CUSTOMER LINE AND OUTGOING TRUNK CONDUCTORS VOLTMETER TESTS USING OFFICE TEST FRAME TEST CIRCUIT SD-27633-01 (J23260) NO. 5 CROSSBAR OFFICES

1. GENERAL

1.01 This section describes the method of making voltmeter tests on customer line and outgoing trunk conductors using office test frame test circuit (OTF) SD-27633-01, (J23260) Issue 2D and subsequent issues, when arranged for voltmeter testing in No. 5 crossbar offices.

1.02 This section is reissued for the following reasons. Revision arrows are used to emphasize the more significant changes. Equipment Test Lists are not affected.

(a) To revise the Preparation part of this section to provide means of determining when the customer line under test is idle and to provide customer line identification.

(b) To include operation of the SCO key at the office test frame to prevent transmitter noise from interfering with transmission while performing tests on customer lines.

1.03 The tests covered are:

1.04 Customer lines served by a No. 1A line concentrator are tested the same as nonconcentrated lines. An exception to the regular concentrator lines are the test terminations. Usually, one test termination is provided for each concentrator trunk group. If a line test is made to the test termination, the normal test indication will be a 33-kilohm shunt at the remote unit. Also, when making either Test A or B in this section and it is necessary to test an individual concentrator trunk, the concentrator control circuit must be blocked according to the method described in Section 067-105-502, Line Concentrator No. 1A—Systems Tests. Whenever this is done, a test call originated in the office test frame will connect the line called through the concentrator trunk desired.

Caution: Do not block No. 1A line concentrator trunks busy any longer than necessary when making tests on individual trunks.

2. APPARATUS

All Tests

2.01 Office test frame test circuit, SD-27637-01.

If Testing is Accomplished Through T1 or T2 Jack at Jack, Lamp, and Key Circuit

2.02 Patching cord, P3F cord, 4 feet long, equipped with one 309 plug and one 310 plug (3P12A cord).

3. PREPARATION

STEP	ACTION	VERIFICATION
All Tests		
1	At OTF— Restore all keys and switches.	
2	At TIC— Momentarily operate RLS key.	All lamps extinguished.
Customer Line Conductor Tests Line Test Feature		
3	At OTF— Operate SCO, LT keys.	SL lamp lighted. If dial pulsing is provided— Low tone heard. If multifrequency pulsing is provided— KP lamp lighted.
4	Dial or key C digit, if required, and numericals of line being tested.	If dial pulsing is provided— Low tone silenced. If MF pulsing is provided— KP lamp extinguished.
5	Restore SCO, LT keys.	
6	Operate 3WO Key.	If high tone is heard— Customer line busy is indicated. ***Note:*** If high tone is heard, testing of customer line cannot be performed until it becomes idle as determined in Step 7a.
7a	If customer line busy is indicated— Restore 3WO key.	When customer line becomes idle— Interrupted busy tone with high tone between low tone intervals heard.
8a	When customer line is idle— Operate 3WO key.	
9	Observe VMA meter. ***Note:*** Operate VM REV key if VMA meter reads in reverse direction.	If battery is present on ring of line— Connection is set up to ring party or individual line. If battery is present on tip of line— Connection is set up to ring party. If ground is present on ring of line—

STEP	ACTION	VERIFICATION
		Connection is set up to PBX hunting line including last line of hunting group.
10	Restore 3WO and VM REV (if operated) key(s).◀	
	Customer Line Conductor Tests Via the Plugging-up Line Circuit, the Permanent Signal Holding Trunk Circuit, or the Common Overflow Trunk Circuit	
11	▶Operate SCO key.◀	
12	At jack, lamp, and key circuit— Patch T2 jack to L jack of plugging-up line circuit or T jack of trunk circuit.	At OTF— BY2 lamp ***not*** lighted.
13	▶Restore SCO key.◀	
	Outgoing Trunk Conductor Tests	
14	▶Operate SCO key.◀	
15	At jack, lamp, and key circuit— Patch T2 jack to T jack of trunk circuit associated with outgoing trunk being tested.	At OTF— BY2 lamp ***not*** lighted.
16	▶Restore SCO key.◀ ***Note:*** Lighted BY2 lamp indicates a busy condition; in which case, the T1 jack may be used for monitoring the busy trunk.	

4. METHOD

STEP	ACTION	VERIFICATION
	A. Continuity Test of Customer Line Conductors Equipped With Cold-Cathode Tube Type Telephone Sets	
17	Operate VMT1/VMT2 key. ***Note:*** VMT1 and T1 REV keys should be used when access is through line test feature. VMT2 and T2 REV keys should be used when access is through T2 jack.	Steady voltmeter reading of less than 67 volts (120-volt scale). ***Note 1:*** This voltmeter reading of less than 67 volts indicates that the conductor insulation resistance is more than 50,000 ohms. It should be noted whether the reading is above or below 45 volts. ***Note 2:*** A steady voltmeter reading of more than 67 volts indicates that the conductor

STEP	ACTION	VERIFICATION
		insulation resistance is less than 50,000 ohms, in which case, this test should not be made.
18	Restore VMT1/VMT2 key.	
19	Operate -STA (negative station) key.	
20	Operate VMT1/VMT2 key.	When voltmeter reading obtained in Step 17 for conductor being tested is between 0 and 45 volts— Steady voltmeter reading of more than 17 volts (120-volt scale) indicating that the station tested for is connected and the tube is operative. When voltmeter reading obtained in Step 17 for conductor being tested is between 45 and 67 volts— Steady voltmeter reading of more than 24 volts (120-volt scale) indicating that the station tested for is connected and the tube is operative. ***Note:*** If, as on an 8-party line, two stations of the same polarity are connected to the same conductor, this test checks that at least one station of the polarity tested for is connected, but does not distinguish between one and two stations.
21	Restore VMT1/VMT2 key.	
22	Operate +STA (positive station) key.	
23	Repeat Steps 20 and 21.	
24	Restore +STA key.	
25	Operate T1 REV/T2 REV key.	
26	Repeat Steps 17 through 25.	
27	Restore T1 REV/T2 REV key.	SL lamp extinguished.
29	Remove patching cord, if used, and not required in next test.	

B. Tests for Trouble Conditions—Customer Line or Outgoing Trunk Conductors

Note: When testing for trouble conditions on outgoing trunk conductors, make arrangements to have the trunk conductors opened at the

STEP	ACTION	VERIFICATION
	distant end until the test or series of tests is completed.	
	Test for Foreign Battery on Ring Conductor	
17	Operate FEMF key.	
18	Operate VMT1/VMT2 key.	No steady voltmeter reading.
	Note: VMT1 and T1 REV keys should be used when access is through line test feature. VMT2 and T2 REV keys should be used when access is through T2 jack.	***Note:*** If there is a steady voltmeter reading to the right of 0 volts, the conductor is crossed to negative voltage. If the reading is to the left, the cross is to positive voltage, at which time the VM REV key should be operated for verification and then restored.
19	Restore VMT1/VMT2, FEMF keys.	
	Test for Foreign Battery on Tip Conductor	
20	Operate T1 REV/T2 REV key.	
21	Repeat Steps 17 through 19.	
22	Restore T1 REV/T2 REV key.	
	Test for Ring Conductor Resistance to Ground	
23	Operate VMT1/VMT2 key.	Steady voltmeter reading.
		Note: Tables A, B, C, and D should be used to determine the resistance. Operate the AM, 1000, or 20,000 key, as required, to obtain the reading which is closest to midscale.
24	Restore VMT1/VMT2 key and, if operated, AM, 1000, or 20,000 key.	
	Test for Tip Conductor Resistance to Ground	
25	Operate T1 REV/T2 REV key.	
26	Repeat Steps 23 and 24.	
27	Restore T1 REV/T2 REV key.	
	Test for Tip to Ring Conductor Resistance	
28	Operate G key.	
29	Repeat Steps 23 and 24.	

TABLE A

100,000-OHM METER RESISTANCE
120- OR 150-VOLT SCALE
20,000; 1000; AM KEYS NONOPERATED

METER READING VOLTS	RESISTANCE — OHMS TEST BATTERY VOLTAGE 99	100	101
100		0	1,000
98	1,020	2,040	3,061
96	3,125	4,166	5,208
94	5,319	6,382	7,446
92	7,608	8,695	9,782
90	10,000	11,110	12,220
88	12,500	13,640	14,770
86	15,120	16,280	17,440
84	17,860	19,050	20,240
82	20,730	21,950	23,170
80	23,750	25,000	26,250
78	26,920	28,200	29,490
76	30,260	31,580	32,890
74	33,780	35,130	36,490
72	37,500	38,890	40,280
70	41,430	42,860	44,280
68	45,590	47,060	48,530
66	50,000	51,510	53,030
64	54,690	56,250	57,810
62	59,680	61,290	62,900
60	65,000	66,670	68,330
58	70,690	72,410	74,140
56	76,780	78,570	80,360
54	83,330	85,180	87,040
52	90,380	92,310	94,230
50	98,000	100,000	102,000
48	106,200	108,300	110,400
46	115,200	117,400	119,600
44	125,000	127,300	129,500
42	135,700	138,100	140,500
40	147,500	150,000	152,500
38	160,500	163,200	165,800
36	175,000	177,800	180,600
34	191,200	194,100	197,100
32	209,400	212,500	215,600
30	230,000	233,300	236,700
28	253,600	257,100	260,700
26	280,800	284,600	288,500
24	312,500	316,700	320,800
22	350,000	354,500	359,100
20	395,000	400,000	405,000
18	450,000	455,600	461,100
16	518,700	525,000	531,300
14	607,100	614,300	621,400
12	725,000	733,300	741,700
10	890,000	900,000	910,000
8	1,137,000	1,150,000	1,162,000
6	1,550,000	1,367,000	1,583,000
4	2,375,000	2,400,000	2,425,000
2	4,850,000	4,900,000	4,950,000

TABLE B

20,000-OHM METER RESISTANCE
20- OR 30-VOLT SCALE
20,000 KEY OPERATED
1000; AM KEYS NONOPERATED

METER READING VOLTS	RESISTANCE — OHMS TEST BATTERY VOLTAGE 19.4	20	20.6
20		0	600
19.6		408	1,020
19.2	208	833	1,458
18.8	638	1,276	1,914
18.4	1,086	1,739	2,392
18.0	1,556	2,222	2,888
17.6	2,046	2,727	3,410
17.2	2,558	3,255	3,954
16.8	3,096	3,809	4,524
16.4	3,658	4,390	5,122
16.0	4,250	5,000	5,750
15.6	4,872	5,641	6,410
15.2	5,526	6,315	7,106
14.8	6,236	7,027	7,838
14.4	6,944	7,777	8,612
14.0	7,714	8,571	9,428
13.6	8,530	9,411	10,290
13.2	9,394	10,300	11,210
12.8	10,310	11,250	12,260
12.4	11,290	12,260	13,230
12.0	12,330	13,330	14,330
11.6	13,450	14,480	15,520
11.2	14,640	15,710	16,790
10.8	15,930	17,040	18,150
10.4	17,310	18,460	19,620
10.0	18,800	20,000	21,200
9.6	20,420	21,670	22,920
9.2	22,170	23,480	24,780
8.8	24,090	25,450	26,820
8.4	26,190	27,620	29,050
8.0	28,500	30,000	31,500
7.6	31,050	32,630	34,210
7.2	33,890	35,360	37,220
6.8	37,060	38,820	40,590
6.4	40,620	42,500	44,380
6.0	44,670	46,670	48,670
5.6	49,290	51,430	53,570
5.2	54,620	56,920	59,230
4.8	60,830	63,330	65,830
4.4	68,180	70,910	73,640
4.0	77,000	80,000	83,000
3.6	87,780	91,110	94,450
3.2	101,200	105,000	108,800
2.8	118,600	122,900	127,100
2.4	141,700	146,700	151,700
2.0	174,000	180,000	186,000
1.6	222,500	230,000	237,500
1.2	303,300	313,300	323,300
0.8	465,000	480,000	495,000
0.4	950,000	980,000	1,010,000

TABLE C

1000-OHM METER RESISTANCE
30-VOLT SCALE
1000 KEY OPERATED
20,000; AM KEYS NONOPERATED

METER READING VOLTS	RESISTANCE — OHMS TEST BATTERY VOLTAGE 19.4	20	20.6
20.0		0	30
19.6		20	51
19.2	10	42	73
18.8	32	63	96
18.4	54	87	120
18.0	78	111	144
17.6	102	136	171
17.2	128	163	198
16.8	155	190	226
16.4	183	220	256
16.0	213	250	288
15.6	244	282	321
15.2	276	316	355
14.8	312	351	392
14.4	347	389	431
14.0	386	428	471
13.6	427	471	515
13.2	470	515	561
12.8	516	563	613
12.4	565	613	661
12.0	617	667	717
11.6	672	724	776
11.2	732	786	839
10.8	796	852	907
10.4	865	925	981
10.0	940	1,000	1,060
9.6	1,021	1,083	1,146
9.2	1,109	1,174	1,239
8.8	1,205	1,273	1,341
8.4	1,310	1,381	1,452
8.0	1,425	1,500	1,575
7.6	1,553	1,632	1,711
7.2	1,694	1,778	1,861
6.8	1,853	1,941	2,029
6.4	2,031	2,125	2,219
6.0	2,233	2,333	2,433
5.6	2,464	2,571	2,679
5.2	2,731	2,846	2,962
4.8	3,042	3,167	3,292
4.4	3,409	3,545	3,682
4.0	3,850	4,000	4,150
3.6	4,389	4,556	4,722
3.2	5,062	5,250	5,438
2.8	5,929	6,143	6,357
2.4	7,083	7,333	7,583
2.0	8,700	9,000	9,300
1.6	11,130	11,500	11,880
1.2	15,170	15,670	16,170
.8	23,250	24,000	24,750
.4	47,500	49,000	50,500

TABLE D

200-OHM METER RESISTANCE
300-MILLIAMMETER SCALE
AM KEY OPERATED
20,000; 1000 KEYS NONOPERATED

METER READING MILLIAMPERES	RESISTANCE — OHMS CENTRAL OFFICE BATTERY VOLTAGE 47	48.5	50
250			0
245			4.1
240		2.1	8.3
235	0	6.4	12.8
230	4.3	10.9	17.4
225	8.9	15.6	22.2
220	13.6	20.5	27.3
215	18.6	25.6	32.6
210	23.8	31.0	38.1
205	29.3	36.6	43.9
200	35.0	42.5	50.0
195	41.0	48.7	56.4
190	47.4	55.1	63.2
185	54.1	62.2	70.3
180	61.1	69.4	77.8
175	68.6	77.1	85.7
170	76.5	84.5	94.1
165	84.9	93.9	103.0
160	93.8	103.1	112.5
155	103.2	112.9	122.6
150	113.3	123.3	133.3
145	124.1	134.5	144.8
140	135.7	146.4	157.1
135	148.2	159.3	170.4
130	161.5	173.1	184.6
125	176.0	188.0	200.0
120	191.7	204.2	216.7
115	208.7	221.7	234.8
110	227.3	240.9	254.6
105	247.6	261.8	276.2
100	270.0	285.0	300.0
95	294.7	310.5	326.3
90	322.2	338.9	355.6
85	352.9	370.6	388.2
80	387.5	406.2	425.0
75	426.7	446.7	466.7
70	471.4	492.9	514.3
65	523.1	546.2	569.2
60	588.3	608.3	633.3
55	654.6	681.8	709.1
50	740.0	770.0	800.0
45	844.0	878.0	911.0
40	975.0	1013.0	1050.0
35	1143.0	1186.0	1229.0
30	1367.0	1417.0	1467.0
25	1680.0	1740.0	1800.0
20	2150.0	2225.0	2300.0
15	2933.0	3033.0	3133.0
10	4500.0	4650.0	4800.0
5	9200.0	9500.0	9800.0
0			

STEP	ACTION	VERIFICATION
30	Restore G key.	
	Test for Capacity on Tip and Ring Conductors	
31	Operate G, T1 REV/T2 REV, VMT1/VMT2 keys. ***Note:*** Do not proceed with this test until there is a steady voltmeter reading indicating that the line or outgoing trunk conductors are fully charged.	
32	Restore T1 REV/T2 REV key.	Momentary (ballistic) voltmeter deflection returning to a steady reading. ***Note:*** The degree of the momentary voltmeter deflection depends on the ring conductor capacity and insulation resistance. To determine the insulation resistance from the steady reading, use Table A. To determine the correct degree of momentary deflection, use Table E.
33	Operate T1 REV/T2 REV key.	Momentary (ballistic) voltmeter deflection returning to a steady reading. ***Note 1:*** The degree of the momentary voltmeter deflection depends on the tip conductor capacity and insulation resistance. To determine the insulation resistance from the steady reading, use Table A. To determine the correct degree of momentary deflection, use Table E. ***Note 2:*** When testing outgoing trunk conductors, the degree of the momentary deflections in Step 33 and 34 should be equal.
34	Restore G, T1 REV/T2 REV, VMT1/VMT2, FEMF keys.	
35	Momentarily operate RLS key.	SL lamp extinguished.
36	Remove patching cord, if used, and not required in next test.	

C. Metallic Meter Test—Outgoing Trunk Conductors

Caution: To protect the milliammeter, a check for foreign battery on the tip and ring conductors (see Test B)

TABLE E

BALLISTIC DEFLECTIONS USING 100,000-OHM METER RESISTANCE 20,000; 1000; AM KEYS NONOPERATED

These values are approximate and are based on zero customer loop

TYPE OF LINE	EQUIPMENT ON LINE		BALLISTIC DEFLECTION OF POINTER INSULATION RESISTANCE OF LINE				
			INFINITE OHMS	500,000 OHMS	200,000 OHMS	100,000 OHMS	50,000 OHMS
Individual Line	No. 68A (1400 ohms) ringer with 1-mf capacitance bridged across line		50	53	57	63	72
Individual Line	No. 8AA (1000 ohms) ringer with 2-mf capacitance bridged across line		77	74	73	74	78
2-Party Message Rate or 2-Party Flat Rate	No. 68AA (1000 ohms) or No. 68A (1400 ohms) ringer in series with 1-mf capacitance legged from one side of line to ground		25	35	45	57	70
2-Party	No. 8AA (1000 ohms) ringer in series with 2-mf capacitance legged from one side of line to ground		39	46	53	62	72
4-Party Semiselective	No. 68A (1400 ohms) ringer in series with 1-mf capacitance, two stations legged from one side of line to ground		40	46	53	62	72
4-Party Semiselective	No. 8AA (1000 ohms) ringer in series with 2-mf capacitance, two stations legged from one side of line to ground		55	59	63	69	76
4-Party Full Selective	85-type relay in series with 0.5-mf capacitance bridged across line	1 station	30	38	47	57	70
		2 stations	51	54	58	65	73
		3 stations	67	66	67	70	76
		4 stations	79	76	74	75	79
4-Party Full Selective	85-type relay in series with 0.5-mf capacitance bridged across line	1 station	50	53	57	63	72
		2 stations	78	75	73	74	78
		3 stations	97	90	85	83	83
		4 stations	110	101	94	89	86
19- and 22-Gauge Cable		5 miles	22	32	42	55	68
		10 miles	38	44	51	60	71
		15 miles	49	53	58	64	73
		20 miles	57	59	63	68	75
		25 miles	64	65	67	72	77
		30 miles	69	70	71	74	78
24-Gauge Cable		5 miles	21	31	42	55	68
		10 miles	35	42	50	59	71
		15 miles	45	50	56	63	73
		20 miles	53	56	60	67	75
		25 miles	59	61	65	71	76
		30 miles	64	66	68	72	77

STEP	ACTION	VERIFICATION
	should be made before proceeding with this test.	
17	Operate RG, FEMF, AM keys.	
18	Operate VMT2 key.	Steady ammeter reading. ***Note:*** If there is a steady ammeter reading to the left of 0 milliamperes, operate the T2 REV key.
19	Restore AM key.	Steady voltmeter reading indicating proper voltage and polarity. ***Note:*** If there is a steady voltmeter reading to the left of 0 volts, operate or restore the T2 REV key.
20	Restore VMT2, FEMF, RG, T2 REV keys.	
21	Momentarily operate RLS key.	SL lamp extinguished.
22	Remove patching cord if not required in next test.	
D. Continuity and Polarity Test—Outgoing Trunk Conductors		
17	Operate RG, FEMF keys.	
18	Operate VMT2 key.	Steady voltmeter reading indicating proper voltage and polarity. ***Note:*** If there is a steady voltmeter reading to the left of 0 volts, operate T2 REV key.
19	Restore VMT2, RG, FEMF, T2 REV keys.	
20	Momentarily operate RLS key.	SL lamp extinguished.
21	Remove patching cord.	