6 A	J95417 SD-96480-01	AA 388.079		A204.478 A204.479	951-118-100	INTERCEPT (TEL. CO.)
7 A	J33108	AA 431.101		A304.510 A438.927 A509.927	951-116-100	INTERCEPT (TEL. CO.)
8 A	J95420 SD-96515-01	AA 388.095	AB 22.345	C70.451.00 C70.453 .1,.2,.3,.4 C43.021 .2, .3 C43.033.00, .01, .02, .03, .04	951-120-100	STOCK QUOTATION, ETC. (SUBS.)
9 A	J95419 SD-95885-01	AA 388.094	AB 22.346	C70.451.00 C70.453.1, .2, .3, .4		SPORTS, NEWS, ETC. (SUBS.)
11A	J95276	AA 388.133				PORTABLE INTERCEPT (TEL. CO.)
EMERGENCY	J95415	AA 388.061				OVERFLOW, CABLE BREAKS, ETC.

2.03 Control Point—The point at which the announcement may be originated or changed. It may be at the announcement equipment, at another location in the building, at another building or on a subscriber's premises, depending on the type of system.

2.04 Local Control—An arrangement for control directly at the main center announcement equipment.

2.05 Remote Control—An arrangement for control at a point remote from the main center announcement equipment.

2.06 Main Center—The location at which the announcement originates. This is the point at which announcements start, stop, or change under direction of the control point.

2.07 Subcenter—A point at which subscribers receive announcements from equipment amplifying the message received from the main center over subcenter trunks.

2.08 Tandem Center—A subcenter which, in addition to providing announcements to subscribers, also provides signals to other subcenters over subcenter trunks.

2.09 Subcenter Trunk—An interoffice trunk which connects main centers to tandem centers and subcenters and also connects tandem centers to subcenters. The facility may be loaded or nonloaded cable or short-haul carrier.

2.10 Subcenter Trunk Circuit—The facilities necessary to connect a subcenter trunk to the bus bar of a main center or subcenter. It usually provides an impedance match and may furnish a certain amount of equalization.

2.11 Announcement Trunk—The trunk facility between a main center or subcenter and a local office, local tandem, or toll switch. This is the subscriber's access to the serving main center or subcenter.

2.12 Announcement Trunk Circuit—The facilities necessary to connect an announcement trunk to the bus bar of a main center or subcenter. It provides an impedance match between the bus bar and the trunk, and it usually includes the signaling and supervision features and idle circuit termination if used. It determines the return loss seen by the trunk circuit on toll connections.

2.13 Manual or "Live" Announcement—An announcement made directly into the announcement system by a speaker using a microphone or a telephone at the contol point.

2.14 Recorded Announcement—An announcement made by recorder-reproducer equipment at the main center. The recording is made by an announcer at the control point and is reproduced automatically whenever a subcenter is connected to the announcement system.

2.15 Bus Bar—The point in a center which is the common connection for all subcenter trunks and announcement trunks.

2.16 Volume—An indication of the strength of voice signals as obtained on a VU meter and measured in volume units. It is obtained by noting a mental average of the highest 5 or 6 peaks in a speech of 3 to 10 seconds duration. Occasional high peaks are ignored. The arithmetic average of 4 to 10 individual readings, obtained as above, is the speech volume.

2.17 Bus Bar Level—The level of the announcement as indicated across the bus bar with VU meter. Such indications are ***only*** meter readings and ***neither VU or db,*** because the bus bar usually has ***low impedance.*** When the bus bar level is stated at a main center, it is understood to include a variation of ± 3 VU; when specified at a subcenter, it is understood to include a variation of ± 5 VU, due to cumulative variations in the announcement system.

2.18 Bus Bar Impedance—The impedance seen between the tip and ring of the bus bar. It is made up of the amplifier output impedance, and permanent terminations such as subcenter trunk circuits and shunting resistors. It may also include the cumulative effect of announcement trunk circuits in use or using idle circuit terminations or pads with shunt elements.

2.19 Talk-Through Loss—The loss between any two announcement trunks connected to the bus bar. Total talk-through loss between two subscribers would include the losses in the connected announcement trunks and subscriber lines.

2.20 Regulations—The variation in bus bar level with change in load. It is usually specified as the difference in level between no-load and full-load conditions.

3. LIMITATIONS ON TANDEM CENTER ARRANGEMENTS

3.01 The three general types of announcement systems are (a) Telephone Company sponsored general purposes, (b) Telephone Company sponsored intercept, and (c) subscriber sponsored. Telephone Company sponsored general purpose announcement systems may require only a main center, or they may also use several subcenters and tandem centers with subcenters to provide service. A typical arrangement is shown in Fig. 1.

3.02 Announcement systems used for intercept services may have the same arrangements as in Fig. 1. The centers will connect to intercept trunks, overflow trunks, etc, instead of subscriber lines, but the transmission problems are similar.

3.03 Subscriber sponsored systems may provide announcements from the customer's premises. A typical arrangement is shown in Fig. 2. The system capacity is limited primarily by the number of lines the subscriber is willing to pay for, and tandem arrangements are not provided because of the supervision and signaling arrangements.

3.04 The subscriber may contract for an arrangement similar to Fig. 3, with the announcement

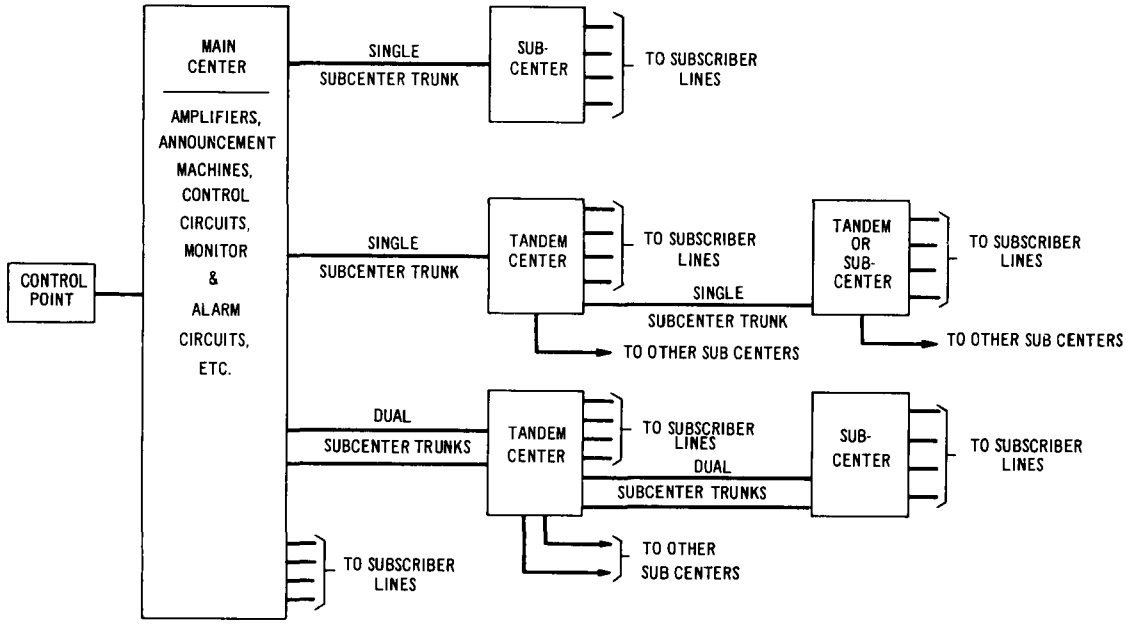


Fig. 1—Typical Tandem Arrangement—Telephone Company Sponsored General Announcement Systems

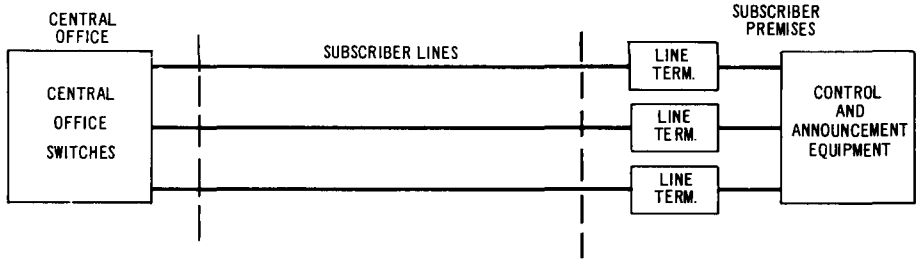


Fig. 2—Typical Arrangement Subscriber Sponsored System with Announcement from Subscriber's Premises

equipment located in a central office. There may be a main center only, or a main center and several subcenters, depending on the subscriber's requirements. The transmission requirements for these systems are the same as for Telephone Company sponsored systems.

3.05 The number of subcenter trunks that can be connected in tandem is shown in Table III. The limitations are primarily due to transmission limitations of the trunks. More details are to be found in Parts 7 and 8.

3.06 The number of subcenters that can be operated from a main or tandem center will depend on the number of subscribers that can also be connected and the regulation inherent in the particular system. Regulation is discussed in Part 4C. Practices on individual systems should be consulted for specific information.

4. BUS BAR ANNOUNCEMENT LEVEL OBJECTIVES

A. Central Office

4.01 Bus bar levels in central office main centers and subcenters should be sufficient to deliver a level of −18 VU into subscriber loops at the far end of local, tandem, or toll trunks. Figure 4 shows the method of converting bus bar levels to announcement trunk input levels. It assumes that the bus bar is a constant voltage source. Some of the early design announcement systems have adjustable resistors in the announcement trunk circuit. They can generally be strapped to provide announcement trunk levels of −18 VU with a bus bar of 0 VU. Other systems use resistors selected to provide a good impedance match to the trunk circuit. They may also include a pad to isolate the bus bar from the trunk. In these arrangements, the objective is generally to provide the required level into the trunk without exceeding 0 VU at the bus bar.

4.02 Figure 5 provides a nomograph for easy translation of bus bar levels to announcement trunk levels. For example, assuming an announcement trunk with a loss of 4 db and with an impedance ratio of 5, a −14 VU level into the announcement trunk is produced when the bus bar level is 0 VU. The level at the far end of the announcement trunk will be −18 VU as required.

4.03 Some existing announcement systems exceed the 0-VU bar level and the −18 VU announcement trunk level. It is desirable to review the transmission design of these systems and modify them whenever possible. This may be conveniently done when rearranging or expanding the system.

B. Subscriber's Premises

4.04 Objective levels for annoucement systems having main centers on the subscriber's premises are based on somewhat different criteria. The announcement levels should be at least equal

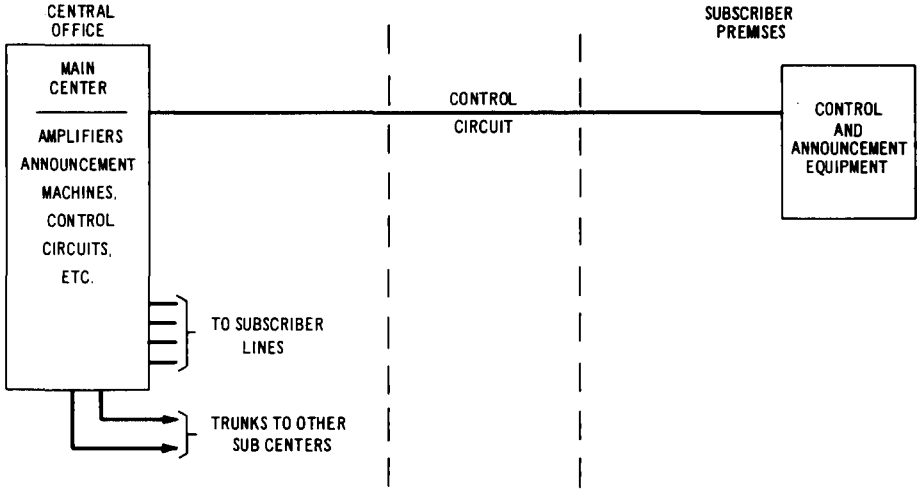
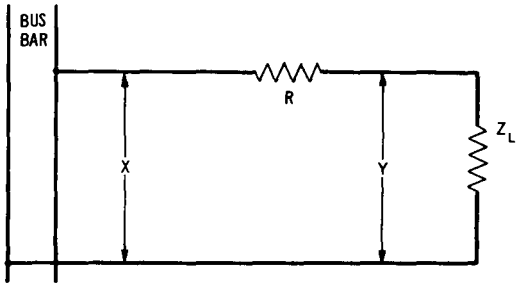


Fig. 3—Typical Arrangements Subscriber Sponsored System with Announcement from Central Office

TABLE III

TANDEM TRUNK ARRANGEMENT	NUMBER OF TRUNKS IN TANDEM
Single	4
Dual	2



R = SERIES RESISTANCE IN ANNOUNCEMENT TRUNK CIRCUIT

Z_L = IMPEDANCE OF CONNECTED ANNOUNCEMENT TRUNK

Y = VOLUME LEVEL INTO ANNOUNCEMENT TRUNK

$X = Y + 20 \log_{10} \frac{R + Z_L}{Z_L}$

* Neglecting phase angle of load

Fig. 4—Conversion of Bus Bar Level to Announcement Trunk Level

to or better than the levels found on average telephone connections. The levels on the loop should not exceed −8 VU at the subscriber's premises, and they should not be lower than about −15 VU at the serving central office.

4.05 In a specific system, where the loop losses are known, the required input to the loop can be determined readily, and then the bus bar level can be established. An example is shown in Fig. 6. A 6-db level reduction in the announcement trunk circuit is assumed.

C. Regulation

4.06 Various regulation schemes are used. They consist of amplifier gain controls, bus bar impedance control, idle circuit terminations, etc. The means used in specific systems are discussed in the appropriate sections.

4.07 Some systems use loading formulas to prevent excessive regulation. These should be carefully followed. In systems using idle circuit terminations, calulation of regulation should not be necessary. When the system does not use idle circuit terminations, regulation can be computed approximately as in Fig. 7. Regulation should generally be held within 3 db. For tandem centered arrangement, overall regulation should not be more than 5 db.

5. RETURN LOSS

5.01 Return loss of announcement system terminations should be considered. It is particularly important in intercept systems where toll calls are terminated. The return loss requirement will depend on the balance requirements for the office in which the equipment is located. In a class 3 or higher office, for example, the requirement is 27 db.

5.02 Systems designed to terminate traffic in toll offices usually have announcement trunk circuits with resistive impedances near the nominal impedance of the office. They should be capable of high return losses. DBO capacitors should be installed, as required, and return loss tests made to insure that the office requirements are met.

5.03 Older-type systems with high impedance or unbalanced announcement trunk circuits should be located only in local offices where the return loss requirement is not so high. It is the practice in modern systems to build out the bus bar impedance with series resistance in the announcement trunk circuit to give good return loss to the connected trunk.

6. TALK-THROUGH DESIGN

6.01 Talk-through loss should be kept high to restrict one subscriber from talking to another through the common connection. In addition to the suppression of unwanted voice signals, talk-through loss provides noise suppression.

6.02 Talk-through design is essentially a matter of keeping bus bar impedance low in comparison to the impedance of each subscriber line. Talk-through loss can be calculated approximately as in Fig. 8. A conversion table is provided in Fig. 9. A separate entry is made for each part of the problem. The worst condition will exist when only two subscriber line circuits are connected, or one line and one trunk. Under these conditions, the bus bar impedance will be maximum.

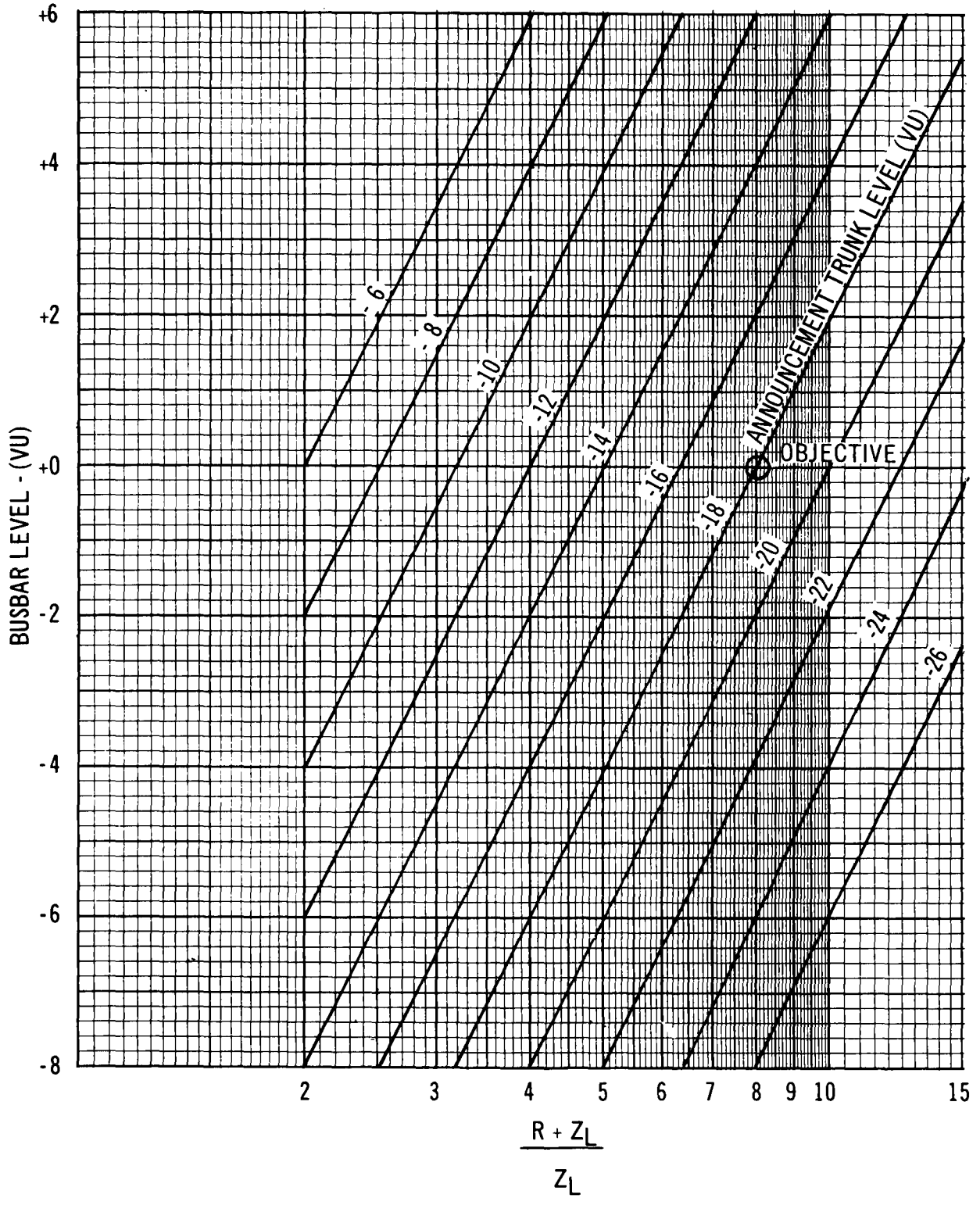


Fig. 5—Nomograph for Conversion of Bus Bar Levels to Announcement Trunk Levels

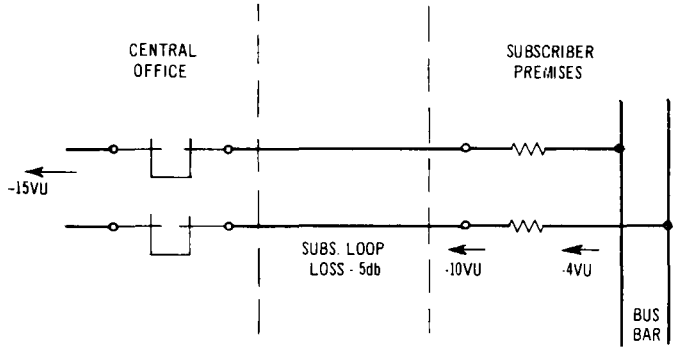


Fig. 6—Computation of Required Bus Bar Level

6.03 For example, assume 600-ohm lines, with 600-ohm series resistors in the line circuits and a bus bar impedance of 1.5 ohms. The first ratio needed is 401 and the second ratio is 2. Entering Fig. 9 with these ratios, two loss values are found, 52 db and 6 db. The talk-through loss is, therefore, about 58 db between the lines.

6.04 When announcement trunk circuits are bridged and brought to the bus bar on common wiring, the wiring resistance becomes extremely important. It increases the apparent bus bar impedance as shown in Fig. 10, decreasing talk-through loss. Common wiring resistance should be kept within one ohm, and less if possible.

6.05 Talk-through loss between subscriber lines and subcenter trunks should also be high. This will prevent chance remarks or noise from subscriber lines being heard throughout subcenters fed by the trunks. Figures 6 and 7 can be used, if the resistance of the outgoing trunk is used in the formula.

6.06 Talk-through loss should be sufficient to reduce peak signals from short subscriber loops to acceptable message noise levels. In general, it should be 50 db or better.

7. SUBCENTER TRUNK DESIGN

A. General Requirements

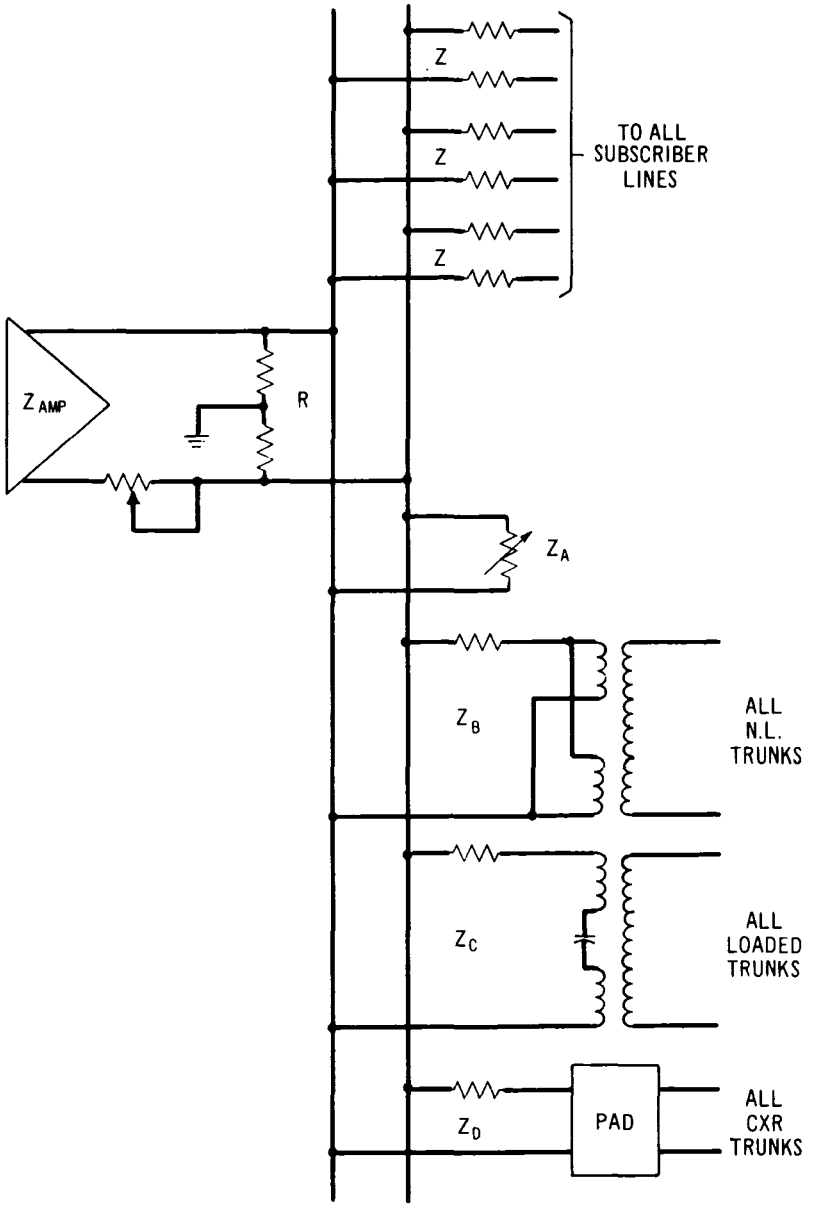
7.01 Allowable trunk losses are limited by input levels, terminating amplifier gains, and noise. Noise is a problem particularly during quiet intervals in the announcement cycle. If the bus bar is not shorted during recycle, any noise in the system will be quite noticeable. The recorder-reproducer and amplifier at the main center are generally designed for signal-to-noise ratios on the order of 35 db or better. To maintain signal-to-noise ratios of this order throughout the announcement system, it will be necessary to restrict losses in the subcenter trunks to about 12 db. Steady noise should be measured at the receiving end of subcenter trunks and related to the expected received voice levels to insure that good S/N ratios are maintained.

7.02 Subcenter trunk facilities should meet the structural return loss requirements that are standard for facilities used as toll-connecting trunks. The rules for load spacing, bridge tap, build-out, etc, should be observed. Loaded and nonloaded cable pairs as well as short-haul carrier channels may be used.

7.03 A nominally flat frequency response over the voice-band is desirable. The objective is a maximum frequency roll-off of about 8 db at 3000 cycles compared to 1000 cycles. For the single channel system, with the maximum of four trunks in tandem, the roll-off is restricted to 2 db per trunk. These objectives are shown in Fig. 11. They will be difficult to meet, and some carrier channels will not meet the requirements. Facilities should be chosen carefully to attain the objectives as closely as possible. Consideration should be given to the use of Schedule C program channels in short-haul carrier systems.

7.04 When dual subcenter trunks are used, the number of trunks in tandem is reduced to two because the combining of signals at the tandem center or subcenter tends to increase the roll-off. Dual trunks will usually be assigned to different trunk groups for increased reliability, but they must be the same electrical length so the voice signals will not be reduced when combined at the tandem center or subcenter. This means that both trunks must use the same ***type*** of facility.

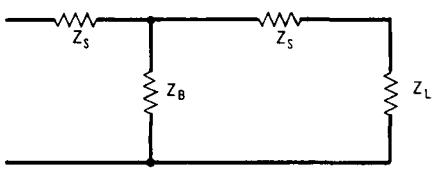
7.05 The electrical lengths of dual subcenter trunks can be compared approximately by computing their absolute delays. This can be done using the information in Section AB27.401.1. A method of checking the degree of match is shown in Fig. 12. When dual trunks are matched in this fashion the roll-off of the combination at 3000 cycles as compared to 1000 cycles should not be more than 2 db greater than the roll-off of either individual trunk as measured separately.



PROCEDURE:

1. COMPUTE Z FOR EACH TYPE OF TRUNK. NEGLECT PHASE ANGLE FOR AN APPROXIMATION. USE NOMINAL VALUES.
2. DIVIDE EACH VALUE BY THE NUMBER OF IDENTICAL TRUNKS.
3. COMPUTE FIXED IMPEDANCE ACROSS BUSBAR FROM:
   $$\frac{1}{Z_F} = \frac{1}{Z_A} + \frac{1}{Z_B} + \frac{1}{Z_C} + \frac{1}{Z_D} + \frac{1}{R} + \frac{1}{Z_{AMP}}$$
4. COMPUTE Z OF ONE SUBSCRIBER LINE. USE A NOMINAL IMPEDANCE VALUE FOR LINE. NEGLECT PHASE ANGLE.
5. COMPUTE Z_L FOR ALL SUBSCRIBER LINES BY DIVIDING RESULT OF STEP 4 BY NUMBER OF LINES.
6. COMPUTE BUSBAR IMPEDANCE FROM:
   A. $\frac{1}{Z_T} = \frac{1}{Z} + \frac{1}{Z_F}$ FOR ONE LINE
   B. $\frac{1}{Z_T} = \frac{1}{Z_L} + \frac{1}{Z_F}$ FOR FULL LOAD
7. REGULATION WILL BE APPROXIMATELY
   $$R = 10 \log_{10} \frac{A}{B}$$

Fig. 7 – Computations of Bus Bar Impedance and Regulation



Z_S = SERIES IMPEDANCE OF INCOMING TRUNK CIRCUIT
Z_B = BUSBAR IMPEDANCE
Z_L = IMPEDANCE OF CONNECTED LINE
NEGLECTING PHASE ANGLE, TALK-THROUGH LOSS IS:

$$L\ (db) = 20\ LOG_{10}\frac{Z_S + Z_B}{Z_B} + 20\ LOG_{10}\frac{Z_S + Z_L}{Z_L}$$

Fig. 8—Computation of Talk-Through Loss

B. Nonloaded Cable Facilities

7.06 Nonloaded cable pairs may be used for subcenter trunks, but some improvement of frequency response is needed. A method of termination is shown in Fig. 13. At low frequencies the drop sides of the coils approach low values of impedance, while the line sides of the coils tend to rise because of the series capacitors. This mismatch at the low frequencies tends to flatten out the low-frequency response of the circuit. The resistor at the main center protects the bus bar from being effectively shorted at low frequencies, and the resistors at the subcenter end maintain the impedance match to the amplifier input.

C. Loaded Cable Facilities

7.07 A typical method for termination of loaded cable pairs is shown in Fig. 14. The coil is strapped at the main center to match the circuit approximately to the combined impedance of the bus bar and the series resistor. Capacitors are used only on the line sides of the coils to increase losses at low frequencies and improve the loss-frequency characteristics.

D. Carrier Facilities

7.08 Short-haul carrier channels may be used for subcenter trunks. A method of connection is shown in Fig. 15. The resistors provide an impedance match between the bus bar and the carrier channel. The pad is necessary to provide suitable levels to the carrier. Input levels to the carrier should be about 12 db below the carrier lineup levels. For example, with a channel lined up with a −16 dbm tone, if the announcement level into the pad is −6 VU, the pad should be selected to provide 22 db of loss. If the channel were aligned to provide +7 dbm at the channel output, the voice level to the amplifier would be −5 VU.

7.09 When dual carrier channels are used, both channels should be the same type of carrier facility, and not more than two trunks should be connected in tandem. Some precautions that must be observed with carrier system are:

(a) O, ON and N systems—Only the middle frequency channels should be used. Any T1 carrier channel can be used.

(b) The difference in number of repeater sections should be limited to zero for O carrier, three for ON or N, and six for T1.

8. CONTROL CIRCUIT DESIGN

8.01 Control points for telephone company sponsored systems will normally be in the same building as the main center. Transmission design should be in accordance with requirements for the specifc system. This is also true of customer sponsored systems when the main center is on the customer's premises.

8.02 When a system is installed with the main center in a central office and the control point on a subscriber's premises, the control circuit should meet the requirements for PBX trunks. Bridge tap should be removed and good exchange loop design should be used.

9. SUBSCRIBER LOOP DESIGN

9.01 When announcement systems use main centers located on a subscriber's premises, the subscriber's loops should meet PBX trunk design requirements. Bridge tap should be removed, and good exchange loop design should be used.

9.02 Since the same message may be simultaneously fed over several pairs in a common exchange cable, crosstalk should be considered. Nonstaggered twist cable should be avoided and crosstalk calculations should be made in accordance with Section 852-100-101.

10. NOISE AND CROSSTALK

10.01 Noise will generally not be a problem if recorder-reproducers and amplifiers are

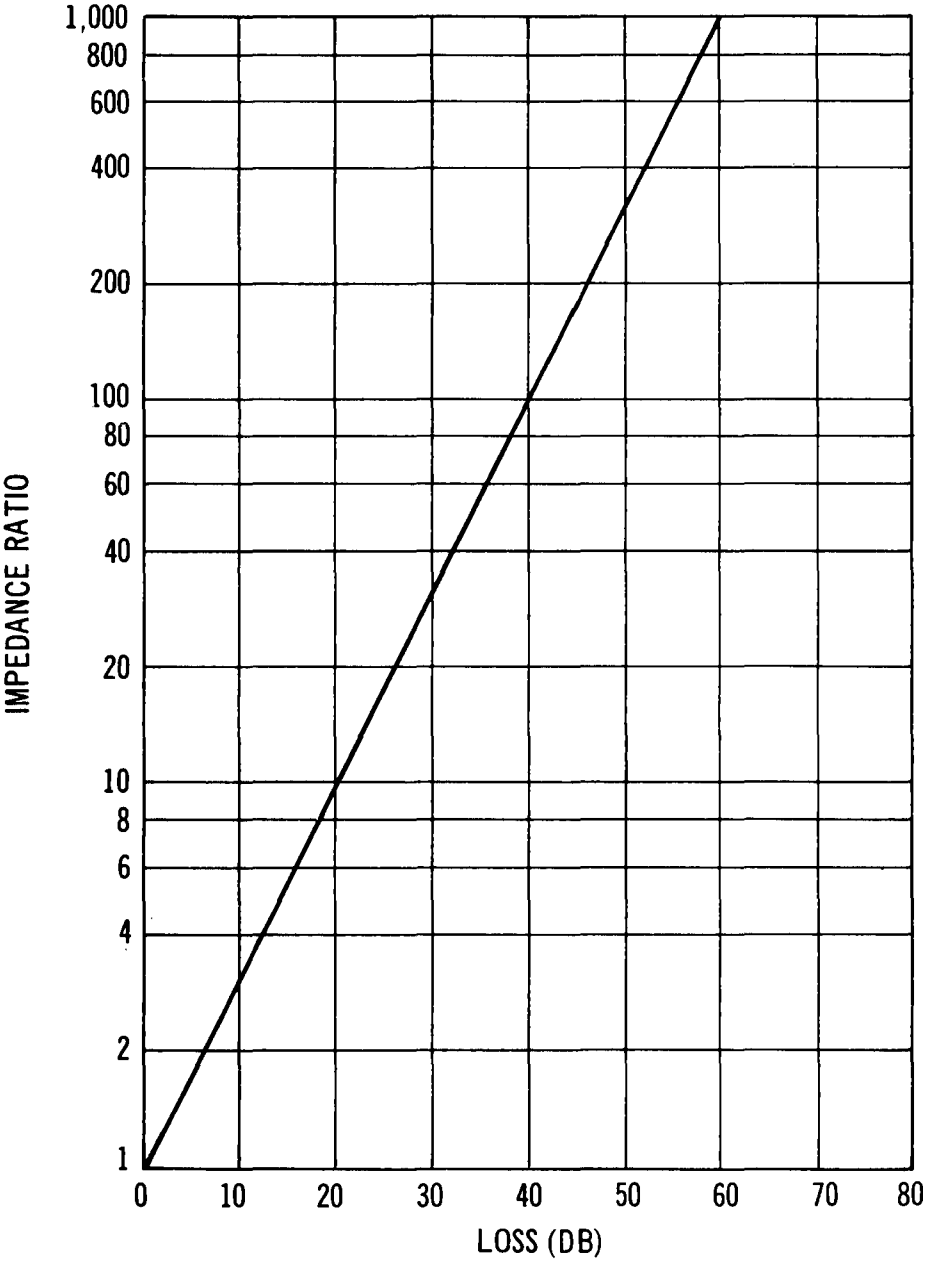


Fig. 9—Conversion of Impedance Ratio to Loss (Line-to-Line or Line-to-Trunk)

maintained in good condition. Also, subcenter trunk losses should be controlled as discussed in Part 7.

10.02 A 35-db signal-to-noise ratio throughout the system should provide good performance. This can usually be checked by measuring the steady noise at low level points in the system and relating the noise levels to the voice levels at that point. A 3A NMS with C Message weighting should be used.

10.03 Crosstalk should not be a problem if objective voice levels are not exceeded. Nonstaggered twist cables should be avoided when assigning announcement trunks and subcenter trunks. Where a substantial number of trunks is concentrated in a single cable, it would be advisable to make

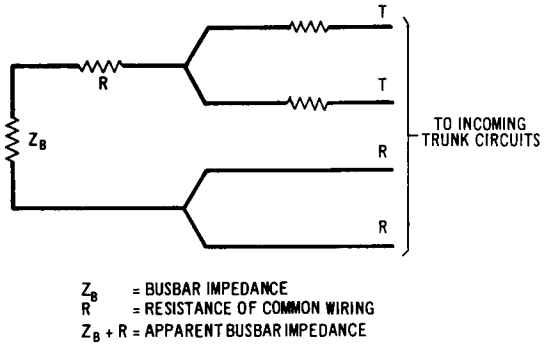


Fig. 10—Effect of Common Wiring on Bus Bar Impedance

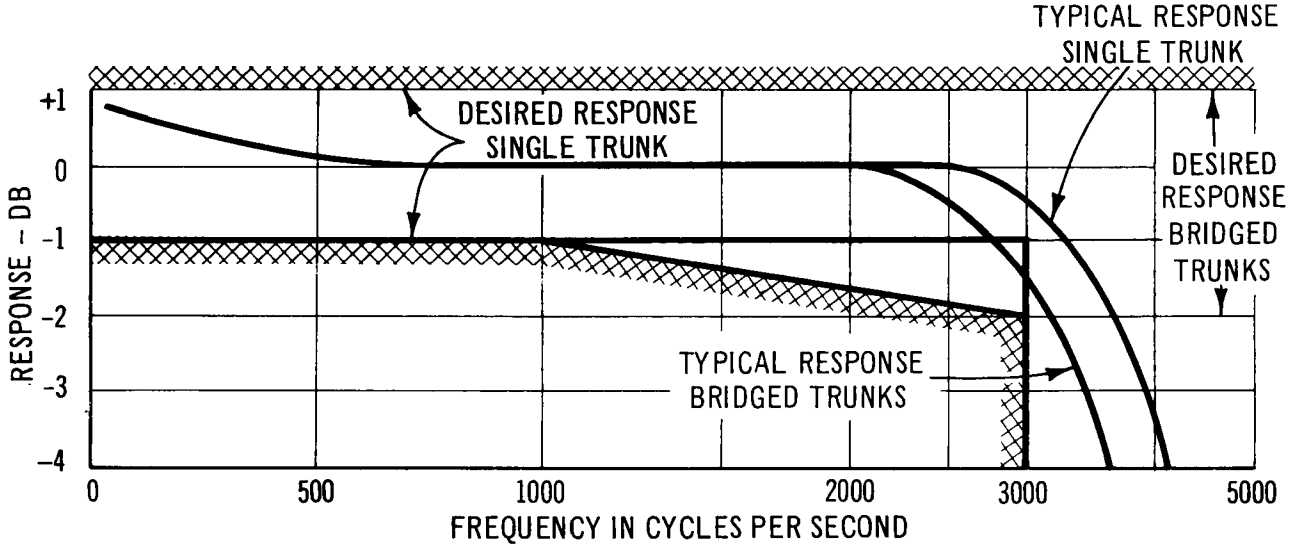
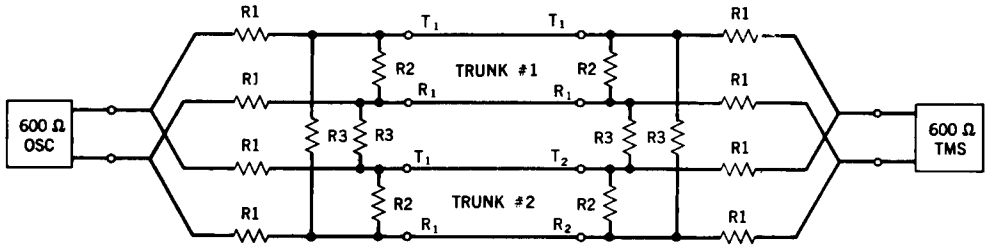


Fig. 11—Desired Frequency Response Subcenter Trunks

crosstalk calculations in accordance with Section 852-100-101.

10.04 Crosstalk may occur in systems which have the main center on a subscriber's premises. Simultaneous announcement into serveral pairs of a subscriber cable may interfere with other services in the cable. Nonstaggered twist cable is also more likely to be found in the connecting loops. Crosstalk computations should be made in these situations and, if crosstalk is likely, it may be necessary to recommend a remote control system.



RESISTOR	VALUE	TYPE
R1	422	WE221A
R2	2050	WE145A
R3	1450	WE145A

Fig. 12—Test Arrangement for Dual Trunks

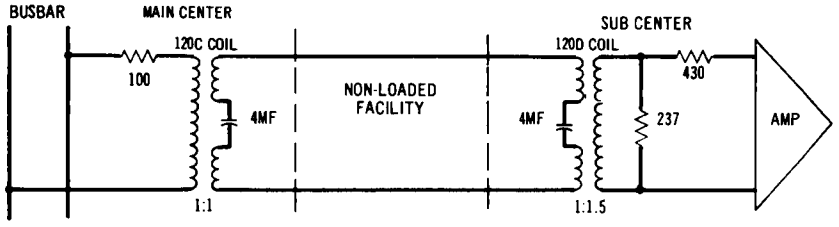


Fig. 13—Termination of Nonloaded Cable Pair

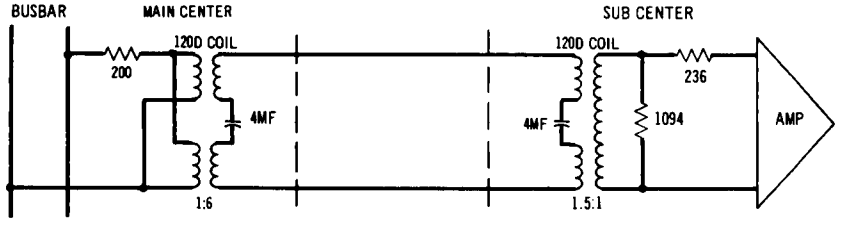


Fig. 14—Termination of Loaded Cable Pair

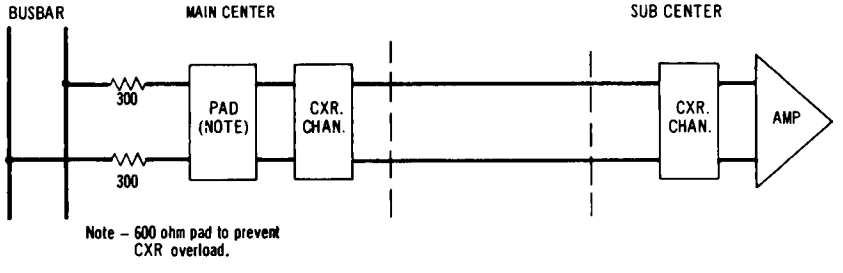


Fig. 15—Termination of CXR Channels