

DATA LINE SWITCHING PLAN
VOICE BAND WADS TRUNKS
CIRCUIT ORDER, ROUTINE, AND TROUBLE TESTING

CONTENTS	PAGE
1. GENERAL	1
2. PRELIMINARY TESTING	2
3. ATTENUATION EQUALIZATION	2
4. NOISE REQUIREMENTS	8
5. 17B (MODIFIED) TOLL TEST BOARD	9
6. ROUTINE MEASUREMENTS	12

1. GENERAL

1.01 This section specifies the initial circuit order, routine and trouble investigation tests to be made on one way and two way full voice bandwidth trunks for WADS service. Issue 2 covers in more detail, the alignment of "Data Only" trunks, and changes the losses and levels involved with -13 and +4 db level offices.

1.02 Three general types of trunks are covered in this testing procedure. These may be between WADS offices, between a WADS office and a 6A Switchboard and between a WADS primary office and a DDD telephone message office for the inter-connection of WADS and TWX customers. These three types of trunks and the usual arrangement of incoming and outgoing trunk circuits are shown in FIGURES 1, 2 and 3.

1.03 This section assumes the use of a modified 17B toll testboard as described below for the testing of all WADS trunks. These testboards are arranged and intended only for WADS service, as the testing levels and impedance requirements differ from those required for inter-toll message circuit testing.

1.04 Trunks between WADS offices will be tested and aligned at the F2M (Mark) frequency of 2225 cycles. Measurements at other

frequencies, as covered below, will also be made for equalization and other purposes.

1.05 Trunks between WADS offices will have a nominal loss at 2225 cycles of 8 db measured between 17B testboards. This loss includes the 3.7 db pad and the 1.5:1 ratio transformer combination at both ends of the circuit and a 0 db loss for the trunk itself. These pads are introduced by the trunk circuit equipment whenever the connection originates or terminates at either a primary or secondary office but are omitted at WADS primary offices on a trunk to trunk switch. Two four db pads are also included in the intra-office trunk circuit (see Fig. 1) so that the same 8 db overall loss is obtained on a local connection between two WADS customers served from the same WADS office.

1.06 Trunks between the #5 WADS office switches and the 6A switchboard may be short trunks in the building to a local switchboard or may be long circuits of inter-toll type facilities where the office is served by a remote switchboard.

1.07 These switchboard trunks will also be aligned and tested from the 17B testboard, at the F2M frequency of 2225 cycles. Jacks provided at the switchboard end will permit the use of portable transmission testing equipment at that end.

1.08 These trunks to and from the 6A switchboard will encounter the usual 4 db pad at the WADS office on originating or terminating connections. The pad is omitted in the line link frame appearance of the trunk circuit used in a trunk to trunk connection.

1.09 In addition to the usual WADS 4 db terminating pad the switchboard trunks are built out by other pads to a total loss (facility plus pad) of 4.0 ± 1.0 db at 2225 cycles from the switchboard to the line link appearance

SECTION 314-016-301

(8 ± 1.0 db from switchboard to trunk link appearance) for originating and terminating connections. These building out pads are shown as Fig. 3 of SD-95756-01. Each Fig. 3 unit has a loss of 2.0 db and these should be wired into the trunk circuit as needed to give the over-all loss required.

1.10 No attenuation equalization will be required on the switchboard trunks to 6A boards.

1.11 WADS "Data Only" trunks from DDD to WADS primary offices (See Fig. 3 Trunk Types D1 and D2) and from WADS primary and secondary offices with 6A switchboards to DDD offices (See Fig. 3 Trunk Type DOS) will be lined-up and measured over-all at F1S (1070 cycles) or 1000 cycles. These trunks will be tested and maintained at the WADS 17B test positions. Trunks which may be used for both telephone and data traffic from WADS primary and secondary offices to DDD offices (See Fig. 3 Trunk Type DO — Loop and DO — E & M) will be lined-up and measured overall at 1000 cycles. These trunks will be maintained at test locations along with other DDD trunks, and are not covered in this practice. The over-all loss of the above trunks, shown on Fig. 3, will depend on the class of DDD office and type of traffic handled. Trunk losses and levels should be adjusted from circuit order information.

2. PRELIMINARY TESTING

2.01 Before proceeding with initial line-up tests of WADS trunks, certain preliminary tests should be made on the facility components to be used. This testing is covered only briefly here but the tests should be made in accordance with the standard applicable sections using the same limits that would be used for the facility if used in telephone message service.

2.02 *DC Tests of Cable and Open Wire Pairs.* Facilities to be used in the voice frequency portions of trunks should be checked for continuity, loop resistance, insulation resistance and resistance unbalance.

2.03 *Voice Frequency Repeaters.* Repeaters and associated equipment used on voice frequency WADS trunks, or VF extensions on carrier trunks should be tested in accordance with

the standard sections for telephone service, and gain adjustments made as specified in circuit order information.

2.04 *Carrier Channels.* Carrier channels to be used in WADS trunks should be tested in accordance with standard carrier maintenance instructions and the channel levels adjusted as for telephone service at -16 db and $+7$ db points at 1000 cycles. (Or -13 and $+4$ db if standard in the particular toll office)

2.05 *Carrier Channel Noise.* Noise on types N or ON carrier channels should meet requirements for telephone message service. Where special service channel units are used, noise should be measured in accordance with Section 362-330-504. This noise measurement is on the carrier channel alone as a pre-lineup measurement. Over-all noise measurements and requirements are covered below after line-up and equalization of the over-all circuit.

2.06 *Office Balance Adjustments.* All NBO and Drop BO adjustments in both terminating offices should be completed before initial line-up tests are started on particular trunks. Balance procedures for WADS offices are covered in Section 314-016-515.

3. ATTENUATION EQUALIZATION

3.01 Echo and noise considerations require that the loss of WADS trunks at the F1S (F1 Space) frequency (1070 cycles) be within -1.0 db to $+2.0$ db of the loss at the F2M (F2 Mark) line-up frequency of 2225 cycles for the over-all WADS trunk. In order to meet this requirement, attenuation equalizers will have to be used on many of the circuits between WADS offices. The loss of "Data Only" trunk types D1, D2 and DOS to DDD Class 1 and 2 offices at 2225 cycles should be within ± 2 db of the loss at the lineup frequency of 1070 cycles or 1000 cycles.

3.02 This section covers the line-up procedure required on equalized trunks and the test measurements to be made. Details of the equalizers used, and the adjustment of these units to obtain the amount of equalization required, are covered in Section 314-016-125.

3.03 For equalization and line-up purposes the facilities making up the trunk should be divided into three parts. The voice frequency extensions between the WADS office and the carrier terminal location, the carrier facilities, and the voice frequency extensions at the far end. These two voice frequency extensions may be extremely short where the carrier terminal is in one of the two WADS terminal offices, or may contain considerable length of loaded or non-loaded cable facilities. The voice frequency extensions, when long enough to require equalization, are in general equalized with 359A type equalizers for loaded facilities and 359B types for non-loaded facilities. Types 359G and 359H equalizers are used for carrier facilities. These equalizer networks are associated with 227 amplifier units in various 44V4 repeater shelf arrangements. Details of the equipment arrangements and shelf details are covered in Section 314-016-125. Equalization of voice frequency and carrier sections is done at the receiving end of the facility.

3.04 Correction for envelope delay distortion on WADS trunks may be required in the future with the addition of B1 data carrier equipment. It is not contemplated that any envelope delay correction will be required on the voice bandwidth trunks.

3.05 As noted above, the reference frequency for the lineup of all WADS trunks (except "Data Only" trunks) will be the F2M frequency of 2225 cycles. All carrier facilities, however, used in the trunks will continue to be lined up in the usual way using 1000 cycle losses and standard office levels. Equalization of the carrier channels will be done outside the voice frequency patch bay terminals of the carrier channels. Slope adjustment of these equalizers will be made by measurements thru the carrier channels at the F2M and F1S frequencies of 2225 and 1070 cycles.

3.06 A typical step by step equalization procedure for a WADS trunk is given below. Reference is made here to levels, test point and jack details shown in Figures 4 and 5. The typical WADS trunk is assumed to be made up of one or more carrier sections, known as the carrier facility, and voice frequency extensions, from each end of the carrier facility to the circuit terminals, known as the voice frequency ex-

tensions. It is assumed in the lineup procedure that the carrier facility requires equalization and that both VF extensions are long enough to require equalization and the equalization procedure in this section is set up accordingly.

3.07 In the actual engineering and assignment of WADS trunks it is recognized that there will be cases where the carrier facility or the voice frequency extensions (if present) will not require equalization, or where because of DDD network requirements (the "Data Only" trunks) the required over-all losses may vary from the typical trunk covered in detail in this section. In these cases the lineup and equalization method of this section should be followed as closely as possible and adjusted for the particular trunk requirements as specified in the circuit order information.

3.08 In the following procedure, measurements are specified at a particular equalizer jack appearance. In the case of circuits where this particular equalizer is omitted, this jack will, of course, not exist. In these cases the measurements required into adjacent sections should be made at the same levels at jack access points as nearly as possible equivalent to the point intended. In all cases the test levels, section losses, and equalization requirements shown in Figure 4 should be adhered to as closely as possible. The over-all measurements and requirements for F2M and F1S covered in Step 6 should be applied regardless of the equalization used in the component sections.

EQUALIZATION PROCEDURE

Step 1. CARRIER CHANNEL LINEUP

Step 2. CARRIER CHANNEL EQUALIZATION

Step 3. VF EXTENSION EQUALIZATION — Near End

Step 4. VF EXTENSION EQUALIZATION — Far End

Step 5. TRANSMITTING-RECEIVING PAD ADJUSTMENT

Step 6. OVER-ALL MEASUREMENT

Step 1 — CARRIER CHANNEL LINEUP

As covered in Par. 3.05 the carrier section or sections should be lined up between VF patch bays to standard 1000 cycle levels in both directions of transmission. The loss at the SF signal-

↑ ing frequency measured between the terminal VF patch bays, should be within ± 4 db of the 1000 cycle measurement. The WADS lineup is based on a 23 db gain for the carrier section. In the case of -13 and $+4$ db offices the over-all channel gain is 17 db and an additional flat gain of 6 db should be provided to permit a standard lineup at the WADS test frequencies for the over-all circuit. This additional 1000 cycle gain may be obtained as follows. The 849C network in the transmitting carrier attenuation equalizer, (in both directions) should be replaced with a 227 type amplifier. This amplifier should be adjusted to a gain of 3 db at 1000 cycles by measurement between AMP 1 "IN" and "OUT" jacks after the 227 unit has been plugged in place. The other 3 db required will be obtained in Step 2 by the adjustment of the 227 amplifier in the ↓ receiving carrier equalizer.

Step 2 — CARRIER CHANNEL EQUALIZATION

↑ After the 1000 cycle lineup of the carrier facilities covered in Step 1, the section is adjusted and equalized at the F2M and F1S frequencies by measurements between the carrier equalizer jacks in offices B and C (see Figs. 4 and 5). (If the additional 227 type amplifiers required in -13 db offices are to be used they should now have been adjusted for the 3 db gain covered in Step 1 above.) Test levels shown below are based on -16 and $+7$ db standard levels at the carrier equalizer jacks. For -13 and $+4$ db offices that are not changed to -16 and $+7$ db, as discussed above, the test levels should be changed from -28 dbm to -25 dbm for -13 db offices and from -5 dbm to -8 dbm for ↓ $+4$ db offices.

a. To determine the amount of carrier equalization required, **replace the 359G equalizer unit in the receiving carrier equalizer in office C with a 359E unit. If a 359H equalizer is assigned instead of the 359G (as will be the case on ON type carrier lower sideband channels) it should be replaced with a 359C unit for this test.**

b. In office B, send into the AMP "IN" jack of the carrier equalizer a test tone of 2225 cycles at a level of -28 dbm.

c. In office C, measure the level received at the receiving AMP "OUT" jack of the carrier equalizer and adjust the 227 receiving amplifier to give a level of -5 dbm.

d. Repeat b and c above with a test tone of 1070 cycles at the same transmitting level of -28 dbm. Without changing the receiving amplifier gain adjustment, record the F1S (1070) level received at office C. The F1S level should be -6 dbm. The difference in the received levels of F1S and -6 dbm is a measure of the equalization required.

e. **Replace the 359G (or 359H) equalizer unit in office C as originally assigned.**

f. Refer to the appropriate part (Fig. 11 or 12 and Table A or B) of Section 314-016-125 and set the screw adjustments of the receiving 359G or 359H equalizer in office C. (For illustration, also refer to the example in Part C of the above Section).

g. Repeat measurements at 2225 and 1070 cycles (steps b, c, and d, above) and adjust the 227 receiving amplifier, as required. When properly equalized, and the receiving amplifier gain properly adjusted, the F2M tone (2225) should be received at a level of -5.0 dbm and the F1S (1070) tone at a level between -5.5 and -7.0 dbm.

Note: The above requirement assumes that the nominal 1000 cycle levels of the carrier section between terminal VF patch bays is exact at the moment of lineup. If a check measurement at 1000 cycles show that there has been some drift from the standard levels, and it is not feasible to correct this at the time of the WADS lineup, the WADS levels as specified above should be offset so that when the 1000 cycle levels are corrected, the F2M and F1S levels as specified above will be obtained as closely as possible.

h. Repeat steps a thru g above in the opposite direction and adjust the receiving carrier equalizer in office B to obtain the same F2M and F1S tone levels as in step g above.

↑ i. For "Data Only" trunk types D1, D2 and DOS perform steps a thru h; however, as a final step in both directions of transmission adjust the gain of the receiving amplifier associated with the carrier attenuation equalizer to obtain a received level of -5 dbm at 1000 cps. The received level of F2M (2225 cps) ↓ should be between -3 and -4.5 dbm.

j. In the case of *trunks with non-equalized carrier sections* the requirement that the loss at F1S be within -1.0 db to $+2.0$ db of the loss at F2M (measured switch through switch) still applies. To meet this requirement the loss of the carrier section at F1S shall be within -0.1 to $+0.5$ of the loss at F2M measured between the Voice Frequency Patch Bays at the terminal WADS offices. The circuit alignment procedure must be modified as follows:

- (1) The F2M loss from the Trunk Link Frame to the EQ OUT jacks at the Voice Frequency Patch Bay shall be adjusted to 18 db (including 4 db Trunk Switch Pad loss) -10 dbm to -28 dbm.
- (2) The F2M loss from the Voice Frequency Patch Bay EQ "IN" jacks to the Trunk Link Frame shall be 13 db (including the 4 db Trunk Switch Pad loss) -5 dbm to -18 dbm.

In the case of -13 and $+4$ db offices the levels shown in A and B above should be adjusted as discussed in the first paragraph of Step 2 of this section.

Step 3 — VF EXTENSION EQUALIZATION — Near End

The voice frequency facilities making up the extensions from office A to B, and from C to D, if long enough to require equalization, should be lined up to an over-all section loss between VF equalizer test jacks, of 0 db at 2225 cycles, and 0 ± 0.5 db at 1070 cycles. For "Data Only" trunk types D1, D2 and DOS, the over-all section loss between VF equalizer test jacks should be 0 db at 1000 cps and $0 \pm .5$ db at 2225 cps. Facilities may be either loaded or non-loaded cable. For non-loaded cable, either of two equipment arrangements, shown in Fig. 5 of Section 314-016-125 are used. Equipment arrangements for loaded cable are shown in Fig. 6 of the same section. The following step-by-step procedure assumes that no prescription equalization information is available from circuit order information. If such information is available, preliminary adjustments may be made and only the final adjustment steps and the final overall measurements as specified here will be required.

Step-by-Step Procedure

(A-1) NON-LOADED FACILITIES — Using 44V4 Repeaters with L3 Shield Arrangements. (See Section 314-016-125 — Fig. 5, Upper Diagram)

- a. In office A, adjust the 227 amplifier in the transmitting VF equalizer to a gain of 15.0 db at 2225 cycles. Measure this between AMP "IN" and AMP "OUT" jacks. Send test tone at -28 dbm and adjust the amplifier output to -13 dbm.
- b. In office B, *replace the 359A equalizer unit in the receiving VF equalizer with a 359E dummy unit.*
- c. At office A, send 2225 cycles into the equalizer AMP "IN" jack at -28 dbm. Measure the received level at the office B input MON JACK associated with carrier equalizer (*block out carrier equalizer AMP "IN" jack*) and adjust the receiving amplifier associated with the VF extension 44V4 repeater in office B to obtain a level of -28 dbm.
- d. Repeat measurement in c above at 1070 cycles at the same sending level of -28 dbm, and without changing the receiving amplifier gain, record the received level at office B at this frequency. The difference in received levels of these two frequencies (2225 and 1070 cycles) is the amount of equalization required.
- e. *Replace the 359A equalizer in the office B receiving VF equalizer* (removing the 359E unit) and adjust the screws on the unit in accordance with Table C of Section 314-016-125.
- f. Repeat measurements at the F2M and F1S frequencies (2225 and 1070 cycles) to check the equalization obtained. The section should now be lined up to a loss of 0 db at F2M and 0 ± 0.5 db at F1S. That is, the received level should be -28 dbm at 2225 cycles and -27.5 to -28.5 dbm at 1070 cycles when sending at -28 dbm at office A.
- g. Repeat in the opposite direction. In this direction the transmitting level at office B should be -5.0 dbm (instead of -28 dbm). Also, the office B attenuation equalizer will be equipped with an 849-type network instead of

a 227-type transmitting amplifier. An 89AN-type resistor should be plugged into the 849 network (8.0 db loss pad). This network and the pad will give a line level of -13 dbm at the input to the VF facilities. Using the test level in this direction of -5.0 dbm, the office → A receiving requirement for the section is -5.0 dbm at 2225 cycles and -5.0 ± 0.5 dbm at 1070 cycles as measured at the office A AMP "OUT" jack.

↗ h. For "Data Only" trunk types D1, D2 and DOS perform steps a. thru g.; however, as a final step in both directions of transmission adjust the receiving amplifier associated with the VF extension 44V4 repeater (1) to receive a level of -28 dbm at 1000 cps at office B. Equalized level at F2M should be -27.5 to -28.5 dbm. (2) to receive a level of -5 dbm at 1000 cps at office A. Equalized level at F2M ↘ should be -4.5 to -5.5 dbm.

(A-2) NON-LOADED FACILITIES — Using 44V4 Repeaters with L2 and L3 Shelf Arrangements. (See Section 314-016-125 — Fig. 5, Lower Diagram)

Procedure and requirements are the same for this equipment as for the previous arrangement except for the following:

In step b., *the receiving equalizer 359G unit should be replaced for the preliminary measurement with a 359E unit.*

In step e., the screws on the (359G) unit should be adjusted in accordance with Fig. 11 and Table A of Section 314-016-125.

(B) LOADED FACILITIES — Using 44V4 Repeaters with L2 Shelf Arrangements. (See Fig. 6 of Section 314-016-125).

a. In office A, adjust the 227 amplifier in the transmitting VF equalizer to a gain of 15.0 db at 2225 cycles. Measure this between AMP "IN" and AMP "OUT" jacks. Send test tone at -28 dbm and adjust amplifier for an output level of -13.0 dbm.

b. At office B, set the screws in the LF section of the 359A or 359D unit in the receiving VF equalizer for the length and type of loaded facilities in accordance with Table D of Section 314-016-125.

c. At office A send a test tone of 2225 cycles at -28 dbm into the AMP "IN" jack of the VF equalizer. Measure the level received at the office B carrier equalizer input MON jack (*dummy plug in associated AMP "IN" jack*) and adjust the receiving 227 amplifier or 849B network in the VF equalizer for a level of -28 dbm as measured in the above MON jack.

d. Repeat step c above at a frequency of 1070 cycles at the same sending level and record the level of this frequency received at office B. The 1070 cycle level should be -28.0 ± 0.5 dbm. If this limit is not met, further adjustment of the office B receiving 359A or 359D unit should be made in accordance with Paragraph 4.05 of Section 314-016-125. After this further adjustment, repeat the above measurement.

e. Repeat steps a thru d above in the opposite direction, transmitting at the office B carrier equalizer output MON jack (*plug out AMP "OUT" jack*) and receiving at the office A AMP "OUT" jack. A transmitting test level of -5.0 dbm should be used and the 849A network in the office B transmitting VF equalizer equipped with an 89AN resistor (8.0 db loss). The received level requirements at office A are -5.0 dbm F2M and -5.0 ± 0.5 dbm F1S.

→ f. Same as Step (A-1) see par. h.

Step 4 — VF EXTENSION EQUALIZATION — Far End

↗ Lineup procedures and requirements for the VF section at the far end of the circuit, between offices C and D, are the same as for the VFE section between offices A and B covered in Step 3. Testing levels, as shown in Figure 4, should be -5.0 dbm transmitting away from the carrier terminal and -28.0 dbm transmitting toward the carrier facilities. Over-all requirements for the VF extension of 0 db at F2M and of ± 0.5 db at F1S are the same as for the corresponding near end section. For "Data Only" trunk types D1, D2 and DOS over-all requirements for the VF extension of 0 db at F1S and $0 \pm .5$ db at F2M are the same as for the ↘ corresponding near end section.

Step 5 — TRANSMITTING AND RECEIVING PAD ADJUSTMENT

↗ The basic requirement is to set the T and R pads at the circuit terminating offices so that ↘ the loss from the 17B testboard to the input of

the VF extension (*or input to the carrier equalizer if the equalized VF extension does not exist*) is 18 db transmitting or 13 db receiving. (15 db transmitting for -13 db offices and 10 db receiving for +4 db offices.)

a. At the originating 17B testboard, transmit the F2M tone (2225) at a level of -10 dbm through the 4 db testboard pad into the testboard TST jack.

b. Measure the level received at the input MON jack of the VFE, office A equalizer.

Note: Place a dummy plug in the associated equalizer AMP "IN" jack in order to isolate the amplifier (the MON jacks are hard wired and do not open the circuit in the opposite direction). Condition the "M" signaling lead of the trunk to remove the idle SF signal tone.

c. Adjust the T pad in the terminal hybrid in office A until a 2225 cycle level of $-28 \pm .125$ dbm is measured at the VFE MON jack. ($-25 \pm .125$ dbm for -13 db offices.)

Note: Office T and R pad values may have been previously assigned in circuit order information for preliminary testing. The final value of the pad used should, however, be based on the above level measurements rather than on the computed values.

d. Transmit a test signal of 2225 cycles into the output MON jack at office A at a level of -5 dbm, (looking toward the office A circuit terminal). *The dummy plug should be placed in the associated AMP "OUT" jack in the VF equalizer.*

e. *At office A replace the receiving SF signaling circuit amplifier unit with the dummy test unit.*

f. Measure the level received at the office A 17B testboard jack through the 4 db pad. Adjust the R pad in the terminal hybrid until this received level is $-18 \pm .125$ dbm ($-15 \pm .125$ dbm for +4 db offices.) (See note under step 5c).

g. *Replace the amplifier unit in the SF signaling unit and recheck the measurement.* If any deviation has occurred the SF amplifier unit should be checked, out of the circuit, in

accordance with the SF maintenance practice and adjusted for the correct gain.

h. The T and R pads at the non-control end of the circuit are adjusted in the terminal condition, in the manner described in Par. 5.08 (see Fig. 9). The T and R pads are adjusted to give a loss of 18 db (15 db for -13 db offices) toward the carrier facilities, and a loss of 13 db (10 db for +4 db offices) incoming to the test line jack. (See Fig. 4.) In those cases where the VF extension does not exist, the MON jack at the carrier equalizer should be used as the point of measurement.

i. For the "Data Only" trunk types D1, D2 and DOS the T and R pads should be adjusted in the same manner as in steps a. thru g. above except that measurements should be made at 1070 or 1000 cycles; however, the R pad is adjusted to give the assigned circuit net loss. At the DDD office end of the trunk, T and R pads are adjusted by following normal DDD office procedures.

Note 1: Always use isolating dummy plugs in the AMP "IN" jack when using the equalizer MON jack toward the line. Always replace the SF signaling circuit AMP unit with the standard KS dummy test plug before measuring thru the SF unit in the receiving direction. (See maintenance sections for SF signaling unit.)

Note 2: The circuit should now have been adjusted and equalized to meet the level and loss requirements shown in Figure 4 for WADS trunks of 8.0 db over-all loss and having equalized carrier and VF sections.

Step 6 — OVER-ALL MEASUREMENTS

The following over-all measurements are intended as a check of the adjustments made in the previous steps and **NOT** for a final adjustment of the circuit. If the over-all requirements for the F2M and F1S test frequencies given below are not met, the circuit should be broken down and the section measurements repeated to determine the "long" or "short" section rather than apply any "mop-up" adjustment on the overall circuit.

a. Originate a test call from the control office (A) 17B TTB "TST" jack through the 4 db pad to the distant office test line using the NNX-XXXX code.

TABLE I			
Permissible Deviations in DB From Specified Received Level			
TYPE OF TRUNK	LENGTH OF TRUNK IN MILES		
	0-100	101-500	OVER 500
<i>No VFE — No CXR EQZN</i> Single Link Cxr Section — Cable or Radio	0.6	1.0	1.0
<i>VFE — CXR EQZN</i> Single Link Cxr Section — Cable or Radio	1.0	1.0	1.0
<i>VFE — CXR EQZN</i> Multi-Link Cxr or Combination Cxr and VF	1.0	1.0	1.5

- b. At the 17B testboard in office A, transmit the 2225 cycle test tone at a level of -10.0 dbm.
- c. Measure the level received at the terminating office testboard jack (Office D). This received level should be -18.0 dbm. (See TABLE I for limits.)
- d. Repeat the above measurements at the F1S frequency (1070). The over-all loss of the trunk at 1070 cycles should be within -1.0 to +2.0 db of the *actual measured* loss at 2225 cycles. For example: If the F2M measured level is -18.0 dbm, the F1S level should measure between -17.0 to -20.0 dbm.
- e. Make the over-all measurement in the opposite direction of transmission. The received levels at the office A testboard should meet the same limits as in steps c and d above.
- f. For "Data Only" trunks, sending test levels at the WADS office will be -10 dbm at the originating trunk link frame at 1000 cps while at the DDD office it will be 0 dbm at 1000 cps. Received levels will depend upon assigned circuit losses. The over-all loss at F2M for trunks to DDD Class 1 and 2 offices should be within ± 2.0 db of the 1000 cps loss.
- L For trunks to Class 3, 4 & 5 DDD offices the

- over-all loss at F2M should be within -2 db
→ to +4 db of the 1000 cps loss.

4. NOISE REQUIREMENTS

4.01 Over-all noise measurements of both steady and impulse type noise should be made on all WADS trunks and trunks between WADS and DDD offices after equalization and lineup adjustments are completed. Measurements should be made from both ends of the circuit in the terminal mode.

4.02 Steady noise should be measured with a 3A Noise Measuring Set using "C Message" weighting (or a 2B NMS with F1A weighting and a 2AB AUX TRANS. TEST SET if a 3A set is not available) thru the 4 db terminal pad. Measured noise should not exceed the following values:

STEADY NOISE LIMITS	NON-COMPANDORED	COMPANDORED
3A NMS (C weighting)	36 dbrn	24 dbrn
2B NMS (F1A weighting)	30 dba	18 dba

The above value are direct noise set readings and should *not* be corrected for circuit or pad losses.

4.03 Impulse noise measurements should be made from the same terminal points used for the measurement of steady noise, except that a 6A Impulse Counter is used in accordance with Section E40.467. The "Narrow-Band" procedure as covered in Section E40.467 should be followed except that measurements should be made with **both** the 1170-cycle and the 2125-cycle weighting networks. The measured values should not exceed the following values:

MAX. COUNTS 30 MIN:	NON- COMPANDORED FACILITIES	COMPANDORED FACILITIES
20	53 dbrn	41 dbrn

These dbrn values should be set directly on the 6A counter and not corrected for circuit or pad losses. (Use the next higher value on switch S3.)

5. 17B (MODIFIED) TOLL TESTBOARD

5.01 Full voice bandwidth WADS trunks should be tested from a 17B Toll Testboard (modified for testing WADS trunks in a number 5 crossbar office). The 17B (modified) TTB is provided exclusively for the testing of WADS trunks, and no provision has been made for the combined testing of **both** WADS and DDD trunks from the same testboard position. The reason for this is that the transmission requirements (levels, impedances, etc.) of WADS trunks differ considerably from the DDD objectives, therefore, different test procedures must be employed for each type of service.

5.02 Figs. 5, 6 & 7 of this section show the schematic layout of a typical 17B (modified) TTB and its associated WADS trunk circuit. It is not the purpose of this section to describe the actual operation of the 17B TTB, since, this subject will be covered in other sections. Therefore, various cords and patch arrangements will be indicated as connections between two or more test points, however, the actual operation of keys, cord circuits, lamps etc, will be found in the section covering the operation of the 17B (modified) TTB.

5.03 WADS full voice bandwidth trunks should be aligned and tested at F2M (2225 cps) using a 19C or equivalent oscillator adjusted to a level of -10 dbm at F2M (2225 cps). *Use an external pad with the 19C to obtain correct level.* Transmission measurements at the 17B TTB (modified) should be made using the

transmission and noise measuring circuit per SD-95900-01 (modified for WADS) as shown in Fig. 6 of this section. The transmission measuring circuit per SD-95900-01 is not sufficiently accurate to measure levels as low as -28 db that are tested at the attenuation equalizer bays, therefore, a 21A TMS should be used for these measurements. Tests involving transmission measurements on "one-way outgoing", or "two-way" WADS Trunk Circuits should be made from the 17B (modified) TTB via the "TST" jack. The "TST" jack connects directly from the TTB to the "one-way outgoing" or "two-way" WADS Trunk Circuits in the "through condition."

Note: The term "through condition" refers to the mode of the trunk circuit. A WADS trunk is recognized to be in the "through condition" when the switches are arranged to pass a modulated, voice frequency, data signal through the trunk circuit without encountering the 1.5:1 transformer and 3.7 db pad that is in the trunk circuit in the "terminal condition." The "TST" jack is directly connected to the WADS trunk circuit at the line side of the terminal pad and transformer combination and its impedance is 600 ohms.

The impedance of the 17B (modified for WADS) TTB is 900 ohms. Measurements made at the "TST" jack should be at 600 ohms, therefore, it is necessary to match the impedances before accurate measurements can be made. WADS trunks are designed to operate with a 4 db loss at both ends of the over-all connection. A 3.7 db pad and 1.5:1 transformer combination (4.0 db total loss) are wired in series with the 900-ohm "IN" and 600-ohm "OUT" jacks of test pad "TP" in the "MISCELLANEOUS JACK PANEL" of the 17B (modified) TTB. Two "TP" combination pad and transformer arrangements will be located in the "MISCELLANEOUS JACK PANEL" at each TTB location. One "TP" unit must be used in series with the "test cord" whenever transmission measurements are to be made using the "TST" jack.

5.04 The "MON" jack as provided at the TTB is wired in series with two 10,000-ohm resistors which allow for "high-impedance" monitoring of the trunk circuit. Thus, it is possible to monitor signals on an associated trunk without interfering with the signal.

5.05 The "MB" jack at the 17B TTB is connected to terminals B1 and B2 of the WADS Trunk Circuit. The insertion of a short circuited plug (OS) into the associated (MB) jack will make the trunk appear busy to outgoing service. The distant TTB should be notified that the trunk will be made busy, and the distant TTB should arrange to make their trunk termination busy also. The reverse of this procedure should be applied prior to restoring the trunk to service.

↗ **5.06** The signaling jacks (SIG L & SIG D) permit access to the E and M leads of the associated trunk circuit, for testing and monitoring purposes. This circuit is arranged to operate an E & M splitting relay in the trunk circuit when a ground is applied to the sleeve of the SIG L jack at the test board.

5.07 The "MISCELLANEOUS JACK PANEL" provides a means of access to various test arrangements found in the 17B (modified) TTB. A 19C or equivalent variable frequency oscillator, located at the TTB, is employed to generate the F2M (2225 cps) at a level of -10 dbm. To send the F2M frequency via the "TST" jacks, over the WADS "one-way outgoing" or "two-way" trunk circuit, proceed as follows:

↗ (a) To establish a connection to the distant WADS 17B (modified) TTB, insert a front cord into the 900 ohm jack of the "TP" combination. Using a patch cord, patch between the "TP" 600 ohm jack and the "TST" jack. Key pulse the distant 17B (modified) TTB over the trunk using the NNX-XXXX calling code for that TTB. See Fig. 8 for jack connections.

(b) To calibrate the "OSC" OUTPUT — Use a patch cord e/w 310 plugs, patch from the "OSC" jack to the "VF" — "IN" jack on the "MISC. JACK PANEL". Operate the "CAL" key on the measuring circuit, and read the result on the "PROJECTION METER SCALE". Adjust the 19C or equivalent oscillator "OUTPUT" until the meter reads -10 dbm at F2M (2225 cps).

(c) To send F2M (2225 cps at -10 dbm) to the distant TTB — Connect the "rear test cord" to the "MEAS" jack, operate the

"TALK-MON" key to the "MON" position. Operate the "SEND-REC" key to the "SEND" position. Send F2M as long as necessary to complete the tests on the trunk circuit.

(d) To receive from a distant TTB using the same connection — Operate the "SEND-REC" key to "REC" position. Operate the "B+10" key, and read the result on the "B" scale of the "PROJECTION METER". The objective loss on the receiving end of a WADS trunk, with the sending end "OSC" set at F2M (2225 cps at -10 dbm) is -18 dbm, measured at the receiving 17B (modified) TTB. Since, it is necessary to read -18 dbm on the "B" scale of the "PROJECTION METER" the meter reading at the TTB will be $8 \pm$ the limits shown in TABLE I. Since a WADS full voice bandwidth trunk is designed to zero db net loss in the through switched mode (both ends), the measured loss between two 17B (modified) TTBs becomes the loss of the two 4 db pad and transformer combinations, i.e. 8 db. However, since a sending level (F2M) of -10 dbm is used, the received test power should be -18 dbm. The net loss on the trunk in the "through mode" is zero db.

↗ **5.08** Transmission tests on "one way" incoming WADS trunks or two-way trunks at the noncontrol terminal should be made using the NNX-XXXX jack at the 17B (modified) Toll Test Board as follows:

(a) Using spare central office equipment, establish an arrangement similar to the "loop back" circuit shown in Section 314-016-515, Fig. 14. The "loop back" circuit provides a means of access from the #5 cross bar equipment to the NNX-XXXX code jack located at the TTB. After the connection has been established it may be "held up" by placing an "off hook" signal on the "E" lead of the trunk circuit under test.

(b) To set the "T" pad in the 4-wire term. set — At the 17B TTB, adjust the OSC "OUTPUT" to -10 dbm at F2M (2225 cps). See Par. 5.07 (b) and Fig. 8. Insert the "front test cord" into the testboard NNX-XXXX jack. To send F2M to the "Equalizer Bay" or "VF Patch Bay" operate the "TALK-MON"

key to the "MON" position, and the "SEND-REC" key to the "SEND" position. Using a 21A TMS at the "Equalizer Bay" or "VF Patch Bay" (See Note 1 below) adjust the "T" pad value so that reading of $-28 \pm .125$ dbm is obtained as described in Step 5 of this section.

(c) To set the "R" pad in the 4-wire term. set
 - At the 17B TTB, with the "rear test cord" in the MEAS jack, and the "front test cord" in the NNX-XXXX jack (as described in (b) above), operate the "TALK-MON" key to "MON" position. With a 21A TMS located at the "Equalizer Bay" or "VF Patch Bay", send 2225 cps at -5 dbm. At the 17B (modified) TTB operate the "SEND-REC" key to "REC" position and read the result on the "PROJECTION METER SCALE" by operating the "B+10" key. The objective loss on the receiving end of this connection is 13 db at F2M. Since, it is necessary to read -18 dbm on the "B" scale of the "PROJECTION METER" the actual reading will be 8. Adjust the "R" pad until the meter reads $8 \pm .125$ dbm as described in Step 5 of this section.

Note 1: A 21A TMS should be used at the "Equalizer Bay" or "VF Patch Bay" whenever it is necessary to send to, or receive from, the 17B (modified) TTB on a WADS trunk circuit.

5.09 Steady and impulse noise measurements on a WADS trunk circuit should be made in one direction at a time, **FROM** the **CONTROLLING 17B** (modified) TTB **TOWARD** the **DISTANT END 17B** (modified) TTB. For steady noise measurements, a 3A NMS using "C" message weighting (or a 2B NMS "F1A") should be used at the **CONTROLLING TTB**. Proceed as follows:

(a) To establish a connection to the distant
 WADS 17B TTB, insert a "front test cord" into the 900 ohm jack of the "TP" combination (see Fig. 8). Using a patch cord, patch between the "TP" 600 ohm jack and the "TST" jack of the trunk to be tested. Key pulse the distant end TTB over the trunk, using the NNX-XXXX calling code for that TTB. After the call has been answered, the distant end will feed battery and ground from

his test cord. At the controlling TTB, insert the associated "rear test cord" into the jack of the noise measuring set. Operate the "TALK-MON" key to the "MON" position and proceed with measurements as indicated in Par. 4 of this section.

(b) To measure steady noise in the opposite direction on the same trunk, the **DISTANT END** will now act as the **CONTROLLING TTB**, and by using the same procedure as described in Par. (a), above, test the trunk in the reverse direction. *It is necessary to establish a new connection FROM the former DISTANT END TTB to the former CONTROLLING TTB, using its NNX-XXXX code on the same WADS trunk circuit.*

(c) Impulse noise measurements should be made in the same manner as described in (a) and (b) above, however, a 6A Impulse Counter should be used instead of the 3A or 2B NMS. See Par. 4 of this section for impulse noise objectives.

5.10 On tests made from a 17B (modified) Toll Test Board, in connection with WADS trunk circuits, it should be noted, that unusual variations from the normal test measurements could be due to improper operation of the TTB. Failure to set up test arrangements in the proper sequence, could result in impedance mismatches, or the addition of undesired losses on a connection. If this situation occurs, check the following items at the TTB:

(a) In connection with tests made via the "TST" jack, the patch cord between the "TST" jack and the "TP" combination, should have one end in the "TST" jack of the trunk to be tested, and the other end in the 600 ohm jack of the "TP" combination.

(b) The "front test cord" should be in the 900 ohm jack of the "TP" combination, or in the NNX-XXXX jack at the incoming end.

(c) The "rear test cord" should be in either the MEAS jack or the 900 ohm jack of the NMS. If the NMS is a 600 ohm impedance set, it will be necessary to use a 1.5:1 transformer of 2AB TEST SET to achieve an impedance match. Correct the result by the loss of the transformer or 2AB TEST SET.

(d) **VERY IMPORTANT**

In all instances, when the front and rear "test cords" are used in making transmission measurements, the "TALK-MON" key should be operated to the "MON" position. Failure to operate the "TALK-MON" key to "MON" position, will result in the ADDITION OF A BRIDGING LOSS TO THE MEASURED RESULTS.

↗ 5.11 For additional information covering the operation of the **17B TOLL TEST BOARD, ARRANGED FOR TESTING WADS TRUNKS** — See Section 314-016-500.

6. ROUTINE MEASUREMENTS

6.01 All routine tests on WADS trunks should be made on a release basis. Two types of ↘ measurements should be made.

↗ (a) **Noise Measurements:** Both steady noise and impulse noise measurements should be made at **six month** intervals from both ends of the circuit in the same manner as covered in the initial lineup procedure of this section (Part 4). The same limits should be used.

(b) **Loss Deviation Measurements:** Over-all loss measurements should be made at 2225 cycles **monthly** in the same manner as in Step 6 of Part 3. Deviation from the specified received level should not exceed the value in Table 2. If this level does exceed the "Routine" value in Table 2 the trunk should be left in service and readjusted as soon as feasible to meet the original lineup limits of Table 1. If the measurement exceeds the "Turn Down" limit of Table 2, the circuit should be removed from service immediately and turned down until re-adjusted to within ↘ Table 1 limits.

TABLE 2
Permissible Deviations in DB From Specified Received Level
For Routine and Turn Down

TYPE OF TRUNK	LENGTH OF TRUNK IN MILES					
	0-100		101-500		OVER 500	
	ROUTINE	TURN DOWN	ROUTINE	TURN DOWN	ROUTINE	TURN DOWN
No VFE — No CXR EQZN Single Link Cxr Section — Cable or Radio	1.0	3.0	1.5	3.0	1.5	3.0
VFE — CXR EQZN Single Link Cxr Section — Cable or Radio	1.5	3.0	1.5	3.0	1.5	3.0
VFE — CXR EQZN Multi-Link Cxr or Combination Cxr and VF	1.5	3.0	1.5	3.0	2.0	3.0

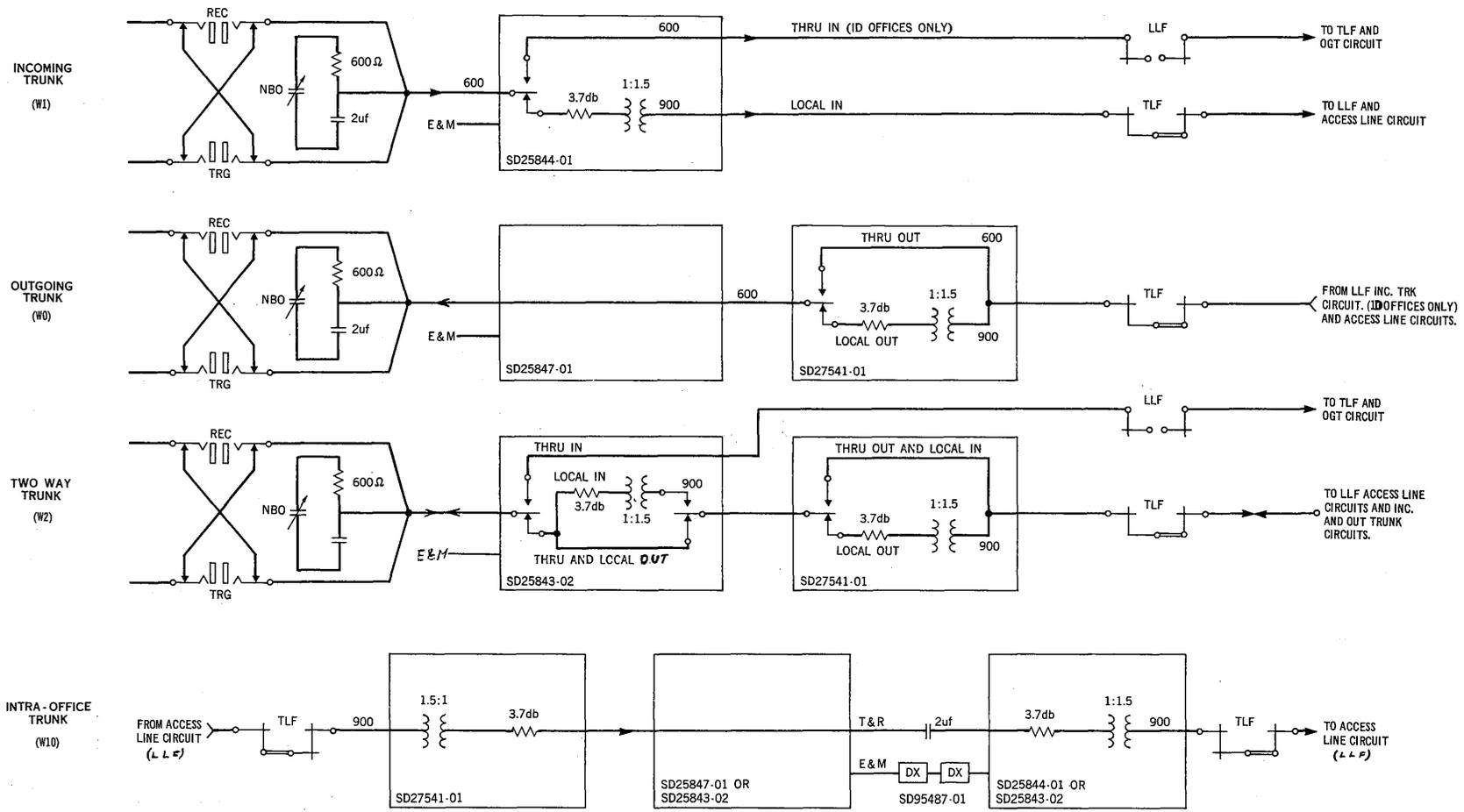


Fig. 1 - Trunk Circuits — WADS to WADS Connections

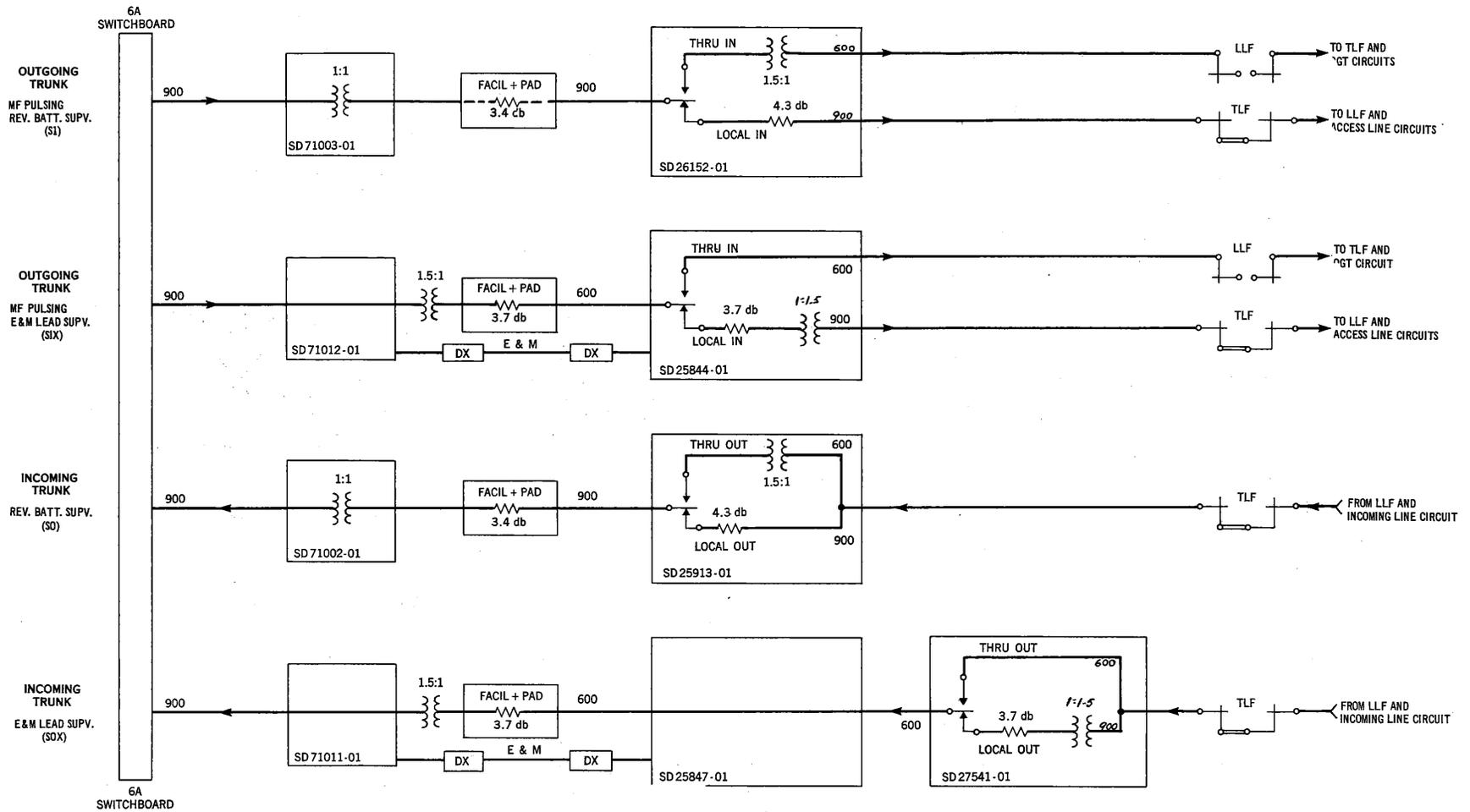


Fig. 2 — 6A WADS Switchboard Trunks

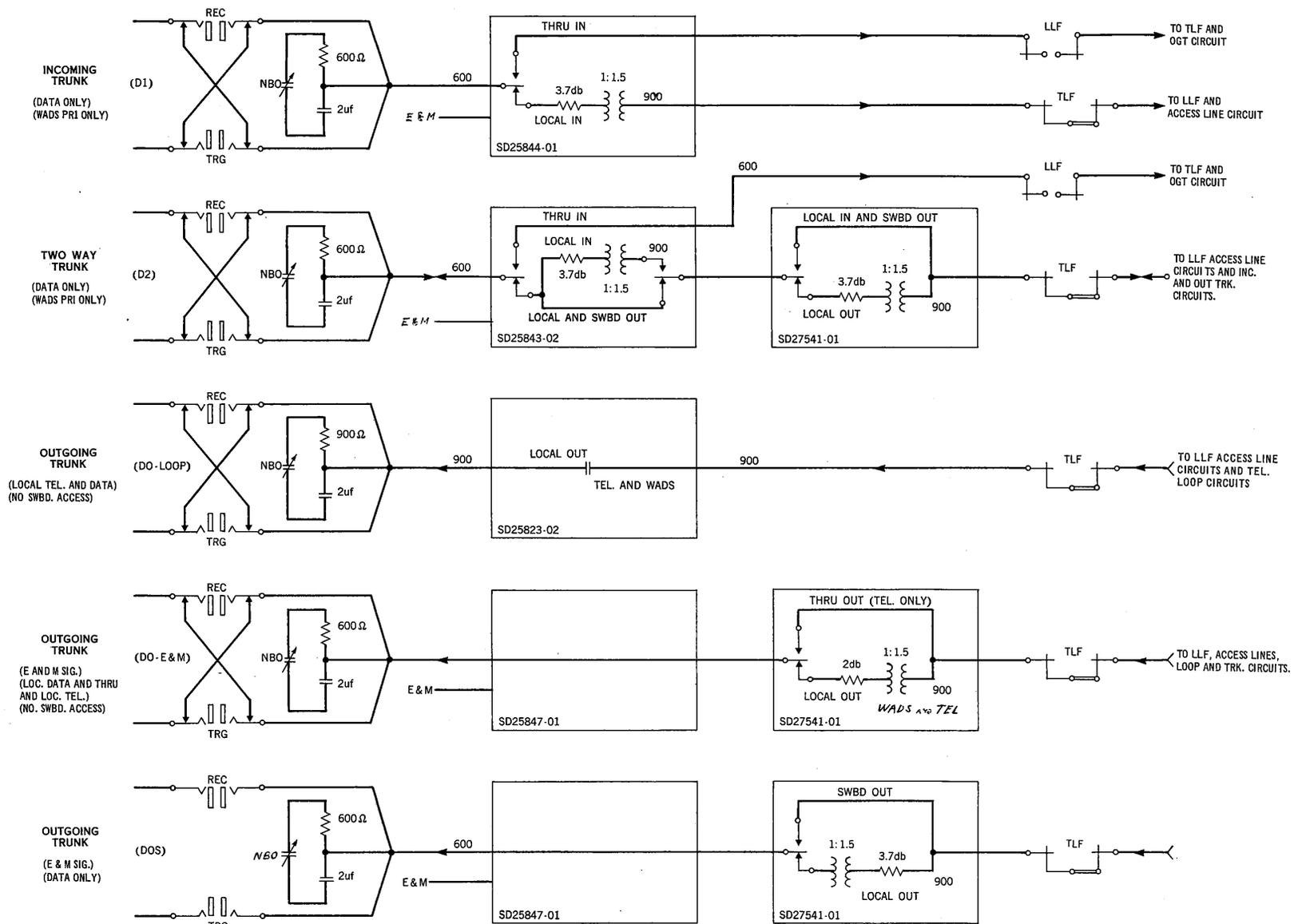
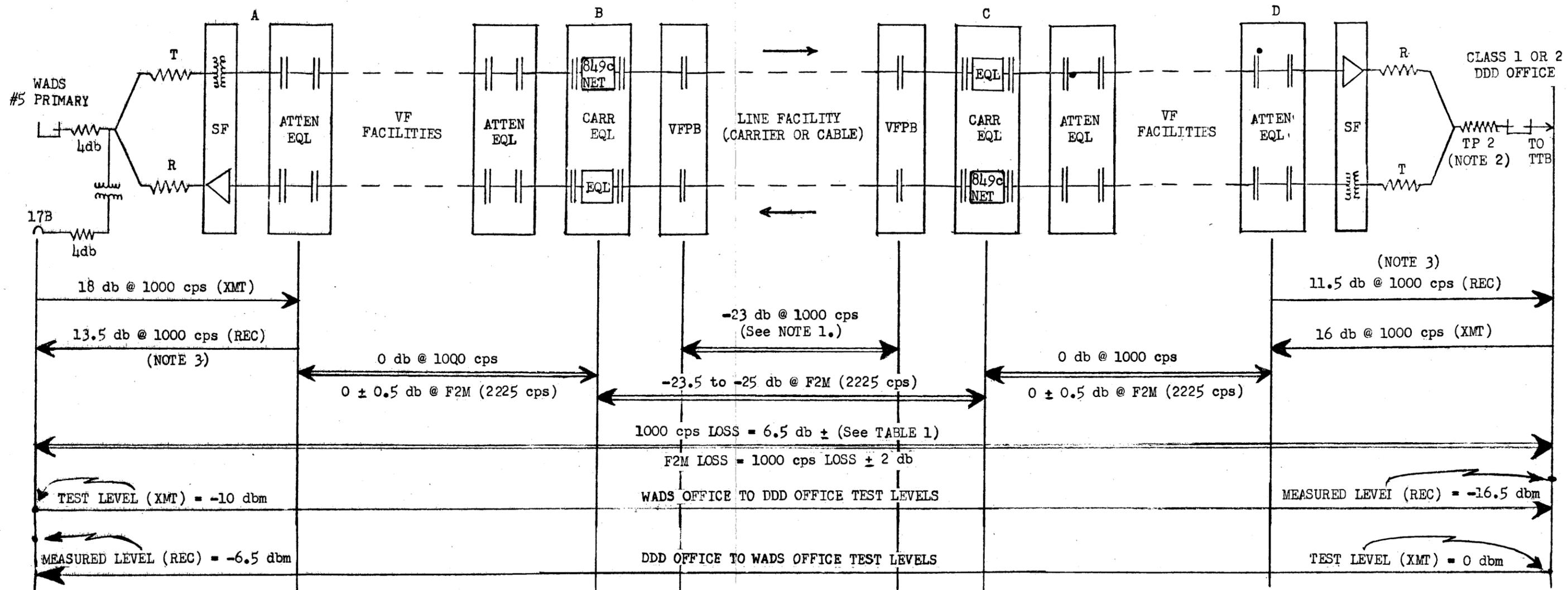


Fig. 3 - Trunk Circuits — WADS to DDD Connections



- NOTE 1. THE LEVEL MAY BE -23, -20 OR -17 db AT 1000 cps DEPENDING UPON STANDARD CARRIER LEVELS FOR THE OFFICES.
- NOTE 2. ASSUMES 0.5 db CIRCUIT NET LOSS OF "DATA ONLY" TRUNK.
- NOTE 3. TP 2, OR EQUIVALENT 2 db LOSS IN THE TEST CONDITION.

Fig. 4A

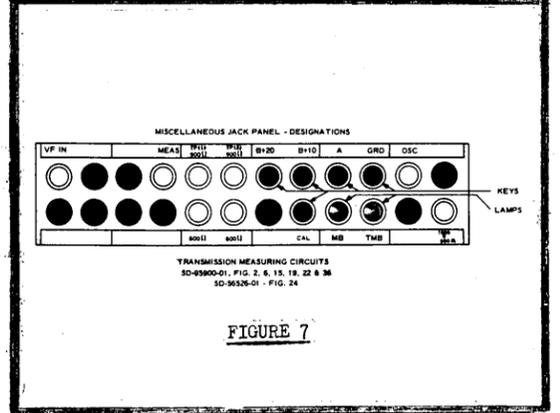
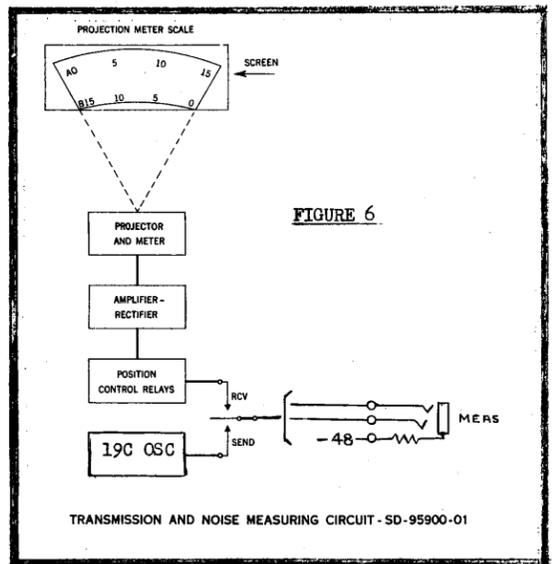
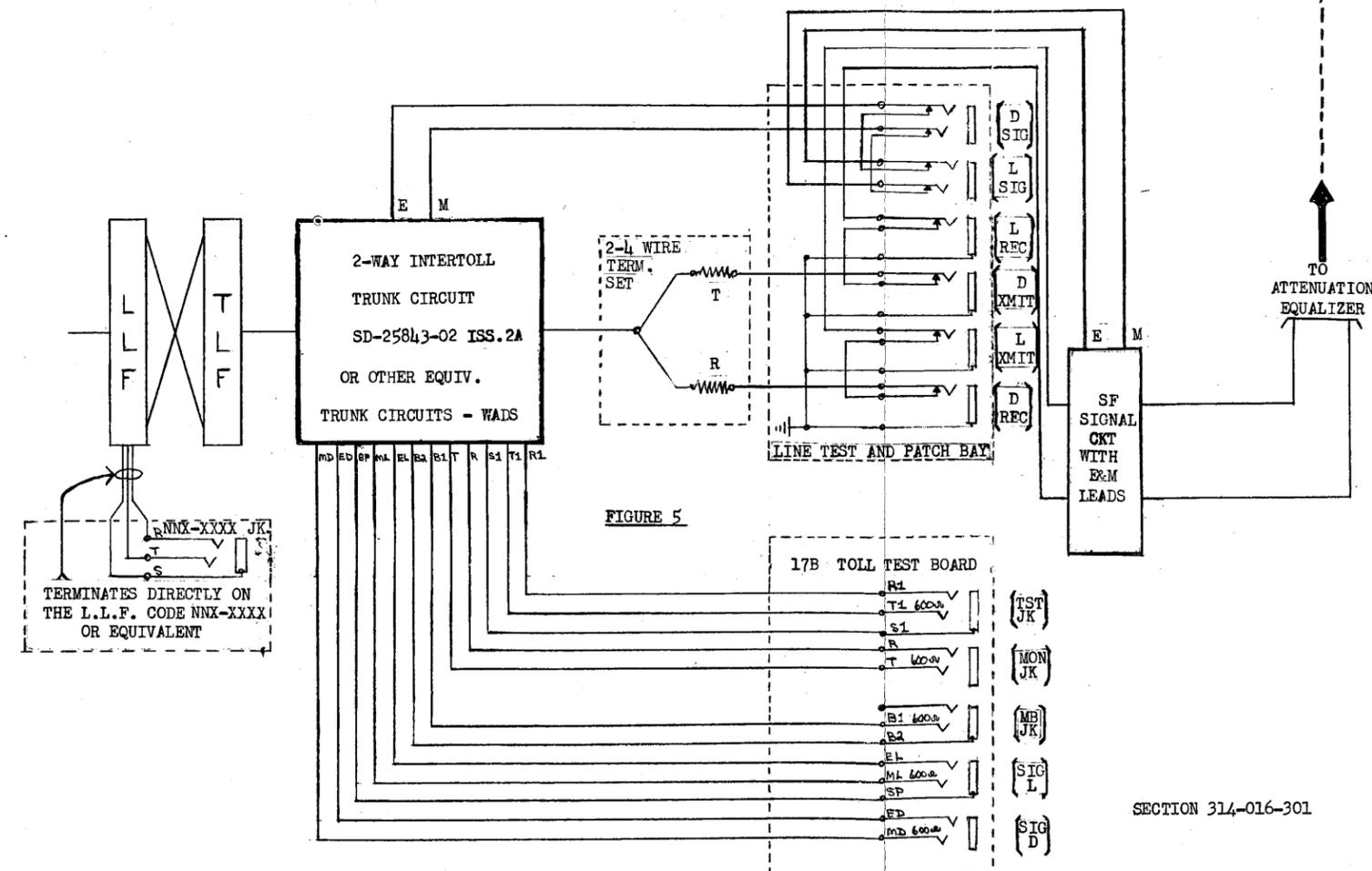
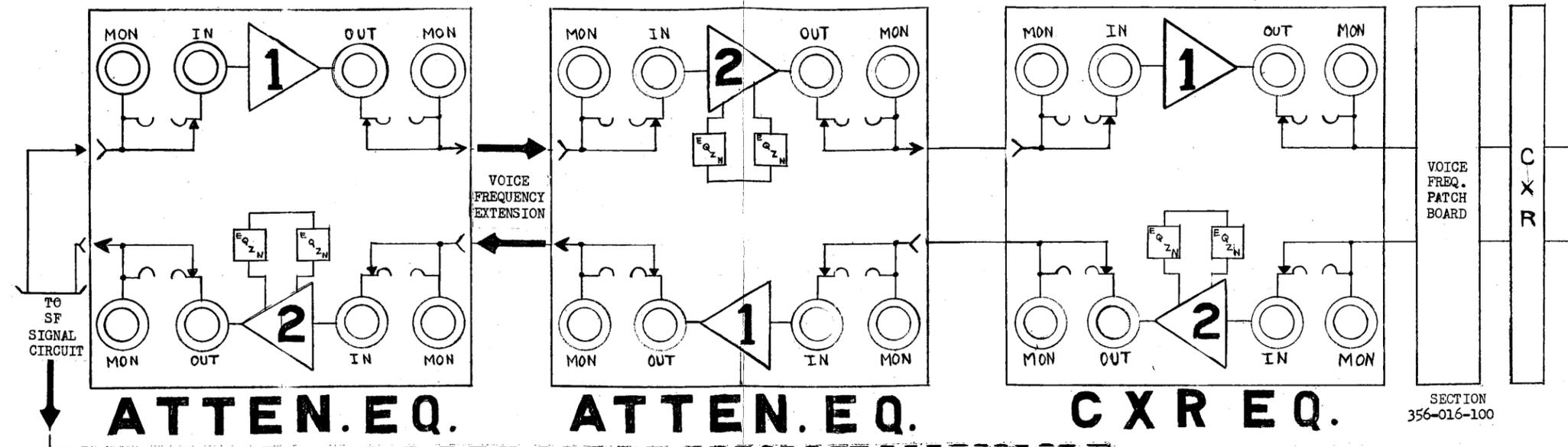


Fig. 5, 6, and 7

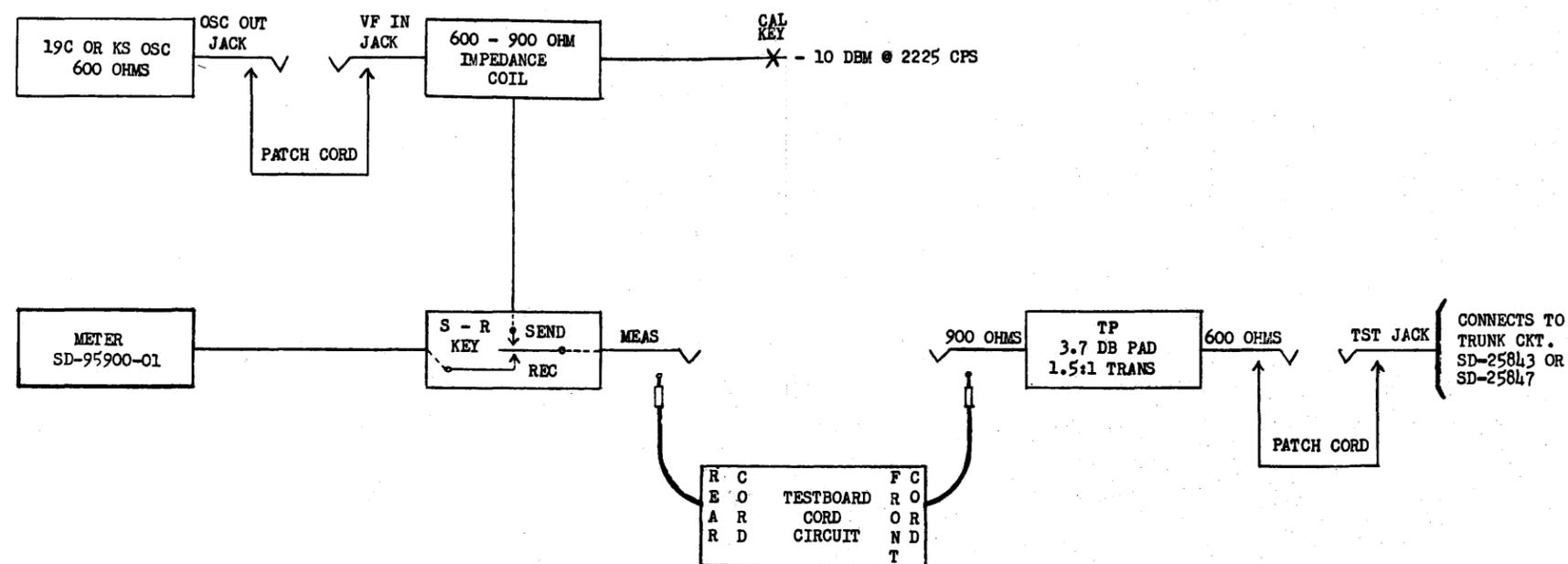


Fig. 8 - 17B (Modified) TTB Test Arqts. WADS
One-way Outgoing & Two-way Trunks

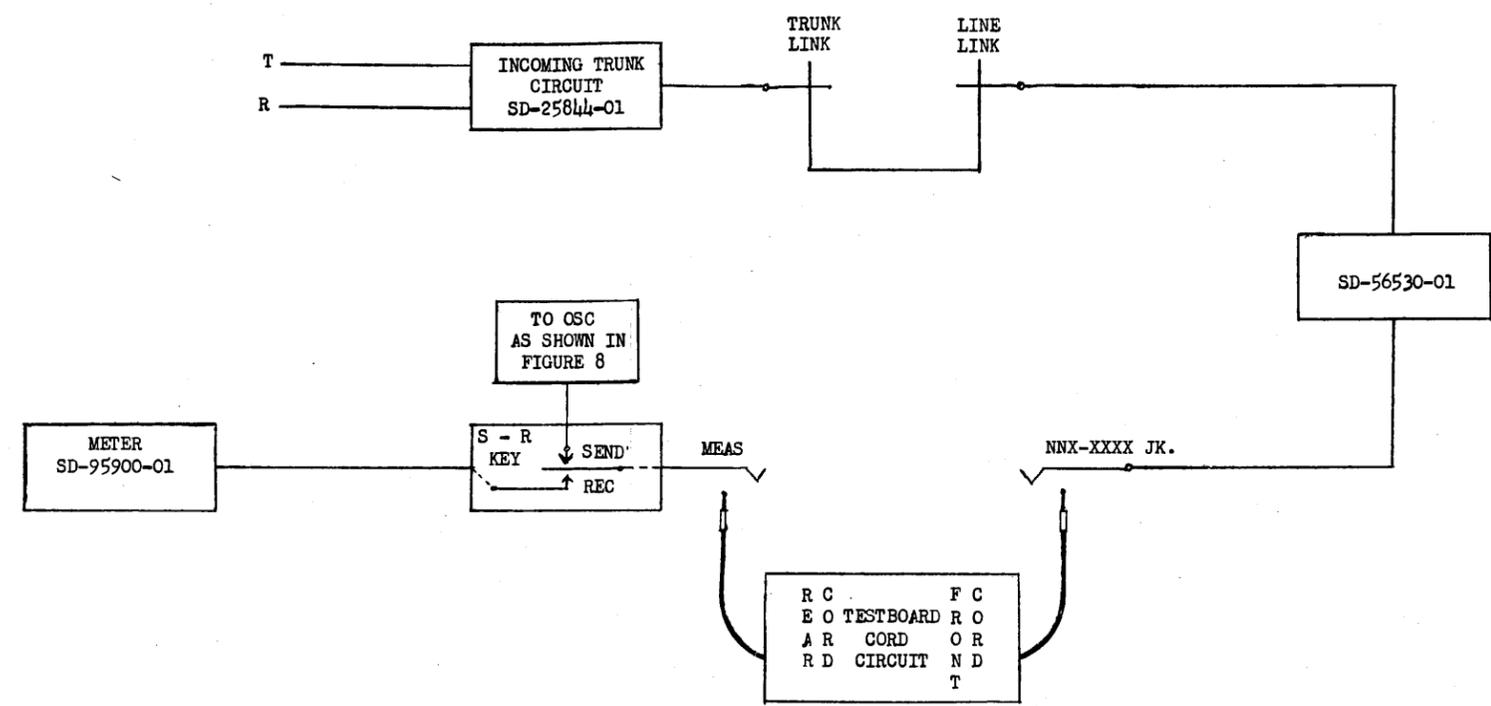


Fig. 9 - 17B (Modified) TTB Test Argts. WADS One-way Incoming Trunk