NO. 4 TYPE CROSSBAR OFFICES

TERMINAL BALANCE REQUIREMENTS

1. GENERAL

1.01 Table A provides terminal balance measurement requirements of the various intertoll terminating connection paths in class 4 and higher No. 4 type crossbar switching offices. Both the echo return loss (ERL) and singing point or singing return loss (SP/SRL) requirements must be met.

1.02 This section is reissued for the following reasons:

(a) to change paragraphs 2.01, 2.02, and 2.03.

(b) to delete paragraph 2.04.

(c) to add Emergency Access Trunk in Test 2, Table A.

(d) to delete test termination information in Test 11, Table A.

(e) to add note 5.

1.03 Measurement results are to be recorded on Form E-6005 or E-6006 as shown in Section 660-473-010. The form to be used is dependent on the type of test equipment used in obtaining the measurements. The available test equipment and specific methods for performing the measurements are covered in Section 660-473-504. The procedures for establishing the test conditions and making adjustments are contained in Section 660-473-502. General information on balance testing is covered in Section 660-473-100.

2. APPLICATIONS

2.01 To ensure that an office will meet balance objectives and can be certified by the responsible transmission engineer, the requirements for the terminal balance objectives should be applied on a test condition basis. This means that 50 percent of all measurements for each test condition in Table A must be equal to or greater than the median requirement given in Table A. Similarly, not more than two percent of the measurements for each test condition may be below the minimum requirements.

2.02 The certification of an office as meeting terminal balance objectives is the responsibility of a transmission engineer. The requirements for office certification are given in Section 853-500-110 and apply the requirements of this section to specific trunk categories (primary intertoll, secondary intertoll, intrabuilding toll connecting, 2-wire interbuilding toll connecting, and 4-wire interbuilding toll connecting). The measurements as recorded by plant maintenance personnel for the various test conditions must be summarized by the transmission engineer to determine if the office can be certified. Certification is based on trunks rather than measurements; therefore, trunks with more than one mode of operation will not be considered as balanced unless all modes meet requirements. In addition, all 4-wire terminating sets in the toll office end of switchboard terminated toll connecting trunks must meet the requirements shown in Table A.

2.03 All trunks with a test condition measuring below minimum should be investigated and corrective action taken. No trunks should have a test condition that measures equal to or below the turndown limit. The turndown limit indicates severe balance irregularities.

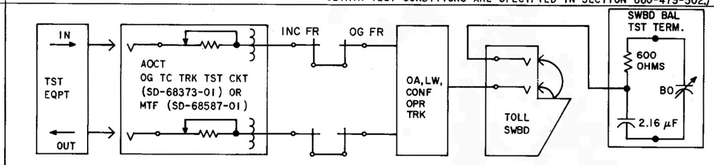
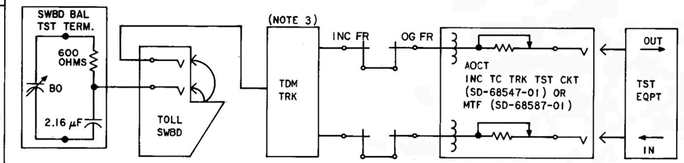
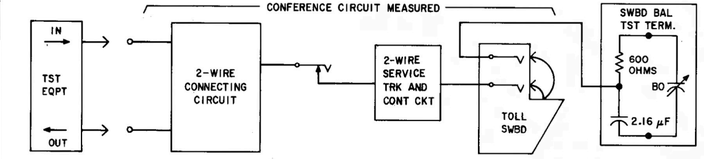
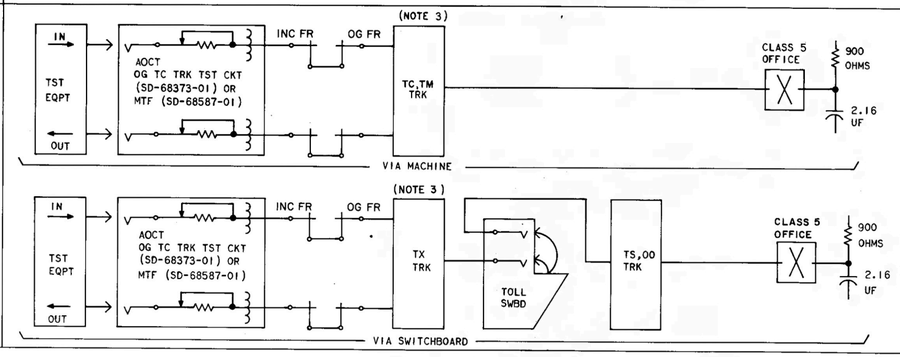
3. INTERPRETING REQUIREMENTS

3.01 Balance requirements in No. 4 type crossbar offices are complicated by the fact that the expected measured loss (EML) for toll connecting trunks need not be VNL (via net loss) + 2.5 dB. This is due to the practice of utilizing available gain with switching pads. Either incoming or outgoing (not both) toll connecting trunks may be designed to an EML of "A" dB greater than VNL

+ 2.5 dB, and the trunk is referred to as a high-loss trunk. If an office has high-loss trunks, then all trunks (intertoll as well as toll connecting) which can switch to the high-loss trunks are designed to switch in an extra "A" dB of gain when connecting to a high-loss trunk. In some offices, the balance requirements are further complicated by the presence of split "A" pads, in which case two different values of extra loss are possible ("A" dB or "A" – 2 dB).

TABLE A (SHEET 1 OF 5)

CLASS 4 AND HIGHER RANKING NO. 4 TYPE CROSSBAR OFFICE
TERMINAL BALANCING TEST CONDITIONS AND REQUIREMENTS

TEST NO.	TEST AND CIRCUIT CLASSIFICATION	ERL AND SP/SRL TEST CONDITIONS (TEST EQUIPMENT IS SPECIFIED IN SECTION 660-473-504. PROCEDURES TO OBTAIN TEST CONDITIONS ARE SPECIFIED IN SECTION 660-473-502.)	A-PAD CONDITION (NOTE 1)	REQUIREMENTS (NOTE 2)					
				ERL IN DB			SP/SRL IN DB		
				MEDIAN	MINIMUM	TURNDOWN LIMIT	MEDIAN	MINIMUM	TURNDOWN LIMIT
1	INCOMING SECONDARY INTERTOLL PATHS OPERATOR ASSISTANCE (OA) LEAVEWORD (LW) CONFERENCE OPERATOR		LOW LOSS	27 (31)	21 (25)	18 (22)	20 (24)	14 (18)	11 (15)
2	OUTGOING SECONDARY INTERTOLL PATHS TERMINAL, THROUGH, OR CONFERENCE TANDEM (TDM) EMERGENCY ACCESS TRUNK		HIGH LOSS	27+2A (31+2A)	21+2A (25+2A)	18+2A (22+2A)	20+2A (24+2A)	14+2A (18+2A)	11+2A (15+2A)
3	TOLL CONFERENCE SERVICE MULTIPORT CONFERENCE BRIDGE TEST	 PROCEDURES TO OBTAIN TEST CONDITION ARE SPECIFIED IN SECTION 332-435-500							
4	2-WIRE OUTGOING TOLL CONNECTING TRUNKS TOLL SWITCHING (TS) TOLL COMPLETING (TC) OPERATOR OFFICE (OO) (WHEN CLASS 5 OFFICE IS IN SAME OR ADJACENT BUILDING)		LOW LOSS	22 (26)	18 (22)	10.5 (14.5)	14 (18)	10 (14)	4 (8)
			LOW LOSS (SPLIT-PAD OFFICES ONLY)	26 (30)	22 (26)	14.5 (18.5)	18 (22)	14 (18)	8 (12)
			HIGH LOSS	22+2A (26+2A)	18+2A (22+2A)	10.5+2A (14.5+2A)	14+2A (18+2A)	10+2A (14+2A)	4+2A (8+2A)

NOTES:

1. THE A-PAD CONDITION IS DETERMINED BY CLASS LEAD OF CONNECTING TRUNK DESIGNED FOR EITHER:

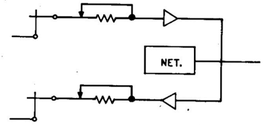
   LOW LOSS, (N)-CLASS
   (BATTERY OR OPEN ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMAINS IN TRUNK.

   LOW LOSS (SPLIT-PAD OFFICES ONLY),
   (S)-CLASS (11,500-OHM GROUND ON PAD CONTROL SIMPLEX)
   THE 2-DB PORTION OF THE SPLIT-PAD ARRANGEMENT IS REMOVED FROM THE TRUNK.

   HIGH LOSS, (A)-CLASS
   (500-OHM GROUND ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMOVED FROM TRUNK
   (A-PAD AND 2-DB PORTION IN SPLIT-PAD OFFICES).

2. ALL REQUIREMENTS ARE INCREASED BY 4 DB WHEN TESTING THROUGH TP2 PAD IN AOCT. THE VALUES ARE IN PARENTHESES.

3. THESE TRUNKS MAY HAVE AMPLIFIERS AND THE 'A' PAD IN LOW-LOSS DESIGNS.

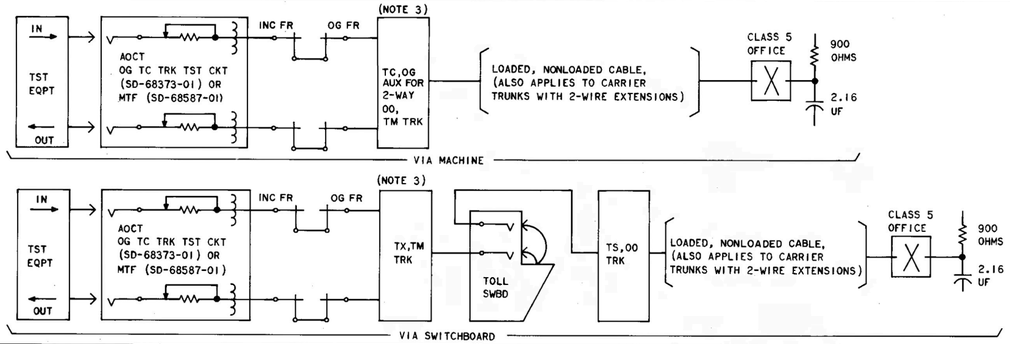
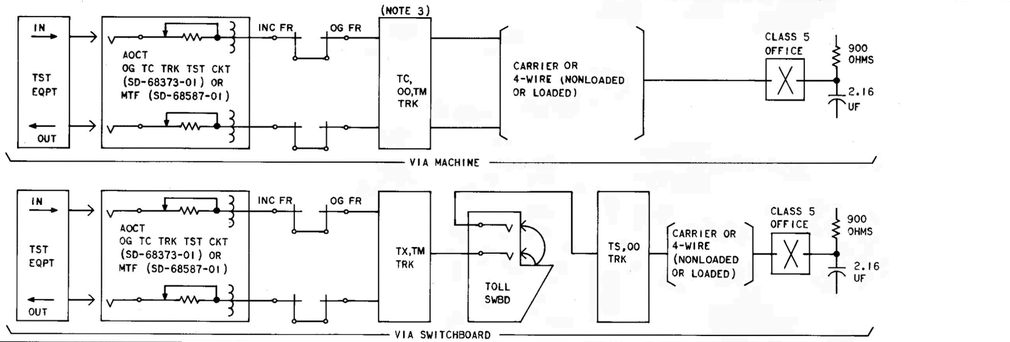


4. TRUNKS USING E-TYPE SIGNALING UNITS WITH BUILT-IN HYBRID AND FIXED NBO CAPACITOR HAVE SAME REQUIREMENTS AS 2-WIRE FACILITY.

5. WHEN PBX IS EQUIPPED WITH A TEST TERMINATION FOR BALANCE TESTING (600 OR 900 OHM PLUS 2.16 μF, DEPENDING ON THE NOMINAL IMPEDANCE OF PBX) THE TEST CONDITION IS SIMILAR TO A CLASS 5 OFFICE. IN THESE CASES THE REQUIREMENTS OF EITHER TEST 5 OR 8 APPLY.

TABLE A (SHEET 2 OF 5)

CLASS 4 AND HIGHER RANKING NO. 4 TYPE CROSSBAR OFFICE
TERMINAL BALANCING TEST CONDITIONS AND REQUIREMENTS

TEST NO.	TEST AND CIRCUIT CLASSIFICATION	ERL AND SP/SRL TEST CONDITIONS (TEST EQUIPMENT IS SPECIFIED IN SECTION 660-473-504. PROCEDURES TO OBTAIN TEST CONDITIONS ARE SPECIFIED IN SECTION 660-473-502.)	A-PAD CONDITION (NOTE 1)	REQUIREMENTS (NOTE 2)					
				ERL IN DB			SP/SRL IN DB		
				MEDIAN	MINIMUM	TURNDOWN LIMIT	MEDIAN	MINIMUM	TURNDOWN LIMIT
5	2-WIRE OUTGOING TOLL CONNECTING TRUNKS TOLL COMPLETING (TC),(TM) OUTGOING AUXILIARY FOR 2-WAY OPERATOR OFFICE (OG AUX 00) (WHEN CLASS 5 OFFICE IS NOT IN SAME OR ADJACENT BUILDING)		LOW LOSS	18 (22)	13 (17)	10.5 (14.5)	10 (14)	6 (10)	4 (8)
			LOW LOSS (SPLIT-PAD OFFICE ONLY)	22 (26)	17 (21)	14.5 (18.5)	14 (18)	10 (14)	8 (12)
			HIGH LOSS	18+2A (22+2A)	13+2A (17+2A)	10.5+2A (14.5+2A)	10+2A (14+2A)	6+2A (10+2A)	4+2A (8+2A)
6	4-WIRE OUTGOING TOLL CONNECTING TRUNKS TOLL COMPLETING (TC),(TM) TOLL SWITCHING (TS) OPERATOR OFFICE (00) (WHEN CLASS 5 OFFICE IS NOT IN SAME OR ADJACENT BUILDING) (NOTE 4)		LOW LOSS	22 (26)	16 (20)	10.5 (14.5)	15 (19)	11 (15)	4 (8)
			HIGH LOSS	22+2A (26+2A)	16+2A (20+2A)	10.5+2A (14.5+2A)	15+2A (19+2A)	11+2A (15+2A)	4+2A (8+2A)

NOTES:

1. THE A-PAD CONDITION IS DETERMINED BY CLASS LEAD OF CONNECTING TRUNK DESIGNED FOR EITHER:

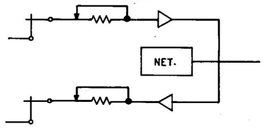
   LOW LOSS, (N)-CLASS
   (BATTERY OR OPEN ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMAINS IN TRUNK.

   LOW LOSS (SPLIT-PAD OFFICES ONLY),
   (S)-CLASS (11,500-OHM GROUND ON PAD CONTROL SIMPLEX)
   THE 2-DB PORTION OF THE SPLIT-PAD ARRANGEMENT IS REMOVED FROM THE TRUNK.

   HIGH LOSS, (A)-CLASS
   (500-OHM GROUND ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMOVED FROM TRUNK
   (A-PAD AND 2-DB PORTION IN SPLIT-PAD OFFICES).

2. ALL REQUIREMENTS ARE INCREASED BY 4 DB WHEN TESTING THROUGH TP2 PAD IN AOCT. THE VALUES ARE IN PARENTHESES.

3. THESE TRUNKS MAY HAVE AMPLIFIERS AND THE 'A' PAD IN LOW-LOSS DESIGNS.

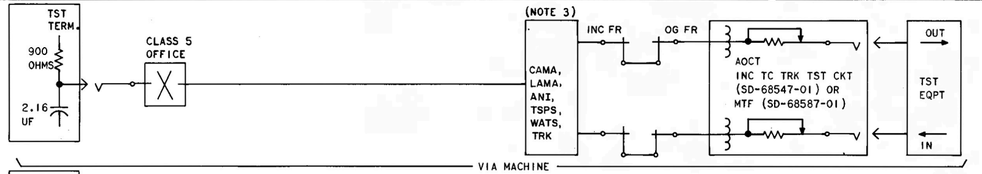
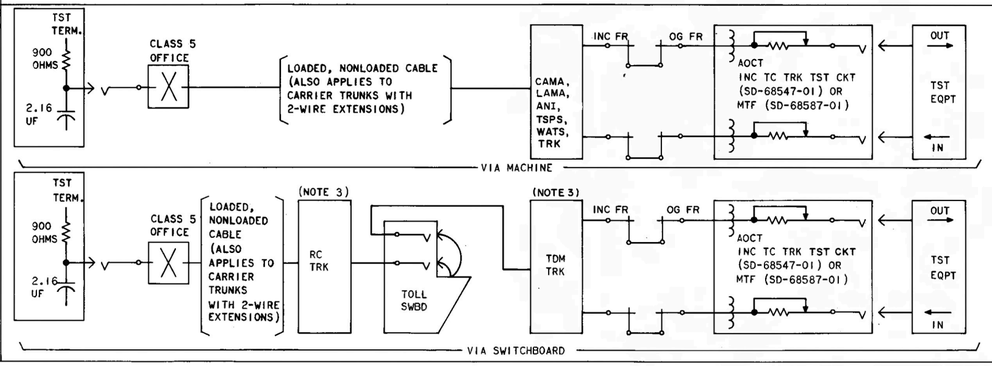


4. TRUNKS USING E-TYPE SIGNALING UNITS WITH BUILT-IN HYBRID AND FIXED NBO CAPACITOR HAVE SAME REQUIREMENTS AS 2-WIRE FACILITY.

5. WHEN PBX IS EQUIPPED WITH A TEST TERMINATION FOR BALANCE TESTING (600 OR 900 OHM PLUS 2.16 MF, DEPENDING ON THE NOMINAL IMPEDANCE OF PBX) THE TEST CONDITION IS SIMILAR TO A CLASS 5 OFFICE. IN THESE PBXS THE REQUIREMENTS OF EITHER TEST 5 OR 6 APPLY.

TABLE A (SHEET 3 OF 5)

CLASS 4 AND HIGHER RANKING NO. 4 TYPE CROSSBAR OFFICE
TERMINAL BALANCING TEST CONDITIONS AND REQUIREMENTS

TEST NO.	TEST AND CIRCUIT CLASSIFICATION	ERL AND SP/SRL TEST CONDITIONS (TEST EQUIPMENT IS SPECIFIED IN SECTION 660-473-504. PROCEDURES TO OBTAIN TEST CONDITIONS ARE SPECIFIED IN SECTION 660-473-502)	A-PAD CONDITION (NOTE 1)	REQUIREMENTS (NOTE 2)					
				ERL IN DB			SP/SRL IN DB		
				MEDIAN	MINIMUM	TURNDOWN LIMIT	MEDIAN	MINIMUM	TURNDOWN LIMIT
7	2-WIRE INCOMING TOLL CONNECTING TRUNKS RECORDING COMPLETION (RC) CAMA, LAMA, ANI, TSPS,WATS (WHEN CLASS 5 OFFICE IS IN SAME OR ADJACENT BUILDING)		LOW LOSS	22 (26)	18 (22)	10.5 (14.5)	14 (18)	10 (14)	4 (8)
			LOW LOSS (SPLIT-PAD OFFICES ONLY)	26 (30)	22 (26)	14.5 (18.5)	18 (22)	14 (18)	8 (12)
			HIGH LOSS	22+2A (26+2A)	18+2A (22+2A)	10.5+2A (14.5+2A)	14+2A (18+2A)	10+2A (14+2A)	4+2A (8+2A)
8	2-WIRE INCOMING TOLL CONNECTING TRUNKS RECORDING COMPLETING (RC) CAMA, LAMA, ANI, TSPS,WATS (WHEN CLASS 5 OFFICE IS NOT IN SAME OR ADJACENT BUILDING)		LOW LOSS	18 (22)	13 (17)	10.5 (14.5)	10 (14)	6 (10)	4 (8)
			LOW LOSS (SPLIT-PAD OFFICES ONLY)	22 (26)	17 (21)	14.5 (18.5)	14 (18)	10 (14)	8 (12)
			HIGH LOSS	18+2A (22+2A)	13+2A (17+2A)	10.5+2A (14.5+2A)	10+2A (14+2A)	6+2A (10+2A)	4+2A (8+2A)

NOTES:

1. THE A-PAD CONDITION IS DETERMINED BY CLASS LEAD OF CONNECTING TRUNK DESIGNED FOR EITHER:

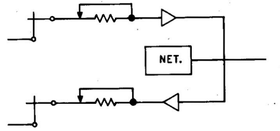
   LOW LOSS, (N)-CLASS
   (BATTERY OR OPEN ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMAINS IN TRUNK.

   LOW LOSS (SPLIT-PAD OFFICES ONLY),
   (S)-CLASS (11,500-OHM GROUND ON PAD CONTROL SIMPLEX)
   THE 2-DB PORTION OF THE SPLIT-PAD ARRANGEMENT IS REMOVED FROM THE TRUNK.

   HIGH LOSS, (A)-CLASS
   (500-OHM GROUND ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMOVED FROM TRUNK
   (A-PAD AND 2-DB PORTION IN SPLIT-PAD OFFICES).

2. ALL REQUIREMENTS ARE INCREASED BY 4 DB WHEN TESTING THROUGH TP2 PAD IN AOCT. THE VALUES ARE IN PARENTHESES.

3. THESE TRUNKS MAY HAVE AMPLIFIERS AND THE 'A' PAD IN LOW-LOSS DESIGNS.



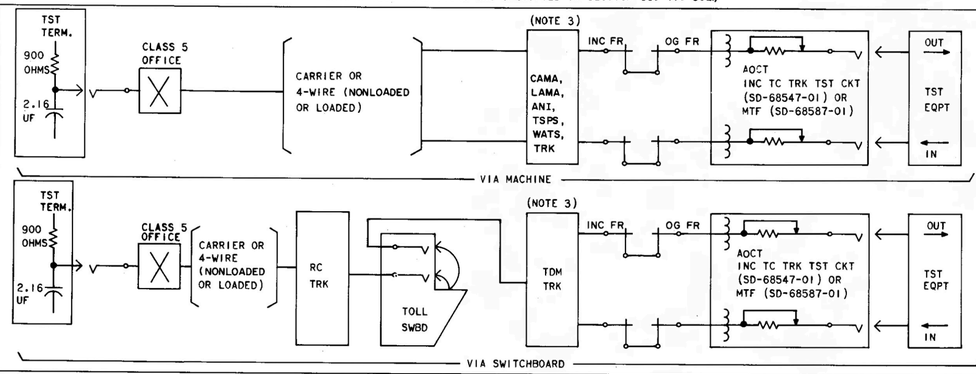
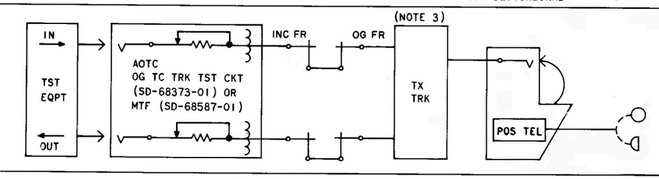
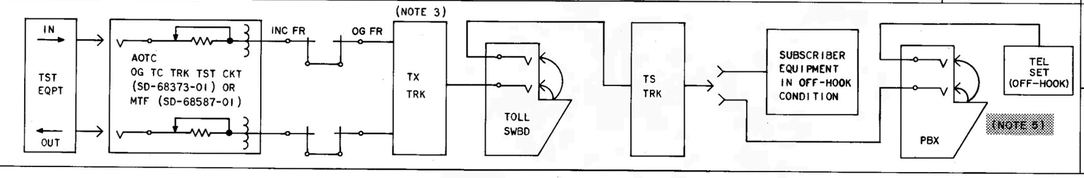
4. TRUNKS USING E-TYPE SIGNALING UNITS WITH BUILT-IN HYBRID AND FIXED NBO CAPACITOR HAVE SAME REQUIREMENTS AS 2-WIRE FACILITY.

5. WHEN PBX IS EQUIPPED WITH A TEST TERMINATION FOR BALANCE TESTING (600 OR 900 OHM PLUS 2.16 μF, DEPENDING ON THE NOMINAL IMPEDANCE OF PBX) THE TEST CONDITION IS SIMILAR TO A CLASS 5 OFFICE. IN THESE PBXS THE REQUIREMENTS OF EITHER TEST 5 OR 6 APPLY.

Table A—Table A (Sheet 3 of 5)

TABLE A (SHEET 4 OF 5)

CLASS 4 AND HIGHER RANKING NO. 4 TYPE CROSSBAR OFFICE
TERMINAL BALANCING TEST CONDITIONS AND REQUIREMENTS

TEST NO.	TEST AND CIRCUIT CLASSIFICATION	ERL AND SP/SRL TEST CONDITIONS (TEST EQUIPMENT IS SPECIFIED IN SECTION 660-473-504. PROCEDURES TO OBTAIN TEST CONDITIONS ARE SPECIFIED IN SECTION 660-473-502.)	A-PAD CONDITION (NOTE 1)	REQUIREMENTS (NOTE 2) ERL IN DB MEDIAN	ERL IN DB MINIMUM	ERL IN DB TURNDOWN LIMIT	SP/SRL IN DB MEDIAN	SP/SRL IN DB MINIMUM	SP/SRL IN DB TURNDOWN LIMIT
9	4-WIRE INCOMING TOLL CONNECTING TRUNKS RECORDING COMPLETING (RC) CAMA, LAMA, ANI, TSPS/WATS (WHEN CLASS 5 OFFICE IS NOT IN SAME OR ADJACENT BUILDING) (NOTE 4)		LOW LOSS	22 (26)	16 (20)	10.5 (14.5)	15 (19)	11 (15)	4 (8)
			HIGH LOSS	22+2A (26+2A)	16+2A (20+2A)	10.5+2A (14.5+2A)	15+2A (19+2A)	11+2A (15+2A)	4+2A (8+2A)
10	POSITION TELEPHONE SET TERMINATED IN OPERATOR HEADSET AT TOLL SWBD, TOLL TST BD, OR INFORMATION SYSTEM		INFO, RATE AND ROUTE, ETC	LOW LOSS	15 (19)	11 (15)	9 (13)	12 (16)	8 (12)	6 (10)
			TOLL SWBD		12 (16)	8 (12)	6 (10)	10 (14)	6 (10)	4 (8)
			INFO, RATE AND ROUTE, ETC	HIGH LOSS	15+2A (19+2A)	11+2A (15+2A)	9+2A (13+2A)	12+2A (16+2A)	8+2A (12+2A)	6+2A (10+2A)
			TOLL SWBD		12+2A (16+2A)	8+2A (12+2A)	6+2A (10+2A)	10+2A (14+2A)	6+2A (10+2A)	4+2A (8+2A)
11	OUTGOING TOLL CONNECTING TRUNKS VIA SWBD SPECIAL SERVICES, MOBILE RADIO SERVICE, TOLL SUBSCRIBER LINES, ETC		LOW LOSS	15 (19)	9 (13)	6 (10)	10 (14)	6 (10)	4 (8)
			HIGH LOSS	15+2A (19+2A)	9+2A (13+2A)	6+2A (10+2A)	10+2A (14+2A)	6+2A (10+2A)	4+2A (8+2A)

NOTES:

1. THE A-PAD CONDITION IS DETERMINED BY CLASS LEAD OF CONNECTING TRUNK DESIGNED FOR EITHER:

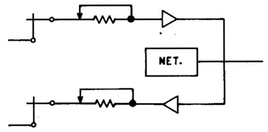
   LOW LOSS, (N)-CLASS
   (BATTERY OR OPEN ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMAINS IN TRUNK.

   LOW LOSS (SPLIT-PAD OFFICES ONLY),
   (S)-CLASS (11,500-OHM GROUND ON PAD CONTROL SIMPLEX)
   THE 2-DB PORTION OF THE SPLIT-PAD ARRANGEMENT IS REMOVED FROM THE TRUNK.

   HIGH LOSS, (A)-CLASS
   (500-OHM GROUND ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMOVED FROM TRUNK
   (A-PAD AND 2-DB PORTION IN SPLIT-PAD OFFICES).

2. ALL REQUIREMENTS ARE INCREASED BY 4 DB WHEN TESTING THROUGH TP2 PAD IN AOCT THE VALUES ARE IN PARENTHESES.

3. THESE TRUNKS MAY HAVE AMPLIFIERS AND THE 'A' PAD IN LOW-LOSS DESIGNS.



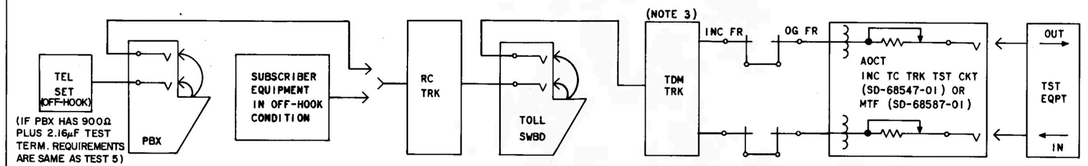
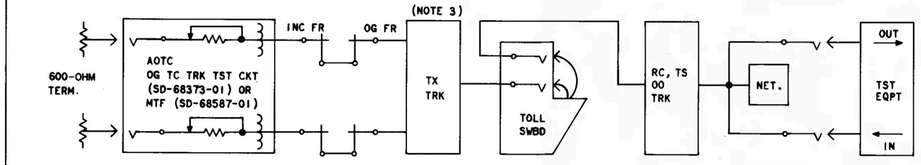
4. TRUNKS USING E-TYPE SIGNALING UNITS WITH BUILT-IN HYBRID AND FIXED NBO CAPACITOR HAVE SAME REQUIREMENTS AS 2-WIRE FACILITY.

5. WHEN PBX IS EQUIPPED WITH A TEST TERMINATION FOR BALANCE TESTING (600 OR 900 OHM PLUS 2.16 μF, DEPENDING ON THE NOMINAL IMPEDANCE OF PBX) THE TEST CONDITION IS SIMILAR TO A CLASS 5 OFFICE. IN THESE PBXS THE REQUIREMENTS OF EITHER TEST 5 OR 6 APPLY.

Table A—Table A (Sheet 4 of 5)

TABLE A (SHEET 5 OF 5)

CLASS 4 AND HIGHER RANKING NO. 4 TYPE CROSSBAR OFFICE
TERMINAL BALANCING TEST CONDITIONS AND REQUIREMENTS

TEST NO.	TEST AND CIRCUIT CLASSIFICATION	ERL AND SP/SRL TEST CONDITIONS (TEST EQUIPMENT IS SPECIFIED IN SECTION 660-473-504. PROCEDURES TO OBTAIN TEST CONDITIONS ARE SPECIFIED IN SECTION 660-473-502.)	A-PAD CONDITION (NOTE 1)	REQUIREMENTS (NOTE 2)					
				ERL IN DB			SP/SRL IN DB		
				MEDIAN	MINIMUM	TURNDOWN LIMIT	MEDIAN	MINIMUM	TURNDOWN LIMIT
12	INCOMING TOLL CONNECTING TRUNKS VIA SWBD SPECIAL SERVICES, MOBILE RADIO SERVICE, TOLL SUBSCRIBER LINES, LD, ETC.		LOW LOSS	15 (19)	9 (13)	6 (10)	10 (14)	6 (10)	4 (8)
			HIGH LOSS	15+2A (19+2A)	9+2A (13+2A)	6+2A (10+2A)	10+2A (14+2A)	6+2A (10+2A)	4+2A (8+2A)
13	4WTS OF 4-WIRE INCOMING OR OUTGOING TOLL CONNECTING TRUNKS TERMINATING ON SWITCHBOARD RECORDING COMPLETING (RC) TOLL SWITCHING (TS) OPERATOR OFFICE (00)			14 (18)	14 (18)		6 (10)	6 (10)	
		(MEASUREMENT IS MADE TO VERIFY COMP NET. AND NBO CAPACITOR WIRING. ALL TRUNKS MEASURED SHOULD EXCEED OR EQUAL THESE REQUIREMENTS)							

NOTES:

1. THE A-PAD CONDITION IS DETERMINED BY CLASS LEAD OF CONNECTING TRUNK DESIGNED FOR EITHER:

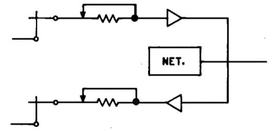
   LOW LOSS, (N)-CLASS
   (BATTERY OR OPEN ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMAINS IN TRUNK.

   LOW LOSS (SPLIT-PAD OFFICES ONLY),
   (S)-CLASS (11,500-OHM GROUND ON PAD CONTROL SIMPLEX)
   THE 2-DB PORTION OF THE SPLIT-PAD ARRANGEMENT IS REMOVED FROM THE TRUNK.

   HIGH LOSS, (A)-CLASS
   (500-OHM GROUND ON PAD CONTROL SIMPLEX)
   ENTIRE PAD REMOVED FROM TRUNK
   (A-PAD AND 2-DB PORTION IN SPLIT-PAD OFFICES).

2. ALL REQUIREMENTS ARE INCREASED BY 4 DB WHEN TESTING THROUGH TP2 PAD IN AOCT. THE VALUES ARE IN PARENTHESES

3. THESE TRUNKS MAY HAVE AMPLIFIERS AND THE 'A' PAD IN LOW-LOSS DESIGNS.



4. TRUNKS USING E-TYPE SIGNALING UNITS WITH BUILT-IN HYBRID AND FIXED NBO CAPACITOR HAVE SAME REQUIREMENTS AS 2-WIRE FACILITY.

5. WHEN PBX IS EQUIPPED WITH A TEST TERMINATION FOR BALANCE TESTING (600 OR 900 OHM PLUS 2.16 μF, DEPENDING ON THE NOMINAL IMPEDANCE OF PBX), THE TEST CONDITION IS SIMILAR TO A CLASS 5 OFFICE. IN THESE PBX'S, THE REQUIREMENTS OF EITHER TEST 5 OR 8 APPLY.

Table A—Table A (Sheet 5 of 5)