

**J98710U EXPRESS OFFICE REPEATER PANEL
PAIR-LOSS MEASUREMENTS
T1 AND T1/OS DIGITAL LINES
DIGITAL TRANSMISSION SYSTEMS**

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1. GENERAL

1.01 This section contains the procedures for making pair-loss measurements on T1 or T1/OS repeatered line cable sections between the J98710U express office repeater panel (EORP) and the first apparatus case.

1.02 The reasons for reissuing this section are listed below. Since this reissue is a general revision, no revision arrows have been used to denote significant changes.

- (1) To include T1/OS digital lines in pair-loss measurement tests

- (2) To replace Form E-4946 with Form E-6779
 - (3) To add a calibration procedure for the 113-type test set and the J98725AA test set
 - (4) To add a pair-loss measurement procedure using the J98725AA test set
 - (5) To add a dc test using the J98725AA test set.
- 1.03** To meet central office requirements for T1 and T1/OS digital lines, the following modes of cable-repeater operation are available:
- (a) One cable using bidirectional line repeaters
 - (b) One cable using unidirectional line repeaters
 - (c) Two cables using bidirectional line repeaters
 - (d) Two cables using unidirectional line repeaters
 - (e) One cable (screened) using bidirectional or unidirectional line repeaters.

Both directions of transmission are carried in a single cable sheath using modes (a), (b), and (e); whereas, each direction of transmission is carried in a separate cable sheath using modes (c) and (d). Modes (a) and (d) are the most widely used arrangements for T1 digital lines. The procedures in this section are based on line repeater operation and not on the number of cables.

1.04 The pair-loss measurements help to ensure the correctness of splicing and to secure an average pair loss that is based on all cable pairs in the regenerative section. The measurements are made on an out-of-service basis only, usually as

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part of the installation tests associated with the preparation of a route for the T1 or T1/OS carrier system. If the facilities of a working system must be remeasured, however, the procedures in Section 365-226-500 (T1) or Section 365-224-600 (T1/OS) should be followed for patching equipment out of service.

1.05 The repeaters used in an EORP have an automatic line buildout (ALBO) which eliminates the need for 836-type line buildout (LBO) networks. However, the repeaters are designed as line repeaters and it is necessary to compensate for the short-end sections between the central office and the first apparatus case. Either 3-dB flat loss pads or 7.5 dB (100-ohm) artificial line networks are connected in series with the inputs and outputs of the repeaters for this purpose. (See Section 365-200-105.) The 3-dB loss pad or 7.5 dB (100-ohm) artificial line or the through connector must be installed in the span line before attempting pair-loss measurements. If the 3-dB pad or 7.5 dB (100-ohm) artificial line is installed rather than the through connector, the measurements must be adjusted accordingly.

1.06 All pair-loss measurements are made with the J98725AA T1C/T1 test set or the 113-type test set. Both types are designed to measure the loss of a conductor pair in T1 or T1/OS systems at a frequency of 650 kHz. The sets are used in pairs—one to send from one repeater location and the other to receive and measure the level at an adjacent repeater location. Similar sets must be used to test a cable pair. Personnel using the J98725AA or the 113-type test sets are required to have a knowledge of their operation. Descriptive and operative information is provided in Section 103-493-100 (113A test set), Section 103-493-101 (113B test set), and Section 103-494-104 (J98725AA test set).

1.07 The 113A or 113B test set probe must be used with the 217A, 247A, or 247B adapter to enable insertion into the EORP, 475-type apparatus case, or 479-type apparatus case (equipped with the 245A or 253A adapter). The 246A adapter or 246B adapter can be used with the 113-type test set probe at the 479-type apparatus case; but not without first removing the 245A or 253A adapter

installed in the repeater slot. All adapters necessary to enable insertion of the J98725AA test set probe into the EORP or apparatus case are furnished with the test set.

1.08 Before attempting T1 pair-loss measurements, permanent ABAM cable connections must be made between the EORP and the cable vault or the main distributing frame (MDF) in order to ensure the accuracy of the test results.

1.09 In a bidirectional mode of transmission containing up to 25 systems, two E-6779 forms (Fig. 1) are used for recording measurements (one for repeater side 1 and one for repeater side 2). In a unidirectional mode of transmission containing up to 50 systems, four E-6779 forms are used (two for recording measurements of repeater side 1 and two for recording measurements of repeater side 2). The data recorded must be evaluated in order to determine if the dc tests are to be performed. If the 113-type test sets are used, dc tests are performed per Section 365-227-500. If the J98725AA test sets are used, dc tests are performed per Part 6 of this section. The evaluation in paragraphs 1.10 through 1.12 consists of totaling the checks in each column and then using the following procedures to determine if the individual pairs are satisfactory for T1 or T1/OS systems.

EVALUATION

1.10 After all cable pairs of a group have been tested, the number of measurements falling in each column of Form E-6779 should be totaled, and the column containing the largest number of tallies should be noted. Pairs are considered satisfactory for use if their indicated LBO or loss range readings fall in:

- (a) the column having the largest total,
- (b) the column lettered the same but opposite in sign (- or +) of the column having the largest total,
- (c) the + column of the next lower letter, or
- (d) the - column of the next higher letter.

EXAMPLES

LARGEST TOTAL (COLUMN)	ACCEPTABLE CABLE PAIRS (COLUMNS)
E-	D+ E- E+ F-
F-	E+ F- F+ G-

Pairs measuring outside the limits (such as D+ and F- in Fig. 2) should be examined for trouble. An additional precaution can be taken against future line trouble by checking any pair that falls in a column not adjacent to the column with the largest number of checks (column F- in Fig. 2 in addition to pairs in columns C+ and F+).

1.11 The readings between two adjacent locations should not differ markedly between side 1 and side 2. The column with the largest total of checks for side 1 should be adjacent to the column with the largest total for side 2. For example, if the reading for side 1 indicates that the largest total of checks is in E- column, the reading for side 2 must then have the largest total of checks in D+, E-, or E+.

1.12 If the requirement of paragraph 1.11 is not met, one of the test sets is suspected to be faulty. The test sets should be checked by exchanging sets between locations and repeating the measurements. If the measurements are the same as those previously taken, the test sets are in acceptable condition. If the measurements reverse, one of the test sets requires maintenance. Both sets should be returned for repair in accordance with local instructions. Obtain two more sets and repeat the measurements.

2. APPARATUS

2.01 The following apparatus is required for performing the tests in this section.

At the EORP

1—J98725AA T1C/T1 Pair Loss Test Set or 113A or 113B Test Set

1—217A, 247A, or 247B Adapter (see paragraph 1.07)

At the Repeater Apparatus Case

1—J98725AA T1C/T1 Pair Loss Test Set or 113A or 113B Test Set

1—217A, 247A, or 247B Adapter (when 475-type apparatus cases are used; see paragraph 1.07)

1—246A or 246B Adapter (when 479-type apparatus cases are used; see paragraph 1.07)

3. PREPARATION

3.01 It is not necessary for the entire span to be spliced in before the pair-loss measurements are made. Pair-loss measurements can be made as soon as the EORP and the first apparatus cases are installed.

3.02 Air pressure must be released in the apparatus case and the cover removed as outlined in Section 640-525-210.

3.03 In the event that testing will be done before the order wire is in operation, it will be necessary to establish communication between the two locations. This can be most conveniently accomplished by the use of a 76-type test set connected to the order wire terminals in the apparatus case. Other locally approved methods are acceptable.

4. CALIBRATION OF TEST SETS

4.01 Each test set must be calibrated before being used to make pair-loss measurements. Although calibration is obtained in the following procedure, it must be maintained throughout the pair-loss measurement test in Part 5 to ensure accurate measurements.

STEP	PROCEDURE
A. 113-TYPE TEST SETS	
1	Remove the test set cover.
2	Set the FUNCTION switch to BAT.
Requirement: The meter needle should move beyond midscale (MED).	
Note: If the requirement is not met replace the batteries per Section 103-493-100.	
3	Insert the probe in the probe cavity (113A test set only).
4	Set the FUNCTION switch to the CAL position (113A or 113B test set).
5	For cable temperatures between 33°F and 77°F, adjust the CAL control until the meter needle is at MED.
6	For cable temperatures below 33°F, adjust the CAL control as follows:
(a) If the section of span line to be measured is less than or equal to 3000 feet, adjust the CAL control until the meter needle is centered between LO and MED.	
(b) If the section of span line to be measured is greater than 3000 feet, adjust the CAL control until the meter needle is at LO (left side of the meter scale).	
7	For cable temperatures above 77°F, adjust the CAL control as follows:
(a) If the section of span line to be measured is less than or equal to 3000 feet, adjust the CAL control until it is centered between MED and HI.	
(b) If the section of span line to be measured is greater than 3000 feet, adjust the CAL control until the needle is at HI (right side of the meter scale).	
Note: The underground cable temperatures will be influenced by the depth at which the cable is placed. Generally, the underground cable temperature will be 40 to 60°F. However, in extremely hot or cold climates, the cable temperature may be above 77°F or below 33°F. Obtain the underground cable temperature by measuring the duct temperature with a thermometer. The aerial cable temperature is approximately the same as air temperature, and for the purpose of calibrating the test set, this temperature may be assumed to be the cable temperature.	
B. J98725AA T1C/T1 TEST SET	
1	Remove the test set cover.
2	Set the FUNCTION switch to LED CHK and the power switch to ON.
Requirement: BAT, LO, and HI lamps should light.	

STEP	PROCEDURE
	<p>Note: If the requirement is met, proceed to Step 3. If the requirement is not met, change the batteries per Section 103-494-104. If the requirement is still not met, the test set is defective and cannot be used for pair-loss measurement.</p>
3	<p>Set the test set controls as follows:</p> <p style="padding-left: 40px;">FUNCTION to CAL TEST to AC DC CONN/SYSTEM to T1</p> <p>Note: The LO lamp will light when the DC CONN/SYSTEM switch is set to T1.</p>
4	Adjust the CAL potentiometer for a meter indication at the midscale MED mark.
5. PAIR-LOSS MEASUREMENTS	or the repeater location to obtain a reading in a given repeater slot or if the readings differ markedly from the mean, that particular cable pair should be examined for trouble after all repeater slots have been measured. Trouble location for cable pairs is the same as that for trunk cable.
<p>5.01 After completing the preparatory steps in Part 3 and calibrating the test sets per Part 4, the applicable pair-loss measurements must be performed as follows.</p>	
	<p>Note: In any of the following tests, if it is not possible for the tester at either the EORP</p>

STEP	PROCEDURE
	<p>Note: Record the test results of the following procedure on Form E-6779 (Fig. 1) per the example in Fig. 2.</p>
	<p>A. USING THE 113-TYPE TEST SET</p>
1	After calibration of the 113-type test sets, insert the 217A, 247A, or 247B adapter into repeater slot 1 on the EORP associated with the first cable pair to be tested (see Fig. 3).
2	Insert the test set probe into the adapter.
3	At the EORP, set the FUNCTION switch as follows. (See Fig. 4.)

STEP

PROCEDURE

DIRECTION OF TEST	REPEATER TYPE	SIDE OF REPEATER TO BE MEASURED	SET FUNCTION SWITCH TO
West	Bidirectional or Unidirectional	Side 1	SEND A
		Side 2	REC B
Side 1		REC A	
Side 2		SEND B	
East			

Note: Complete tests in one direction before attempting the other.

- 4 At the apparatus case, insert the test set probe into the adapter(s) and then insert the adapter into repeater slot 1.

Note: See Table A for adapter(s) to use with test set probe at apparatus cases.

- 5 At the apparatus case, set the FUNCTION switch as follows. (See Fig. 4.)

APPARATUS CASE LOCATION	REPEATER TYPE	SIDE OF REPEATER TO BE MEASURED	SET FUNCTION SWITCH TO
West	Bidirectional or Unidirectional	Side 1	REC A
		Side 2	SEND B
Side 1		SEND A	
Side 2		REC B	
East			

- 6 At the EORP, test side 2 by scanning the range of the LBO switch until a reading is observed on the meter. Record the meter reading on Form E-6779 (Fig. 1). **Measurements are made at receiving end only.**

Note: If a reading is not observed on the meter and the test set is in working order, check for one of the following:

- (a) Stub cable improperly spliced into the main cable, or other metallic troubles
- (b) Defective cable pair

STEP	PROCEDURE
	(c) Load coils not removed from pair
	(d) Building-out capacitors not removed from pair.
7	Leave the FUNCTION switch on both test sets as is and repeat Steps 1, 2, and 6 for each of the remaining 24 repeater slots.
8	Recalibrate the 113-type test sets.
9	Change the FUNCTION switch position at both locations to test side 1, as indicated in Steps 3 and 5.
10	Test side 1 of all 25 repeater slots in the same manner as side 2, recording the data on Form E-6779 (Fig. 1).
11	Steps 1 through 10 are required for both directions.
12	Disconnect the test sets and perform data evaluation per paragraphs 1.10 and 1.11.
B. USING J98725AA T1C/T1 TEST SET	
Note: Testing for both sides of the repeater is always done in the direction of transmission of side 1 of the line repeater.	
1	After calibration of the test sets, insert the test set probe into repeater slot 1 on the EORP (see Fig. 3).
2	At the apparatus case, insert the test set probe into the adapter(s) (see Table B) and then into repeater slot 1.
Note: In the steps that follow, the EORP may be designated as the send location and the apparatus case as the receive location, or vice versa, depending on the direction of transmission of repeater side 1. (See Fig. 5).	
3	At both locations on the test sets, set the AC/DC TEST switch to AC and the DC CONN/SYSTEM switch to T1.
4	At the send location, set the FUNCTION switch to SEND A. (See Fig. 5.)
5	At the receive location, set the FUNCTION switch to RCV A. (Enter RCV A on Form E-6779.)
6	Set the LOSS switch to the letter position (A1 through M) for a meter indication closest to the MED mark.
7	Record the LOSS switch letter code and meter polarity indication on Form E-6779 for side 1.

STEP	PROCEDURE
	Note: In Steps 7 and 11 if the meter indication is balanced on the MED mark, place a check mark in both the + and - columns of the letter code indicated by the LOSS switch.
8	At the send location, set the FUNCTION switch to SEND B.
9	At the receive location, set the FUNCTION switch to RCV B. (Enter RCV B on another E-6779 form.)
10	Set the LOSS switch to the letter position for a meter indication closest to the MED mark.
11	Record the LOSS switch letter code and meter polarity indication on Form E-6779 for side 2.
12	At both locations, move the test set probe [with adapter(s) if attached] to the next repeater slot.
13	Steps 4 through 12 are required for both directions.
14	Disconnect the test sets and perform data evaluation per paragraphs 1.10 and 1.11.

6. DC TESTS USING J98725AA TEST SET

6.01 The dc tests are performed on any pair which does not meet the requirements of

paragraphs 1.10 and 1.11. The tests are performed with the J98725AA T1C/T1 test set. If this test set is not available, refer to Section 365-227-500 for dc tests.

STEP	PROCEDURE
1	After calibration of the test sets, insert the test set probe into the repeater slot on the EORP associated with the defective cable pair.
2	At both locations on the test sets, set the POWER switch to OFF, the AC/DC TEST switch to DC, and the DC CONN/SYSTEM switch to T-R.
3	At the apparatus case, insert the test set probe into the adapter(s) (see Table B) and then into the repeater slot associated with the cable pair used in Step 1.
4	At the receive location, set the FUNCTION switch as indicated on Form E-6779 that lists the defective pair.
5	At the transmit location, set the FUNCTION switch to SEND A (if receive location is set to RCV A) or SEND B (if receive location is set to RCV B).
6	At the receive location, connect an ohmmeter (KS-20599, L4 DMM or equivalent) to the DC TEST OUTPUT pin jacks on the test set.

STEP	PROCEDURE
7	Observe the ohmmeter and record the indication in the T-R OPEN column. Requirement: Ohmmeter should indicate open. Note: Proceed to Step 8 whether or not the requirement is met.
8	At the transmit location, depress and hold the LOOP SHORT switch.
9	At the receive location, observe the ohmmeter and record the indication in the T-R LOOP SHORT column.
10	At the transmit location, release the LOOP SHORT switch.
11	At both locations, set the DC CONN/SYSTEM switch to T-G.
12	At the receive location, observe the ohmmeter indication. Requirement: The ohmmeter should indicate open. Note: If the requirement is met, proceed to Step 13. If it is not met, record the indication on Form E-6779 in the T-G column preceded by the designation OC for open circuit test and proceed to step 16.
13	At the transmit location, depress and hold the LOOP SHORT switch.
14	At the receive location, observe the ohmmeter and record the indication in the T-G column preceded by the designation LS for loop short test. Requirement: The indication should be one-half of the value recorded in Step 9.
15	At the transmit location, release the LOOP SHORT switch.
16	At both locations, set the DC CONN/SYSTEM switch to R-G.
17	At the receive location, observe the ohmmeter indication. Requirement: The ohmmeter should indicate open. Note: If the requirement is met, proceed to Step 18. If it is not met, record the indication on Form E-6779 in the R-G column preceded by the designation OC for open circuit and proceed to Step 21.
18	At the transmit location, depress and hold the LOOP SHORT switch.
19	At the receive location, observe the ohmmeter and record the indication in the R-G column preceded by the designation LS for loop short. Requirement: The indication should be one-half of the value recorded in Step 9.

STEP	PROCEDURE
20	At the transmit location, release the LOOP SHORT switch.
21	If the defect in the cable pair has been identified in the preceding steps, take corrective action to clear the defect. Then repeat Part 4. If the defect has not been identified, refer to Section 365-227-500 for further tests to isolate the defect.

TABLE A

**ADAPTERS TO USE WITH 113-TYPE
TEST SET PROBE AT APPARATUS CASE**

APPARATUS CASE	REPEATER SLOT TYPE	ADAPTER
466 () or 468 ()	201 or 205	None required
475 ()	208, 209, 238, or 239	217A, 247A, or 247B
479 () (Equipped with 245A or 253A adapters)	208, 209, 238, or 239	217A, 247A, or 247B
479 () (Without adapters)	208, 209, 238, or 239	246A or 246B
818 () or 819 () (Replacement for 475-type apparatus case)	208, 209, 238, or 239	217A, 247A, or 247B
818 () or 819 () (Replacement for 479-type apparatus case)	208, 209, 238, or 239	245C and 217A, 247A, or or 247B

TABLE B

**ADAPTER(S) TO USE WITH J98725AA TEST SET
AT APPARATUS CASE**

APPARATUS CASE	REPEATER SLOT TYPE	ADAPTER
475 ()	208, 209 238, or 239	Not required
479 ()	218, 219 248, or 249	ED-3C559, G2
466 () 468 ()	201 or 205	ED-3C559, G2 and ED-3C559, G3
818 () or 819 () (Replacement for 475- type apparatus case)	238 or 239	Not required
818 () or 819 () (Replacement for 479- type apparatus case)	218, 219 248, or 249	ED-3C559, G2

PAIR LOSS TEST SET DATA SHEET

TEST SET USED 113A

SHELF	REPEATER SLOT	AC TEST																DC TEST													
		LBO OR LOSS SWITCH POSITION INCLUDING POLARITY OF DEVIATION																T-R		TG	RG										
		A1	A1	A	A	B	B	C	C	D	D	E	E	F	F	G	G	H	H			J	J	K	K	L	L	M	M	OPEN	LOOP SHORT
SHELF NUMBER 1	1										✓																				
	2										✓																				
	3											✓																			
	4											✓																			
	5											✓																			
	6											✓																			
	7											✓																			
	8											✓																			
	9											✓																			
	10											✓																			
	11											✓																			
	12											✓																			
	13											✓																			
SHELF NUMBER 2	14										✓																				
	15										✓																				
	16																									OPEN	211 Ω	1.5 Ω	1.5 Ω		
	17																														
	18																														
	19																														
	20																														
	21																														
	22																														
	23																														
	24																														
	25																														
TOTAL																															
		A1	A1	A	A	B	B	C	C	D	D	E	E	F	F	G	G	H	H	J	J	K	K	L	L	M	M				
		-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+	-	+				

LARGEST TOTAL IS IN COLUMN E1 ACCEPTABLE COLUMNS

FROM #284
TO #307

FUNCTION SWITCH POSITION SEND A
RELAY RACK NUMBER _____
OR
APPARATUS CASE NUMBER 5
DATE 1-20-76
TIME 3 PM
TESTER M.H. ALDRIDGE
CABLE NUMBER IDENTIFICATION 5627
COUNT 1-25

CONTINUITY CHECK
FAULT LOCATE PAIR
ORDER WIRE PAIR

E-6779 OCTOBER, 1977

CABLE	UNDERGROUND	AERIAL
	TYPE (CHECK ONE)	(22GACuPULP) ✓
LENGTH	4.5 KFT	

J98725AA SYSTEM SWITCH POSITION		
T1	T1C LO	T1C HI
✓		

Fig. 2—Measurement Recorded on Form E-6779

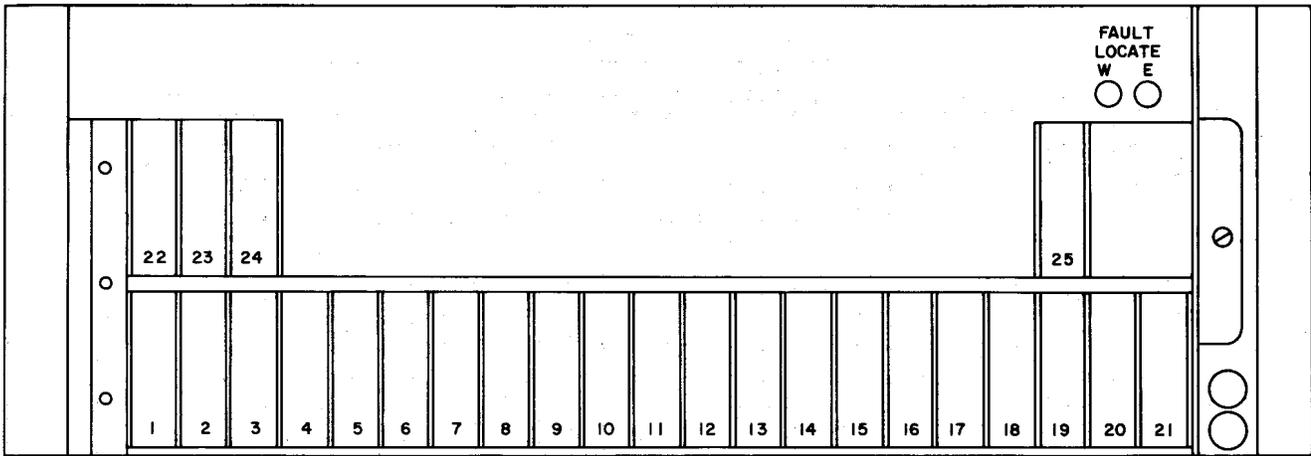
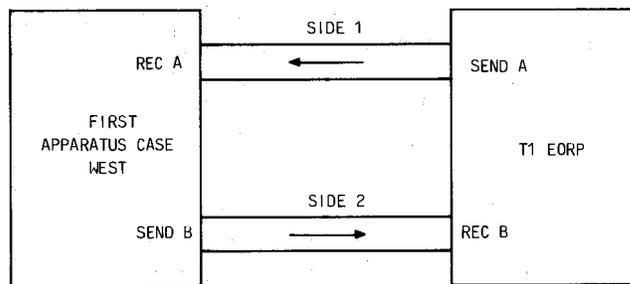
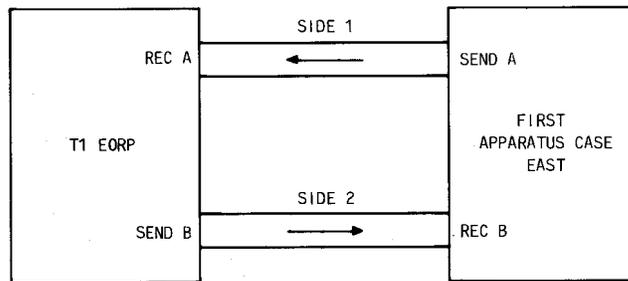


Fig. 3—T1 Carrier Express Office Repeater Panel Numbering

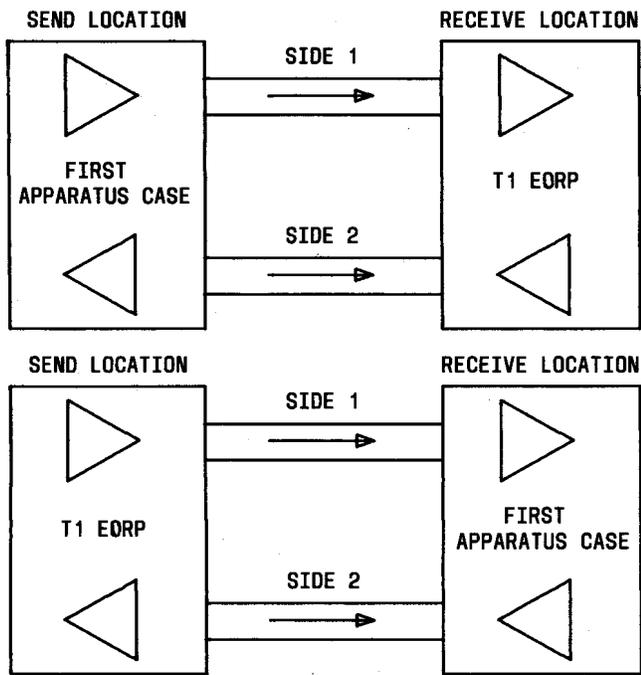


FUNCTION SWITCH SETTINGS FOR MEASURING BETWEEN THE EORP AND THE FIRST APPARATUS CASE WEST

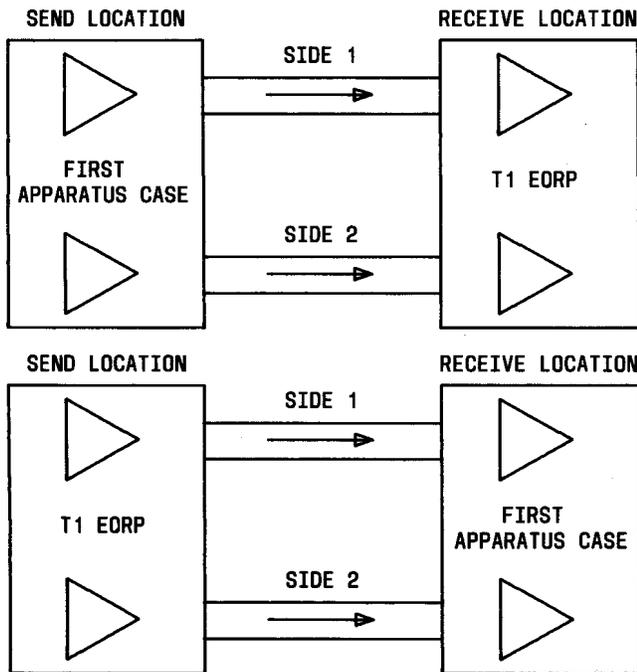


FUNCTION SWITCH SETTINGS FOR MEASURING BETWEEN THE EORP AND THE FIRST APPARATUS CASE EAST

Fig. 4—113-Type Test Set Function Switch Settings for Measuring Between the EORP and the First Apparatus Case



A - BIDIRECTIONAL SYSTEM



B - UNIDIRECTIONAL SYSTEM

NOTE:
ARROWS INDICATE DIRECTION OF TRANSMISSION TEST.

Fig. 5—Send and Receive Locations Using J98725 T1C/T1 Test Set