

CROSS-COUPLING TEST

L3 COAXIAL CARRIER SYSTEM

This section provides procedures for (a) measuring the near-end cross-coupling (crosstalk) between a pair of lines in an L3 switching section and (b) locating and correcting the cause of cross-coupling in L3 lines.

This section is reissued to establish a cross-coupling indication of -50 dBm as a requirement. Arrows are used to indicate significant changes. **Equipment Test Lists are not affected.**

Cross-coupling is the result of signal crossover from a high-level point to a low-level point, primarily through a ground path. It may be caused by signal-path shield discontinuity in the coaxial connectors associated with the L3 amplifiers, basic equalizers, power separation filters, and cable terminals. Such discontinuity may be caused by loose, corroded, or tarnished connections, etc.

The L3 lines must be tested in pairs (ie, 301-2, 303-4, etc), with the lines under test out-of-service in both directions and with spare pilots applied at the transmitting ends. An 8450-kHz test signal at -22 dBm is applied at the spare hybrid IN jack and adjusted for $+8$ dBm at the AMP OUT jack for flat amplifier T. The 8450-kHz signal power is measured at the LINE AMP OUT jack of the associated receive line. ♦ A cross-coupling indication of -50 dBm or less (-80 dBm for bridged measurement) is required. ♦ Tests are made at one end of the switching section and then repeated at the other end. In this procedure, the end applying the signal and making the measurement is designated the "testing end"; the other end is the "far end."

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CHART 1

MEASURE CROSS-COUPLING IN L3 LINES

APPARATUS:

At both ends of the switching section, refer to Section 356-010-500 and select from available equipment sending and receiving units having the following capabilities:

Sending Test Equipment (STE) capable of sending into 75-ohm circuits 8450 kHz at -22 dBm

NOTICE

Not for use or disclosure outside the
Bell System except under written agreement

CHART 1 (Contd)

APPARATUS (Contd):

Receiving Test Equipment (RTE) capable of 75-ohm circuit measurements of 8450 kHz over a range of -20 through -90 dBm

11B Attenuator (75 ohms, 30-dB loss)—One required

368A Plugs (75-ohm termination)—Two required

P2BJ Cords (for 75-ohm patches)—Three required

Spare Hybrid (type 2518, or equivalent)—One required

STEP	PROCEDURE
1	Designate one end of the switching section as the testing end. Designate the other end as the far end. At Testing End (See Fig. 4)
2	At the receive line of the pair to be tested, remove from service as follows: For protection lines —Lock normal the LPSS-1 Line Protection Switching System. For regular lines —Switch message service to protection lines.
3	Request far end to remove from service the other line of the pair under test.
4	Terminate spare hybrid OUT B jack with 368A plug [patch (1), Fig. 4]; apply spare pilots to the transmit line, via spare hybrid and FLAT AMP T IN multiple jack [patches (2) and (3), Fig. 4]; then remove regular pilots by disconnecting the 372A plug from between the TRSG HY OUT A jack and the FLAT AMP T IN jack.
5	Request far end to terminate spare hybrid IN and OUT B jacks with 368A plugs [patches (7) and (8), Fig. 4]; apply spare pilots to the other line of the pair under test, via spare hybrid and FLAT AMP T IN multiple jack [patches (9) and (10), Fig. 4]; then remove regular pilots.
6	Condition STE to send and RTE to measure 8450 kHz at -22 dBm. Note: Test frequency must be within range of 8440 through 8460 kHz.
7	Connect STE output to IN jack on spare hybrid [patch (4), Fig. 4].
8	Connect RTE, through 11B attenuator, to AMP OUT multiple jack for flat amplifier T [patch (5), Fig. 4].

CHART 1 (Contd)

STEP	PROCEDURE
9	Adjust RTE tuning control for maximum indication on RTE meter.
10	Adjust STE output for RTE indication of -22 dBm (+8 dBm at AMP OUT jack).
11	Disconnect RTE from the AMP OUT jack [patch (5), Fig. 4].
12	Connect RTE, through 11B attenuator, to line amplifier LINE AMP OUT jack (in patch panel of receive line bay under test) [patch (6), Fig. 4].
13	Record the line number and RTE indication.
	◆Requirement: An RTE indication of -80 dBm or less (-50 dBm or less at the LINE AMP OUT jack plus 30-dB attenuator loss). Note: Any deviation from this requirement must be approved by the responsible Transmission Engineer.◆
14	Disconnect the STE from the spare hybrid IN jack [patch (4), Fig. 4].
15	Disconnect the RTE from LINE AMP OUT jack [patch (6), Fig. 4].
16	Request far end to remove 368A plug from spare hybrid IN jack [patch (7), Fig. 4].
17	Inform far end that that station is now designated testing end.
18	At the "new" testing end, perform applicable Steps 5 through 13.
19	At both ends of switching section, restore regular pilots, then remove spare pilots and all test connections [patches (1) through (10), Fig. 4].
20	Restore the LPSS-1 Line Protection Switching System to normal.
21	Repeat this procedure from Step 1 for each pair of lines in the switching section.
22	Record all test data in office records for future reference.
23	If the requirement of Step 13 was not met for any line, the trouble must be cleared. Charts 2 and 3 are suggested methods for locating and clearing trouble.

CHART 2

**LOCATE CROSS-COUPLING TROUBLE
MEASURE CROSS-COUPLED POWER ON L3 RECEIVE LINE****APPARATUS:**

At both ends of the switching section, refer to Section 356-010-500 and select from available equipment sending and receiving units having the following capabilities:

Sending Test Equipment (STE) capable of sending into 75-ohm circuits 8450 kHz at -22 dBm

Receiving Test Equipment (RTE) capable of 75-ohm circuit measurements of 8450 kHz over a range of -20 through -90 dBm

11B Attenuator (75 ohms, 30-dB loss)—One required

368A Plugs (75-ohm termination)—Two required

P2BJ Cords (for 75-ohm patches)—Three required

Spare Hybrid (type 2518, or equivalent)—One required.

The following will be required *at the line repeater location under test*:

Receiving Test Equipment (RTE) capable of 75-ohm circuit measurements of 8450 kHz over a range of -20 through -90 dBm

P2BJ Cord (for 75-ohm patch)—One required

STEP**PROCEDURE**

- 1 Designate end of switching section that measures excessive cross-coupling on the receive line as the **testing** end. Designate the other end as the **far** end.

At Testing End (See Fig. 4)

- 2 At the receive line of the pair to be tested, remove from service as follows:

For protection lines—Lock normal the LPSS-1 Line Protection Switching System.

For regular lines—Switch message service to protection lines.

- 3 Request far end to remove from service the other line of the pair under test.
- 4 Terminate spare hybrid OUT B jack with 368A plug [patch (1), Fig. 4]; apply spare pilots to the transmit line, via spare hybrid and FLAT AMP T IN multiple jack [patches (2) and (3), Fig. 4];

CHART 2 (Contd)

STEP	PROCEDURE
	then remove regular pilots by disconnecting the 372A plug from between the TRSG HY OUT A jack and the FLAT AMP T IN jack.
5	Request far end to terminate spare hybrid IN and OUT B jacks with 368A plugs [patches (7) and (8), Fig. 4]; apply spare pilots to the other line of the pair under test, via spare hybrid and FLAT AMP T IN multiple jack [patches (9) and (10), Fig. 4]; then remove regular pilots.
6	Condition STE to send and RTE to measure 8450 kHz at -22 dBm. Note: Test frequency must be within range of 8440 through 8460 kHz.
7	Connect STE output to IN jack on spare hybrid [patch (4), Fig. 4].
8	Connect RTE, through 11B attenuator, to AMP OUT multiple jack for flat amplifier T [patch (5), Fig. 4].
9	Adjust RTE tuning control for maximum indication on RTE meter.
10	Adjust STE output for RTE indication of -22 dBm (+8 dBm at AMP OUT jack).
11	Disconnect RTE from the AMP OUT jack [patch (5), Fig. 4].
12	Connect RTE, through 11B attenuator, to line amplifier LINE AMP OUT jack (in patch panel of receive line bay under test) [patch (6), Fig. 4].
13	Record the RTE indication.
14	Request technician to begin at far end and test at every fourth or fifth (4th or 5th) repeater location as follows: - Verify that pilots are adjusted properly per Section 359-025-500. - Ensure that either (a) two 372A plugs (hairpins) or (b) one 372A plug and one Pearl probe are in the BA EQ/AMP IN and AMP OUT/LINE IN multiple jacks for the repeaters under test. See Caution. In the receive line, remove one 372A plug from the AMP OUT/LINE IN multiple jacks. Caution: The Pearl output probe or second 372A plug, as applicable, must not be removed. - Connect the RTE to the AMP OUT jack [patch (1), Fig. 1]. - Measure and record the cross-coupled 8450-kHz test signal at the AMP OUT jack.

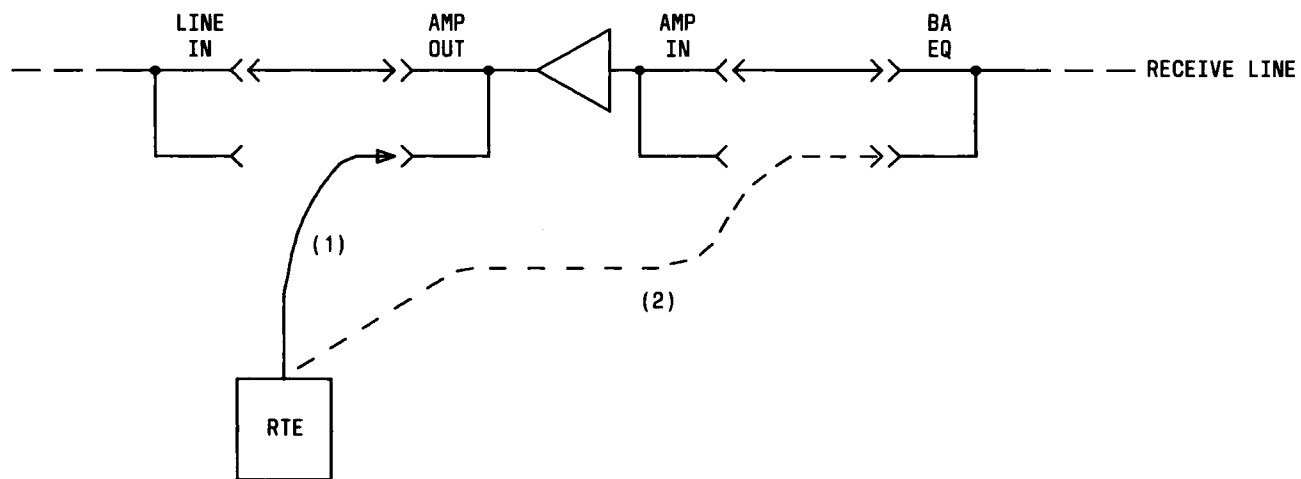
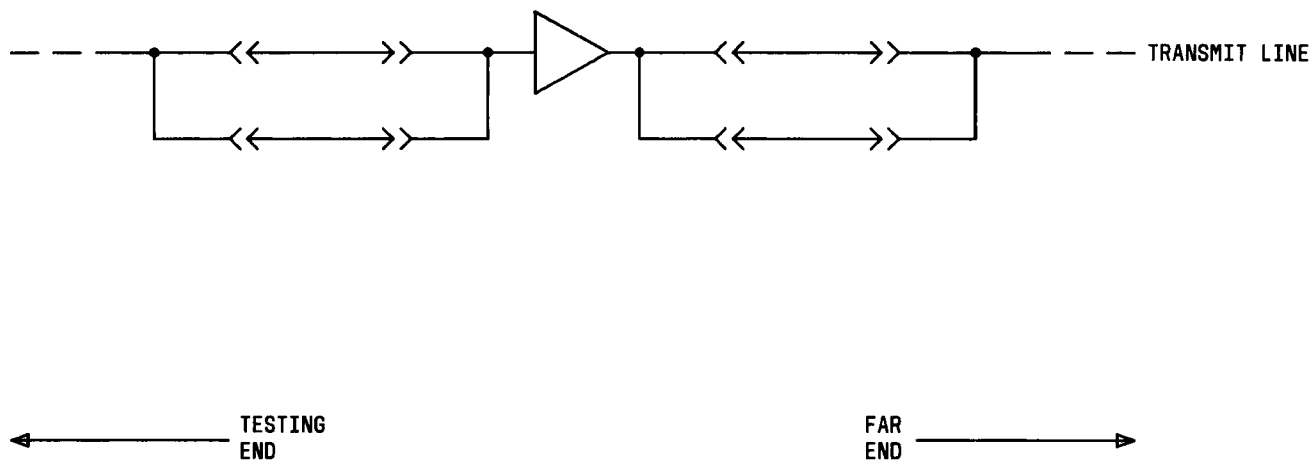


Fig. 1—Connections—Cross-Coupling Trouble Location—Testing With RTE on L3 Line

CHART 2 (Contd)

STEP

PROCEDURE

◆**Requirement:** An RTE indication of -65 dBm or less

Note: Retain for office records, RTE indication at each repeater location measured.◆

(f) If the RTE indication at the AMP OUT jack ◆meets the requirement of Step 14e,◆repeat from Step 14a at each 4th or 5th repeater location toward the testing end until a substantial **increase** in level is observed.

(g) **See Caution.** If the RTE indication at the AMP OUT jack (Step 14e) is **substantially greater than** the ◆required◆ level, remove **one** 372A plug from the BA EQ/AMP IN multiple jacks, connect the RTE to the BA EQ jack, and measure the cross-coupled 8450-kHz test signal [patch (2), Fig. 1].

Caution: *The Pearl input probe or second 372A plug, as applicable, must not be removed.*

(h) **See Danger.** If the RTE indication at the BA EQ jack (Step 14g) is **more than 47 dB below** the indication at the AMP OUT jack (Step 14e) ◆(nominal gain of repeater is 47 dB)◆, look for trouble at the repeater location under test. ◆Gently tap amplifiers, filters, line buildout (LBO) networks, electrolytic capacitors on rear side of main power supply, cord assemblies, and cable stubs to help locate trouble. Replace (with a spare) any amplifier, filter, LBO network, or capacitor causing trouble. Even if tapping clears the trouble, it probably will recur in the near future. Look for and repair defective connections and grounds in or near the L3 transmission path. Look for loose or corroded connectors on cable terminal heads, power separation filters, amplifiers, or primary frequency supply. Ensure that all connectors and shields are clean and tight. Tighten retaining nuts on amplifier jacks with a 1-1/8 inch open-end wrench—**never** with pliers.◆ Spray and clean amplifier plugs with a suitable contact cleaner. If a cable terminal head is defective, replace it with a 66-type unit—**never** with a 42-type unit. Also, do not replace coaxial cable connectors with silver-plated units. If trouble still exists, replace amplifier with a spare.

Danger: *Use extreme care when tightening power cord connectors.*

(i) If the RTE indication at the BA EQ jack (Step 14g) is **approximately 47 dB below** the indication at the AMP OUT jack (Step 14e), repeat this procedure from Step 14a at each repeater location back toward the far end until the point of substantial increase is located.

(j) When the trouble has been located and repaired (normal RTE indications are obtained at the repeater location), disconnect the RTE, replace the 372A plug removed in Step 14c (and 14g if applicable), and inform the testing end that satisfactory indications are obtained.

15 Remeasure the cross-coupled 8450-kHz power at the LINE OUT AMP jack (at testing end).

◆**Requirement:** An RTE indication of -80 dBm or less (includes 30-dB attenuator loss)◆

CHART 2 (Contd)

STEP	PROCEDURE
16	If the requirement of Step 15 is met, restore regular pilots, then remove all test connections and restore to service the pair of L3 lines under test.
17	If the requirement of Step 15 is not met, request technician to continue with trouble-locating procedure in Step 14 at every 4th or 5th repeater location until it is satisfactory. <i>Note:</i> Cross-coupling measured at the testing end is the sum of cross-coupling at the various repeater locations on the L3 line; therefore, it may be the result of trouble at one or many locations.
18	Record all test data in office records for future reference.

CHART 3

**LOCATE CROSS-COUPLING TROUBLE
OPEN THE TRANSMISSION PATH ON L3 TRANSMIT LINE—WITH REGULATED PILOTS**

APPARATUS:

At both ends of the switching section, refer to Section 356-010-500 and select from available equipment sending and receiving units having the following capabilities:

Sending Test Equipment (STE) capable of sending into 75-ohm circuits 8450 kHz at -22 dBm

Receiving Test Equipment (RTE) capable of 75-ohm circuit measurements of 8450 kHz over a range of -20 through -90 dBm

11B Attenuator (75 ohms, 30-dB loss)—One required

368A Plugs (75-ohm termination)—Two required

P2BJ Cords (for 75-ohm patches)—Three required

Spare Hybrid (type 2518, or equivalent)—One required.

The following will be required *at the line repeater location under test*:

A. Using Hybrid for Patching Pilots

Hybrid (type 2518, or equivalent)—One required

CHART 3 (Contd)

APPARATUS (Contd):

P2BJ Cords (for 75-ohm patches)—Three required

368A Plugs (75-ohm terminations)—Two required

or

B. Using Patch Cord for Patching Pilots

P2BJ Cord (for 75-ohm patch)—One required

368A Plugs (75-ohm terminations)—Two required

STEP**PROCEDURE**

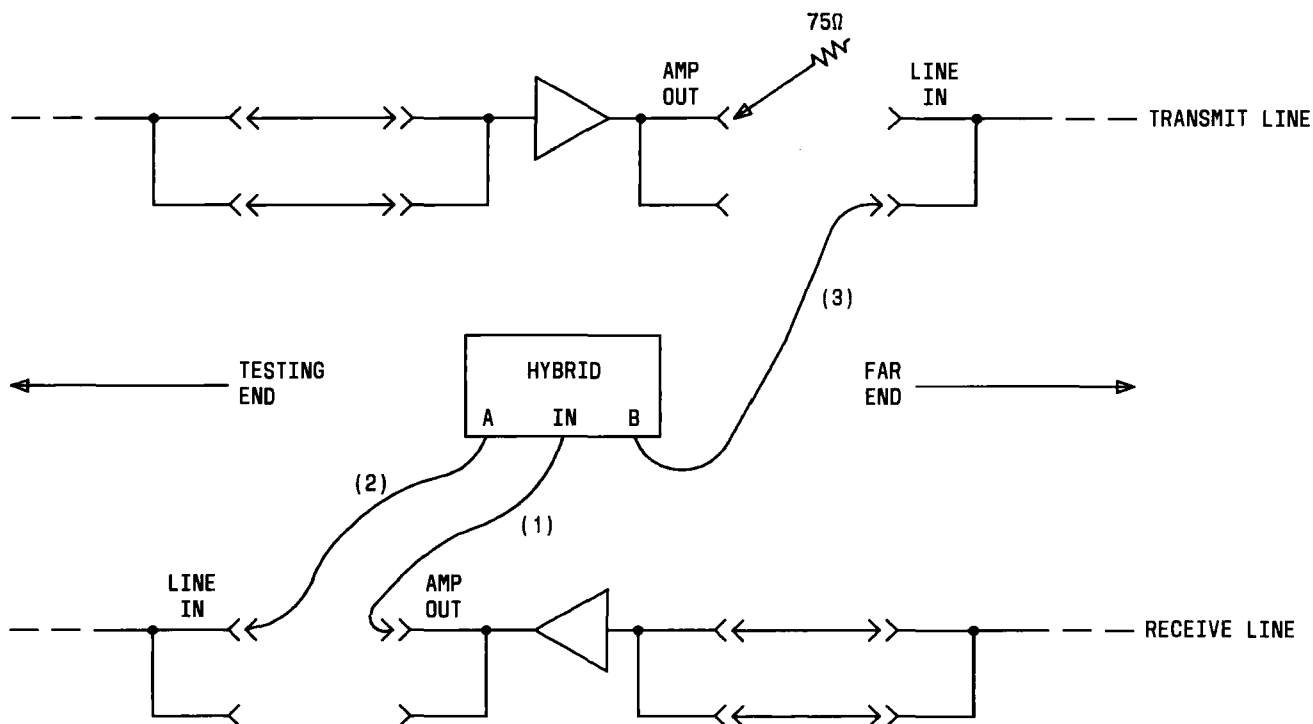
-
- | | |
|---|--|
| 1 | Designate end of switching section that measures excessive cross-coupling on the receive line as the testing end. Designate the other end as the far end. |
| | At Testing End (See Fig. 4) |
| 2 | At the receive line of the pair to be tested, remove from service as follows:

<div style="margin-left: 40px;">For protection lines—Lock normal the LPSS-1 Line Protection Switching System.</div> <div style="margin-left: 40px;">For regular lines—Switch message service to protection lines.</div> |
| 3 | Request far end to remove from service the other line of the pair under test. |
| 4 | Terminate spare hybrid OUT B jack with 368A plug [patch (1), Fig. 4]; apply spare pilots to the transmit line, via spare hybrid and FLAT AMP T IN multiple jack [patches (2) and (3), Fig. 4]; then remove regular pilots by disconnecting the 372A plug from between the TRSG HY OUT A jack and the FLAT AMP T IN jack. |
| 5 | Request far end to terminate spare hybrid IN and OUT B jacks with 368A plugs [patches (7) and (8), Fig. 4]; apply spare pilots to the other line of the pair under test, via spare hybrid and FLAT AMP T IN multiple jack [patches (9) and (10), Fig. 4]; then remove regular pilots. |
| 6 | Condition STE to send and RTE to measure 8450 kHz at -22 dBm.

<div style="margin-left: 40px;">Note: Test frequency must be within range of 8440 through 8460 kHz.</div> |
| 7 | Connect STE output to IN jack on spare hybrid [patch (4), Fig. 4]. |
| 8 | Connect RTE, through 11B attenuator, to AMP OUT multiple jack for flat amplifier T [patch (5), Fig. 4]. |

CHART 3 (Contd)

STEP	PROCEDURE
9	Adjust RTE tuning control for maximum indication on RTE meter.
10	Adjust STE output for RTE indication of -22 dBm (+8 dBm at AMP OUT jack).
11	Disconnect RTE from the AMP OUT jack [patch (5), Fig. 4].
12	Connect RTE, through 11B attenuator, to line amplifier LINE AMP OUT jack (in patch panel of receive line bay under test) [patch (6), Fig. 4].
13	Record the RTE indication.
14	Request technician to begin at the 4th or 5th repeater location from the testing end of the L3 line and test as follows: (a) Verify that pilots are adjusted properly per Section 359-025-500. (b) Ensure that either (a) two 372A plugs (hairpins) or (b) one 372A plug and one Pearl probe are in the BA EQ/AMP IN and AMP OUT/LINE IN multiple jacks for the repeaters under test. (c) See Caution. In both the <i>transmit</i> and <i>receive</i> lines, remove the 372A plug from <i>one</i> of the AMP OUT/LINE IN multiple jacks. Caution: <i>The Pearl output probe or second 372A plug, as applicable, must not be removed at this time.</i> (d) In the <i>receive</i> line, either (a) connect spare hybrid IN jack to AMP OUT jack and spare hybrid A jack to LINE IN jack [patches (1) and (2), Fig. 2A], then remove Pearl output probe or second 372A plug, as applicable, from the associated AMP OUT/LINE IN jacks, or (b) connect one end of patch cord to AMP OUT jack [patch (1), Fig. 2B]. (e) In the <i>transmit</i> line, connect either (a) spare hybrid B jack to LINE IN jack [patch (3), Fig. 2A] or (b) other end of patch cord to LINE IN jack [patch (1), Fig. 2B]. (f) In the <i>transmit</i> line, remove Pearl output probe or second 372A plug, as applicable, from AMP OUT/LINE IN jack, then terminate the AMP OUT jack with a 368A plug (Fig. 2A or 2B). (g) Inform testing end that the transmit transmission path is open and pilots are applied to both lines at repeater location.
15	Record RTE indication at testing end.
	◆ Requirement: An RTE indication of -80 dBm or less (includes 30-dB attenuator loss)◆



A. USING HYBRID

B. USING PATCH CORD

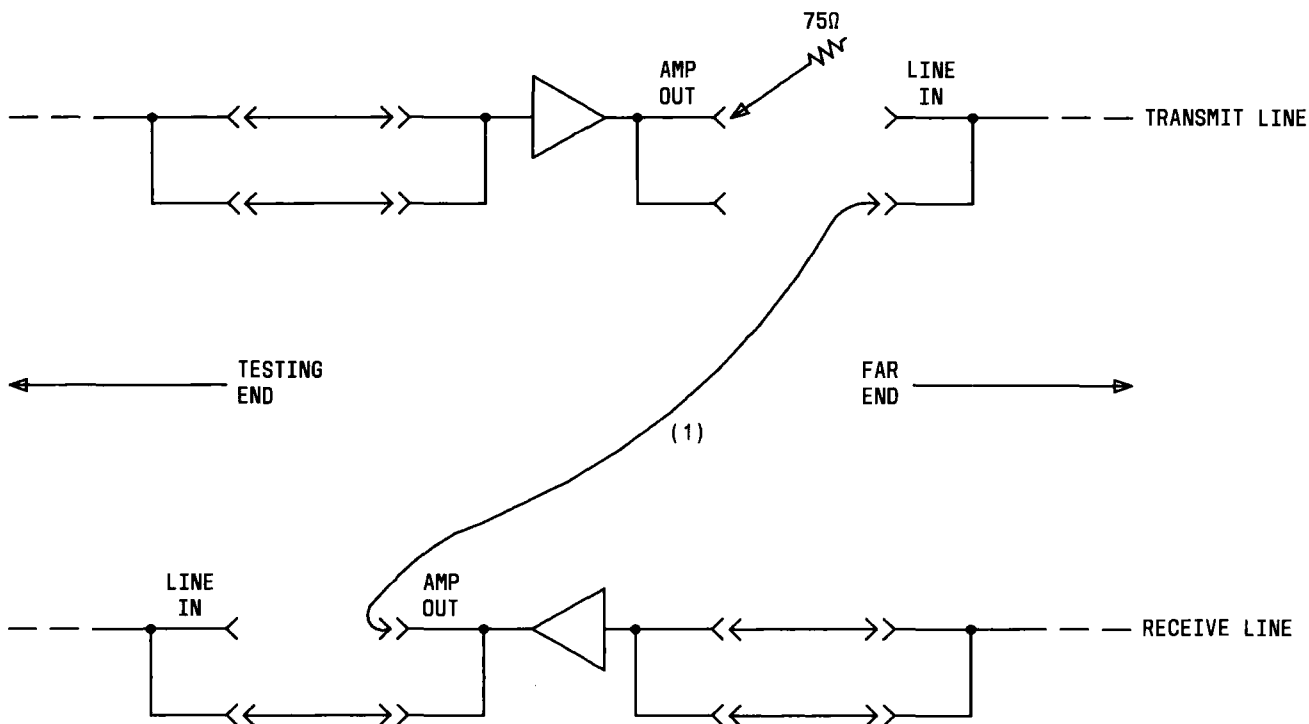
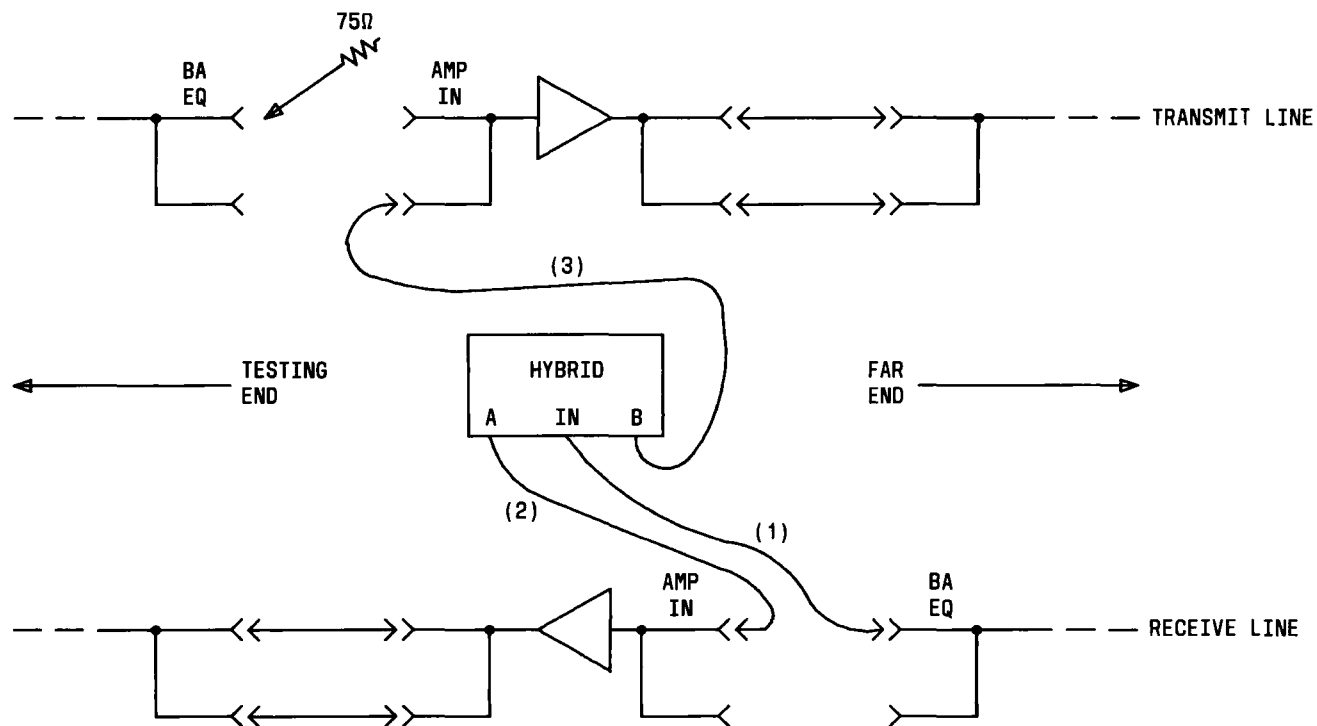


Fig. 2—Connections—Cross-Coupling Trouble Location—Output Loopback on L3 Line

CHART 3 (Contd)

STEP	PROCEDURE
16	Request technician to remove test connections and restore transmit and receive lines at repeater location as follows:
	(a) In the transmit line, remove the 368A plug from the AMP OUT jack (Fig. 2A or 2B), then reinsert applicable Pearl output probe or 372A plug in AMP OUT/LINE IN jacks. (b) In the transmit line, disconnect (a) spare hybrid B jack [patch (3), Fig. 2A] or (b) patch cord [patch (1), Fig. 2B] from LINE IN jack. (c) In the receive line, either (a) reinsert applicable Pearl output probe or 372A plug in AMP OUT/LINE IN multiple jack and disconnect spare hybrid IN and A jacks from AMP OUT/LINE IN jacks [patches (1) and (2), Fig. 2A], or (b) disconnect patch cord from AMP OUT jack [patch (1), Fig. 2B]. (d) In the transmit and receive lines, reinsert 372A plugs in AMP OUT/LINE IN multiple jacks.
17	If the requirement of Step 15 was met, repeat procedure from Step 14 at each 4th or 5th repeater location toward the far end until a substantial increase in level is obtained.
18	If the requirement of Step 15 was not met, request technician to proceed as follows:
	(a) See Caution. In both the transmit and receive lines, remove the 372A plug from one of the BA EQ/AMP IN multiple jacks.
	Caution: The Pearl input probe or second 372A plug, as applicable, must not be removed at this time.
	(b) In the receive line, either (a) connect spare hybrid IN jack to BA EQ jack and spare hybrid A jack to AMP IN jack [patches (1) and (2), Fig. 3A], then remove Pearl input probe or second 372A plug, as applicable, from the associated BA EQ/AMP IN jacks, or (b) connect one end of patch cord to BA EQ jack [patch (1), Fig. 3B]. (c) In the transmit line, connect either (a) spare hybrid B jack to AMP IN jack [patch (3), Fig. 3A] or (b) other end of patch cord to AMP IN jack [patch (1), Fig. 3B]. (d) In the transmit line, remove Pearl input probe or second 372A plug, as applicable, from BA EQ/AMP IN jacks, then terminate the BA EQ jack with a 368A plug (Fig. 3A or 3B). (e) Inform testing end that the transmit transmission path is open and pilots are applied to both lines at repeater location.
19	Record RTE indication at testing end.
	Requirement: An RTE indication of -80 dBm or less (includes 30-dB attenuator loss)



A. USING HYBRID

B. USING PATCH CORD

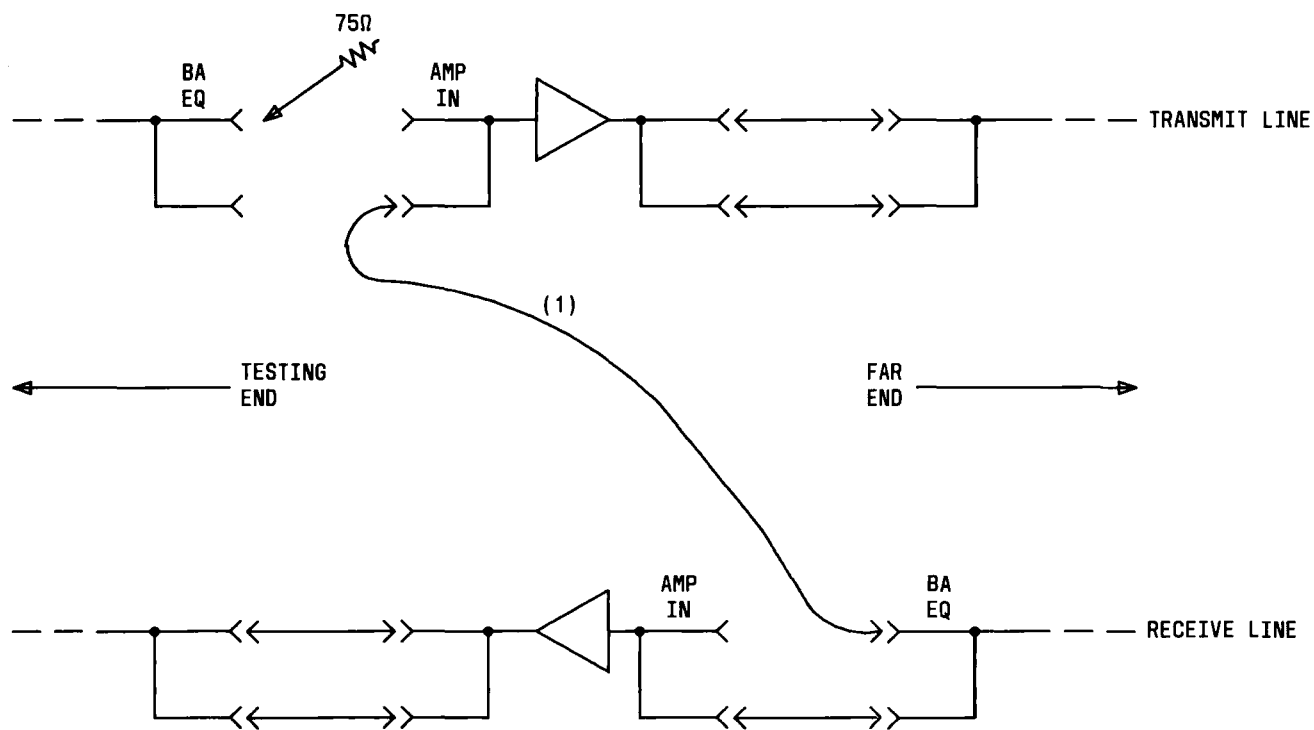


Fig. 3—Connections—Cross-Coupling Trouble Location—Input Loopback on L3 Line

CHART 3 (Contd)

STEP	PROCEDURE
20	Request technician to remove test connections and restore transmit and receive lines at repeater location as follows: (a) In the transmit line, remove the 368A plug from the BA EQ jack (Fig. 3A or 3B), then reinsert applicable Pearl input probe or 372A plug in BA EQ/AMP IN jacks. (b) In the transmit line, disconnect (a) spare hybrid B jack [patch (3), Fig. 3A] or (b) patch cord [patch (1), Fig. 3B] from AMP IN jack. (c) In the receive line, either (a) reinsert applicable Pearl input probe or 372A plug in BA EQ/AMP IN multiple jack and disconnect spare hybrid IN and A jacks from BA EQ/AMP IN jacks [patches (1) and (2), Fig. 3A], or (b) disconnect patch cord from BA EQ jack [patch (1), Fig. 3B]. (d) In the transmit and receive lines, reinsert 372A plugs in BA EQ/AMP IN multiple jacks.
21	See Danger. If the requirement of Step 19 was met, request technician to look for trouble at the repeater location under test. Gently tap amplifiers, filters, line buildout (LBO) networks, electrolytic capacitors on rear side of main power supply, cord assemblies, and cable stubs to help locate trouble. Replace (with a spare) any amplifier, filter, LBO network, or capacitor causing trouble. Even if tapping clears the trouble, it probably will recur in the near future. Look for and repair defective connections and grounds in or near the L3 transmission path. Look for loose or corroded connectors on cable terminal heads, power separation filters, amplifiers, or primary frequency supply. Ensure that all connectors are clean and tight. Tighten retaining nuts on amplifier jacks with a 1-1/8 inch open-end wrench—never with pliers. Spray and clean amplifier plugs with a suitable contact cleaner. If a cable terminal head is defective, replace it with a 66-type unit—never with a 42-type unit. Also, do not replace coaxial connectors with silver-plated units. If trouble still exists, replace amplifier with a spare. Danger: Use extreme care when tightening power cord connectors.
22	If the requirement of Step 19 was not met, repeat procedure from Step 14 at each repeater location toward the testing end until it is satisfactory. Note: Cross-coupling measured at the testing end is the sum of cross-coupling at the various repeater locations on the L3 line; therefore, it may be the result of trouble at one or many locations.
23	Restore regular pilots, remove all test connections, and restore to service the pair of L3 lines under test.
24	Record all test data in office records for future reference.

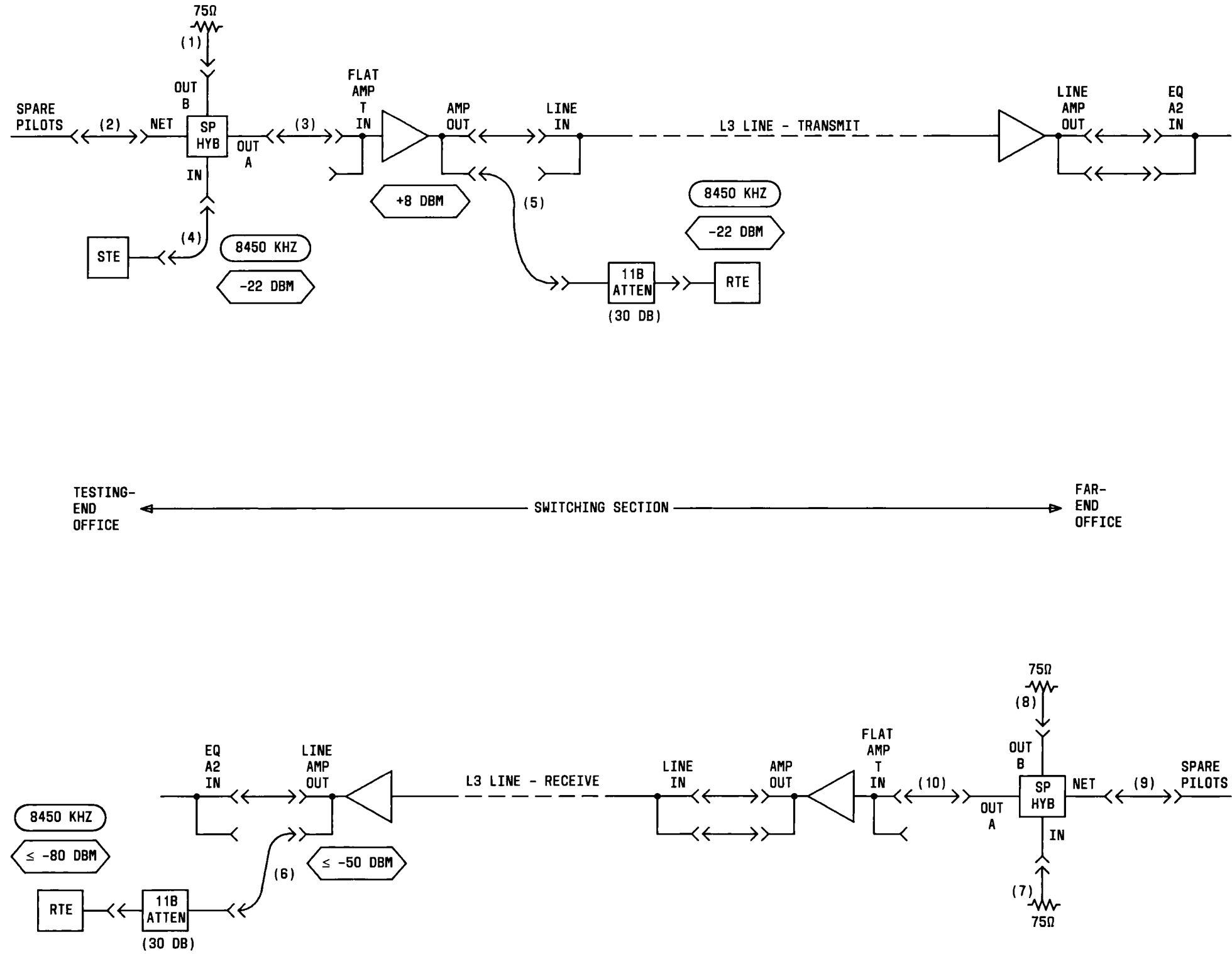


Fig. 4—Connections—Cross-Coupling Measurement—Regular or Protection Lines