SPECIAL SERVICE LINK LINEUP
CENTRAL OFFICE TO CENTRAL OFFICE
2-WIRE LINK USING E6 REPEATERS

CONTENTS PAGE

1. GENERAL

1.01 The E6 repeatered line is used in several types of special service circuits. Each of these special service circuits may consist of one or more of the following links: private branch exchange (PBX) to central office (CO), CO to CO, and CO to station. This section provides the lineup procedure for the CO to CO 2-wire link.

1.02 This section is reissued to include information and adjustment procedure for new line building-out (LBO) networks and the KS-20501 return loss measuring set (RLMS). Since this is a general revision, arrows normally used to indicate changes have been omitted.

1.03 The CO to CO link may include E6 repeaters, repeater disablers, dial long line (DLL) units, and LBO networks on loaded lines. The equipment used in individual links varies widely; therefore, the procedures in this section rely on the circuit layout record (CLR) to provide the necessary details for specific links.

1.04 The CLR provides the following information:

(a) Equipment used at CO.

(b) Initial adjustments or prescription settings of all E6 repeater LBO networks and gain units. Temperature corrections, if required, are included.

(c) Simplex or loop strapping options for E6 repeater disablers.

(d) Diagram of special service circuit showing 1-kHz net loss and echo return loss requirement for each link.

(e) Overall expected measured loss (EML) for the special service circuit.

1.05 The lineup of CO to CO links begins with initial adjustments of the E6 repeater LBO networks and gain units according to the information on the CLR. Gain is checked with the J99254A (54A) transmission measuring set (TMS); final LBO network adjustments, if required, are made using the J99254C (54C) RLMS. Where available, the KS-20501 RLMS (103-106-115) may be used as an alternative to the 54C set. It is powered from commercial 60-Hz supply only and needs no auxiliary supply. Where this section specifies using the 500- to 2500-Hz sweep of the 54C set, the echo range of the KS set may be used. Where this section specifies using the 2000- to 3000-Hz sweep, the high range of the KS set may be used. Although the readings of the 54C and the KS sets would usually differ a little from each other, the same numerical requirements should be used for the readings of the KS set and the 54C set.

2. APPARATUS

2.01 The following listed test apparatus or the equivalent is required for performing the CO to CO lineup:

1—Line Extension Cord ED-97023-30

1—J99254A, L1 Transmission Loss Measuring Set (54A) with Cords

1—J99254B Test Stand (54B)

1—J99254C Return Loss Measuring Set (Required only if LBO networks are adjusted)

1—Circuit Layout Record.

3. LINK WITH 837A, 837B, 837E, 837F, OR 837G NETWORK AT CO1; LOADED CABLE; AND 830A, 830B, OR 830G NETWORK AT CO2

3.01 With this circuit layout, network adjustments are made in accordance with the CLR. No change in gain adjustment for this link is required.

4. LINK WITH 830A OR 830B NETWORK AT CO1, LOADED CABLE, AND NO NETWORK AT CO2

4.01 With this circuit layout, network adjustments are made in accordance with the CLR. No change in gain adjustment for this link is required.

5. LINEUP

5.01 For circuit layouts that call for links between central offices, the repeater gain and LBO settings should be set according to the CLR. The settings of the LBO networks do not need to be optimized unless there is doubt about the end sections. Part 6 provides the procedure for optimizing the LBO networks. The E6 repeaters may be located at either end of the link or at an intermediate CO. To check the gain of the E6 repeater, the procedure in the following steps should be used:

STEP	PROCEDURE
1	Consult the CLR to determine gain settings of the 831-type network in the E6 repeater. *Note:* Under certain circumstances, the gain of a single repeater will be used to supply gain for two adjacent links. The gain on the CLR for those cases will be higher than that ordinarily required. The single repeater would also contain the proper LBO for the adjacent link. If a repeater disabler is used on this link, the enabler relay must be blocked in its operated position.
2	Check the gain of the E6 repeater by using the procedure in the following steps.
3	Place the printed wiring-board side of the 831-type network face up. Loosen screws A through K and 1 through 9. All adjustments on the gain network are now made by tightening some of these screws. Contact with the printed wiring-board conductors is made under the screwheads. Therefore, the screwheads should be either fully down on or fully clear of the printed wiring board as required.
4	Set the 54B test stand and 54A TMS near the −48 volt power distribution outlet, which is provided on bays equipped with E6 repeaters.
5	Connect −48 volt power to the 54B test stand and connect the test stand to the 54A TMS, as shown in Fig. 1. *Note:* The 54A TMS has neither a switch to apply power nor a pilot light. No warm-up period is necessary. No connection to the cable pairs is required for the gain adjustment of the 831-type network.
6	Carefully insert the repeater into the 54B test stand. Lower (do not drop or force) the repeater into the stand so that the repeater terminals at the back of the repeater fit into the connector of the test stand. Rotate the head of the 54B test stand so that the 831-type gain unit side of the repeater is easily accessible.

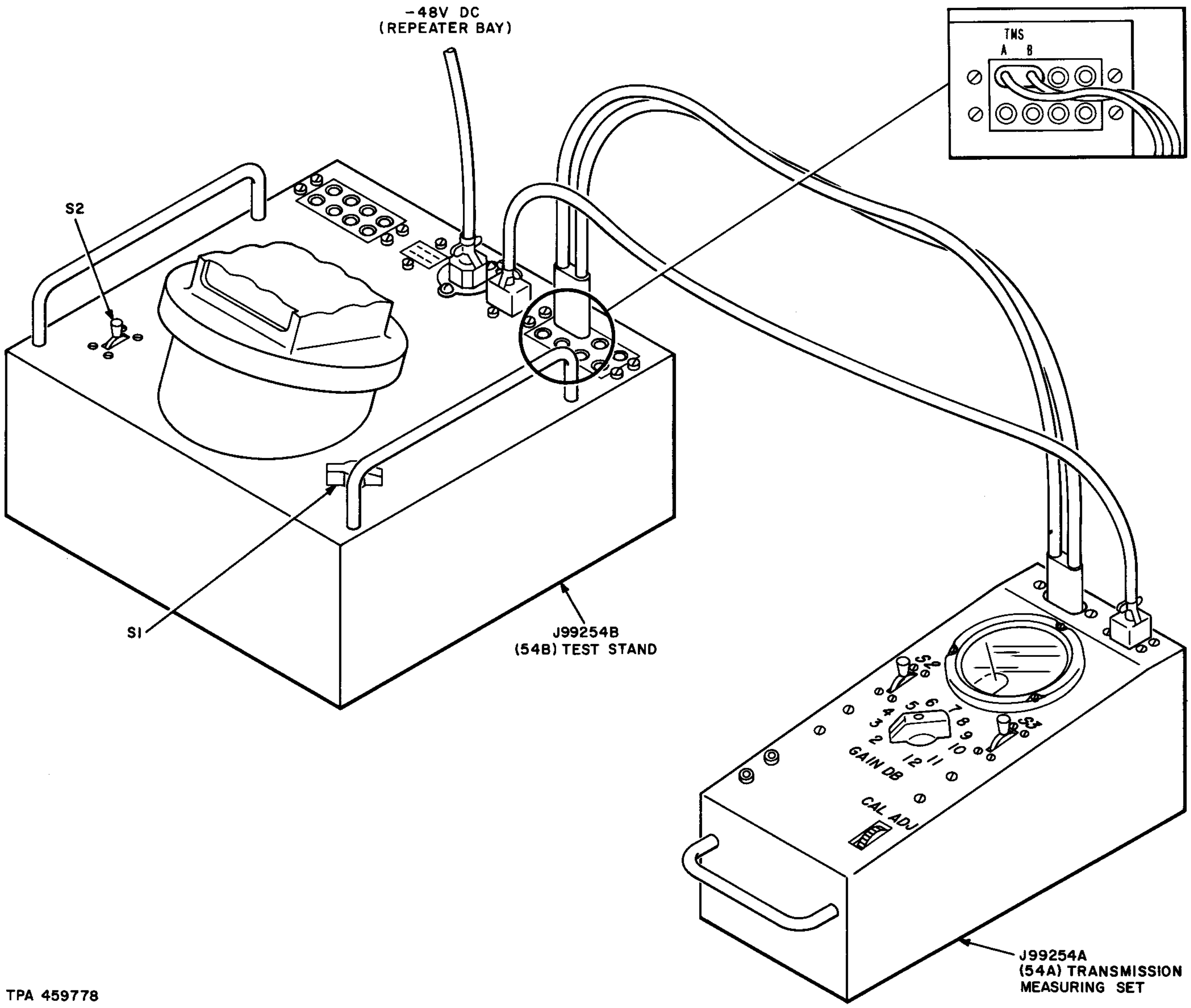

Fig. 1—Converter Gain—Test Equipment Connections

STEP	PROCEDURE
7	All screws on the gain unit side should have been loosened as in Step 3. Consult the CLR for the specified gain adjustment. Refer to Table A to determine the necessary screw settings for this specified gain value. ***Example:*** In the row corresponding to 12-dB gain, screws A, B, C, E, H, and 1, 2, 4, 5, 7, 9, are listed to be turned down. Tighten these firmly, but not excessively, and leave all other screws raised. ***Caution: Excessive tightening may strip threads.***

STEP	PROCEDURE
	Converter Unit Gains
8	On the 54B test stand, set switch S2 to a neutral position and switch S1 to GAIN position.
9	Throw S2 on the 54A TMS to CAL and adjust the knurled knob CAL ADJ to give a 0-dB reading. Then set S2 to MEAS position. The position of other keys and knobs on the 54A set does not affect this reading.
10	Rotate GAIN DB knob S1 to the specified gain value. Make certain that screw K on the 831-type network is loosened. Operate S3 to SERIES and rotate gain knob S1 counterclockwise until the meter reads between 0 and +1 dB. The series converter gain equals the sum of the gain knob setting plus the meter reading. Note this value.
11	Throw switch S3 from SERIES to SHUNT. Measure and note this gain.
12	Compare the two measured gain values with the value given for the 831-type network adjustment shown in Table A.
	Example: For 12-dB total gain, the separate converters should measure 7.9-dB gain as shown in Table A. If both series and shunt gain measurements fall within ±0.2 dB of this value and the difference between the two gain readings is less than 0.2 dB, proceed to measure the combined gain as described in Step 16. If not, adjust the gain of either the series or shunt converter or both as in the following steps.
13	Verify that the proper screws are turned down and that all others are clear of the printed wiring board. If no error can be found and the series converter gain measurement deviates by more than ±0.2 dB from the listed value, throw S3 to SERIES. Recalibrate as in Step 9 and then restore S2 to MEAS. Adjust screws A through J on the 831-type network to give the tabulated gain for a single converter to within ±0.1 dB.
	Note: Screw A gives the finest gain change; screws B, C, etc, give larger changes in approximately 2:1 steps. Tightening a screw on the series converter lowers the gain; loosening a screw raises the gain.
14	If the shunt converter gain measurement deviates by more than ±0.2 dB from the listed value, throw S3 to SHUNT and adjust the measured gain to within ±0.1 dB of the listed value, using screws 1 through 9 on the 831-type network.
	Note: Screws 1, 2, etc, are the fine gain adjustment. Loosening a screw on this converter lowers the gain; tightening a screw raises the gain.
15	The gains of the individual converters must agree with each other within 0.2 dB before combined gain can be measured.
16	Tighten screw K on the 831-type network and leave it in this position. (This screw connects series and shunt converter units together in the operating position.)
17	Recalibrate the 54A TMS.

TABLE A

831-TYPE NETWORK
E6 GAIN-UNIT SETTINGS

TOTAL 1-KHZ GAIN (DB) MEASURED†	SERIES OR SHUNT GAIN‡ (DB)	SERIES SCREWS DOWN	SHUNT SCREWS DOWN	TOTAL 1-KHZ GAIN (DB) MEASURED	SERIES OR SHUNT GAIN‡ (DB)	SERIES SCREWS DOWN	SHUNT SCREWS DOWN	TOTAL 1-KHZ GAIN (DB) MEASURED	SERIES OR SHUNT GAIN‡ (DB)	SERIES SCREWS DOWN	SHUNT SCREWS DOWN	TOTAL 1-KHZ GAIN (DB) MEASURED	SERIES OR SHUNT GAIN‡ (DB)	SERIES SCREWS DOWN	SHUNT SCREWS DOWN
0.0	0.0	BCDGHJK	123	3.4	1.8+	ADEFGJK	13467	6.8	4.0	CDEJK	1578	10.1	6.3+	DGHK	469
0.1	0.0	ABDGHJK	14	3.5	1.9	BCEFGJK	567	6.9	4.0+	BDEJK	3578	10.2	6.4	BCGHK	12469
0.2	0.1	ADGHJK	134	3.6	2.0	CEFGJK	12567	7.0	4.1	ABCEJK	123578	10.3	6.5	ABGHK	13469
0.3	0.1+	BCGHJK	5	3.7	2.0+	AEFGJK	23567	7.1	4.2	CEJK	24578	10.4	6.5+	AGHK	123469
0.4	0.2	ABGHJK	35	3.8	2.1	ABCDFGJK	24567	7.2	4.3	AEJK	134578	10.5	6.6	BCDEFHK	2569
0.5	0.2+	GHJK	235	3.9	2.1+	CDFGJK	134567	7.3	4.4	ABCDJK	1234578	10.6	6.7	ABDEFHK	3569
0.6	0.3	BCDEFHJK	145	4.0	2.2	ADFGJK	8	7.4	4.5	CDJK	2678	10.7	6.8	DEFHK	4569
0.7	0.3+	CDEFHJK	345	4.1	2.3	ABCFGJK	128	7.5	4.5+	ADJK	13678	10.8	6.9	BCEFHK	124569
0.8	0.4	BDEFHJK	2345	4.2	2.3+	CFGJK	238	7.6	4.6	ABCJK	123678	10.9	7.0	CEFHK	234569
0.9	0.4+	DEFHJK	16	4.3	2.4	AFGJK	148	7.7	4.7	CJK	24678	11.0	7.1	AEFHK	179
1.0	0.5	BCEFHJK	36	4.4	2.5	BCDEGJK	348	7.8	4.7+	AJK	134678	11.1	7.2	BCDFHK	1279
1.1	0.6	ABEFHJK	1236	4.5	2.5+	ABDEGJK	12348	7.9	4.8	ABCDEFGHK	1234678	11.2	7.2+	CDFHK	2379
1.2	0.6+	AEFHJK	246	4.6	2.6	DEGJK	258	8.0	4.8+	CDEFGHK	25678	11.3	7.3	ADFHK	1479
1.3	0.7	BCDFHJK	1346	4.7	2.6+	ACEGJK	1358	8.1	4.9	ADEFGHK	135678	11.4	7.4	ABCFHK	12479
1.4	0.7	ABDFHJK	56	4.8	2.7	BEGJK	458	8.2	5.0	ABCEFGHK	1235678	11.5	7.5	CFHK	23479
1.5	0.7+	ADFHJK	1256	4.9	2.8	ABCDGJK	12458	8.3	5.1	CEFGHK	245678	11.6	7.5+	BFHK	579
1.6	0.8	BCFHJK	2356	5.0	2.8+	CDGJK	23458	8.4	5.1+	AEFGHK	345678	11.7	7.6	ABCDEHK	2579
1.7	0.9	CFHJK	1456	5.1	2.9	ADGJK	168	8.5	5.2	BCDFGHK	12345678	11.8	7.7	CDEHK	13579
1.8	0.9+	AFHJK	3456	5.2	2.9+	BCGJK	368	8.6	5.3	CDFGHK	9	11.9	7.8	BDEHK	4579
1.9	1.0	ABCDEHJK	123456	5.3	3.0	CGJK	12368	8.7	5.4	ADFGHK	129	12.0	7.9	ABCEHK	124579
2.0	1.0	CDEHJK	27	5.4	3.1	AGJK	2468	8.8	5.5	ABCFGHK	239	12.1	8.0	ACEHK	134579
2.1	1.1	BDEHJK	137	5.5	3.2	ABCDEFJK	13468	8.9	5.5+	CFGHK	149	12.2	8.0+	BEHK	1234579
2.2	1.2	ABCEHJK	47	5.6	3.2+	CDEFJK	568	9.0	5.6	AFGHK	349	12.3	8.1	EHK	2679
2.3	1.2	ACEHJK	1247	5.7	3.3	ADEFJK	12568	9.1	5.6+	ABCDEGHK	12349	12.4	8.1+	BCDHK	3679
2.4	1.3	BEHJK	2347	5.8	3.4	ABCEFJK	23568	9.2	5.7	ACDEGHK	159	12.5	8.2	CDHK	23679
2.5	1.3	ABCDHJK	157	5.9	3.5	CEFJK	14568	9.3	5.8	ABDEGHK	1259	12.6	8.2+	BDHK	14679
2.6	1.4	ACDHJK	357	6.0	3.5	AEFJK	34568	9.4	5.9	DEGHK	2359	12.7	8.3	DHK	124679
2.7	1.4+	BDHJK	12357	6.1	3.6	ABCDFJK	234568	9.5	6.0	BCEGHK	1459	12.8	8.4	BCHK	134679
2.8	1.5	DHJK	2457	6.2	3.6+	CDFJK	178	9.6	6.1	CEGHK	12459	12.9	8.5	CHK	5679
2.9	1.5+	ACHJK	13457	6.3	3.7	ADFJK	378	9.7	6.1+	BEGHK	23459	13.0	8.6	BHK	125679
3.0	1.6	BHJK	167	6.4	3.8	ABCFJK	12378	9.8	6.2	ABCDGHK	169	13.1	8.7	HK	135679
3.1	1.7	HJK	367	6.5	3.8+	CFJK	2478	9.9	6.2+	ACDGHK	1269	13.2	8.8	BCDEFGK	1235679
3.2	1.7+	BCDEFGJK	12367	6.6	3.9	BFJK	3478	10.0	6.3	ABDGHK	1369	13.3	8.9	CDEFGK	145679
3.3	1.8	ABDEFGJK	2467	6.7	3.9+	ABCDEJK	123478								

Notes: † Measured total gain is the gain measured with a 54A TMS. Possible variation in measured gain due to component allowances is ± 0.3 dB for gains above 13 dB and in proportion for lower gains.

‡ Measured series or shunt gain with the K screw UP.

STEP	PROCEDURE
18	Throw S3 to SH and SER and measure combined gain. This should check specified gain to within ±0.3 dB. Record the measured gain in pencil in the rectangular recess on the front face of the repeater after the word GAIN.
19	With S3 on SH and SER, operate S1 to LOAD MEAS; the meter reading will decrease slightly. If this decrease is less than 0.4 dB, record both gain measurements on the repeater face. This data will be valuable for future maintenance checks on the repeater.
20	Repeaters that fall off in gain more than 0.4 dB between MEAS and LOAD MEAS are considered defective. Their converters should be returned to the Western Electric Company for repair.

6. OPTIMIZING NETWORKS

6.01 Prescription settings, when provided, are usually satisfactory. The following procedures may be required where prescription settings are not provided or where requirements are not met.

STEP	PROCEDURE
	A. 830A, 830B, and 830G Network Adjustment (For Touch-up Only)
1	Patch from the TST PWR jack of the 54C set to RLMS TST PWR jacks of the 54B test stand. Patch from the RL jack of the 54B test stand to MEAS RL jack of the 54C RLMS, using a 3P7B cord, as shown in Fig. 2.
2	Have the circuit to be measured turned down at the originating end or at both ends if it is a 2-way link.
3	Patch from the vacant position on the repeater shelf where the E6 repeater will be installed to the 54B test stand LINE EXT A and B jacks using the ED-97023-30 Group 2 cord. Insert the plug gently in order not to damage the shelf connector spring contacts. Rotate the head of the 54B test stand to bring the 830-type networks forward for easy accessibility. The network connected to line A is uppermost.
	Building-Out Capacitor (BOC) and LATTICE Adjustments
4	If the LBO network on line B is to be adjusted, have the line busied out but not terminated at the distant end.
5	Set the switch on the 54B test stand to RL LINE B. Set S1 switch on the 54C RLMS to 2000—3000 ~. If the 54A TMS is also plugged into the 54B test stand, operate switch S3 to SH and SER. This is required only on early models of the 54B test stand.

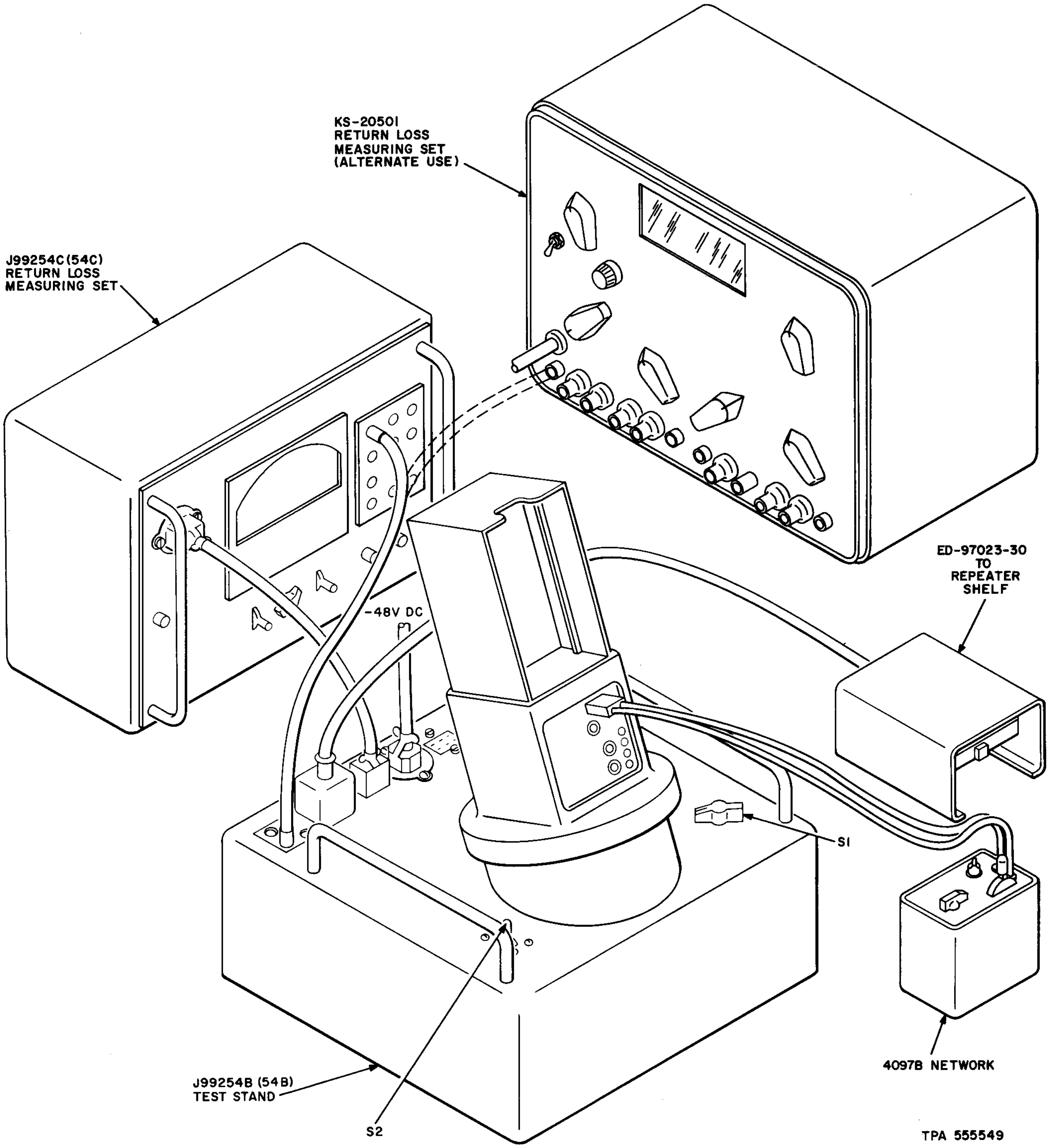

Fig. 2—Return Loss Adjustment of E6 Repeater—Test Equipment Connections

STEP	PROCEDURE
6	Plug in the power cord of the 54C RLMS to a 120-volt 60-Hz ac outlet and turn the PWR switch on. A 10-minute warm-up period is required. On the 54C RLMS, set S2 to SEND LEVEL CAL, S3 to 900Ω 2 μF, and gain knob AT1 to 0 on the RETURN LOSS scale. Calibrate the 2000—3000~ range of the 54C RLMS to 0 dB by adjusting the SEND LEVEL ADJ knob for 2000—3000~. Release S2 to MEAS.
7	Adjust gain knob AT1 on the 54C RLMS until the meter reads on scale.
8	Set the line B LBO network screws to the preliminary screw settings given on the CLR by tightening the specified screws and loosening all others. If the network being adjusted is an 830A or 830B network and no screw settings are given, start with A, C, E, F, 1, 2, and 1, 2 for 22-gauge cable, and TERM. for both terminal and intermediate repeaters. This is required for special service circuits. These suggested initial settings correspond to those for a 22-gauge cable with a 3000-foot end section. If the network being adjusted is an 830G and no screw settings are given, start with A, E, F, and Y, Y. This initial setting corresponds to that of a 26-gauge cable with a 3000-foot end section. Only the X, X or Y, Y screws of the LATTICE section should be turned down in an 830G network. ***Never*** should both X, X and both Y, Y screws be turned down concurrently.
9	Bring the meter on scale by rotating S2 on the 54C RLMS.
10	Request a termination at the distant end of line B and observe the meter of the 54C RLMS for a change indicating that the termination has actually been connected to the line being used. This termination is to be 900 ohms in series with 2.14 μF for a 900-ohm impedance PBX or 600 ohms in series with 2.14 μF for a 600-ohm impedance PBX.
11	The 54B test stand includes a balanced inductor of 400-ohm resistance to permit holding dialed-up terminations while testing. For this purpose the tester operates a key that inserts the two balanced windings of the inductor in series with the tip and ring wires of the cable pair. A patch is thus provided for direct current from one end of the link to the other through the test location. At the same time, the two parts of the link are isolated at voice frequencies so that neither part affects tests made on the other.
12	Optimize the return loss by adjusting BOC screws A through G to obtain the highest return loss. Do this by increasing the BOC in 0.004-μF steps; if this causes the return loss to rise, increase the capacitance still further until a maximum is reached. If no maximum is found by increasing the BOC, decrease the capacitance in 0.004-μF steps and follow up until a maximum return loss is obtained. If critical, repeat with 0.002-μF steps. ***Note 1:*** In some cases the adjustment may not be critical. In such cases, use the average of the two settings where a decrease in return loss is just noticeable. ***Note 2:*** If there are two BOC settings that give the same average meter reading, choose the setting for which the meter needle wavers less. ***Note 3:*** Negative values of return loss sometimes occur. ***Note 4:*** Remove screwdriver from screwheads when observing 54C RLMS readings.

STEP	PROCEDURE
	Note 5: If the network being adjusted is an 830G network, the BOC should not exceed 0.039 μF when both Y, Y screws are down. Should the optimization procedure indicate that more BOC is necessary, use screws X, X; turn down screws 1, 2, 3 and 1, 2, 3; and add BOC in the above described manner.
13	The values of the BOC screws are as follows: **CAPACITANCE OF BOC SCREWS OF NETWORK ±2%** A 0.001 μF D 0.007 μF F 0.025 μF B 0.002 μF E 0.013 μF G 0.049 μF C 0.004 μF *Example:* Tightening a screw adds capacitance. Thus, when the A, E, and F screws are down, they equal 0.001 plus 0.013 plus 0.025, or 0.039 μF. In this case, 0.004 μF could be added by tightening screw C. To remove 0.004 μF, the screws would be A, B, D, and F down. **830A and 830B Network Low-Frequency (LF) Adjustment**
14	Set S1 on the 54C RLMS to 500—2500 ~ . Set S2 to SEND LEVEL CAL. Calibrate the 500—2500 ~ range of the 54C RLMS to 0 dB by adjusting the SEND LEVEL ADJ knob for 500—2500 ~ . Release S2 to MEAS. Bring the reading of the meter on scale by rotating gain knob AT1. Turn out LBO screw(s) for the cable gauge originally selected. Turn LBO screw(s) in for one of the other gauges. *Note 1:* The screw setting that gives the greater return loss value is the best setting, but screw(s) for one gauge only shall be left down. *Note 2:* If the setting for two different gauges gives the same results, use the one for coarser wire, ie, set for 19 gauge when the same results within 0.5 dB are obtained on 19 and 22 gauges. **Building-Out Resistor (BOR) Adjustment**
15	Set S1 on the 54C RLMS to 500—2500 ~ sweep. Reduce the initial BOR value on LBO to the next lower value to verify that the return loss is increased. If not, increase the BOR value. *Note 1:* The condition that gives the greater return loss value is the better setting. If the same results are obtained for two different values of BOR, set for the lower value of resistance. Be sure that the same value of resistance is used in the tip and ring side of line, ie, 1 + 1, 2 + 2, 3 + 3 screws must be in a corresponding position. When different values are used, the circuit becomes unbalanced and is susceptible to noise.

STEP	PROCEDURE
	Note 2: The resistance values that can be obtained are as follows:

	NETWORK 830A & 830B	NETWORK 830G
All screws down	0 ohms	0 ohms
1, 2 and 1, 2 down	28 ohms	33 ohms
1, 3 and 1, 3 down	56 ohms	66 ohms
1 and 1 down	84 ohms	99 ohms
2, 3 and 2, 3 down	112 ohms	132 ohms
2 and 2 down	140 ohms	165 ohms
3 and 3 down	168 ohms	198 ohms
No screws down	196 ohms	231 ohms

B. 837A, 837B, 837E, 837F, or 837G Network Adjustment (For Touch-Up Only)

1 Make an initial adjustment of the 837-type network according to the CLR. If the prescription settings are not specified, use the following preliminary settings:

NETWORK	BOC	LBOC*	LBOR	LATTICE
837A	0.033 μF	—	—	—
837B	—	0.033 μF	112, 112	—
837E	0.033 μF	—	—	—
837F	—	0.033 μF	—	—
837G	0.039 μF	—	—	Y,Y

* A DBOC is used for terminal balance and should usually be set to zero.

2 Connect the 54C RLMS, the J87241B power supply, and the 837-type network as shown in Fig. 2 (an 837C is shown). Set the switches on the 54C RLMS as follows:

S1 to 2000—3000 ~

S2 to SEND LEVEL CAL

S3 to 900Ω 2 MF

DB to RETURN-LOSS scale.

3 Calibrate the 2000—3000 ~ range of the 54C RLMS to 0 dB and then throw switch S2 to MEAS.

STEP	PROCEDURE
4	Increase the 837-type network BOC (or LBOC) by 0.004-μF steps (capacitance of BOC and LBOC screws are the same as listed in Step 13 above for the 830A, 830B, and 830G networks); if this causes the return loss to rise, increase the capacitance still further until a maximum return loss is reached. If no maximum is found, decrease the capacitance by 0.004-μF steps until a maximum is obtained. ***Note:*** Only the X, X or Y, Y screws of the LATTICE section should be turned down in an 837G network. Never should both X, X and both Y,Y screws be turned down concurrently. The BOC in an 837G network should not exceed 0.039 μF when both Y, Y screws are down. Should the optimization procedure indicate that more BOC is necessary, use screws X, X; turn down screws 1, 2, 3 and 1, 2, 3; and add BOC in the above described manner.
5	When a maximum return loss is obtained, repeat Step 4 with the 0.002-μF step.
6	If there are two settings that give the same average meter reading, choose the setting for which the meter wavers less. Remove screwdriver from screwheads when observing 54C meter reading.
7	Set the S1 switch on the 54C RLMS to 500—2500 ~ and S2 to SEND LEVEL CAL range. Calibrate to 0 dB and then throw switch S2 to MEAS.
8	Observe the measured return loss and then turn out the GAUGE screw(s) for the cable gauge originally selected. Turn in screw(s) for one of the other gauges.
9	The screw setting that gives the greater return loss value is the better setting, but screw(s) for one gauge only shall be left turned down. If the setting for two different gauges gives the same results, use the one for the coarser gauge, ie, set for 19 gauge when the same results within 0.5 dB are obtained on 19 and 22 gauges.
	837A and 837B Networks—Low-Frequency (LF) Adjustment (Gauge Screws)
10	Set S1 on the 54C RLMS to 500—2500 ~ . Set S2 to SEND LEVEL CAL. Calibrate the 500—2500 ~ range of the 54C RLMS to 0 dB by adjusting the SEND LEVEL ADJ knob for 500—2500 ~ . Release S2 to MEAS. Bring the reading of the meter on scale by rotating gain knob AT1. Turn out LBO screw(s) for the cable gauge originally selected. Turn LBO screw(s) in for one of the other gauges. ***Note 1:*** The screw setting that gives the greater return loss value is the better setting, but screw(s) for one gauge only shall be left down. ***Note 2:*** If the setting for two different gauges gives the same results, use the one for coarser wire, ie, set for 19 gauge when the same results within 0.5 dB are obtained on 19 and 22 gauges.
	837B and 837G Network Building-Out Resistor (BOR or LBOR) Adjustment
11	Set S1 on the 54C RLMS to 500—2500 ~ sweep. Reduce the initial BOR (or LBOR) value on LBO to the next lower value to verify that return loss is increased. If not, increase the BOR value.

STEP	PROCEDURE
	Note 1: The condition that gives the greater return loss value is the better setting. If the same results are obtained for two different values of BOR, set for the lower value of resistance. Be sure that the same value of resistance is used in the tip and ring side of line, eg, 1 + 1, 2 + 2, 3 + 3 screws must be in a corresponding position. When different values are used, the circuit becomes unbalanced and is susceptible to noise.
	Note 2: The resistance values that can be obtained are as follows:

837B NETWORK		837G NETWORK	
All screws down	0 ohms	All screws down	0 ohms
112, 112 and 56, 56 down	28 ohms	132, 132 and 66, 66 down	33 ohms
112, 112 and 28, 28 down	56 ohms	132, 132 and 33, 33 down	66 ohms
112 and 112 down	84 ohms	132 and 132 down	99 ohms
56, 56 and 28, 28 down	112 ohms	66, 66 and 33, 33 down	132 ohms
56 and 56 down	140 ohms	66 and 66 down	165 ohms
28 and 28 down	168 ohms	33 and 33 down	198 ohms
No screws down	196 ohms	No screws down	231 ohms