

**OPERATION AND MAINTENANCE
REGENERATOR STATION
1 X N FREQUENCY DIVERSITY
DR 6/11-135A
REGENERATOR PROCEDURES**

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This section provides the test and adjustment procedures for the regenerator bay. These procedures are normally performed when referred to from the alarm-clearing procedures, the repair verification flowchart, or annual FCC tests. The procedures can also be used on a stand-alone basis.

This section is reissued to update the frame resupply oscillator frequency, to add requirements for IF interconnections longer than 50 feet, to update requirements for the IF Loopback S/I Stress Check, and to update the procedure for the IF Loopback Transversal Equalizer Performance Check. The section is used in binders 421-103-001AC and 421-103-002AC.

Each procedure lists the recommended test equipment and accessories. Each piece of equipment is keyed with an item number (e.g., Item A1) that corresponds to an item number in Table A, B, or C under the "Test Equipment and Accessories" tab. These tables provide the minimum specifications for each piece of test equipment. These specifications allow the technician to select alternate test equipment.

Using other than the recommended test equipment may require a slightly different test setup to perform the following procedures. Follow the manufacturer's setup and/or operation procedures.

AT&T COMMUNICATIONS—PROPRIETARY

Use pursuant to Company instructions

ADMONISHMENTS

Admonishments are strategically-placed reminders to assure the safety of personnel (**DANGER**), to minimize service interruptions (**Caution**), and to prevent equipment damage (**Warning**). Read the "Admonishments" section of the "Maintenance" tab.

SERVICE PROTECTION

Service must be protected before most of the procedures in this section are performed. The preface information for each procedure contains one of the following:

Note: THIS IS AN IN-SERVICE PROCEDURE.

Caution: *THIS IS AN OUT-OF-SERVICE PROCEDURE.*

The **Note** indicates that the procedure can be performed on working equipment without performing any service protection operations. The **Caution** indicates that manual service protection operations **must** be performed to avoid interrupting service. The appropriate manual operation is referenced at the appropriate step in the procedure.

Generally, the payload signal on regular equipment to be tested **must** be manually switched to the protection equipment to prevent service interruptions. If the protection equipment is to be tested, it **must** be manually locked out to prevent the regular equipment from switching to it during the testing.

If necessary, refer to the "Service Protection" tab and/or the "Operations" tab to perform or verify proper service protection.

REGENERATOR POWER UNIT VOLTAGE CHECKS

This procedure is used to check both the input and output voltages on the 471- and 474-type power units (color-coded white). The 471-type power unit is used with a -24 V battery supply. The 474-type is used with a -48 V battery supply.

This procedure can be performed on any power unit installed in a regular or protection regenerator shelf or in the control and service channel shelf.

Note: THIS IS AN IN-SERVICE PROCEDURE.

The following test equipment is required to perform this procedure:

- 1 - Digital multimeter (Item A1).

For digital multimeter specifications, see "Test Equipment and Accessories" tab.

DANGER: To prevent electrical shock, follow office safety requirements when measuring dc voltage.

STEP	PROCEDURE
1.	Using a digital multimeter, verify that the requirements at the specified test points listed in Table A are met.
2.	This test is complete. Return to the instruction that referenced this procedure. If this procedure was used on a stand-alone basis, go to the "Repair Verification" tab unless other tests are required.

TABLE A
POWER UNIT VOLTAGES

VOLTAGE TO BE CHECKED	VOLTAGE VALUE	TEST POINTS	REQUIREMENTS (Vdc)
INPUT	-24V	V IN + and -	-20.0 to -28.5
	-48V		-42.0 to -60.0
OUTPUT	+5V	V1 + and RTN*	+4.8 to +5.2
	-5V	V1 - and RTN*	-5.0 to -5.4
	+15V	V2 + and RTN*	+14.0 to +19.0
	-15V	V2 - and RTN*	-14.0 to -19.0

* Use RTN test point on ± 15 volt power unit. (V2)

Note: The expected output voltage(s) is identified on the shelf label below each power unit.

REGENERATOR IF INPUT POWER LEVEL CHECK

This procedure is used to measure the IF signal level into a digital regenerator shelf. This level is measured at the patch panel located on the right side of the shelf.

The IF input signal (coming from the radio receiver) is measured at the plug end of the IF cable connected to the IF IN jack.

Caution: THIS IS AN OUT-OF-SERVICE PROCEDURE.

The following test equipment is required to perform this procedure:

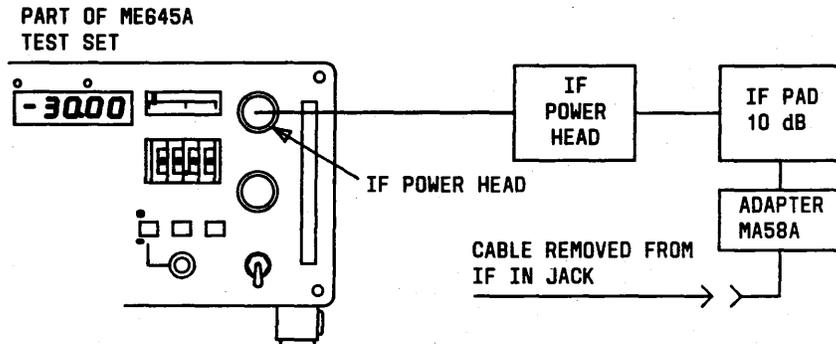
- 1 - ME645A MRTS (Item A4)
- 1 - 4-inch screwdriver (Item C8).

Note: If a test cable is necessary, it must not exceed 5 feet in length.

For recommendations and specifications of test equipment, see "Test Equipment and Accessories" tab.

STEP	PROCEDURE
1.	Protect service as follows: <ul style="list-style-type: none"> • If testing a regular regenerator (shelf C or D), have terminal station or remote alarm center perform a manual line switch for the appropriate (A/C or B/D) direction. • If testing a protection regenerator (shelf A or B), have terminal station or remote alarm center perform a protection channel lockout for the appropriate (A/C or B/D) direction.
2.	Remove the right side bay cover, if equipped.
3.	Condition the ME645A IF power meter to measure -8.0 dBm at 70 MHz (Fig. 1).
4.	On the patch panel, remove the IF cable from the associated IF IN jack for the regenerator under test.
5.	Note: When using the MRTS to measure IF and RF power, limit the input level to -15 dBm or less (e.g., -20 dBm) using fixed attenuators. <p>Connect the MRTS IF power meter to the plug end of the IF cable removed in Step 4.</p>

STEP	PROCEDURE
6.	Observe the power meter indication. Requirement: Regenerators equipped with standard IF interconnect cable (less than or equal to 50 feet) -7.2 to -9.2 dBm Regenerators equipped with long IF interconnect cable (greater than 50 feet) -10.5 to -12.9 dBm.
7.	If further tests require access to the regenerator patch panel, return to the instruction that referenced this procedure.
8.	If no further tests require access to the regenerator patch panel, disconnect all test equipment and reinstall all cables removed.
9.	Remount side cover.
10.	This test is complete. Return to the instruction that referenced this procedure. If this procedure was used on a stand-alone basis, go to the " Repair Verification" tab unless other tests are required.



PREPARATION FOR TEST

1. Arrange and calibrate the ME645A test set as described in ME645A MRTS tab, Steps 16 through 25.

Fig. 1—IF Input Power Level Check

SECTION 421-103-085AC

REGENERATOR IF OUTPUT POWER LEVEL CHECK

This procedure is used to measure the IF signal level out of a digital regenerator shelf. This level is measured at the patch panel located on the right side of the shelf.

The IF output signal (going to the radio transmitter) is measured at the IF OUT jack.

Caution: *THIS IS AN OUT-OF-SERVICE PROCEDURE.*

The following test equipment is required to perform this procedure:

- 1 - ME645A MRTS (Item A4)
- 1 - 4-inch screwdriver (Item C8).

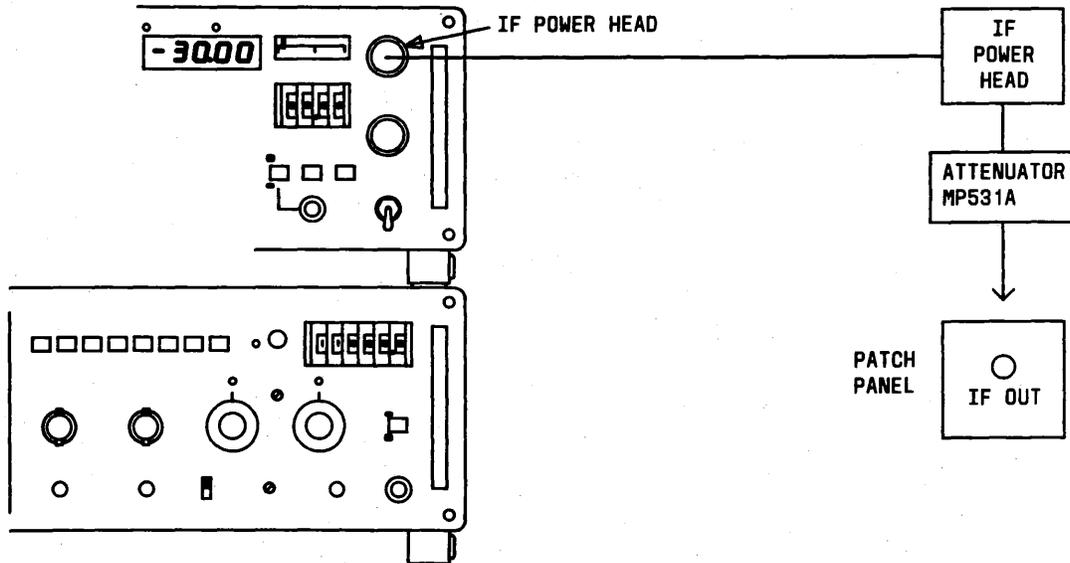
Note: If a test cable is necessary, it must not exceed 5 feet in length.

For recommendations and specifications of test equipment, see "Test Equipment and Accessories" tab.

STEP	PROCEDURE
1.	Protect service as follows: <ul style="list-style-type: none">• If testing a regular regenerator (shelf C or D), have the terminal station or remote alarm center perform a manual line switch for the appropriate (A/C or B/D) direction.• If testing a protection regenerator (shelf A or B), have the terminal station or remote alarm center perform a protection channel lockout for the appropriate (A/C or B/D) direction.
2.	Remove the right side bay cover, if equipped.
3.	Condition the ME645A IF power meter to measure -7.0 dBm at 70 MHz (Fig. 2).
4.	On the patch panel, remove the IF cable from the associated IF OUT jack for the regenerator under test.
5.	Note: When using the MRTS to measure IF and RF power, limit the input level to -15 dBm or less (e.g., -20 dBm) using fixed attenuators.

Connect the MRTS IF power meter to the IF OUT jack.

STEP	PROCEDURE
6.	Observe the power meter indication. Requirement: Regenerators equipped with standard IF interconnect cable (less than or equal to 50 feet) -6.1 to -8.1 dBm. Regenerators equipped with long IF interconnect cable (greater than 50 feet) -1.0 to +1.0 dBm.
7.	If further tests require access to the regenerator patch panel, return to the instruction that referenced this procedure.
8.	If no further tests require access to the regenerator patch panel, disconnect all test equipment and reinstall all cables removed.
9.	Remount side cover.
10.	This test is complete. Return to the instruction that referenced this procedure. If this procedure was used on a stand-alone basis, go to the "Repair Verification" tab unless other tests are required.



PREPARATION FOR TEST

1. Arrange and calibrate the ME645A test set as described in ME645A MRTS tab, Steps 16 through 25.

Fig. 2—IF Output Power Level Check

REGENERATOR FRAME RESUPPLY CLOCK FREQUENCY CHECK

This procedure is used to check the frequency of the oscillator in the FRAME RSPLY unit. This unit is located in the transmit portion of the digital regenerator shelf. The frequency of the oscillator is measured at the FRS CLK jack.

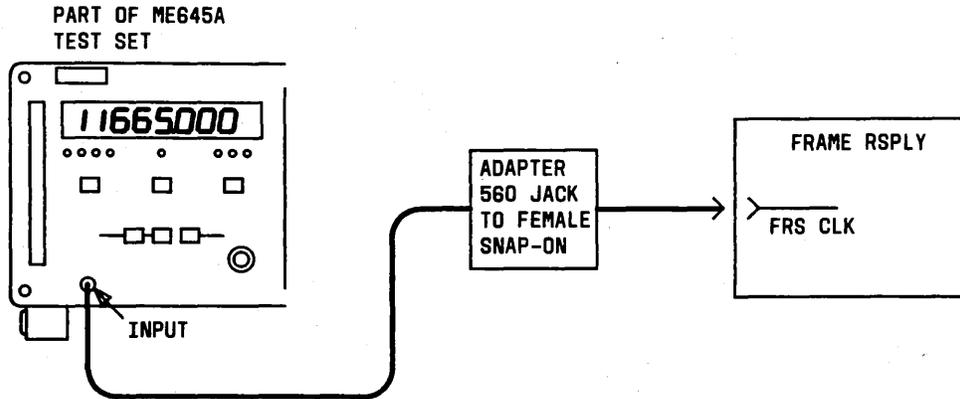
Note: THIS IS AN IN-SERVICE PROCEDURE.

The following test equipment, adapters, and cables are required to perform this procedure:

- 1 - ME645A MRTS (Item A4).

For recommendations or specifications of test equipment, see the "Test Equipment and Accessories" tab.

STEP	PROCEDURE
1.	Condition the ME645A MRTS to measure 22 MHz (Fig. 3).
2.	Connect the MRTS to the FRS CLK jack on the FRAME RSPLY plug-in unit (color-coded red).
3.	Observe the frequency counter indication.
	Requirement: 22,766,000 Hz to 22,769,000 Hz.
4.	Disconnect all test equipment.
5.	This test is complete. Return to the instruction that referenced this procedure.
	If this procedure was used on a stand-alone basis, go to the "Repair Verification" tab unless other tests are required.



PREPARATION FOR TEST

1. Condition frequency counter per ME645A MRTS tab, Steps 26 through 32.

Fig. 3—Frame Resupply Frequency Check

REGENERATOR MODULATOR CARRIER FREQUENCY CHECK

This procedure is used to check the frequency of the internal oscillator that provides the 70-MHz carrier frequency. This measurement is made at the CARRIER FREQ jack on the faceplate of the 64QAM MOD unit in the transmit portion (color-coded red) of the digital regenerator shelf.

Note: THIS IS AN IN-SERVICE PROCEDURE.

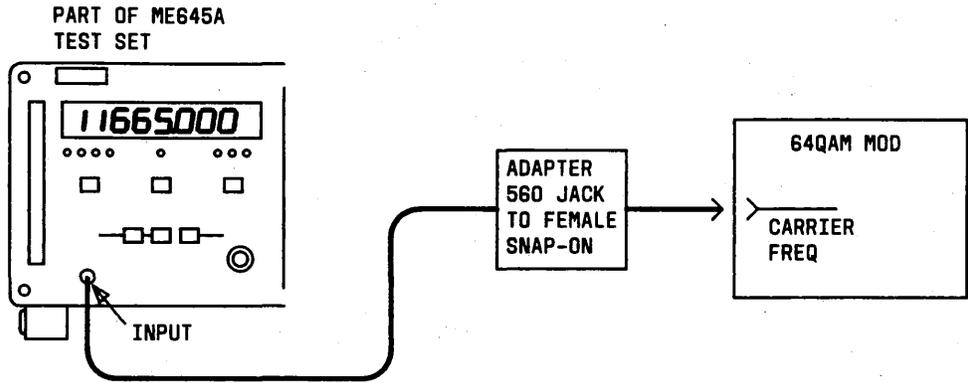
The following test equipment, adapters, and cables are required to perform this procedure:

- 1 - ME645A MRTS (Item A4).

For recommendations and specifications of the test equipment, see the "Test Equipment and Accessories" tab.

STEP	PROCEDURE
1.	Condition the ME645A MRTS to measure 70 MHz (Fig. 4).
2.	Connect the MRTS to CARRIER FREQ jack on 64QAM MOD unit (color coded red).
3.	Observe the frequency counter indication.
	Requirement: 69,993,000 Hz to 70,007,000 Hz.
4.	Disconnect all test equipment.
5.	This test is complete. Return to the instruction that referenced this procedure.

If this procedure was used on a stand-alone basis, go to the "Repair Verification" tab unless other tests are required.



PREPARATION FOR TEST

1. Condition frequency counter per ME645A MRTS tab, Steps 26 through 32.

Fig. 4—Modulator Carrier Frequency Check

REGENERATOR IF LOOPBACK S/I STRESS CHECK

This procedure is used to check the performance of the digital regenerator while it is isolated from the radio equipment. For this test, the IF output signal is looped back to supply the IF input signal to the receiver of the same channel. This procedure is often useful in isolating a performance problem between radio and regenerator equipment. It is also useful in evaluating the preservice performance of a regenerator following circuit pack replacement or other repairs that could affect system performance.

Performance quality is determined by measuring the tolerance of the looped digital regenerator pair to a 74-MHz interference tone injected into the IF signal path at the receiver input. Performance evaluation is then made on the basis of the BER (bit-error-rate) performance at a specified S/I (signal-to-interference) ratio.

The test configuration for the looped back S/I test is shown in Fig. 7. The IF output signal "S" from the transmitter is looped back, through the low-loss path of the unequal loss combining network, to the receiver IF input. The adjustable level 74-MHz interference signal "I" is injected into the receiver IF input signal through the high-loss path of the combining network.

This procedure is applicable to regular or protection equipment with or without the transversal equalizer option.

Caution: THIS IS AN OUT-OF-SERVICE PROCEDURE.

The following test equipment, adapters, cables, and tools are required to perform this procedure:

- 1 - ME645A MRTS (Item A4)
- 1 - IF termination (Item B15)
- 1 - Unequal split pad (Item A13)
- 2 - 5-foot RG-59 coaxial cables equipped with 440-type plugs (Item B18)
- 1 - 4-inch screwdriver (Item C8).

For recommendations and specifications of test equipment, see the "Test Equipment and Accessories" tab.

Warning: To prevent ESD (electrostatic discharge) damage to plug-in units, ensure that all ESD precautions are followed.

STEP	PROCEDURE
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1. Remove the right front side cover of the regenerator bay.
2. Protect service as follows:
 - If testing a regular regenerator (C or D), have terminal station or remote alarm center perform a manual line switch operation for the appropriate (A/C or B/D) direction.
 - If testing a protection regenerator (A or B), have terminal station or remote alarm center perform a protection channel lockout manual operation for the appropriate (A/C or B/D) direction.
3. On the right shelf patch panel of the digital regenerator to be evaluated, remove the IF cables from the IF IN jack and the IF OUT jack.
4. On the regenerator under test, operate the MAN FRS pushbutton of the FRAME RSPLY unit (color-coded red).
5. Determine the test cables to establish the S, I, and S+I paths (Fig. 7), and keep the same cables for all tests in this procedure.

6. Measure the "S" (IF Signal) Power Level (Fig. 5).

- a. Condition the ME645A IF power meter to measure 0 to -10.0 dBm at 70 MHz.
- b. **Note:** When using the MRTS to measure IF and RF power, limit the input level to -15 dBm or less (e.g., -20 dBm) using fixed attenuators.

Make the test connections shown in Fig. 5.

- c. Measure the power at the end of the 5-foot test cable, and record the reading as "S."

Requirement: Regenerators equipped with standard IF interconnect cable (equal to or less than 50 feet)

-6.9 to -8.9 dBm.

Regenerators equipped with long IF interconnect cable (greater than 50 feet)

-11.3 to -13.7 dBm.

If the requirement is **not** met, check the test connections and equipment setup. If it is still **not** met, go to Step 12.

STEP	PROCEDURE
7.	<p>Set the "I" (Interference) Power Level (Fig. 6).</p> <p>a. Condition the MRTS "I" source to send 74.1 MHz at approximately +10.0 dBm.</p> <p><i>Note:</i> If an MRTS is used as the 74-MHz "I" source, ensure that all transmitter sweep and deviation signals are off.</p> <p>b. Make the test connections shown in Fig. 6.</p> <p>c. <i>Note:</i> When using the MRTS to measure IF and RF power, limit the input level to -15 dBm or less (e.g., -20 dBm) using fixed attenuators.</p> <p>Measure the power level at the end of the 5-foot test cable, and adjust the "I" power level to 28 dB below the "S" power level recorded in Step 6.</p> <p><i>Note:</i> To do this, set the "I" power level to 8 dB below the recorded "S" power and then decrease the IF level by 20 dB in the "I" path using IF pads.</p>
8.	<p>Establish the IF Loopback "S+I" Test Connection (Fig. 7)</p> <p>a. Remove the termination and connect the test cable with the "S" signal to the unequal loss combining network as shown in Fig. 7. Connect the "S+I" combined signal to the IF IN jack.</p> <p>b. If the regenerator receiver is being evaluated, go to Step 9.</p> <p>If the regenerator transmitter is being evaluated and the receiver section does <i>not</i> have TRNSV FLT units, go to Step 9.</p> <p>c. <i>Warning: To prevent ESD damage to plug-in units, ensure that ESD precautions are followed, including connecting ESD wrist strap to ground and placing removed plug-in units in ESD protective containers before disconnecting from ground and transporting units.</i></p> <p>Replace the two TRNSV FLT units (color-coded blue) with two TE PATCH units. If necessary, refer to the plug-in unit replacement procedures.</p>
9.	<p>Make the S/I Performance Measurement.</p> <p>a. Observe the ERR RATE (bar graph) display on the associated CHAN CONTR unit (color-coded green). Allow at least 10 seconds before determining if the requirement is met.</p> <p><i>Requirement:</i> The bar graph display shall not be lighted above the line between the 8 and the 7 segments. (That is, a bit error rate equal to or less than 5×10^{-8}.)</p> <p>If the requirement is not met, go to Step 12.</p>

STEP	PROCEDURE
10.	<p>Restore the equipment for normal operation.</p> <p>a. Warning: To prevent ESD (electrostatic discharge) damage to plug-in units, ensure that all ESD precautions are followed.</p> <p>If TRNSV FLT units were removed in Step 8c, remove the TE PATCH units and reinstall the original TRNSV FLT units.</p> <p>b. Disconnect all test connections at the regenerator bay.</p> <p>c. Release the MAN FRS pushbutton on the FRAME RSPLY unit.</p> <p>d. Reinstall the IF cables to the IF IN and IF OUT jacks.</p> <p>e. If no further access to the regenerator IF jacks is required, replace the side cover.</p>
11.	<p>This completes the Regenerator IF Loopback S/I Stress Check. Return to the instruction that referenced this procedure.</p> <p>If this procedure was used on a stand-alone basis, go to the "Repair Verification" tab unless other tests are required.</p>
12.	<p>If the requirement was not met and this procedure was referenced from another procedure, return to that procedure to see if there are instructions regarding a failure to meet requirements. If there are no instructions or the given instructions are inadequate or this procedure was not referenced from another procedure, go to the next step.</p>
13.	<p>The failure of a regenerator receiver or transmitter to meet the requirements of this performance check is most likely due to a defective regenerator circuit pack. Use information from the O&M Maintenance Support manual to do a one-at-a-time replacement/retest procedure with the regenerator still in the looped configuration.</p> <p>If unit replacement does not correct the problem, check for a defective spare, a wiring problem, or a defect on the regenerator shelf. Use the applicable shelf SDs, circuit pack input/output information in the O&M Maintenance Support manual, and a circuit pack extender card to isolate and eliminate the problem.</p> <p>When the problem has been corrected and the regenerator receiver passes the S/I performance check, go to Step 10.</p>

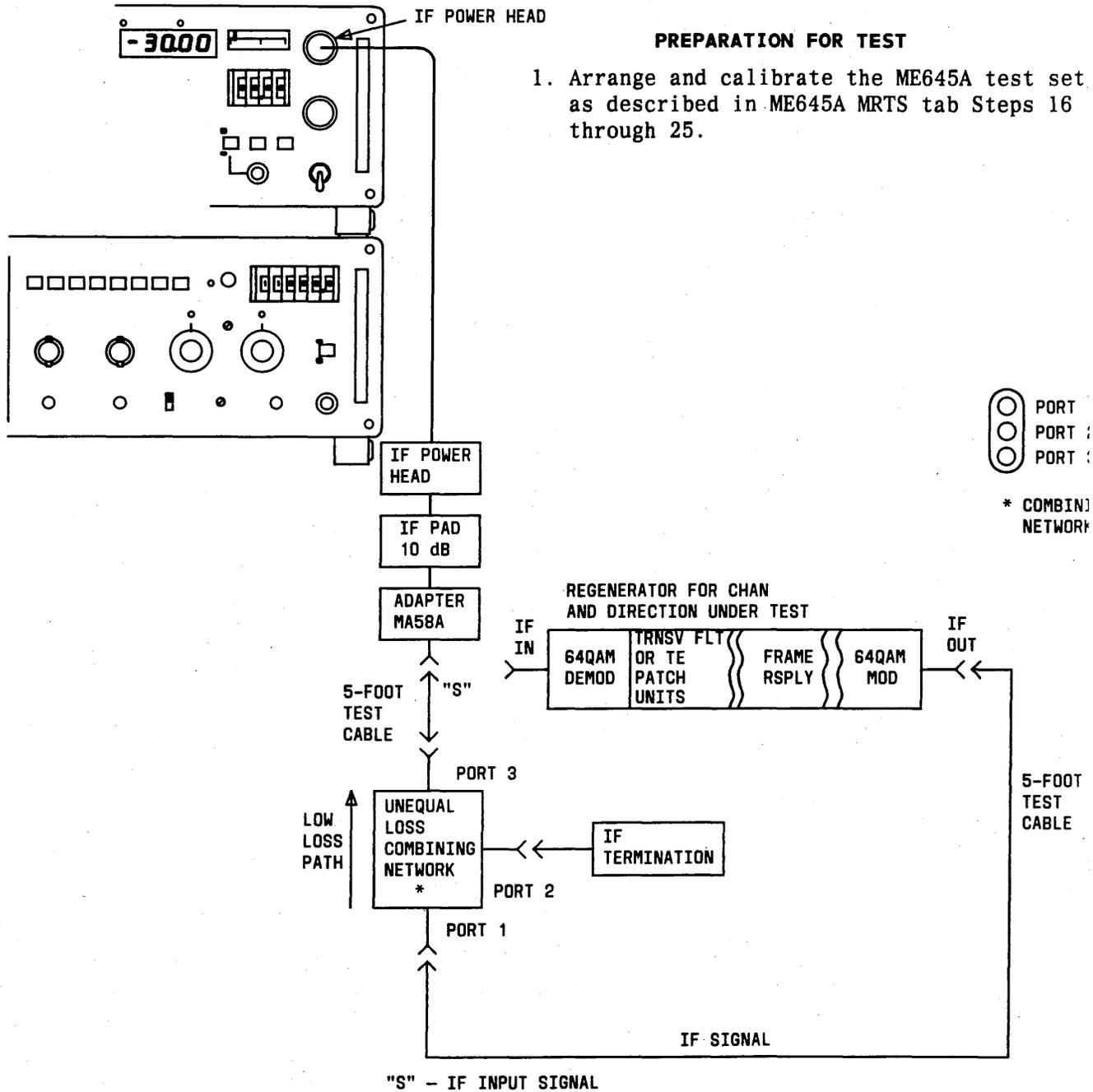


Fig. 5—"S" (IF Signal) Power Level Measuring Connections

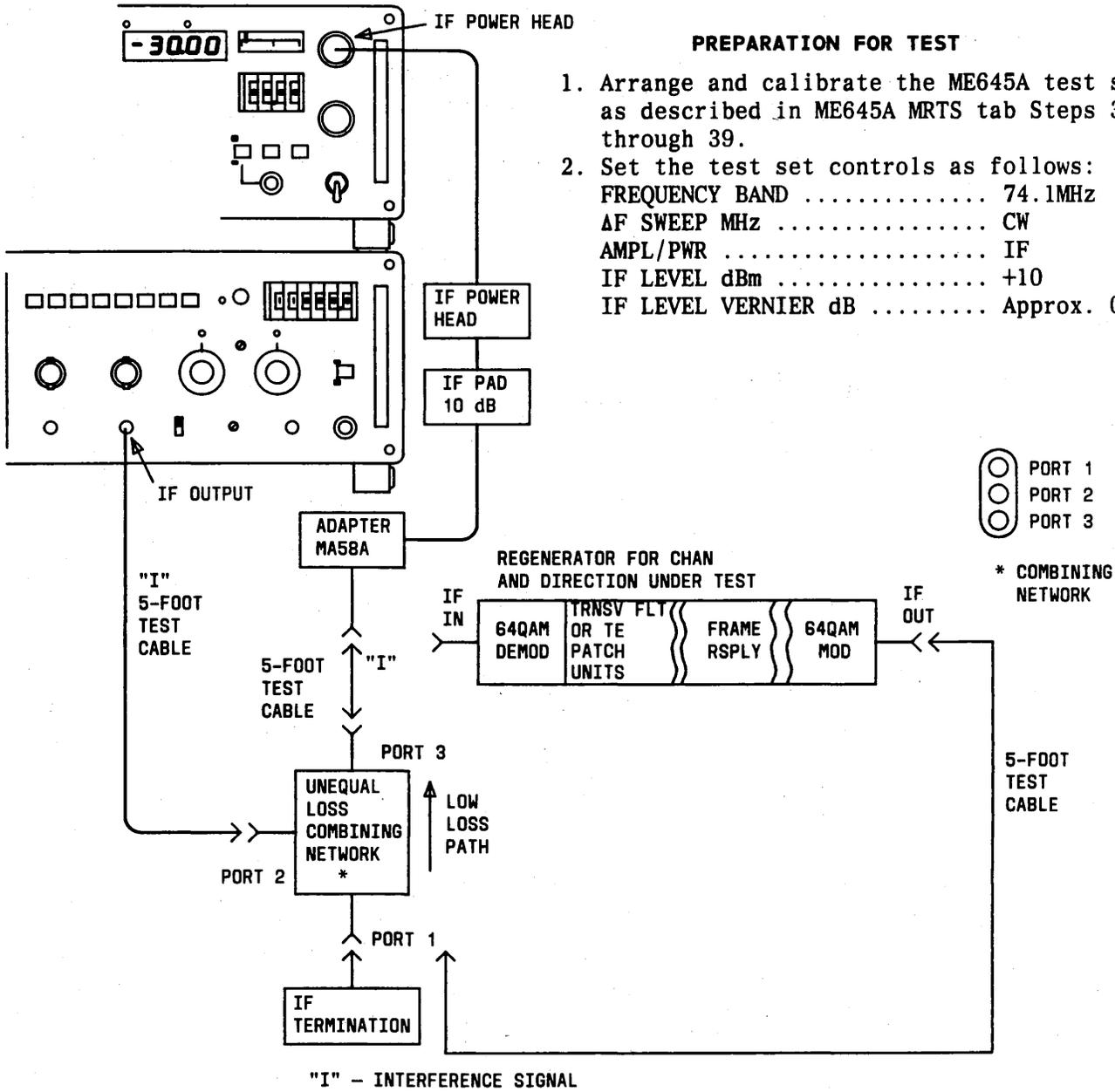


Fig. 6—"I" (Interference) Power Level Setting Connections

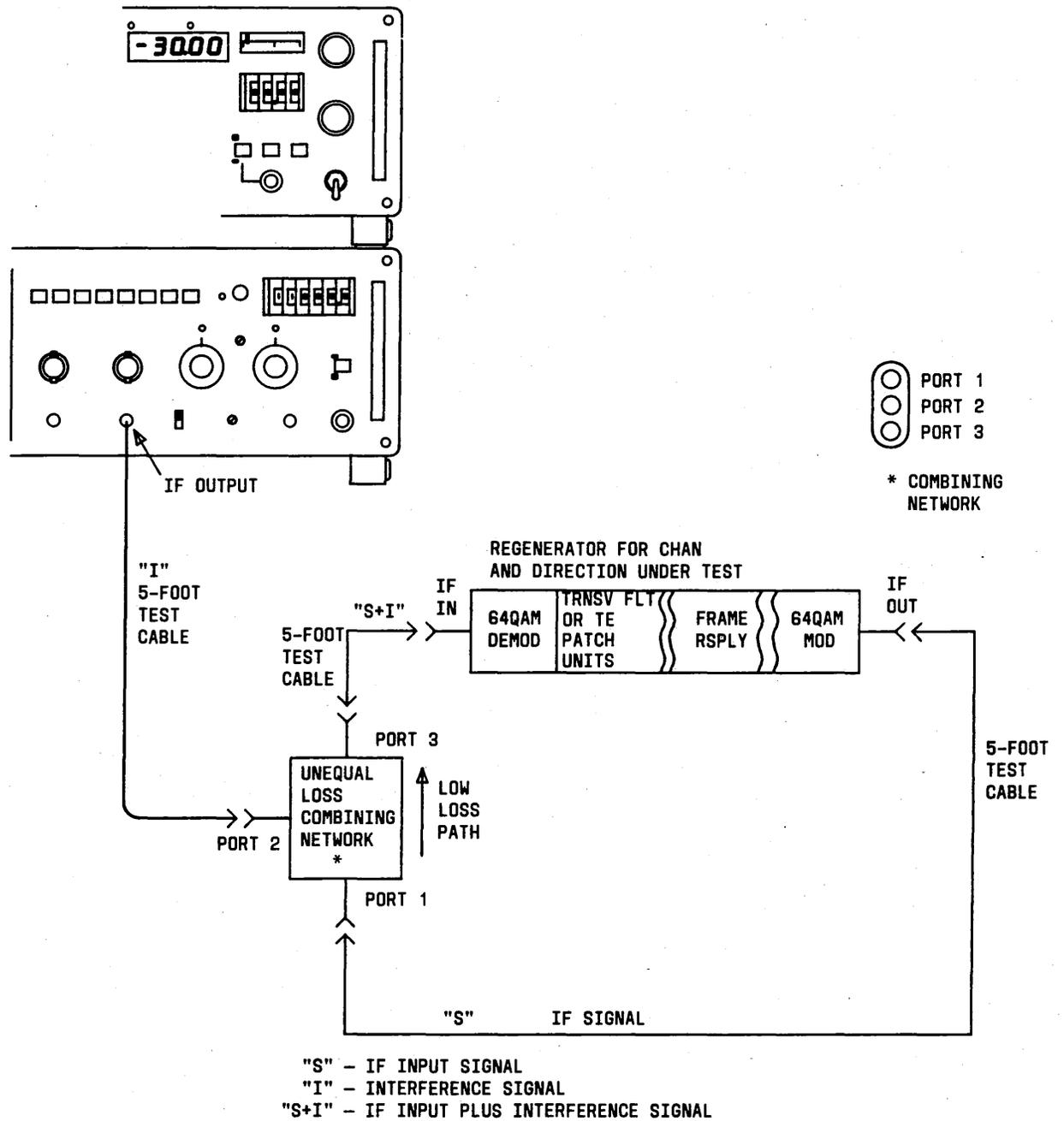


Fig. 7—Regenerator IF Loopback S/I Stress Check Connections

**REGENERATOR IF LOOPBACK TRANSVERSAL EQUALIZER
PERFORMANCE CHECK**

This procedure is used to check the performance of the TE (transversal equalizer) in the digital regenerator receiver while it is isolated from the radio equipment. For this test, the transmitter IF output signal is looped back to supply the IF input signal to the receiver. This procedure is useful in isolating suspected transversal equalizer problems. It is also useful in evaluating the preservice performance of a regenerator receiver following the replacement of circuit packs or other repairs that could affect TE performance.

Performance quality is determined by checking the capability of the TE-equipped receiver to correct for a swept-amplitude notch distortion that is inserted in the IF loopback path.

The test configuration for this dynamic TE performance evaluation is shown in Fig. 8. The transmitter IF output signal is looped back to the receiver through the TE PDS (propagation distortion simulator) and the IF AGC amplifier and ASE (adaptive slope equalizer) circuits in the associated radio receiver. The radio IF AGC amplifier and slope equalizer circuits are necessary in this loopback configuration to compensate for the losses and gross slope shapes introduced by the TE PDS test set during the dynamic stress tests.

The test is completed by observing the ERR RATE on the CHAN CONTR while the TE PDS notch distortion is manually swept back and forth across the IF spectrum for several seconds.

This procedure is applicable to regular or protection equipment. In this procedure, it is assumed that the ASE in the associated radio receiver would pass its Over-the-Air Propagation Distortion Performance Check. If there is any doubt about the ASE, perform that test first.

Caution: THIS IS AN OUT-OF-SERVICE PROCEDURE.

The following test equipment, adapters, cables, and tools are required to perform this procedure:

- 1 - TE PDS (Item A17)
- 1 - 5-foot RG-59 coaxial cable equipped with 440-type plugs (Item B18)
- 3 - Cable assemblies, 6-inch coaxial cable with a 560B jack and female SMB plugs (Item B2)
- 1 - 4-inch screwdriver (Item C8)
- 1 - 50 foot, 731 coaxial cable with 440A plugs (Item B4).

For recommendations and specifications of test equipment, see the "Test Equipment and Accessories" tab.

Warning: To prevent ESD (electrostatic discharge) damage to plug-in units, ensure that all ESD precautions are followed.

STEP	PROCEDURE
1.	Remove the right front side cover on the digital regenerator bay.
2.	Protect service as follows: <ul style="list-style-type: none"> • If testing a regular regenerator (C or D), have terminal station or remote alarm center perform a manual line switch operation for the appropriate (A/C or B/D) direction. • If testing a protection regenerator (A or B), have terminal station or remote alarm center perform a protection channel lockout manual operation for the appropriate (A/C or B/D) direction.
3.	At the radio receiver of the digital receiver being tested, remove the bay cable at the IF IN jack of the IF AGC AMPL unit.
4.	Remove the IF cable on the right shelf patch panel from the IF OUT, and make the test connections shown in Fig. 8.
5.	On the regenerator under test, operate the MAN FRS pushbutton on FRAME RSPLY unit.

Transversal Equalizer Performance Check

6. Set the TE PDS to the left stop position.
7. While observing the ERR RATE display (bar graph) on the associated CHAN CONTR unit (color-coded green), manually rotate the TE PDS test set NOTCH control back and forth between the left and right stop positions. Rotate the control at a rate of one end-to-end sweep about every 2 seconds. Continue the sweep action for approximately 10 seconds.

Requirement: The bar graph display shall not indicate a frame loss (bar graph lights full scale to indicate a frame loss).

If the requirement is met with NON-MIN output, repeat this step with the MIN output of TE PDS. If the requirement is met with both positions, go to Step 8.

If the requirement is not met, repeat Step 7 to verify that the sweep speed and procedure were performed correctly. If the requirement is still not met, go to Step 13.

8. Disconnect all test connections from the radio bay and the digital regenerator bay.
9. If applicable, release the MAN FRS pushbutton on the FRAME RSPLY unit.
10. Reconnect the IF cable at the IF OUT jack on the digital regenerator bay and the bay cable at the IF IN jack of the IF AGC AMPL unit in the radio bay.

STEP	PROCEDURE
11.	If no further access to the IF jacks is required, reinstall the side cover on the digital regenerator bay.
12.	This completes the Regenerator IF Loopback Transversal Equalizer Performance Check. If referenced from another procedure, return to the instruction that referenced this procedure. If the procedure was used on a stand-alone basis, go to the " Repair Verification" tab unless other tests are required.
13.	If the requirement was not met and this procedure was referenced from another procedure, return to that procedure to see if there are instructions regarding a failure to meet requirements. If there are no instructions or the given instructions are inadequate or this procedure was not referenced from another procedure, go to the next step.
14.	The failure of a regenerator receiver to meet the requirements of this TE performance check is most likely due to defective TE units or a failure in one or more of the associated circuits that generate the control signals for the TE units. Use information from the O&M Maintenance Support manual to do a one-at-a-time replacement/retest procedure with the regenerator still in the looped configuration. Start with the TE units and the correlator unit. If this does not solve the problem, the rest of the regenerator receiver demodulation circuits up to and including the decision circuits should also be replaced one at a time while the TE performance check is made. If the problem is still not resolved, replacement of the radio receiver units involved in the loopback should also be suspected and checked by replacement and retest. If unit replacement does not correct the problem, check for a defective spare, a wiring problem, or a defect on the regenerator shelf. Use the applicable shelf SDs, the circuit pack input/output information in the O&M Maintenance Support manual, and a circuit pack extender card to isolate and eliminate the problem. When the problem has been corrected and the regenerator receiver passes the S/I performance check, go to Step 8.

ISSUING ORGANIZATION

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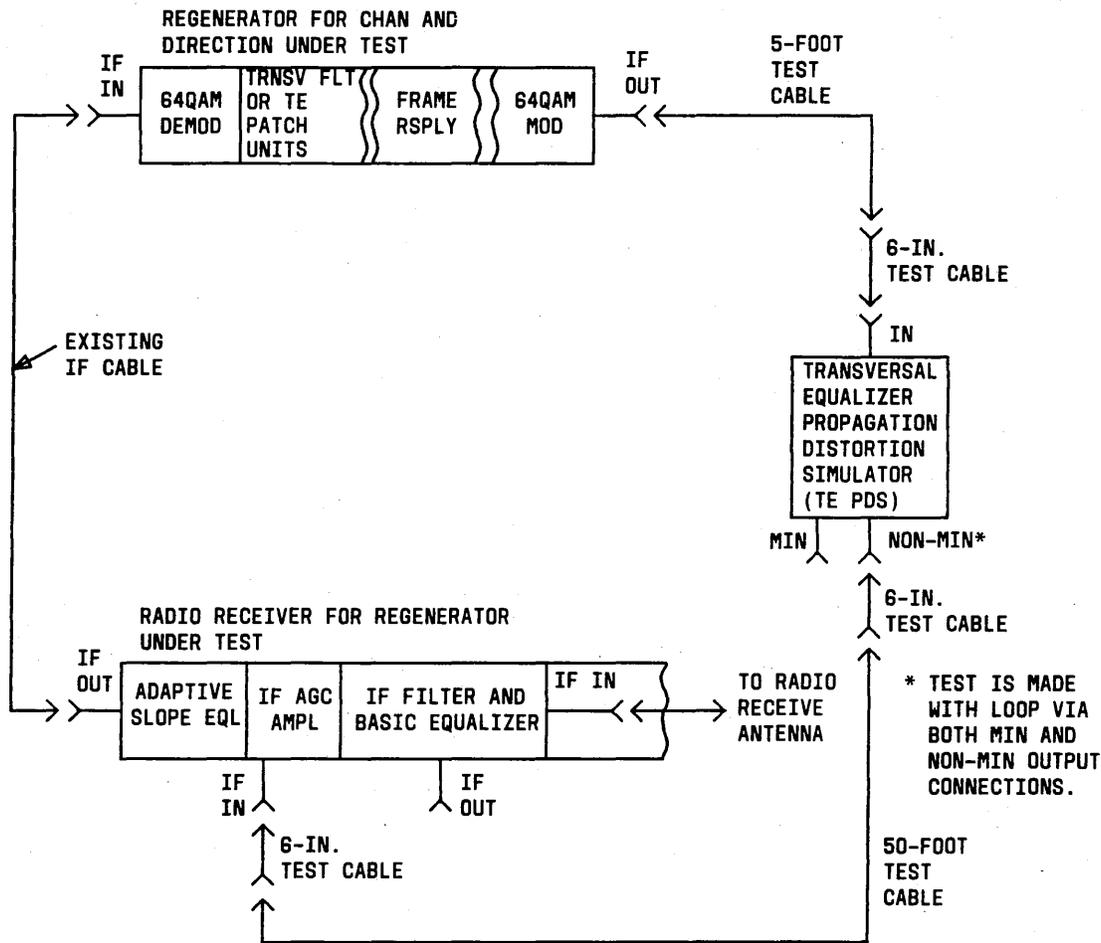


Fig. 8—IF Loopback TE Performance Check Connections