

**ANALOG SIGNALING LINKS
PERFORMANCE TESTS
BETWEEN NO. 2 SIGNAL TRANSFER POINT AND 4A SWITCH
COMMON CHANNEL SIGNALING SYSTEMS**

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1. GENERAL

1.01 This document provides procedures for testing CCSS (common channel signaling systems) VFLs (voice frequency links) between a 2STP (No. 2 signal transfer point) and a 4A switch. Test procedures in this document are performed from the VFLTF (VFL test frame) (SD-3F011-01) or the maintenance center VFL test set (SD-3F024-01) at the 2STP office. These procedures are performed from the IMTF (integrated manual test frame) frame at the 4A switch.

1.02 Whenever this document is reissued, the reason(s) for reissue will be given in this paragraph.

1.03 The procedures in this document are designed to test VFLs of A- and E-type signaling links. The A- and E-type signaling links are equipped with two VFLs each. Mate VFLs are designated VFL-A and VFL-B.

A. Stimulus

1.04 Voice frequency link testing is required at initial circuit order and thereafter only as appropriate to aid in isolation of trouble. At the initial circuit order, benchmarks must be recorded at both the 2STP and the 4A switch. During trouble situations, these benchmarks may provide the tester with information to determine how the VFL has deviated from the circuit order condition.

B. Prerequisites

1.05 If the 2STP office is equipped with a VFLTF (SD-3F011-01), test circuit line trimmer pads located on the VFLTF must be verified or adjusted prior to circuit order VFL performance testing. These pads must be readjusted following the addition or deletion of VFL access circuits (TN919 CPs). Line trimmer pads provide compensation for variable

lengths of office wiring between the VFLTF and the TN919 CPs. Circuit description 3F011-01 provides test and adjustment procedures for these line trimmer pads.

1.06 If the 2STP office is equipped with a VFL test set (SD-3F024-01), the VAT signal level pads located on the VFL test set "VFLT" printed wiring board (ED-3F044) must be verified or adjusted prior to circuit order VFL performance testing. The VAT signal level pads must be readjusted following additions or deletions of VFL access circuits (TN919 CPs). These VAT signal level pads provide compensation for variable lengths of office wiring between the VFL test set and the TN919 CPs. Circuit description 3F024-01 provides test and adjustment procedures for the VAT signal level pads.

1.07 If the 2STP signaling links are equipped with pads (P- or K-pads) located between the VFL access circuits and the channel bank facilities, these pads must meet circuit requirements prior to performing VFL performance tests. These pads are normally installed in noncolocated applications only. Office records provide pad values and physical location of pads. Craft personnel should verify data level at channel bank facilities after VFL access circuit signal level pads are adjusted. If the level does not meet circuit requirements, the pads located between the VFL access circuits and the channel bank facilities may be changed to obtain the required level. Practice 256-040-502 contains test and adjustment procedures for the data level pads between the VFL access circuit and the transmission facilities.

1.08 At the 4A switch, prior to circuit order VFL performance testing, adjustable signal level pads located on the JW291B CP(s) must be verified. These adjustable pads provide compensation for variable lengths of office wiring between the control and display frame and the JW291B CP(s) and between the JW291B CP(s) and the associated data set. Additionally, if pads (P- or K-pads) are installed between the JW291B CP(s) and the channel bank facilities, the value of these pads must be verified prior to VFL circuit order testing. Practice 256-040-502 provides test and adjustment procedures for the VFL access circuit (JW291B CP) and associated level compensation pads. Normally, pads are installed between VFL access circuits and channel bank facilities in noncolocated applications only.

C. Philosophy

1.09 The tests in this document provide procedures to test the VFLs between a 2STP and a 4A switch. Testing may be initiated at either the 2STP or 4A switch.

1.10 Test and adjustment procedures in this document are divided into two groups. One provides for testing initiated from the 2STP, and the other provides for testing initiated from the 4A switch. This distinct categorization attempts to minimize the confusion which may be encountered when a test is applicable to more than one office type. Procedures may become increasingly confusing when connected offices are equipped with unlike test equipment of varying capability.

1.11 During the VFL testing, test signals are inserted and measurements are made at specific points. These points are designated TLPs (transmission level points). Note that TLP is not a unit of measurement but is a location where a power level measurement (in dBm) is made. The TLP concept is a method of expressing signal magnitude at a given point that is relative to its magnitude at another point in the circuit. For example, a reference TLP is defined as the 0 TLP. A signal magnitude measured at the -2 TLP would be 2 dB lower than would be measured at the reference level point (0 TLP). Absolute magnitudes (in dBm) are determined by the applied signal.

1.12 Within the procedures in this document are instructions to insert a test signal or to make a signal level measurement at specified TLPs. Figures 1, 2, and 3 are provided to show the physical location of the TLPs. These figures may be used in conjunction with the test procedures to determine the exact location where the measurement is to be made or where the test signal is to be inserted.

1.13 All referenced figures and tables are located at the end of this document. Figures and tables are arranged in the order that they are referenced.

1.14 The following assumptions have been made:

- (a) Testers at both ends of the VFL to be tested have access to this document.

- (b) All test equipment is calibrated and functioning properly.
- (c) Testers are familiar with the operation of test equipment and the input/output devices.
- (d) Testers are familiar with procedures required to connect a VFL to the test apparatus.
- (e) Testers are familiar with standard procedures for reporting and/or correcting circuit faults.
- (f) Testers have access to supporting documentation (SDs, CDs, IMs, OMs, etc.).
- (g) All audible alarms are retired by the tester as they occur.

D. Supporting Documentation

1.15 The following documents contain information which may be helpful during VFL testing and during VFL trouble isolation.

DOCUMENT	TITLE
SD-3F011-01	CCSS No. 2STP VFL Test Circuit
IM-3F200-01	Input Message Manual - 2STP
OM-3F200-01	Output Message Manual - 2STP
IM-68100-01	Input Message Manual - 4A Switch
OM-68100-01	Output Message Manual - 4A Switch
—	HP* TIMS Operating Instructions Manual - 2STP only.

2. APPARATUS

2.01 Table A provides a list of the test apparatus required for each test procedure. It also references the paragraph in which the particular test apparatus is described in more detail.

2.02 Each 2STP office is equipped with either a VFLTF, SD-3F011-01, or a VFL test set, SD-3F024-01. A detailed description of the VFLTF is pro-

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vided in AT&T Practice 256-210-108. A detailed description of the VFL test set is provided in AT&T Practice 256-210-110.

2.03 The 2STP VFLTF or maintenance center arrangement must be equipped with a TIMS (transmission impairment measuring set) with P/AR (peak-to-average ratio) and nonlinear distortion measurement options. The HP model 4940A or the enhanced HP model 4945A TIMS is considered standard. Operating instructions for the TIMS are provided by the manufacturer. Refer to the TIMS operating instructions for detailed set-up and adjustment procedures. If the 2STP office is equipped with a VFLTF, the TIMS is mounted on the VFLTF. If the 2STP office is equipped with a VFL test set, the TIMS is table top mounted adjacent to the VFL test set.

2.04 At each 2STP office equipped with a VFLTF, four (4) patch cords with WE* -type 310 plugs on each end are required. These patch cords must be long enough to provide the test connections shown in Figure 4. At each 2STP office equipped with a VFL test set, two (2) patch cords with WE-type 310 plugs on each end are required. These patch cords must be long enough to provide the test connections shown in Figure 5.

2.05 In 2STP offices equipped with a VFLTF, the standard input/output device is the VT (video terminal) which is located near the CMF (communication and maintenance frame) in the computer/maintenance area. Refer to AT&T Practice 256-210-100 for a typical floor plan of the 2STP computer/maintenance area. In 2STP offices equipped with a VFL test set, the standard input/output device is the MCRT (maintenance cathode-ray tube) which is located near the VFL test set in the 2STP maintenance center. Refer to AT&T Practice 256-210-110 for a typical floor plan of the 2STP maintenance center.

2.06 Each 4A switch must be equipped with an IMTF (integrated manual test frame) modified for CCS operation and a TTJ (test trunk and VF link jack) bay with VFL test position jacks. Figure 3 shows the functional relationship of the TTJ bay to the IMTF.

2.07 One (1) J94003C (3C) NMS (noise measuring set) equipped with a C-notched plug-in filter (KS-21567-L1) must be available at the 4A switch to

provide the capability for C-notch noise measurements.

2.08 One (1) 723A receiver equipped with W2FS cord and plug assembly must be provided at the 4A switch. The 723A receiver is part of the J94003C NMS.

2.09 Two (2) P6T cords are furnished as part of the TTJ bay. The P6T cord consists of a 6-foot length of green-colored cord equipped with 371-type plugs on each end.

2.10 One (1) modified 3P6F cord must be provided at the 4A switch. This cord must consist of a 10-foot length of P3E slate-colored cord equipped with a 310-type plug on one end and a 289-type plug on the other end.

2.11 One (1) 3P7D cord must be provided at the 4A switch. This cord consists of a 2-foot length of P3E slate-colored cord equipped with a 310-type plug on each end.

2.12 At the 4A switch, the maintenance TTY (channel 10) or the SPC (stored program control) TTY (channel 0) is used as the standard input/output device.

3. TESTS AND ADJUSTMENTS—INITIATED AT 2STP

A. 1004-Hz Net Loss Test

3.01 This test verifies that end-to-end net loss on a VFL does not exceed EML (expected measured loss) by more than 1 dB during circuit order testing or 2 dB during trouble testing. This test also verifies that loopback loss does not exceed the loopback EML by more than 2 dB during circuit order testing or 4 dB during trouble testing. The end-to-end net loss measurements are made at the VFLTF (VFL test frame) or the VFL maintenance center at the 2STP and at the IMTF (integrated manual test frame) at the 4A switch. The loopback loss is measured at the 2STP while an equal level loopback connection is provided at the 4A switch TTJ bay (-2 TLP).

3.02 Apparatus for this test is listed in Table A.

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STEP	PROCEDURE
End-to-End Test	
1	Contact tester (via DDD [Direct Distance Dialing] network) at 4A switch associated with VFL to be tested and request cooperation for VFL testing.
2	At 2STP VFLTF (or 2STP maintenance center)— Power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.
3	Request tester at 4A switch to power up oscillator and level-frequency meter on IMTF and allow it to warm up for a minimum of 10 minutes before making any measurement.
4	Note: All LEDs on VFLTF (or VFL test set) should be extinguished. At 2STP maintenance terminal— Verify status of VFL to be tested via OP:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
5	At 2STP— If selected VFL is active (AVAILABLE-IS)— Transfer VFL to MOOS (manual out-of-service) status via CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
6	At 2STP— Connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.) Requirement: VFLT SLK CDSBY message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.) On VFLTF (or VFL test set)— Green LED (light-emitting diode), associated with VAT I bus serving VFL to be tested, is lighted.
	Note: If no LED lights, release the VAT I bus via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Comment: When the VFLTF is utilized, if access to a VAT I bus is denied, the red LED (associated with that VAT I bus) lights on the VFLTF. If no LED lights, a trouble such as an incorrect software assignment is indicated. When the VFL test set is utilized, only the green LED associated with the idle VAT I bus will light (regardless of VFL requested). A red LED on the VFL test set will light only when the requested VAT I bus is being utilized by the processor for a dedicated maintenance sequence. Note that both red LEDs associated with an unavailable VAT I bus (VAT IA and VAT IB) will always light simultaneously on the VFL test set.

STEP	PROCEDURE
7	<p>At 2STP VFLTF (or VFL test set)— Using patch cords— Connect TIMS to VFL under test (Refer to Fig. 4 [VFLTF arrangement] or Fig. 5 [VFL test set arrangement]).</p>
8	<p>Request tester at 4A switch to verify status of VFL to be tested via SLM-00-STA input message.</p> <p>Requirement: At 4A switch— SLM00 output message indicates VFL to be tested is standby or OOS.</p>
9	<p>Request tester at 4A switch to connect VFL to be tested to TTJ bay via SLM-02-CTP input message.</p> <p>Requirement: At 4A switch— SLM02 output message is printed.</p> <p>On TTJ bay— LED associated with jacks of VFL to be tested is lighted.</p>
10	<p>Request tester at 4A switch, TTJ bay, to connect VF LINK jacks (RCV and TRMT) to IMTF TRUNK DROP jacks (RCV and TRMT) via P6T patch cords.</p> <p>Requirement: At 4A switch— On IMTF— DBT indicator is lighted. On TTJ bay— IMTF BSY indicator is lighted. LED associated with manual test position jacks of VFL to be tested is lighted.</p>
11	<p>Request tester at 4A switch to prepare to measure frequency and level of test signal on VFL under test.</p> <p>Requirement: At 4A switch— On IMTF— RCV, TMS, and VF TEST keys are operated.</p>
12	<p>At 2STP TIMS— Send 1004-Hz test signal at -13.0 dBm level toward 4A switch.</p>
13	<p>Request tester at 4A switch to measure and record frequency and level of received test signal.</p> <p>Requirement: Frequency is measured from 1002 to 1006 Hz.</p> <p>If circuit order testing— Level is measured from -16.0 to -18.0 dBm.</p> <p>If trouble testing— Level is measured from -15.0 to -19.0 dBm.</p>

STEP	PROCEDURE
14	At 2STP— Prepare TIMS to measure frequency and level of test signal from 4A switch.
15	Request tester at 4A switch to send 1004-Hz test signal at -13.0 dBm level from IMTF oscillator (0 TLP). Requirement: At 4A switch— On IMTF— SEND and OSC keys are operated.
16	At 2STP TIMS— Measure and record frequency and level of received test signal. Requirement: Frequency is measured from 1002 to 1006 Hz. If circuit order testing— Level is measured from -16.0 to -18.0 dBm. If trouble testing— Level is measured from -15.0 to -19.0 dBm.
Loopback Test	
17	At 2STP TIMS— Send 1004-Hz test signal at -13.0 dBm level toward 4A switch.
18	Request tester at 4A switch to establish an equal level loopback on VFL under test at TTJ bay (-2 TLP) by connecting VF LINK RCV jack of VFL under test to VF LINK TRMT jack of same VFL via 3P7D cord.
19	At 2STP TIMS— Measure and record frequency and level of received (looped back) test signal. Requirement: Frequency is measured from 1002 to 1006 Hz. If circuit order testing— Level is measured from -15.0 to -19.0 dBm. If trouble testing— Level is measured from -13.0 to -21.0 dBm.
20	Request tester at 4A switch to remove loopback connection. Requirement: At 2STP TIMS— Test signal is no longer received.
21	If additional tests are to be performed on VFL under test— Proceed to next test procedure.

STEP	PROCEDURE
22	Request tester at 4A switch to release VFL under test from TTJ bay via SLM-02-RTP input message.
23	At 2STP— Release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
24	At 2STP— If tested VFL is to be placed in the active state— Enter CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
25	If additional VFLs are to be tested using Test A— Repeat procedure from Step 4.

B. C-Notched Noise and Signal-to-Noise Ratio Test

3.03 The end-to-end C-notched noise test, also called noise-with-tone measurement, is a measurement of the noise level on a VFL. To obtain this measurement, a holding tone of 1004-Hz at a -13.0 dBm level is applied at one end of the VFL and removed (notched out) at the other end with a C-notched filter. This allows the remaining noise to be measured. The 1004-Hz holding tone is necessary to control the compandored transmission facility.

3.04 The tolerance level of noise on a VFL is expressed as a ratio of signal level to C-notched

noise level (S/N ratio). Regardless of VFL length, end-to-end S/N ratio must be 27 dB or greater. To calculate S/N ratio, a measurement of noise plus tone is required. The S/N ratio is calculated by subtracting the end-to-end C-notched noise level from the end-to-end noise plus tone level. The S/N ratio is expressed in dB.

3.05 Due to test equipment limitations, C-notched noise (noise-with-tone) measurements will not be made on a looparound basis.

3.06 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to VFLTF (or VFL test set) at 2STP and to IMTF at 4A switch— Continue with Step 12.
2	Contact tester (via DDD network) at 4A switch associated with VFL to be tested and request cooperation for VFL testing.
3	At 2STP VFLTF (or 2STP maintenance center)— Power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.
4	Request tester at 4A switch to power up test equipment and allow a minimum warm up period of 10 minutes before making any measurement.

STEP	PROCEDURE
5	<p>Note: All LEDs on VFLTF (or VFL test set) should be extinguished.</p> <p>At 2STP— Verify status of VFL to be tested via OP:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: At 2STP— OP SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p>
6	<p>At 2STP— If selected VFL is active (AVAILABLE-IS)— Transfer VFL to MOOS (manual out-of-service) status via CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: At 2STP— CHG SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p>
7	<p>At 2STP— Connect VFL to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: At 2STP— VFLT SLK CDSBY message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p> <p>On VFLTF (or VFL test set)— Green LED, associated with VAT I bus serving VFL to be tested, is lighted.</p> <p>Comment: When the VFLTF is utilized, if access to a VAT I bus is denied, the red LED (associated with that VAT I bus) lights on the VFLTF. If no LED lights, a trouble such as an incorrect software assignment is indicated. When the VFL test set is utilized, only the green LED associated with the idle VFL will light (regardless of VFL requested). A red LED on the VFL test set will light only when the requested VAT I bus is being utilized by the processor for a dedicated maintenance sequence. Note that both red LEDs associated with the VAT I bus (VAT IA and VAT IB) will always light simultaneously.</p>
8	<p>At 2STP VFLTF (or VFL test set)— Using patch cords— Connect TIMS to VFL under test (Refer to Fig. 4 [VFLTF arrangement] or Fig. 5 [VFL test set arrangement]).</p>
9	<p>Request tester at 4A switch to verify status of VFL to be tested via SLM-00-STA input message.</p> <p>Requirement: At 4A switch— SLM00 output message indicates VFL to be tested is standby or OOS.</p>
10	<p>Request tester at 4A switch to connect VFL to be tested to TTJ bay via SLM-02-CTP input message.</p>

STEP	PROCEDURE
	<p>Requirement: At 4A switch— On TTJ bay— LED associated with jacks of VFL to be tested is lighted.</p>
11	<p>Request tester at 4A switch, TTJ bay, to connect VF LINK jacks (RCV and TRMT) to IMTF TRUNK DROP jacks (RCV and TRMT) via P6T patch cords.</p> <p>Requirement: At 4A switch— On IMTF— DBT indicator is lighted. On TTJ bay— IMTF BUSY indicator is lighted. LED associated with manual test position jacks of VFL to be tested is lighted.</p>
12	<p>Request tester at 4A switch to prepare 3C NMS (noise measuring set) or equivalent for C-notched noise measurement.</p> <p>Requirement: On 3C NMS— KS-21567 L1 network is positioned with C-NOTCH stenciling showing at top. DAMP NORM switch is in NORM position. FUNCTION switch is in NM 600 position. DBRN switch is set to 85.</p>
13	<p>At 2STP TIMS— Send 1004-Hz test signal at -13.0 dBm level toward 4A switch.</p>
14	<p>Request tester at 4A switch to measure and record end-to-end C-notched noise level.</p> <p>Requirement: C-notched noise is within limits listed in Table B.</p>
15	<p>Request tester at 4A switch to measure noise-plus-tone level of the 1004-Hz test signal (in dBm).</p> <p>Comment: The measured level should be the same as recorded in Test A.</p>
16	<p>Request tester at 4A switch to add +90 to value obtained in Step 15 (converts dBm to dBm).</p>
17	<p>Request tester at 4A switch to calculate S/N ratio by subtracting measured C-notched noise level (Step 14) from value obtained in Step 16.</p> <p>Requirement: End-to-end S/N ratio is 27 dB or higher.</p>
18	<p>Request tester at 4A switch to send 1004-Hz test signal at -13.0 dBm from IMTF oscillator (0 TLP).</p>
19	<p>At 2STP— Prepare TIMS to measure C-notched noise level utilizing noise filter. (Refer to TIMS operating instructions for detailed procedure.)</p> <p>On HP 4940A TIMS— Rotate MEASUREMENT switch to noise-with-tone position.</p>

STEP	PROCEDURE
	Operate DISPLAY CONNECTED TO key to RCV position. Depress NOISE FILTER key to C-MSG position.
20	At 2STP TIMS— Read C-notched noise level from TIMS display (right display on HP 4940A TIMS). Requirement: C-notched noise level is within maximum limits listed in Table B.
21	At 2STP TIMS— Prepare TIMS to measure noise-tone level. (Refer to TIMS operating instructions for detailed procedure.) On HP 4940A TIMS— Rotate MEASUREMENT switch to MESSAGE CIRCUIT NOISE position.
22	At 2STP TIMS— Read noise-plus-tone level on TIMS display (right display on HP 4940A TIMS) and record the value.
23	At 2STP— Calculate the signal-to-noise ratio by subtracting C-notched noise level recorded in Step 20 from noise-plus-tone level recorded in Step 22. The result is signal-to-noise in dB. Requirement: Signal-to-noise ratio is 27 dB or higher.
24	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
25	Request tester at 4A switch to release VFL under test from TTJ bay via SLM-02-RTP input message.
26	At 2STP— Release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
27	At 2STP— If tested VFL is to be placed in the active state— Enter CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
28	If additional VFLs are to be tested using Test B— Repeat procedure from Step 5.

C. Single Frequency Interference Test

3.07 This test checks for spurious tones that can interfere with data signals. A 600-ohm quiet termination is applied at one end of the VFL under test, and the tester at the other end of the VFL circuit

listens for any predominant tone which indicates a potential single frequency interference problem. This check is performed in both directions, but loopback testing is not performed.

3.08 If a single frequency interference problem is identified, a frequency selective voltmeter, spectrum analyzer, or oscilloscope is required to further analyze the frequency and level of the interfering tone. Refer all "interfering tone" problems to the

transmission facilities maintenance personnel immediately.

3.09 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to VFLTF (or VFL test set) at 2STP and to IMTF at 4A switch—Continue with Step 12.
2	Contact tester (via DDD network) at 4A switch associated with VFL to be tested and request cooperation for VFL testing.
3	At 2STP VFLTF (or 2STP maintenance center)— Power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.
4	Request tester at 4A switch to power up test equipment and allow a minimum warm-up period of 10 minutes before making any measurement.
5	Note: All LEDs on VFLTF (or VFL test set) should be extinguished.
	At 2STP— Verify status of VFL to be tested via OP:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Requirement: At 2STP— OP SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)
6	At 2STP— If selected VFL is active (AVAILABLE-IS)— Transfer VFL to MOOS (manual out-of-service) status via CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Requirement: At 2STP— CHG SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)
7	At 2STP— Connect VFL to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Requirement: At 2STP— VFLT SLK CDSBY message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)

STEP	PROCEDURE
	<p>On VFLTF (or VFL test set)— Green LED, associated with VAT I bus serving VFL to be tested, is lighted.</p> <p>Note: If no LED lights, release the VAT I bus via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Comment: When the VFLTF is utilized, if access to a VAT I bus is denied, the red LED (associated with that VAT I bus) lights on the VFLTF. If no LED lights, a trouble such as an incorrect software assignment is indicated. When the VFL test set is utilized, only the green LED associated with the idle VFL will light (regardless of VFL requested). A red LED on the VFL test set will light only when the requested VAT I bus is being utilized by the processor for a dedicated maintenance sequence. Note that both red LEDs associated with the VAT I bus (VAT IA and VAT IB) will always light simultaneously.</p>
8	<p>At 2STP VFLTF (or VFL test set)— Using patch cords— Connect TIMS to VFL under test (Refer to Fig. 4 [VFLTF arrangement] or Fig. 5 [VFL test set arrangement]).</p>
9	<p>Request tester at 4A switch to verify status of VFL to be tested via SLM-00-STA input message.</p> <p>Requirement: At 4A switch— SLM00 output message indicates VFL to be tested is standby or OOS.</p>
10	<p>Request tester at 4A switch to connect VFL to be tested to TTJ bay via SLM-02-CTP input message.</p> <p>Requirement: At 4A switch— On TTJ bay— LED associated with jacks of VFL to be tested is lighted.</p>
11	<p>Request tester at 4A switch, TTJ bay, to connect VF LINK jacks (RCV and TRMT) to IMTF TRUNK DROP jacks (RCV and TRMT) via P6T patch cords.</p> <p>Requirement: At 4A switch— On IMTF— DBT indicator is lighted. On TTJ bay— IMTF BUSY indicator is lighted. LED associated with manual test position jacks of VFL to be tested is lighted. VFL to be tested is lighted.</p>
12	<p>Request tester at 4A switch to establish a quiet termination on VFL under test.</p>
13	<p>At 2STP— Adjust volume control on TIMS for desired listening level and listen for any predominate tone.</p> <p>Requirement: No predominant tone is detected.</p>

STEP	PROCEDURE
14	If predominant tone is detected in Step 13— Measure noise level at TIMS (-4 TLP). <i>Requirement:</i> Measured noise (SFI) is within limits listed in Table C.
15	If requirement in Step 14 is not met— Record results and notify transmission facilities maintenance personnel.
16	Request tester at 4A switch to remove quiet termination.
17	At 2STP TIMS— Establish a quiet termination on the VFL under test per TIMS operating instructions manual.
18	Request tester at 4A switch to insert 723A test receiver into AC MON jack and listen for any predominate tone indicating SFI. <i>Requirement:</i> No predominate tone detected.
19	If requirement in Step 18 is not met— Request tester at 4A switch to measure noise level using 3C NMS. <i>Requirement:</i> Level is within SFI limits listed in Table C.
20	If requirement in Step 19 is not met— Record results and notify transmission facilities maintenance personnel.
21	At 2STP— Remove quiet termination on VFL under test.
22	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
23	Request tester at 4A switch to release VFL under test from TTJ bay via SLM-02-RTP input message.
24	At 2STP— Release VFL under test via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
25	At 2STP— If tested VFL is to be placed in the active state— Enter CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
26	If additional VFLs are to be tested using Test C— Repeat procedure from Step 5.

D. Peak-To-Average Ratio Test

3.10 This procedure simultaneously measures the gain and phase distortion characteristics (envelope delay distortion, bandwidth compression, and return loss) of the data channel. Precisely shaped pulses of known P/AR (peak to full-wave average ratio) are transmitted through the data channel. These pulses are measured to determine the extent that the ratio was altered by the distortions encountered.

3.11 The P/AR test provides a means for rapid evaluation of the overall quality of a data cir-

cuit. It is a very effective measure of intersymbol interference.

3.12 At circuit order time, perform the P/AR test from the 2STP office in a loopback mode. Record the P/AR as a benchmark value. Limits are not specified for looped back P/AR. However, during trouble testing, P/AR test results should not vary more than 4 units from the benchmark. If the P/AR varies more than 4 units from the benchmark, individually measure return loss, envelope delay distortion, and attenuation distortion.

3.13 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to VFLTF (or VFL test set) at 2STP and to TTJ bay at 4A switch— Continue with Step 9.
2	Contact tester (via DDD network) at 4A switch associated with VFL to be tested and request cooperation for testing.
3	At 2STP VFLTF (or 2STP maintenance center)— Power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.
4	Note: All LEDs on VFLTF (or VFL test set) should be extinguished. At 2STP— Verify status of VFL to be tested via OP:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
5	At 2STP— If selected VFL is active (AVAILABLE-IS)— Transfer VFL to MOOS (manual out-of-service) status via CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
6	At 2STP— Connect VFL to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Requirement: VFLT SLK CDSBY message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)
	On VFLTF (or VFL test set)— Green LED associated with VAT I bus serving VFL to be tested, is lighted.

STEP

PROCEDURE

Note: If no LED lights, release the VAT I bus via **VFLT:SLK CDSBY** input message.
(Refer to latest issue of IM-3F200-01 for message format.)

Comment: When the VFLTF is utilized, if access to a VAT I bus is denied, the red LED (associated with that VAT I bus) lights on the VFLTF. If no LED lights, a trouble such as an incorrect software assignment is indicated. When the VFL test set is utilized, only the green LED associated with the idle VFL will light (regardless of VFL requested). A red LED on the VFL test set will light only when the requested VAT I bus is being utilized by the processor for a dedicated maintenance sequence. Note that both red LEDs associated with the VAT I bus (VAT IA and VAT IB) will always light simultaneously.

7 Request tester at 4A switch to verify status of VFL to be tested via **SLM-00-STA** input message.

Requirement: At 4A switch—
SLM00 output message indicates VFL to be tested is standby or OOS.

8 Request tester at 4A switch to connect VFL to be tested to **TTJ** bay via **SLM-02-CTP** input message.

Requirement: At 4A switch—
SLM02 output message is printed.—

On **TTJ** bay—
LED associated with jacks of VFL to be tested is lighted.

9 At 2STP VFLTF (or VFL test set)—
Using patch cords, connect TIMS to VFL under test.
(Refer to Fig. 4 [VFLTF arrangement] or Fig. 5 [VFL test set arrangement]).

10 At 2STP—
Set up TIMS for P/AR transmission at 0 TLP.
(Refer to TIMS operating instructions manual for detailed procedure.)

Requirement: At 2STP, HP 4940A TIMS—
MEASUREMENT switch is in P/AR position.
DISPLAY CONNECTED TO switch is in TRMT position.
Middle and right LED displays indicate transmitted signal to be 1004 Hz at -13.0 dBm level.
Left LED display indicates transmission of 99 to 101 P/AR units.

11 Request tester at 4A switch to establish an equal level loopback on VFL under test at **TTJ** bay (-2 TLP) by connecting VF LINK RCV jack to VF LINK TRMT jack.

12 At 2STP TIMS—
Measure and record P/AR at -4 TLP.
(Refer to TIMS operating instructions for detailed procedure.)

Requirement: If circuit order testing—
Record measured P/AR for benchmark purposes.

STEP	PROCEDURE
	If trouble testing— Loopback P/AR is within 4 units of benchmark recorded at circuit order.
13	Request tester at 4A switch to remove loopback connection.
	Requirement: At 2STP— P/AR is no longer measured.
14	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
15	Request tester at 4A switch to release VFL under test from TTJ bay via SJM-02 input message.
16	At 2STP— Release tested VFL from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
17	At 2STP— If tested VFL is to be placed in the active state— Enter CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
18	If additional VFLs are to be tested using Test D— Repeat procedure from Step 4.

E. Impulse Noise and Phase and Gain Hits Test

3.14 The impulse noise test is a count of noise hits on a VFL circuit and its associated transmission media whose amplitude exceeds a specified threshold during a specified time interval. A C-notched filter and a counting device are required for all impulse noise measurements.

3.15 The phase hit test is a count of rapid changes of phase that exceed a preset threshold during a specified time interval.

3.16 The gain hit test is a count of rapid changes of gain that exceed a preset threshold during a specified time interval.

3.17 The impulse noise threshold for loopback impulse noise measurement is 73 dBrc0 which

is equivalent to 69 dBrc at the -4 TLP. A maximum of 15 counts in a 15-minute test period is allowed.

3.18 While performing the impulse noise test, the phase and gain hits can also be measured. The phase hit threshold is set for 20 degrees, and the gain hit threshold is set for 4 dB. A maximum of 7 hits in a 15-minute test period is allowed.

3.19 The impulse noise and phase and gain hits test must be performed at circuit order in a loopback mode only. The tester at the 4A switch provides an equal level loopback while measurements are made at the 2STP TIMS.

3.20 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to VFLTF (or VFL test set) at 2STP and to TTJ bay at 4A switch— Continue with Step 9.
2	Contact tester (via DDD network) at 4A switch associated with VFL to be tested and request cooperation for VFL testing.
3	At 2STP VFLTF (or 2STP maintenance center)— Power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.
4	Note: All LEDs on VFLTF (or VFL test set) should be extinguished.
	At 2STP— Verify status of VFL to be tested via OP:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Requirement: OP SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)
5	At 2STP— If selected VFL is active (AVAILABLE-IS)— Transfer VFL to MOOS (manual out-of-service) status via CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Requirement: CHG SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)
6	At 2STP— Connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Requirement: VFLT SLK CDSBY message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)
	On VFLTF (or VFL test set)— Green LED associated with VAT I bus serving VFL to be tested is lighted.
	Note: If no LED lights, release the VAT I bus via VFLT: SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
	Comment: When the VFLTF is utilized, if access to a VAT I bus is denied, the red LED (associated with that VAT I bus) on the VFLTF lights. If no LED lights, a trouble such as an incorrect software assignment is indicated. When the VFL test set is utilized, only the green LED associated with the idle VAT I bus will light (regardless of VFL requested). A red LED on the VFL test set will light only when the requested VAT I bus is being utilized by the processor for a dedicated maintenance sequence. Note that both red LEDs associated with the VAT I bus (VAT IA and VAT IB) will always light simultaneously on the VFL test set.

STEP	PROCEDURE
7	<p>Request tester at 4A switch to verify status of VFL to be tested via SLM-00-STA input message.</p> <p>Requirement: At 4A switch— SLM00 output message indicates VFL to be tested is standby or OOS.</p>
8	<p>Request tester at 4A switch to connect VFL to be tested to TTJ bay via SLM-02-CTP input message.</p> <p>Requirement: At 4A switch— On TTJ bay— LED associated with jacks of VFL to be tested is lighted.</p>
9	<p>At 2STP VFLTF (or VFL test set)— Using patch cords, connect TIMS to VFL under test. (Refer to Fig. 4 [VFLTF arrangement] or Fig. 5 [VFL test set arrangement]).</p>
10	<p>At 2STP— Set up TIMS for 3-level impulse noise, hits and dropouts measurements. (Refer to TIMS operating instructions for detailed procedure.)</p>
11	<p>Request tester at 4A switch to establish an equal level loopback on VFL under test at TTJ bay (–2 TLP) by connecting VF LINK RCV jack to VF LINK TRMT jack.</p>
12	<p>At 2STP TIMS— Send a 1004-Hz test signal at a –13.0 dBm level for looped back impulse noise, hits and dropouts measurement.</p>
13	<p>At 2STP— Prepare TIMS to measure looped back impulse noise, hits and dropouts at –4 TLP. (Refer to TIMS operating instructions for detailed procedure.)</p>
14	<p>At 2STP TIMS— Start count period per TIMS operating instructions.</p>
15	<p>At 2STP TIMS— Read and record COUNTS LO, COUNTS MID, and COUNTS HI at end of count period (15 minutes).</p> <p>Requirement: A maximum of 15 counts are recorded.</p>
16	<p>At 2STP— Prepare TIMS to measure phase hits, dropouts, and gain hits for a 15-minute period. (Refer to TIMS operating instructions for detailed procedure.)</p> <p>Requirement: A maximum of 7 hits are recorded at end of 15-minute count period.</p>
17	<p>If additional tests are to be performed on VFL under test— Proceed to next test procedure.</p>
18	<p>Request tester at 4A switch to release VFL under test from TTJ bay via SLM-02-RPT input message.</p>

STEP	PROCEDURE
19	At 2STP— Release tested VFL from the VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
20	At 2STP— If tested VFL is to be placed in the active state— Enter CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format).
21	If additional VFLs are to be tested using Test E— Repeat procedure from Step 4.

F. Frequency Response Test

3.21 This test checks the amplitude versus frequency characteristics of the VFL circuit and transmission media. Attenuation and distortion of a signal can change as the frequency of the transmitted signal changes. The distortion is stated in terms of the loss at a particular frequency referenced to the loss at 1004 Hz. The frequency response test can be performed in conjunction with the 1004-Hz net loss test, since the frequency response requirements are relative to 1004 Hz. Attenuation distortion/frequency response should be within limits before envelope delay distortion is measured, since adjustment of attenuation distortion equalizers may effect the envelope delay distortion measurement.

3.22 The frequency response test must be performed in end-to-end and loopback modes at circuit order. The results should be recorded in office records.

3.23 Frequency response minimum requirements for end-to-end testing are listed in Table D. For loopback testing, there is no minimum requirement for frequency response measurements. However, if the loopback frequency response measurement during trouble testing varies by more than 2 dB from the loopback value recorded at circuit order time, a more detailed end-to-end frequency response test should be made using the frequencies listed in Table D.

3.24 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
End-to-End Test	
1	If VFL to be tested is connected to VFLTF (or VFL test set) at 2STP and to IMTF at 4A switch— Continue with Step 12.
2	Contact tester (via DDD network) at 4A switch associated with VFL to be tested and request cooperation for VFL testing.

STEP	PROCEDURE
3	<p>At 2STP VFLTF (or 2STP maintenance center)— Power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.</p>
4	<p>Request tester at 4A switch to power up test equipment and allow a minimum warm-up period of 10 minutes before making any measurement.</p>
5	<p>Note: All LEDs on VFLTF (or VFL test set) should be extinguished.</p> <p>At 2STP— Verify status of VFL to be tested via OP:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: OP SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p>
6	<p>At 2STP— If selected VFL to MOOS (manual out-of-service) status via CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: CHG SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p>
7	<p>At 2STP— Connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: VFLT SLK CDSBY message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p> <p>On VFLTF (or VFL test set)— Green LED, associated with VAT I bus serving VFL to be tested, is lighted.</p> <p>Note: If no LED lights, release the VAT I bus via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Comment: When the VFLTF is utilized, if access to a VAT I bus is denied, the red LED (associated with that VAT I bus) lights on the VFLTF. If no LED lights, a trouble such as an incorrect software assignment is indicated. When the VFL test set is utilized, only the green LED associated with the idle VAT I bus will light (regardless of VFL requested). A red LED on the VFL test set will light only when the requested VAT I bus is being utilized by the processor for a dedicated maintenance sequence. Note that both red LEDs associated with the VAT I bus (VAT IA and VAT IB) will always light simultaneously on the VFL test set.</p>
8	<p>At 2STP VFLTF (or VFL test set)— Using patch cords— Connect TIMS to VFL under test. (Refer to Fig. 4 [VFLTF arrangement] or Fig. 5 [VFL test set arrangement].)</p>

STEP	PROCEDURE
9	Request tester at 4A switch to verify status of VFL to be tested via SLM-00-STA input message. Requirement: At 4A switch— SLMOO output message indicates VFL to be tested is standby or OOS.
10	Request tester at 4A switch to connect VFL to be tested to TTJ bay via SLM-02-CTP input message. Requirement: At 4A switch— On TTJ bay— LED associated with jacks of VFL to be tested is lighted.
11	Request tester at 4A switch, TTJ bay, to connect VF LINK jacks (RCV and TRMT) to IMTF TRUNK DROP jacks (RCV and TRMT) via P6T cords. Requirement: At 4A switch— On IMTF— DBT indicator is lighted. On TTJ bay— IMTF BSY indicator is lighted. LED associated with manual test position jacks of VFL to be tested is lighted.
12	Request tester at 4A switch to send 1004-Hz reference signal at -13.0 dBm level from IMTF oscillator (0 TLP).
13	At 2STP TIMS— Measure and record frequency and level of received reference signal. Requirement: At 2STP TIMS— Frequency of reference signal is measured from 1002 to 1006 Hz. If circuit order testing— Level is measured from -16.0 to -18.0 dBm. If trouble testing— Level is measured from -15.0 to -19.0 dBm.
14	At 2STP TIMS— Establish a 0 dB relative loss value for the received reference frequency. (Refer to TIMS operating instructions for detailed procedure.)
15	Request tester at 4A switch to send 404-Hz test signal at -13.0 dBm level from IMTF oscillator (0 TLP).
16	At 2STP TIMS— Read and record frequency and attenuation relative to reference frequency dBm (frequency response).

STEP	PROCEDURE
	<p>Requirement: Frequency of received test signal is measured from 402 to 406 Hz. Attenuation relative to reference frequency dBm (frequency response) is -2.0 to +6.0 dB.</p>
17	Request tester at 4A switch to send 2804-Hz test signal at -13.0 dBm level from IMTF oscillator (0 TLP).
18	<p>At 2STP TIMS— Read and record frequency and attenuation relative to reference frequency dBm (frequency response).</p>
	<p>Requirement: Frequency of received test signal is measured from 2802 to 2806 Hz. Attenuation relative to reference frequency dBm is -2.0 to +6.0 dB.</p>
19	Request tester at 4A switch to prepare to measure frequency and level of reference signal.
20	<p>At 2STP TIMS— Send 1004-Hz reference signal at -13.0 dBm level.</p>
21	Request tester at 4A switch to measure and record frequency and level of received reference signal.
	<p>Requirement: At 4A switch— Frequency of reference signal is measured from 1002 to 1006 Hz.</p> <p>If circuit order testing— Level is measured from -16.0 to -18.0 dBm.</p> <p>If trouble testing— Level is measured from -15.0 to -19.0 dBm.</p>
22	<p>At 2STP TIMS— Send 304 Hz test signal at -13.0 dBm.</p>
23	<p>Note: The 4A switch TTS indicates absolute dBm. To convert absolute dBm to dB loss relative to the reference frequency, subtract the test frequency dBm from the reference frequency dBm.</p>
	<p>Example: A test frequency at -13.0 dBm level and a reference frequency at -11.0 dBm level results in a +2.0 dB relative loss ($-11.0 - [-13.0] = +2.0$). Request tester at 4A switch to read absolute frequency and attenuation of test signal and calculate attenuation relative to reference frequency.</p>
	<p>Requirement: Frequency of received test signal is measured from 302 to 306 Hz. Attenuation relative to reference frequency dBm (frequency response) is -3.0 to +12.0 dB.</p>
24	Repeat Steps 22 and 23 for each frequency listed in Table D.
	<p>Requirement: All frequencies measured at the 4A switch are within 2 Hz of the transmitted frequency.</p>

STEP	PROCEDURE
	Attenuation relative to the reference frequency dBm is within ranges listed in Table D for the transmitted frequency.
Loopback Test	
25	Request tester at 4A switch to establish an equal level loopback on VFL under test at TTJ bay (-2 TLP) by connecting VF LINK RCV jack to VF LINK TRMT jack.
26	At 2STP TIMS— Send a 1004-Hz reference signal at a -13.0 dBm level and measure and record the frequency and level of the looped back reference signal.
	Requirement: Frequency of reference signal is measured from 1002 to 1006 Hz.
	If circuit order testing— Level is measured from -16.0 to -18.0 dBm.
	If trouble testing— Level is measured from -15.0 to -19.0 dBm.
27	At 2STP TIMS— Establish a 0 dB relative loss value for the received reference frequency. (Refer to TIMS operating instructions for detailed procedure.)
28	At 2STP TIMS— Send a 304-Hz test signal at a -13.0 dBm level and read and record frequency and attenuation relative to reference frequency dBm (frequency response).
	Requirement: If circuit order testing— Record loopback frequency response measurements as benchmark values.
	If trouble testing— Frequency of looped back test signal is measured from 302 to 306 Hz. Attenuation relative to reference frequency dBm is not more than 2 dB from loopback value recorded at circuit order.
29	At 2STP TIMS— Repeat Step 28 for each frequency listed in Table D.
	Requirement: If circuit order testing— Record loopback frequency response measurements as benchmark values.
	If trouble testing— All frequencies measured at the 2STP TIMS are within 2 Hz of the transmitted frequency. Attenuation relative to the reference frequency dBm is not more than 2 dB from loopback value recorded at circuit order.
30	Request tester at 4A switch to remove loopback connection.

STEP	PROCEDURE
	Requirement: At 2STP TIMS— Test signal is no longer received.
31	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
32	Request tester at 4A switch to release VFL under test from TTJ bay via SLM-02-RTP input message.
33	At 2STP— Release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
34	At 2STP— If tested VFL is to be placed in the active state— Enter CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)
35	If additional VFLs are to be tested using Test F— Repeat procedure from Step 5.

G. Envelope Delay Distortion

3.25 This test checks the envelope delay distortion of a VFL by transmitting specific test frequencies and measuring the delay. Envelope delay distortion is a source of intersymbol interference in data signals. The envelope delay distortion of a VFL circuit should be measured only after the attenuation distortion (frequency response) of the circuit has been brought within limits. In the event that delay distortion requirements cannot be met using the equalizers specified (equalizers are not always specified), refer to the problem to circuit engineering.

3.26 The envelope delay distortion test is to be performed at circuit order in a loopback mode only. The results should be recorded in office records at the 2STP and 4A switch.

3.27 Envelope delay distortion measurement frequencies and requirements for loopback testing are listed in Table E.

3.28 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to VFLTF at 2STP and to TTJ bay at 4A switch— Continue with Step 9.
2	Contact tester (via DDD network) at 4A switch associated with VFL to be tested and request cooperation for VFL testing.

STEP	PROCEDURE
3	<p>At 2STP VFLTF (or 2STP maintenance center)— Power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.</p>
4	<p>Note: All LEDs on VFLTF (or VFL test set) should be extinguished.</p> <p>At 2STP— Verify status of VFL to be tested via OP:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: OP SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p>
5	<p>At 2STP— If selected VFL is active (AVAILABLE-IS)— Transfer VFL to MOOS (manual out-of-service) status via CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: CHG SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p>
6	<p>At 2STP— Connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: VFLT SLK CDSBY message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p> <p>On VFLTF (or VFL test set)— The green LED associated with VAT I bus serving VFL to be tested is lighted.</p> <p>Note: If no LED lights, release the VAT I bus via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Comment: When the VFLTF is utilized, if access to a VAT I bus is denied, the red LED (associated with that VAT I bus) lights on the VFLTF. If no LED lights, a trouble such as an incorrect software assignment is indicated. When the VFL test set is utilized, only the green LED associated with the idle VAT I bus will light (regardless of VFL requested). A red LED on the VFL test set will light only when the requested VAT I bus is being utilized by the processor for a dedicated maintenance sequence. Note that both red LEDs associated with the VAT I bus (VAT IA and VAT IB) will always light simultaneously on the VFL test set.</p>
7	<p>Request tester at 4A switch to verify status of VFL to be tested via SLM-00-STA input message.</p> <p>Requirement: At 4A switch— SLM00 output message indicates VFL to be tested is standby or OOS.</p>
8	<p>Request tester at 4A switch to connect VFL to be tested to TTJ bay via SLM-02-CTP input message.</p>

STEP	PROCEDURE
	<p>Requirement: At 4A switch— On TTJ bay— LED associated with jacks of VFL to be tested is lighted.</p>
9	<p>At 2STP VFLTF (or VFL test set)— Using patch cords, connect TIMS to VFL under test. (Refer to Fig. 4 [VFLTF arrangement] or Fig. 5 [VFL test set arrangement].)</p>
10	<p>Request tester at 4A switch to establish an equal level loopback on VFL under test at TTJ bay (–2 TLP) by connecting VF LINK RCV jack to VF LINK TRMT jack.</p>
11	<p>At 2STP— Prepare TIMS to measure envelope delay. (Refer to TIMS operating instructions for detailed procedure.)</p>
12	<p>At 2STP TIMS— Set controls to send a reference signal of 1004 Hz at a –13.0 dBm level.</p>
13	<p>At 2STP TIMS— Set controls to receive looped back reference signal.</p>
14	<p>At 2STP TIMS— Establish a reference zero at the reference frequency. (Refer to TIMS operating instructions for detailed procedure.)</p> <p>Requirement: Reading variation on TIMS display are evenly distributed above and below zero microseconds.</p>
15	<p>At 2STP TIMS— Adjust frequency control to send 804-Hz test signal. (Level should be set at –13.0 dBm.)</p> <p>Requirement: Envelope delay is measured within limits listed in Table E.</p>
16	<p>At 2STP— Repeat Step 15 for each frequency listed in Table E.</p> <p>Requirement: Envelope delay is measured within limits listed in Table E for associated test frequency.</p>
17	<p>Request tester at 4A switch to remove loopback connection.</p> <p>Requirement: At 2STP TIMS— Test signal is no longer received.</p>
18	<p>If additional tests are to be performed on VFL under test— Proceed to next test procedure.</p>
19	<p>Request tester at 4A switch to release VFL under test from TTJ bay via SLM-02-RTP input message.</p>

STEP	PROCEDURE
20	At 2STP— Release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)
21	At 2STP— If tested VFL is to be placed in the active state— Enter CHG:SLK message. (Refer to latest issue of IM-3F200-01 for message format.)
22	If additional VFLs are to be tested using Test G— Repeat procedure from Step 4.

H. Nonlinear Distortion Test

3.29 This test checks the second and third order distortions such as compression and clipping. These distortions result in harmonics that interfere with multitone data signals.

3.30 To measure nonlinear (intermodulation) distortion, four equal-level tones are transmitted over the facility to be measured. Two of these tones are closely spaced around a center frequency of 860 Hz, and the other two tones are centered around a center frequency of 1380 Hz. Each pair of narrowly spaced tones is used to simulate a narrowband of noise at each center frequency. The second order distortion is determined by measuring the energy through narrowband filters centered at 520 Hz (1380

Hz - 860 Hz = 520 Hz) and 2240 Hz (1380 Hz + 860 Hz = 2240 Hz). Third order distortion is measured through a narrowband filter centered at 1900 Hz ($2 \times 1380 \text{ Hz} - 860 \text{ Hz} = 1900 \text{ Hz}$).

3.31 The nonlinear distortion test must be performed at circuit order time in a loopback mode only. The results should be recorded at both the 2STP and 4A switch. The ratio of the fundamental to the second-order distortion products must be greater than 20 dB and the ratio of the fundamental to the third-order products must be greater than 25 dB. These requirements assume the 4-tone method of measurement is used with the HP 4940A TIMS.

3.32 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to VFLTF (or VFL test set) at 2STP and to TTJ bay at 4A switch— Continue with Step 9.
2	Contact tester (via DDD network) at 4A switch associated with VFL to be tested and request cooperation for VFL testing.
3	At 2STP VFLTF (or 2STP maintenance center)— Power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.
4	Note: All LEDs on VFLTF (or VFL test set) should be extinguished.

STEP	PROCEDURE
	<p>At 2STP— Verify status of VFL to be tested via OP:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: OP SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p>
5	<p>At 2STP— If selected VFL is active (AVAILABLE-IS)— Transfer VFL to MOOS (manual out-of-service) status via CHG:SLK input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: CHG SLK message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p>
6	<p>At 2STP— Connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Requirement: VFLT SLK CDSBY message is printed. (Refer to latest issue of OM-3F200-01 for explanation of message.)</p> <p>On VFLTF (or VFL test set)— Green LED, associated with VAT I bus serving VFL to be tested, is lighted.</p> <p>Note: If no LED lights, release the VAT I bus via VFLTF:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p> <p>Comment: When the VFLTF is utilized, if access to a VAT I bus is denied, the red LED (associated with that VAT I bus) lights on the VFLTF. If no LED lights, a trouble such as an incorrect software assignment is indicated. When the VFL test set is utilized, only the green LED associated with the idle VAT I bus will light (regardless of VFL requested). A red LED on the VFL test set will light only when the requested VAT I bus is being utilized by the processor for a dedicated maintenance sequence. Note that both red LEDs associated with the VAT I bus (VAT IA and VAT IB) will always light simultaneously on the VFL test set.</p>
7	<p>Request tester at 4A switch to verify status of VFL to be tested via SLM-00-STA input message.</p> <p>Requirement: At 4A switch— SLM00 output message indicates VFL to be tested is standby or OOS.</p>
8	<p>Request tester at 4A switch to connect VFL to be tested to TTJ bay via SLM-02-CTP input message.</p> <p>Requirement: At 4A switch— On TTJ bay— LED associated with jacks of VFL to be tested is lighted.</p>

STEP	PROCEDURE
9	At 2STP VFLTF (or VFL test set)— Using patch cords, connect TIMS to VFL under test. (Refer to Fig. 4 [VFLTF arrangement] or Fig. 5 [VFL test set arrangement].)
10	Request tester at 4A switch to establish an equal level loopback on VFL under test at TTJ bay (-2) TLP) by connecting VF LINK RCV jack to VF LINK TRMT jack.
11	At 2STP— Set controls on TIMS to measure nonlinear distortion. (Refer to TIMS operating instructions for detailed procedure.)
12	At 2STP TIMS— Send 1004-Hz reference signal at -13.0 dBm.
13	At 2STP— Set TIMS to receive mode and measure the level of the looped back reference signal.
	Requirement: Level is 35.0 dBm or greater.
14	At 2STP TIMS— When the received level stabilizes, establish a 0 dB reference so that distortion products can be measured in dB relative to reference signal level. (Refer to TIMS operating instructions for detailed procedure.)
15	At 2STP TIMS— Set controls to measure second order nonlinear distortion normal test signal level and read and record "normal test signal level". (Refer to TIMS operating instructions for detailed procedure.)
16	At 2STP TIMS— Set controls to "check signal" mode and read and record "check signal level" (in dB). (Refer to TIMS operating instructions for detailed procedure.)
17	At 2STP— Subtract "check signal level" recorded in Step 16 from "normal signal level" recorded in Step 15 and record the difference value.
18	At 2STP— Obtain, from Table F, the "correction factor" associated with the difference value recorded in Step 17.
19	At 2STP— Calculate 2nd order nonlinear distortion via the method below:
	"Correction factor" + "normal test signal level" = "nonlinear distortion" (db).
	Requirement: The second order nonlinear distortion is greater than 20.0 dB.

STEP	PROCEDURE
20	<p>At STP TIMS— Set controls to measure third order nonlinear distortion and read and record the “normal test signal level” (in dB). (Refer to TIMS operating instructions for detailed procedure.)</p>
21	<p>On 2STP TIMS— Set controls to “check signal” mode and read and record “check signal level” (in dB).</p>
22	<p>At 2STP— Subtract “check signal level” recorded in Step 21 from “normal signal level” recorded in Step 20 and record the difference value.</p>
23	<p>At 2STP— Obtain, from Table F, the “correction factor” associated with the difference value recorded in Step 22.</p>
24	<p>At 2STP— Calculate third order nonlinear distortion via the method below: “Correction factor” + “normal test signal level” = “nonlinear distortion” (dB).</p>
	<p>Requirement: The 3rd order nonlinear distortion is greater than 25.0 dB.</p>
25	<p>Request tester at 4A switch to remove loopback connection.</p>
	<p>Requirement: At 2STP— Test signal is no longer received.</p>
26	<p>If additional tests are to be performed on VFL under test— Proceed to next test procedure.</p>
27	<p>Request tester at 4A switch to release VFL under test from TTJ bay via SLM-02-RTP input message.</p>
28	<p>At 2STP— Release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p>
29	<p>At 2STP— If tested VFL is to be placed in active state— Enter CHG:SLK message. (Refer to latest issue of IM-3F200-01 for message format.)</p>
30	<p>If additional VFLs are to be tested using Test H— Repeat procedure from Step 4.</p>

4. TESTS AND ADJUSTMENT — INITIATED AT 4A SWITCH

A. 1004-Hz Net Loss Test

4.01 This test verifies that end-to-end net loss on a VFL between a 2STP and 4A switch does not exceed expected measured loss (EML) by more than 1 dB during circuit order testing or 2 dB during trouble testing. This test also verifies loopback loss does

not exceed loopback EML by more than 2 dB during circuit order testing or 4 dB during trouble testing. The end-to-end net loss measurements are made at the VFLTF (VFL test frame) or VFL test set at the 2STP and at the integrated manual test frame (IMTF) at the 4A switch. The loopback loss is measured at the 4A switch while an equal level loopback connection is provided at the 2STP (-2 TLP).

4.02 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
End-to-End Test	
1	Contact tester (via DDD network) at 2STP associated with VFL to be tested and request cooperation for VFL testing.
2	At 4A switch, IMTF— Power up oscillator and level-frequency meter and allow a minimum warm-up time of 10 minutes before making any measurement.
3	Request tester at 2STP to power up TIMS and allow a minimum warm-up period of 10 minutes before making any measurement.
4	Note. All LEDs on IMTF and TTJ bay should be extinguished. At 4A switch TTY— Verify status of VFL to be tested via SLM-00-STA input message. (Refer to latest issue of IM-68100-01 for message format.) Requirement: SLM00 output message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)
5	At 4A switch— If selected VFL is active— Transfer VFL to the OOS (out-of-service) state via SLM-01-00S input message. (Refer to latest issue of IM-68100-01 for message format.) Requirement: SLM00 output message indicates VFL to be tested is standby or OOS. (Refer to latest issue of OM-68100-01 for explanation of message.)
6	At 4A switch— Connect VFL to be tested to TTJ bay via SLM-02-CTP input message. (Refer to latest issue of IM-68100-01 for message format.) Requirement: SLM02 output message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)

STEP	PROCEDURE
	<p>On TTJ bay— LED associated with jacks of VFL to be tested is lighted.</p>
7	<p>At 4A switch, TTJ bay— Using P6T patch cord— Connect VF LINK jacks (RCV and TRMT) associated with VFL to be tested to IMTF TRUNK DROP jacks (RCV and TRMT).</p> <p>Requirement: At IMTF— DBT indicator is lighted. At TTJ bay— Selected IMTF BSY indicator is lighted. LED associated with manual test position jacks of VFL to be tested is lighted.</p>
8	<p>Request tester at 2STP to verify status of VFL to be tested via OP:SLK input message.</p> <p>Requirement: At 2STP— OP SLK message indicates VFL to be tested is standby or OOS.</p>
9	<p>Request tester at 2STP to connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.</p> <p>Requirement: At 2STP— VFLT SLK CDSBY message is printed.</p> <p>On VFLTF (or VFL test set)— Green LED, associated with VAT I bus serving VFL to be tested, is lighted.</p>
10	<p>Request tester at 2STP to connect TIMS to VFL under test via patch cords.</p>
11	<p>Request tester at 2STP to prepare TIMS to measure frequency and level of test signal on VFL under test.</p>
12	<p>At 4A switch, IMTF oscillator— Send 1004-Hz test signal at -13.0 dBm level.</p>
13	<p>Request tester at 2STP to measure and record frequency and level of received test signal.</p> <p>Requirement: Frequency is measured from 1002 to 1006 Hz.</p> <p>If circuit order testing— Level is measured from -16.0 to -18.0 dBm.</p> <p>If trouble testing— Level is measured from -15.0 to -19.0 dBm.</p>
14	<p>At 4A switch— Prepare to measure frequency and level of test signal from 2STP.</p>

STEP	PROCEDURE
15	Request tester at 2STP to send 1004-Hz test signal at -13.0 dBm level.
16	At 4A switch— Measure and record frequency and level of received test signal.
	Requirement: Frequency is measured from 1002 to 1006 Hz.
	If circuit order testing— Level is measured from -16.0 to -18.0 dBm.
	If trouble testing— Level is measured from -15.0 to -19.0 dBm.
Loopback Test	
17	At 4A switch, IMTF oscillator— Send 1004-Hz test signal at -13.0 dBm level.
18	Request tester at 2STP to establish an equal level loopback on VFL under test at -2 TLP.
19	At 4A switch— Measure and record frequency and level of received (looped back) test signal.
	Requirement: Frequency is measured from 1002 to 1006 Hz.
	If circuit order testing— Level is measured from -15.0 to -19.0 dBm.
	If trouble testing— Level is measured from -13.0 to -21.0 dBm.
20	Request tester at 2STP to remove loopback connection.
	Requirement: At 4A switch, IMTF frequency and level meter— Test signal is no longer received.
21	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
22	Request tester at 2STP to release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.
23	At 4A switch— Release VFL under test via SLM-02-RTP input message. (Refer to latest issue of IM-68100-01 for message format.)
24	At 4A switch— If tested VFL is to be placed in active state—

STEP	PROCEDURE
	Enter SLM-01-ACT input message. (Refer to latest issue of IM-68100-01 for message format.)
25	If additional VFLs are to be tested using Test A— Repeat procedure from Step 4.

B. C-Notched Noise and Signal-to-Noise Ratio Test

4.03 The end-to-end C-notched noise test, also called noise-with-tone measurement, is a measurement of the noise level on a VFL. To obtain this measurement, a holding tone of 1004-Hz at a -13.0 dBm level is applied at one end of the VFL and removed (notched out) at the other end with a C-notch filter. This allows the remaining noise to be measured. The 1004-Hz holding tone is necessary to control the compandored transmission facility.

4.04 The tolerance level of noise on a VFL is expressed as a ratio of signal level to C-notched

noise level (S/N ratio). Regardless of VFL length, end-to-end S/N ratio must be 27 dB or greater. To calculate S/N ratio, a measurement of noise-plus-tone level is required. The S/N ratio is calculated by subtracting the end-to-end C-notched noise level from the end-to-end noise-plus-tone level. The S/N ratio is expressed in dB.

4.05 Due to test equipment limitations, C-notched noise (noise-with-tone) measurements will not be made on a looparound basis.

4.06 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to IMTF at 4A switch and to VFLTF (or VFL test set) at 2STP— Continue with Step 11.
2	Contact tester (via DDD network) at 2STP associated with VFL to be tested and request cooperation for VFL testing.
3	At 4A switch, IMTF— Power up test equipment and allow a minimum warm-up period of 10 minutes before making any measurement.
4	Request tester at 2STP to power up TIMS and allow a minimum warm-up period of 10 minutes before making any measurement.
5	Note: All LEDs on IMTF and TTJ bay should be extinguished. At 4A switch— Verify status of VFL to be tested via SLM-00-STA input message. (Refer to latest issue of IM-68100-01 for message format.)

STEP	PROCEDURE
	<p>Requirement: SLM-00 message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)</p>
6	<p>At 4A switch— If selected VFL is active— Transfer VFL to manual OOS status via SLM-01-OOS input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: SLM00 message indicates selected VFL is standby or OOS. (Refer to latest issue of OM-68100-01 for explanation of message.)</p>
7	<p>At 4A switch— Connect VFL to TTJ bay via SLM-02-CTP input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: At 4A switch, TTJ bay— LED associated with jacks of selected VFL is lighted.</p>
8	<p>At 4A switch, TTJ bay— Connect VF LINK jacks (RCV and TRMT) to IMTF TRUNK DROP jacks (RCV and TRMT) via P6T patch cord.</p> <p>Requirement: At 4A switch— On IMTF— DBT indicator is lighted. On TTJ bay— IMTF BSY indicator is lighted.</p>
9	<p>Request tester at 2STP to verify status of VFL to be tested via OP:SLK input message.</p> <p>Requirement: At 2STP— OP:SLK message indicates selected VFL is standby or OOS.</p>
10	<p>Request tester at 2STP to connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.</p> <p>Requirement: At 2STP— VFLT SLK CDSBY message indicates VFL to be tested is connected to VFLTF (or VFL test set).</p> <p>On VFLTF (or VFL test set)— Green LED, associated with the VAT I bus serving VFL to be tested, is lighted.</p>
11	Request tester at 2STP to connect TIMS to VFLTF (or VFL test set) via patch cords.
12	Request tester at 2STP to prepare TIMS for C-notched noise measurement.
13	At 4A switch, IMTF oscillator— Send 1004-Hz test signal at -13.0 dBm level.

STEP	PROCEDURE
14	Request tester at 2STP to measure and record end-to-end C-notched noise level. Requirement: C-notched noise is within maximum limits listed in Table B.
15	Request tester at 2STP to measure and record noise-plus-tone level.
16	Request tester at 2STP to calculate and record the end-to-end S/N ratio by subtracting the end-to-end C-notched noise level (dBrnc) recorded in Step 14 from the noise-plus-tone level recorded in Step 15. (S/N ratio is expressed in dB.) Requirement: End-to-end S/N ratio is 27 dB or higher.
17	At 4A switch, IMTF— Prepare 3C NMS for C-notched noise measurement. Requirement: On 3C NMS— KS-21567 L1 network is positioned with C-NOTCH showing at top. DAMP NORM switch is in NORM position. FUNCTION switch is in NM 600 position. DBRN switch is set to 85.
18	Request tester at 2STP to send 1004-Hz test signal at -13.0 dBm.
19	At 4A switch, IMTF 3C NMS— Read and record end-to-end C-notched noise level. Requirement: C-notched noise is within maximum limits listed in Table B.
20	At 4A switch— Measure and record noise-plus-tone level (in dBm) on VFL under test.
21	At 4A switch— Add +90 to value obtained in Step 20 (converts dBm to dBrn).
22	At 4A switch— Calculate S/N ratio by subtracting measured C-notched noise level (obtained in Step 19) from value obtained in Step 21. Requirement: End-to-end S/N ratio is 27 dB or higher.
23	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
24	Request tester at 2STP to release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.
25	At 4A switch— Release VFL under test from TTJ bay via SLM-02-RTP input message. (Refer to latest issue of IM-68100-01 for message format.)

STEP	PROCEDURE
26	At 4A switch— If tested VFL is to be placed in active state— Enter SLM-01-ACT input message. (Refer to latest issue of IM-68100-01 for message format.)
27	If additional VFLs are to be tested using Test B— Repeat procedure from Step 5.

C. Single Frequency Interference Test

4.07 This test checks for spurious tones that can interfere with data signals. A 600-ohm quiet termination is applied at one end of the VFL under test and the tester at the other end of the VFL circuit listens for any predominant tone which indicates a potential single frequency interference (SFI) problem. This check is performed in both directions, but loopback testing is not performed.

4.08 If a single frequency interference problem is identified, a frequency selective voltmeter, spectrum analyzer, or oscilloscope is required to further analyze the frequency and level of the interfering tone. Refer all "interfering tone" problems to transmission facilities maintenance personnel immediately.

4.09 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to IMTF at 4A switch and to VFLTF (or VFL test set) at 2STP— Continue with Step 11.
2	Contact tester (via DDD network) at 2STP associated with VFL to be tested and request cooperation for VFL testing.
3	At 4A switch— Power up test equipment and allow a minimum warm-up period of 10 minutes before making any measurement.
4	Request tester at 2STP to power up TIMS and allow a minimum warm-up period of 10 minutes before making any measurement.
5	<p>Note: All LEDs on IMTF and TTJ bay should be extinguished.</p> <p>At 4A switch— Verify status of VFL to be tested via SLM-00-STA input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: SLM00 message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)</p>

STEP	PROCEDURE
6	<p>At 4A switch— If selected VFL is active— Transfer VFL to OOS status via SLM-01-OOS input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: SLM00 message indicates selected VFL is OOS. (Refer to latest issue of OM-68100-01 for explanation of message.)</p>
7	<p>At 4A switch— Connect VFL to TTJ bay via SLM-02-CTP input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: At 4A switch, TTJ bay— LED associated with jacks of selected VFL is lighted.</p>
8	<p>At 4A switch, TTJ bay— Connect VF LINK jacks (RCV and TRMT) to IMTF TRUNK DROP jacks (RCV and TRMT) via P6T patch cord.</p> <p>Requirement: At 4A switch— On IMTF— DBT indicator is lighted. On TTJ bay— IMTF BSY indicator is lighted.</p>
9	<p>Request tester at 2STP to verify status of VFL to be tested via OP:SLK input message.</p> <p>Requirement: At 2STP— OP SLK message indicates selected VFL is standby or OOS.</p>
10	<p>Request tester at 2STP to connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.</p> <p>Requirement: At 2STP— VFLT SLK CDSBY message indicates VFL to be tested is connected to VFLTF (or VFL test set). On VFLTF (or VFL test set)— Green LED, associated with the VAT I bus serving VFL to be tested, is lighted.</p>
11	<p>Request tester at 2STP VFLTF (or VFL test set) to connect TIMS to VFL under test via patch cords.</p>
12	<p>At 4A switch— Establish a quiet termination on the VFL under test.</p>
13	<p>Request tester at 2STP to adjust TIMS volume control for desired listening level and listen for any predominant tone.</p> <p>Requirement: No predominate tone is detected.</p>

STEP	PROCEDURE
14	If predominant tone is detected in Step 13— Request tester at 2STP to measure noise level on VFL under test (at TIMS). <i>Requirement:</i> Measured noise (SFI) is within limits listed in Table C.
15	If requirement in Step 14 is not met— Notify facility maintenance personnel.
16	At 4A switch— Remove quiet termination from VFL under test.
17	Request tester at 2STP to establish a quiet termination on the VFL under test.
18	At 4A switch, IMTF— Insert 723A test receiver into AC MON jack and listen for any predominate tone indicating SFI. <i>Requirement:</i> No predominate tone detected.
19	If predominant tone is detected in Step 18— Measure noise level using 3C NMS. <i>Requirement:</i> Measured noise (SFI) is within limits listed in Table C.
20	If requirement in Step 19 is not met— Notify facility maintenance personnel.
21	Request tester at 2STP to remove quiet termination from VFL under test.
22	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
23	Request tester at 2STP to release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.
24	At 4A switch— If tested VFL is to be placed in active state— Enter SLM-01-ACT input message. (Refer to latest issue of IM-68100-01 for message format.)
25	If additional VFLs are to be tested using Test C— Repeat procedure from Step 5.

D. Peak-To-Average Ratio Test

4.10 This procedure simultaneously measures the gain and phase distortion characteristics (envelope delay distortion, bandwidth compression, and return loss) of the data channel. Precisely shaped pulses of known P/AR (peak to full-wave average ratio) are transmitted through the data channel. These pulses are measured to determine the extent that the ratio was altered by the distortions encountered.

4.11 The P/AR test provides a means for rapid evaluation of the overall quality of a data circuit. It is a very effective measure of intersymbol interference.

4.12 At circuit order time, P/AR measurement should be made at the 2STP TIMS while an equal loopback is provided at the 4A switch. The P/AR test results must be recorded as a benchmark value at both the 4A switch and the 2STP. Limits are not specified for looped back P/AR. However, during trouble testing, P/AR test results should not vary more than 4 units from the benchmark. If the P/AR varies more than 4 units from the benchmark, individually measure return loss, envelope delay distortion, and attention distortion.

4.13 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to TTJ bay at 4A switch and to VFLTF (or VFL test set) at 2STP— Continue with Step 9.
2	Contact tester (via DDD network) at 2STP associated with VFL to be tested and request cooperation for testing.
3	Request tester at 2STP to power up TIMS and allow it to warm up for a minimum of 10 minutes before making any measurement.
4	Note: All LEDs on IMTF and TTJ bay should be extinguished.
	At 4A switch— Verify status of VFL to be tested via SLM-00-STA input message. (Refer to latest issue of IM-68100-01 for message format.)
	Requirement: SLM00 message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)
5	At 4A switch— If selected VFL is active— Transfer VFL to OOS status via SLM-01-00S input message. (Refer to latest issue of IM-68100-01 for message format.)
	Requirement: SLM00 message indicates selected VFL is standby or OOS. (Refer to latest issue of OM-68100-01 for explanation of message.)
6	At 4A switch— Connect VFL to TTJ bay via SLM-02-CTP input message. (Refer to latest issue of IM-68100-01 for message format.)

STEP	PROCEDURE
	<p>Requirement: At 4A switch, TTJ bay— LED associated with jacks of selected VFL is lighted.</p>
7	<p>Request tester at 2STP to verify status of VFL to be tested via OP:SLK input message.</p> <p>Requirement: At 2STP— OP SLK message indicates selected VFL is standby or OOS.</p>
8	<p>Request tester at 2STP to connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.</p> <p>Requirement: At 2STP— VFLT SLK CDSBY message indicates VFL to be tested is connected to VFLTF (or VFL test set).</p> <p>On VFLTF (or VFL test set)— Green LED, associated with the VAT I bus serving VFL to be tested, is lighted.</p>
9	<p>Request tester at 2STP to connect TIMS to VFLTF (or VFL test set) via patch cords.</p>
10	<p>At 4A switch, TTJ bay (-2 TLP)— Establish an equal level loopback on VFL under test by connecting VF LINK RCV jack to VF LINK TRMT jack.</p>
11	<p>Request tester at 2STP to set up TIMS for P/AR transmission.</p>
12	<p>Request tester at 2STP to measure P/AR units at TIMS (-4 TLP).</p> <p>Requirement: At 2STP TIMS— If circuit order testing— Record measured P/AR for benchmark purposes.</p> <p>If trouble testing— Loopback P/AR is within 4 units of benchmark recorded at circuit order.</p>
13	<p>At 4A switch, TTJ bay— Remove loopback connection on VFL under test.</p> <p>Requirement: At 2STP TIMS— P/AR is no longer measured.</p>
14	<p>If additional tests are to be performed on VFL under test— Proceed to next test procedure.</p>
15	<p>Request tester at 2STP to release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message. (Refer to latest issue of IM-3F200-01 for message format.)</p>

STEP	PROCEDURE
16	At 4A switch— Release VFL under test from TTJ bay via SLM-02-RTP input message. (Refer to latest issue of IM-68100-01 for message format.) Requirement: SLM02 message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)
17	At 4A switch— If tested VFL is to be placed in active state— Enter SLM-01-ACT input message. (Refer to latest issue of IM-68100-01 for message format.)
18	If additional VFLs are to be tested using Test D— Repeat procedure from Step 4.

E. Impulse Noise and Phase and Gain Hits Test

4.14 The impulse noise test is a count of noise hits on a VFL circuit and its associated transmission media whose amplitude exceeds a specified threshold during a specified time interval. A C-notched filter and a counting device are employed for all impulse noise measurement. The phase hit test is a count of rapid changes of phase that exceed a preset threshold during a specified time interval.

4.15 The gain hit test is a count of rapid changes of gain that exceed a preset threshold during a specified time interval.

4.16 The impulse noise threshold for loopback impulse noise measurement is 73 dB_{rnc0} which

is equivalent to 69 dB_{rnc} at the -4 TLP. A maximum of 15 counts in a 15-minute test period is allowed.

4.17 While performing the impulse noise test, the phase and gain hits can also be measured. The phase hit threshold is set for 20 degrees and the gain hit threshold for 4 dB. A maximum of 7 hits in a 15-minute test period is allowed.

4.18 The impulse noise and phase and gain hits test must be performed at circuit order in a loopback mode only. The measurements are made at the 2STP TIMS while the 4A switch provides an equal level loopback at the TTJ bay (-2 TLP).

4.19 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to TTJ bay at 4A switch and to VFLTF (or VFL test set) at 2STP— Continue with Step 9.
2	Contact tester (via DDD network) at 2STP associated with VFL to be tested and request cooperation for VFL testing.
3	Request tester at 2STP to power up TIMS and allow a minimum warm-up period of 10 minutes before making any measurement.

STEP	PROCEDURE
4	<p>Note: All LEDs on IMTF and TTJ bay should be extinguished.</p> <p>At 4A switch, TTY— Verify status of VFL to be tested via SLM-00-STA input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: SLM00 message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)</p>
5	<p>At 4A switch— If selected VFL is active— Transfer VFL to OOS status via SLM-01-OOS input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: SLM00 message indicates selected VFL is OOS. (Refer to latest issue of OM-68100-01 for explanation of message.)</p>
6	<p>At 4A switch— Connect VFL to TTJ bay via SLM-02-CTP input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: At 4A switch, TTJ bay— LED associated with jacks of selected VFL is lighted.</p>
7	<p>Request tester at 2STP to verify status of VFL to be tested via OP:SLK input message.</p> <p>Requirement: At 2STP— OP SLK message indicates selected VFL is standby or OOS.</p>
8	<p>Request tester at 2STP to connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.</p> <p>Requirement: At 2STP— VFLT SLK CDSBY message indicates VFL to be tested is connected to VFLTF (or VFT test set).</p> <p>On VFLTF (or VFL test set)— Green LED, associated with the VAT I bus serving VFL to be tested, is lighted.</p>
9	<p>Request tester at 2STP VFLTF (or VFL test set) to connect TIMS to VFL under test via patch cords.</p>
10	<p>At 4A switch, TTJ bay (-2 TLP)— Establish an equal level loopback on VFL under test by connecting VF LINK RCV jack to VF LINK TRMT jack.</p>
11	<p>Request tester at 2STP to send 1004-Hz test signal at a -13.0 dBm level.</p>
12	<p>Request tester at 2STP to set up TIMS to measure looped back impulse noise, hits and dropouts.</p>

STEP	PROCEDURE
13	Request tester at 2STP TIMS to start 15-minute count period per TIMS operating instructions.
14	Request tester at 2STP TIMS to read and record COUNTS LO, COUNTS MID, and COUNTS HI at end of count period (15 minutes). <i>Requirement:</i> A maximum of 15 counts are recorded during count period.
15	Request tester at 2STP to prepare TIMS to measure phase hits, dropouts, and gain hits for 15-minute period. <i>Requirement:</i> A maximum of 7 hits are recorded at end of 15-minute count period.
16	At 4A switch, TTJ bay— Remove loopback connection on VFL under test. <i>Requirement:</i> At 2STP— Test signal is no longer received.
17	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
18	Request tester at 2STP to release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.
19	At 4A switch— Release VFL under test from the TTJ bay via SLM-02-RTP input message. (Refer to latest issue of IM-68100-01 for message format.)
20	At 4A switch— If tested VFL is to be placed in active state— Enter SLM-01-ACT input message. (Refer to latest issue of IM-68100-01 for message format.)
21	If additional VFLs are to be tested using Test E— Repeat procedure from Step 4.

F. Frequency Response Test

4.20 This test checks the amplitude versus frequency characteristics of the VFL circuit and transmission media. Attenuation and distortion of a signal can change as the frequency of the transmitted signal changes. The distortion is stated in terms of the loss at a particular frequency referenced to the loss at 1004 Hz. The frequency response test can be performed in conjunction with the 1004-Hz net loss test since the frequency response requirements are

relative to 1004 Hz. Attenuation distortion (frequency response) should be within limits before envelope delay distortion is measured, since adjustment of attenuation distortion equalizers may effect the envelope delay distortion measurement.

4.21 The frequency response test must be performed in end-to-end and loopback modes at circuit order. The results should be recorded in office records.

4.22 Frequency response minimum requirements for end-to-end testing are listed in Table D. For loopback testing, there is no minimum requirement for frequency response measurements. However, if the loopback frequency response measurement during trouble testing varies by more than 2 dB from

the loopback value recorded at circuit order time, a more detailed end-to-end frequency response test should be made using the frequencies listed in Table D.

4.23 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
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End-to-End Test

- 1 If VFL to be tested is connected to IMTF at 4A switch and to VFLTF (or VFL test set) at 2STP—
Continue with Step 11.
- 2 Contact tester (via DDD network) at 2STP associated with VFL to be tested and request cooperation for VFL testing.
- 3 At 4A switch, IMTF—
Power up test equipment and allow a 10 minute warm-up period before making any measurement.
- 4 Request tester at 2STP to power up TIMS and allow a minimum warm-up period of 10 minutes before making any measurement.
- 5 **Note:** All LEDs on IMTF and TTJ bay should be extinguished.

At 4A switch—
Verify status of VFL to be tested via **SLM-00-STA** input message.
(Refer to latest issue of IM-68100-01 for message format.)

Requirement: **SLM00** message is printed.
(Refer to latest issue of OM-68100-01 for explanation of message.)

- 6 At 4A switch—
If selected VFL is active—
Transfer VFL to OOS status via **SLM-01-OOS** input message.
(Refer to latest issue of IM-68100-01 for message format.)

Requirement: **SLM00** message indicates selected VFL is standby or OOS.
(Refer to latest of OM-68100-01 for explanation of message.)

- 7 At 4A switch—
Connect VFL to TTJ bay via **SLM-02-CTP** input message.
(Refer to latest issue of IM-68100-01 for message format.)

Requirement: At 4A switch, TTJ bay—
LED associated with jacks of selected VFL is lighted.

STEP	PROCEDURE
8	<p>At 4A switch, TTJ bay— Connect VF LINK jacks (RCV and TRMT) to IMTF TRUNK DROP jacks (RCV and TRMT) via P6T patch cord.</p> <p>Requirement: At 4A switch, selected IMTF— DBT indicator is lighted. On TTJ bay— IMTF BSY indicator is lighted.</p>
9	<p>Request tester at 2STP to verify status of VFL to be tested via OP:SLK input message.</p> <p>Requirement: At 2STP— OP SLK message indicates selected VFL is standby or OOS.</p>
10	<p>Request tester at 2STP to connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.</p> <p>Requirement: At 2STP— VFLT SLK CDSBY message indicates VFL to be tested is connected to VFLTF (or VFL test set).</p> <p>On VFLTF (or VFL test set)— Green LED, associated with the VAT I bus serving VFL to be tested, is lighted.</p>
11	<p>Request tester at 2STP to connect TIMS to VFLTF (or VFL test set) via patch cords.</p>
12	<p>Request tester at 2STP TIMS to send 1004-Hz reference signal at -13.0 dBm level.</p>
13	<p>At 4A switch— Measure and record frequency and level of received reference signal.</p> <p>Requirement: At 4A switch— Frequency of reference signal is measured from 1002 to 1006 Hz.</p> <p>If circuit order testing— Level is measured from -16.0 to -18.0 dBm.</p> <p>If trouble testing— Level is measured from -15.0 to -19.0 dBm.</p>
14	<p>Request tester at 2STP TIMS to send 304 Hz test signal at -13.0 dBm.</p>
15	<p>Note: The level meter at the 4A switch indicates absolute dBm. To convert absolute dBm to dB loss relative to the reference frequency, subtract the test frequency dBm from the reference frequency dBm.</p> <p>Example: A test frequency at -13.0 dBm level and a reference frequency at -11.0 dBm level give a +2.0 dB relative loss (-11.0 - [-13.0] = +2.0).</p>

STEP	PROCEDURE
	<p>At 4A switch— Read absolute frequency and attenuation of test signal and calculate attenuation relative to reference frequency.</p> <p>Requirement: Frequency of received test signal is measured from 302 to 306 Hz. Attenuation relative to reference frequency dBm (frequency response) is -3.0 to +12.0 dB.</p>
16	<p>Repeat Steps 14 and 15 for each frequency listed in Table D.</p> <p>Requirement: All frequencies measured at the 4A switch are within 2 Hz of the transmitted frequency. Attenuation relative to the reference frequency dBm is within ranges listed in Table D for the transmitted frequency.</p>
17	<p>At 4A switch, IMTF oscillator (0 TLP)— Send 1004-Hz reference signal at -13.0 dBm.</p>
18	<p>Request tester at 2STP to measure and record frequency and level of received reference signal.</p> <p>Requirement: At 2STP— Frequency of reference signal is measured from 1002 to 1006 Hz.</p> <p>If circuit order testing— Level is measured from -16.0 to -18.0 dBm.</p> <p>If trouble testing— Level is measured from -15.0 to -19.0 dBm.</p>
19	<p>Request tester at 2STP to establish a 0 dB relative loss value for the received reference frequency.</p>
20	<p>At 4A switch, IMTF oscillator (0 TLP)— Send 404-Hz test signal at -13.0 dBm level.</p>
21	<p>Request tester at 2STP to read and record frequency and attenuation relative to reference frequency dBm (frequency response).</p> <p>Requirement: Frequency of test signal is measured from 402 to 406 Hz. Attenuation relative to reference frequency dBm is -2.0 to +6.0 dB.</p>
22	<p>At 4A switch, IMTF oscillator (0 TLP)— Send 2804-Hz test signal at -13.0 dBm level.</p>
23	<p>Request tester at 2STP to read and record frequency and attenuation relative to reference frequency dBm (frequency response).</p> <p>Requirement: Frequency of received test signal is measured from 2802 to 2806 Hz. Attenuation relative to reference frequency dBm is -2.0 to +6.0 dB.</p>

STEP	PROCEDURE
Loopback Test	
24	Request tester at 2STP to establish an equal level loopback.
25	At 4A switch, IMTF oscillator (0 TLP)— Send 1004-Hz reference signal at -13.0 dBm level and measure and record the frequency and level of the looped back reference signal.
	Requirement: Frequency of reference signal is measured from 1002 to 1006 Hz.
	If circuit order testing— Level is measured from -16.0 to -18.0 dBm.
	If trouble testing— Level is measured from -15.0 to -19.0 dBm.
26	Note: The level meter at the 4A switch indicates absolute dBm. To convert absolute dBm to dB loss relative to the reference frequency, subtract the test frequency dBm from the reference frequency dBm.
	Example: A test frequency at -13.0 dBm level and a reference frequency at -11.0 dBm level give a $+2.0$ dB relative loss ($-11.0 - [-13.0] = +2.0$).
	At 4A switch, IMTF oscillator (0 TLP)— Send 404-Hz test signal at a -13.0 dBm level and read and record frequency and absolute attenuation level (dBm).
27	At 4A switch— Calculate attenuation relative to reference dBm.
	Requirement: If circuit order testing— Record loopback frequency response measurement as benchmark value.
	If trouble testing— Frequency is measured from 402 to 406 Hz.
	Attenuation relative to the reference frequency dBm (frequency response) is not more than 2 dB from loopback value recorded at circuit order.
28	At 4A switch— Repeat Steps 26 and 27 for a 2804-Hz test signal at -13.0 dBm level.
	Requirement: If circuit order testing— Record loopback frequency response measurement as benchmark value.
	If trouble testing— Frequency is measured from 2802 to 2806 Hz.

STEP	PROCEDURE
	Attenuation relative to the reference frequency dBm is not more than 2 dB from loopback value recorded at circuit order.
29	Request tester at 2STP to remove loopback connection.
	Requirement: At 4A switch— Test signal is no longer received.
30	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
31	Request tester at 2STP to release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.
32	At 4A switch— Release VFL under test via SLM-02-RTP input message. (Refer to latest issue of IM-68100-01 for message format.)
33	At 4A switch— If tested VFL is to be placed in active state— Enter SLM-01-ACT input message. (Refer to latest issue of IM-68100-01 for message format.)
34	If additional VFLs are to be tested using Test F— Repeat procedure from Step 5.

G. Envelope Delay Distortion Test

4.24 This test checks the envelope delay distortion of a VFL by transmitting specific test frequencies and measuring the delay. Envelope delay distortion is a source of intersymbol interference in data signals. The envelope delay distortion of a VFL circuit should be measured only after the attenuation distortion (frequency response) of the circuit has been brought within limits. In the event that delay distortion requirements cannot be met using the equalizers specified (equalizers are not always specified), refer the problem to circuit engineering.

4.25 The envelope delay distortion test is to be performed at circuit order in a loopback mode only. The results should be recorded in office records at the 2STP and 4A switch.

4.26 Envelope delay distortion measurement frequencies and requirements for loopback testing are listed in Table E.

4.27 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to TTJ bay at 4A switch and to VFLTF (or VFL test set) at 2STP— Continue with Step 9.
2	Contact tester (via DDD network) at 2STP associated with VFL to be tested and request cooperation for VFL testing.
3	Request tester at 2STP to power up TIMS and allow a minimum warm-up period of 10 minutes before making any measurement.
4	Note: All LEDs on IMTF and TTJ bay should be extinguished.
	At 4A switch— Verify status of VFL to be tested via SLM-00-STA input message. (Refer to latest issue of IM-68100-01 for message format.)
	Requirement: SLM00 message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)
5	At 4A switch— If selected VFL is active— Transfer VFL to OOS status via SLM-01-OOS input message. (Refer to latest issue of IM-68100-01 for message format.)
	Requirement: SLM00 message indicates selected VFL is standby or OOS. (Refer to latest issue of OM-68100-01 for explanation of message.)
6	At 4A switch— Connect VFL to TTJ bay via SLM-02-CTP input message. (Refer to latest issue of IM-68100-01 for message format.)
	Requirement: At 4A switch, TTJ bay— LED associated with jacks of selected VFL is lighted.
7	Request tester at 2STP to verify status of VFL to be tested via OP:SLK input message.
	Requirement: At 2STP— OP SLK message indicates selected VFL is standby or OOS.
8	Request tester at 2STP to connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.
	Requirement: At 2STP— VFLT SLK CDSBY message indicates VFL to be tested is connected to VFLTF (or VFL test set).

STEP	PROCEDURE
	On VFLTF (or VFL test set)— Green LED, associated with the VAT I bus serving VFL to be tested, is lighted.
9	Request tester at 2STP to connect TIMS to VFLTF (or VFL test set) via patch cords.
10	At 4A switch, TTJ bay (-2 TLP)— Establish an equal level loopback on VFL under test by connecting VF LINK RCV jack to VF LINK TRMT jack.
11	Request tester at 2STP to send 1004-Hz reference signal at -13.0 dBm level.
12	Request tester at 2STP to set TIMS controls to measure looped back reference signal and establish a reference zero for the received signal.
	<i>Requirement:</i> At 2STP TIMS— Reading variations are evenly distributed above and below zero microseconds.
13	Request tester at 2STP to adjust TIMS frequency control to send 804-Hz test signal at -13.0 dBm level and measure envelope delay.
	<i>Requirement:</i> Envelope delay is measured within limits listed in Table E.
14	Request tester at 2STP to repeat Step 13 for each frequency listed in Table E.
	<i>Requirement:</i> Envelope delay is measured within limits listed in Table E for associated test frequency.
15	At 4A switch— Remove loopback connection.
	<i>Requirement:</i> At 2STP TIMS— Test signal is no longer received.
16	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
17	Request tester at 2STP to release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.
18	At 4A switch— Release VFL under test from TTJ bay via SLM-02-RTP input message. (Refer to latest issue of IM-68100-01 for message format.)
	<i>Requirement:</i> SLM02 message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)
19	At 4A switch— If tested VFL is to be placed in active state—

STEP	PROCEDURE
	Enter SLM-01-ACT input message. (Refer to latest issue of IM-68100-01 for message format.)
20	If additional VFLs are to be tested using Test G— Repeat procedure from Step 4.

H. Nonlinear Distortion Test

4.28 This test checks the second and third order distortions such as compression and clipping. These distortions result in harmonics that interfere with multitone data signals.

4.29 To measure nonlinear (intermodulation) distortion, four (4) equal-level tones are transmitted over the facility to be measured. Two of these tones are closely spaced around a center frequency of 860 Hz, and the other two tones are centered around a center frequency of 1380 Hz. Each pair of narrowly spaced tones is used to simulate a narrowband of noise at each center frequency. The second order distortion is determined by measuring the energy through narrowband filters centered at 520 Hz (1380

Hz - 860 Hz = 520 Hz) and 2240 Hz (1380 Hz + 860 Hz = 2249 Hz). Third order distortion is measured through a narrowband filter centered at 1900 Hz ($2 \times 1380 \text{ Hz} - 860 \text{ Hz} = 1900 \text{ Hz}$).

4.30 The nonlinear distortion test must be performed at circuit order time in a loopback mode only. The results should be recorded at both the 2STP and 4A switch. The ratio of the fundamental to the second-order distortion products must be greater than 20 dB, and the ratio of the fundamental to the third-order products must be greater than 25 dB. These requirements assume the 4-tone method of measurement is used with the HP 4940A TIMS.

4.31 Apparatus for this test is listed in Table A.

STEP	PROCEDURE
1	If VFL to be tested is connected to TTJ bay at 4A switch and to VFLTF (or VFL test set) at 2STP— Continue with Step 9.
2	Contact tester (via DDD network) at 2STP associated with VFL to be tested and request cooperation for VFL testing.
3	Request tester at 2STP to power up TIMS and allow a minimum warm-up period of 10 minutes before making any measurement.
4	Note: All LEDs on IMTF and TTJ bay should be extinguished. At 4A switch— Verify status of VFL to be tested via SLM-00-STA input message. (Refer to latest issue of IM-68100-01 for message format.) Requirement: SLM00 message is printed. (Refer to latest issue of OM-68100-01 for explanation of message.)

STEP	PROCEDURE
5	<p>At 4A switch— If selected VFL is active— Transfer VFL to OOS status via SLM-01-OOS input message.</p> <p>Requirement: SLM00 message indicates selected VFL is standby or OOS.</p>
6	<p>At 4A switch— Connect VFL to TTJ bay via SLM-02-CTP input message. (Refer to latest issue of IM-68100-01 for message format.)</p> <p>Requirement: At 4A switch, TTJ bay— LED associated with jacks of selected VFL is lighted.</p>
7	<p>Request tester at 2STP to verify status of VFL to be tested via OP:SLK input message.</p> <p>Requirement: At 2STP— STP OP SLK message indicates selected VFL is standby or OOS.</p>
8	<p>Request tester at 2STP to connect VFL to be tested to VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.</p> <p>Requirement: At 2STP— STP VFLT SLK CDSBY message indicates VFL to be tested is connected to VFLTF (or VFL test set).</p> <p>On VFLTF (or VFL test set)— Green LED, associated with the VAT I bus serving VFL to be tested, is lighted.</p>
9	<p>Request tester at 2STP to connect TIMS to VFLTF (or VFL test set) via patch cords.</p>
10	<p>At 4A switch, TTJ bay (-2 TLP)— Establish an equal level loopback on VFL under test by connecting VF LINK RCV jack to VF LINK TRMT jack.</p>
11	<p>Request tester at 2STP TIMS to send 1004-Hz reference signal at -13.0 dBm level.</p>
12	<p>Request tester at 2STP to set up TIMS to measure nonlinear distortion (per TIMS operating instructions) and measure level of looped back reference signal.</p> <p>Requirement: At 2STP TIMS— Measured level is 35.0 dBm or greater.</p>
13	<p>Request tester at 2STP to allow received level to stabilize, then establish a 0 dB reference so that distortion products can be measured in dB relative to reference signal.</p>
14	<p>Request tester at 2STP to measure and record second order nonlinear distortion "normal test signal level" per TIMS operating instructions.</p>

STEP	PROCEDURE
15	Request tester at 2STP to operate TIMS controls to "check signal" mode and read and record "check signal level" (in dB).
16	Request tester at 2STP to subtract "check signal level" recorded in Step 15 from "normal signal level" recorded in Step 14 and record the difference value.
17	Request tester at 2STP to obtain from Table F the "correction factor" associated with the difference value recorded in Step 16 and calculate second order nonlinear distortion via the method below. "Correction factor" + "normal test signal level" = "nonlinear distortion" (dB). Requirement: The second order nonlinear distortion is greater than 20.0 dB.
18	Request tester at 2STP to measure and record third order nonlinear distortion "normal test signal level" (dB) per TIMS operating instructions).
19	Request tester at 2STP to set TIMS to "check signal" mode and read and record "check signal level" (in dB).
20	Request tester at 2STP to subtract "check signal level" recorded in Step 19 from "normal signal level" recorded in Step 18 and record the difference value.
21	Request tester at 2STP to obtain from Table F the "correction factor" associated with difference value recorded in Step 20 and calculate third order nonlinear distortion via the method below. "Correction factor" + "normal test signal level" = "nonlinear distortion" (dB). Requirement: Third order nonlinear distortion is greater than 25.0 dB.
22	At 4A switch, TTJ bay— Remove loopback connection. Requirement: At 2STP— Test signal is no longer received.
23	If additional tests are to be performed on VFL under test— Proceed to next test procedure.
24	Request tester at 2STP to release VFL under test from VFLTF (or VFL test set) via VFLT:SLK CDSBY input message.
25	At 4A switch— Release VFL under test from TTJ bay via SLM-02-RTP input message.
26	At 4A switch— If tested VFL is to be placed in active state— Enter SLM-01-ACT input message. (Refer to latest issue of IM-68100-01 for message format.)
27	If additional VFLs are to be tested using Test G— Repeat procedure from Step 4.

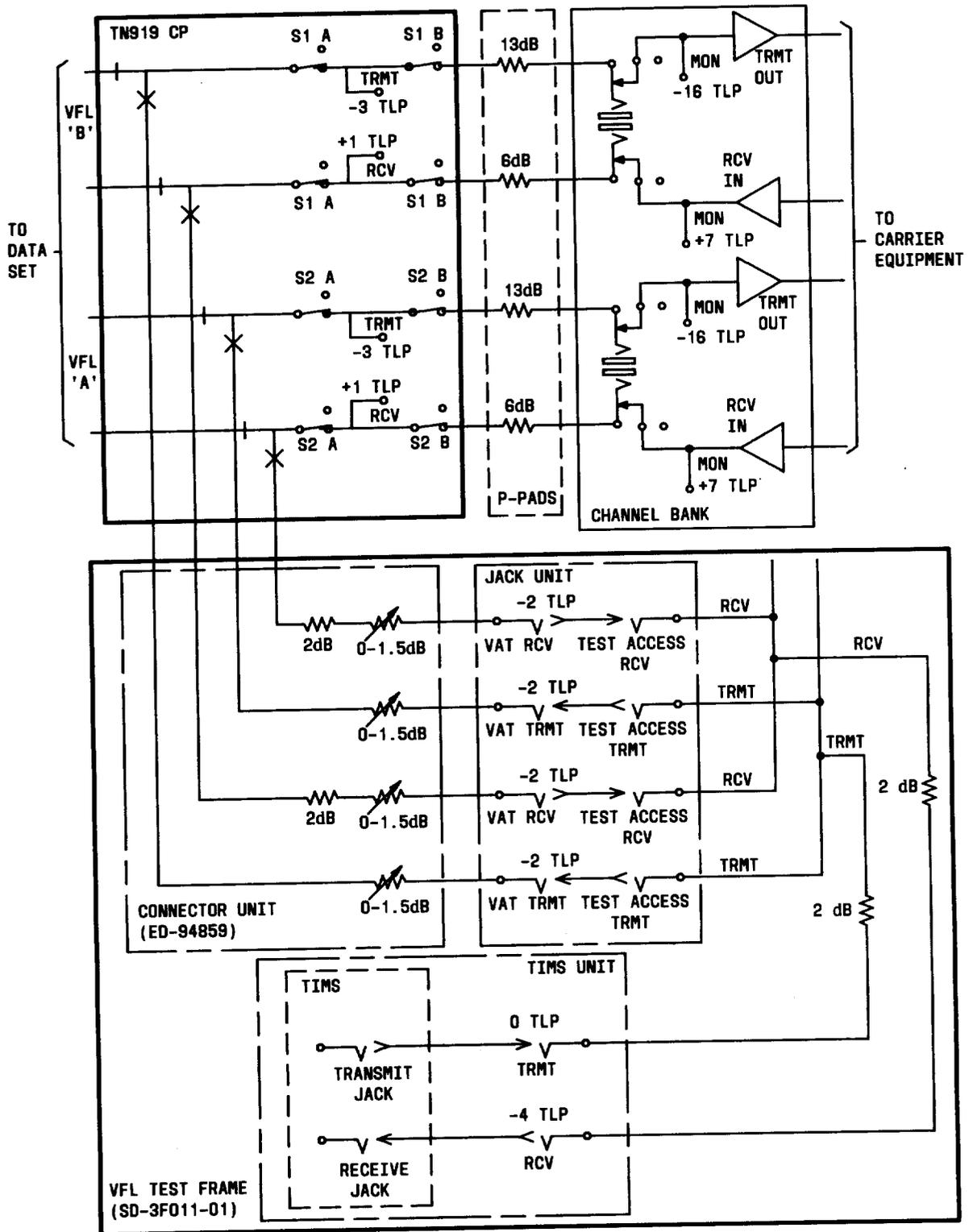


Fig. 1—Typical 2STP Analog VFL Test Arrangement Using VFLTF

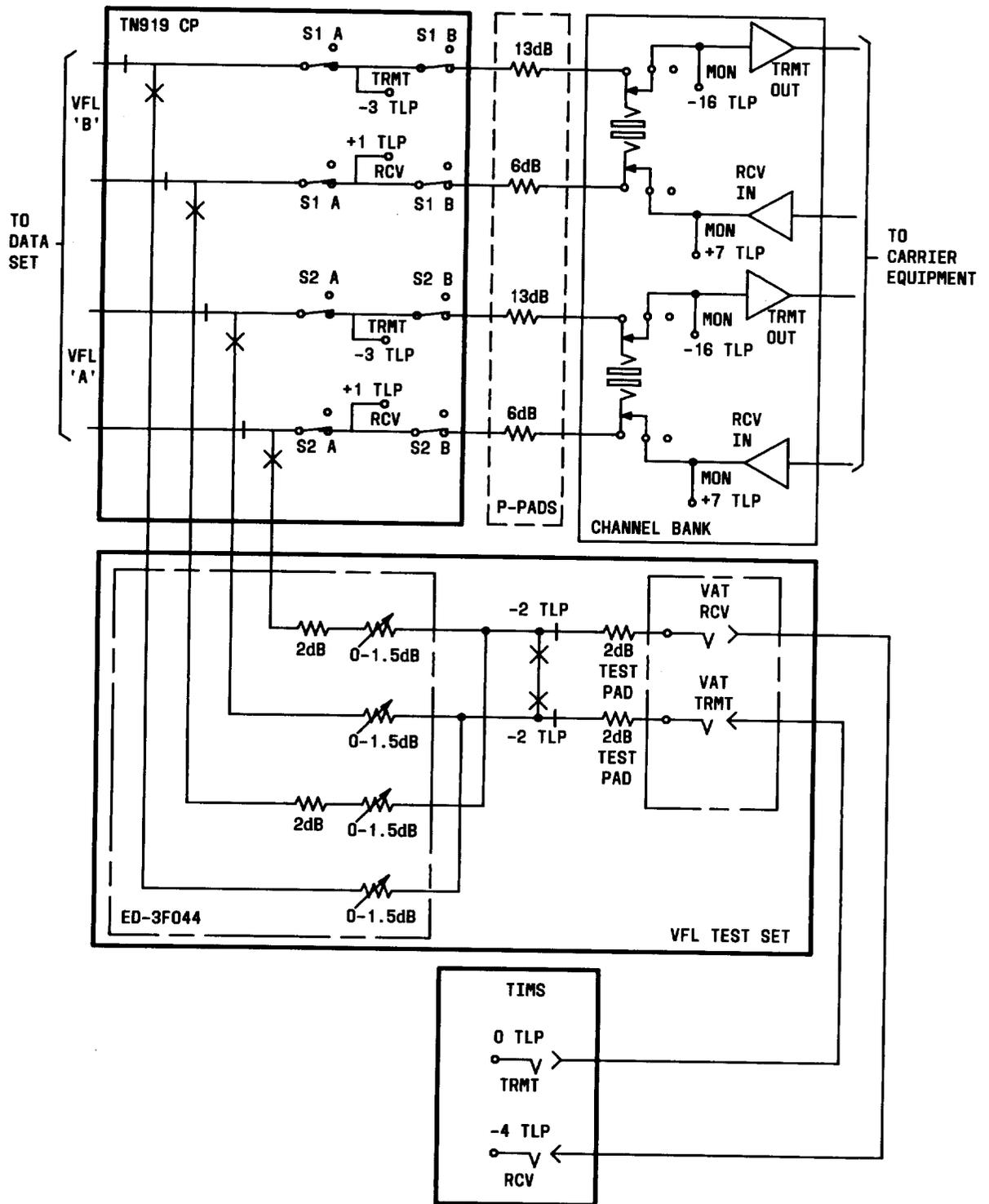


Fig. 2—Typical 2STP Analog VFL Test Arrangement Using VFL Test Set

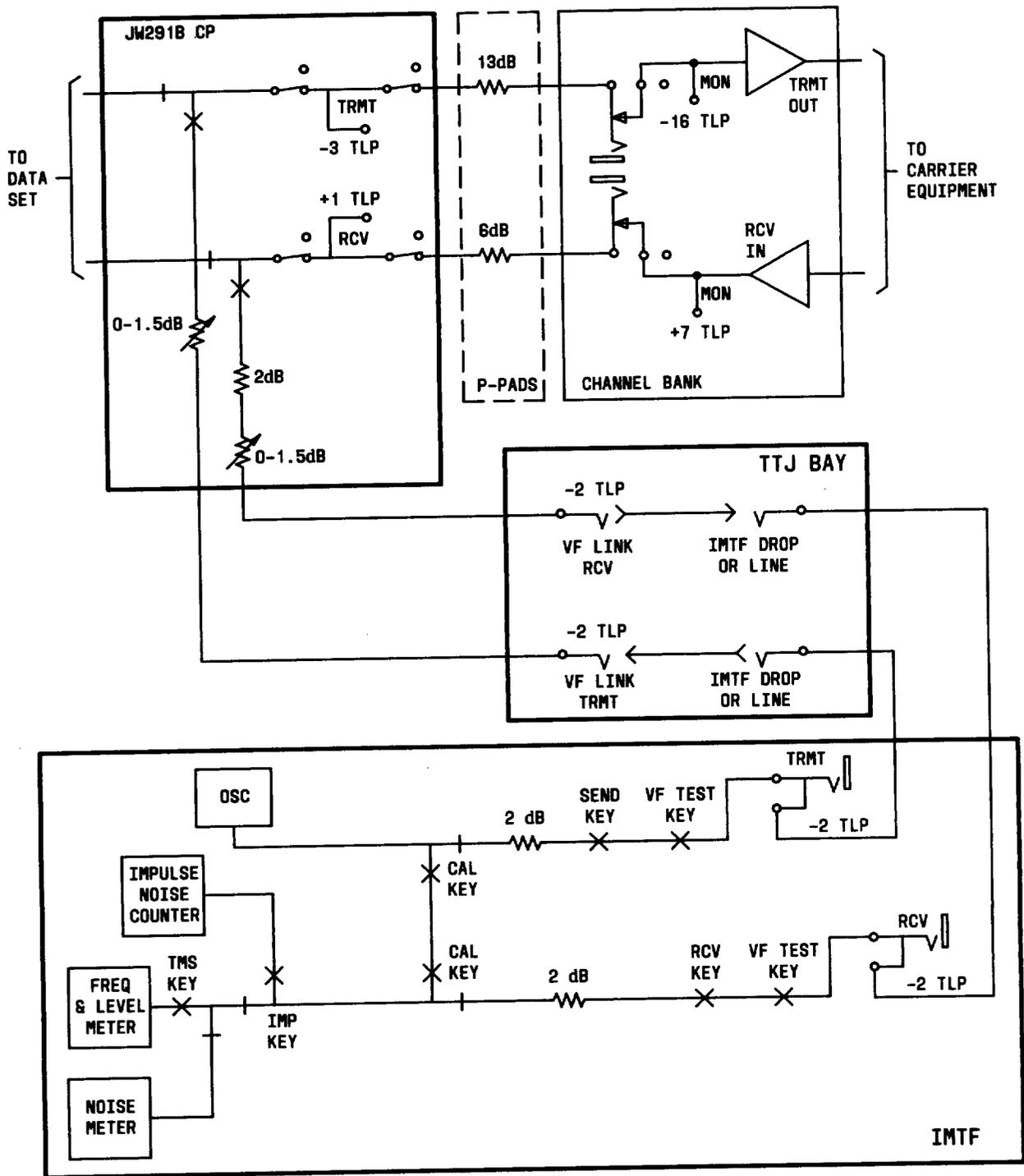


Fig. 3—Typical 4A Switch Analog VFL Test Arrangement

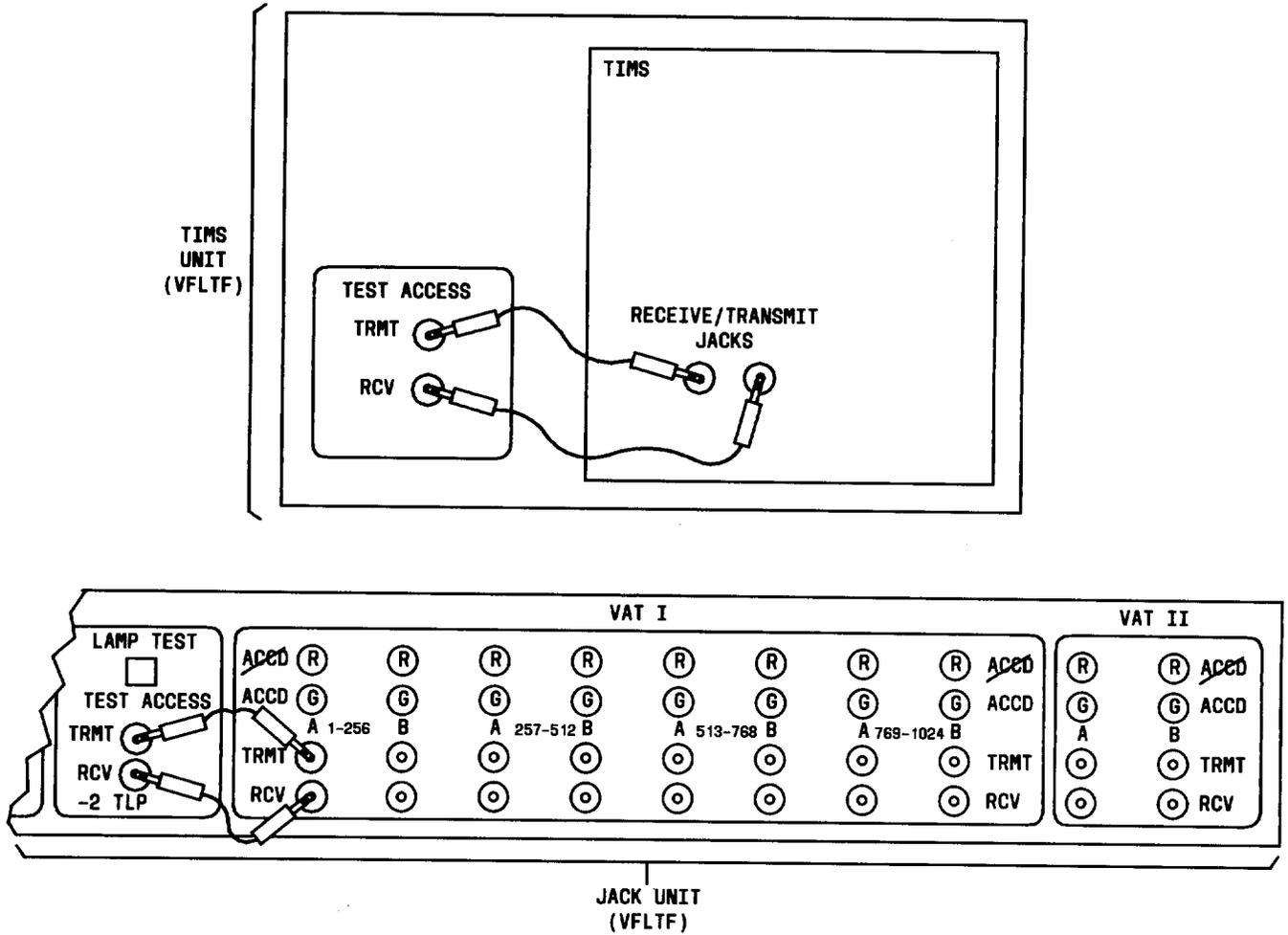


Fig. 4—Typical 2STP Arrangement For Connection Of TIMS To VFL Under Test Via VFLTF

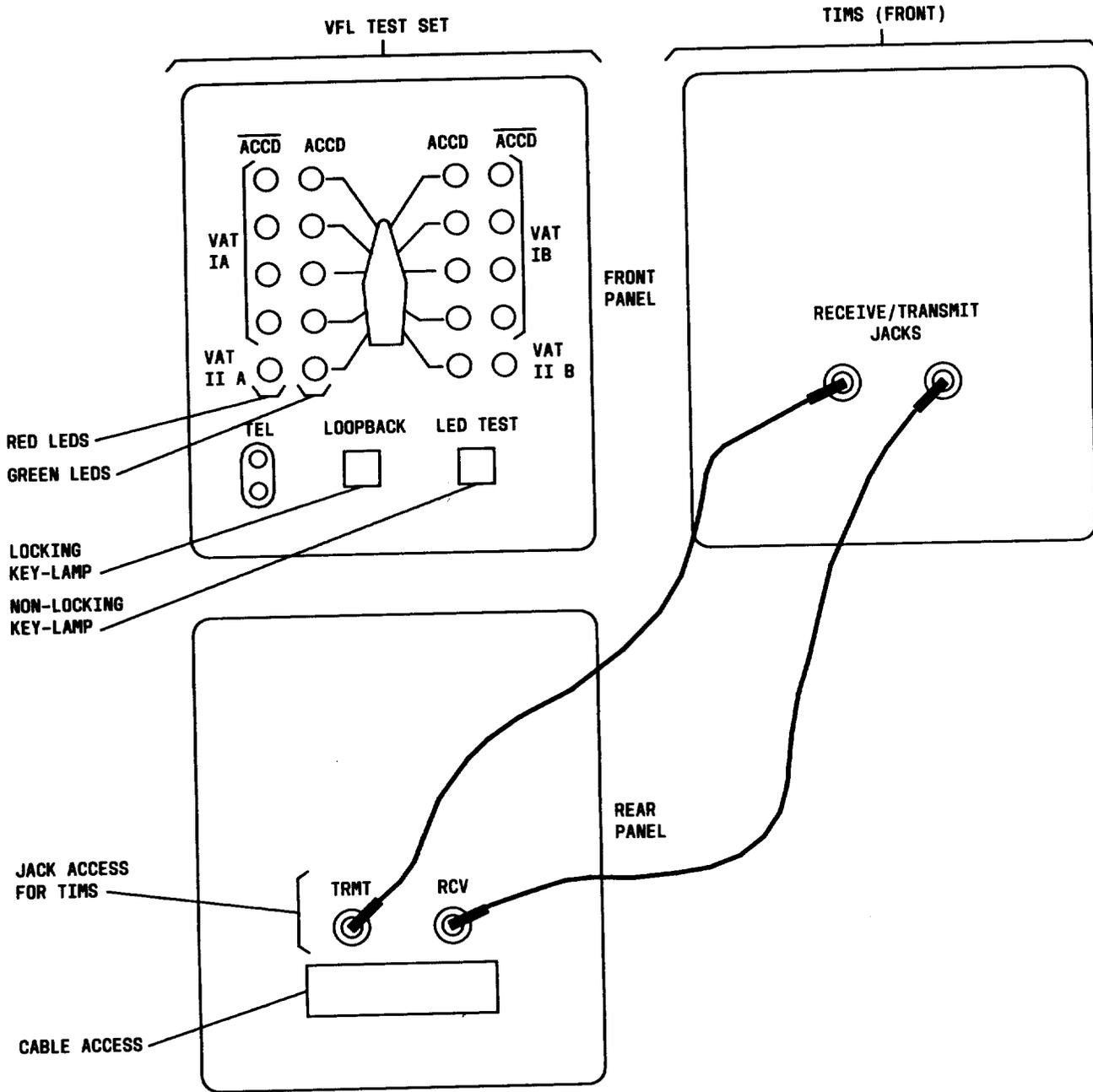


Fig. 5—Typical 2STP Arrangement For Connection Of TIMS To VFL Under Test Via VFL Test Set

TABLE A
TEST APPARATUS

2STP								
APPARATUS	TEST							
	A	B	C	D	E	F	G	H
VFLTF (SD-3F011-01) or VFLTS (SD-3F024-01) (2.02)	X	X	X	X	X	X	X	X
"HP" 4940A TIMS (or equivalent) (2.03)	X	X	X	X	X	X	X	X
Patch Cords (2.04)	X	X	X	X	X	X	X	X
VT/MCRT (2.05)	X	X	X	X	X	X	X	X
4A SWITCH								
APPARATUS	TEST							
	A	B	C	D	E	F	G	H
IMTF and TTJ Bay (2.06)	X	X	X	X	X	X	X	X
J94003 (3C) NMS (or equivalent) (2.07)		X	X					
723A Test Receiver (or equivalent) (2.08)			X					
P6T Cord (2.09)	X	X	X	X	X	X	X	X
Modified 3P6F Cord (2.10)		X	X					
3P7D Cord (2.11)	X	X		X	X	X	X	X
Teletypewriter (2.12)	X	X	X	X	X	X	X	X

TABLE B
END-TO-END
C-NOTCHED NOISE REQUIREMENTS
(NOTE 1)

COMPANDORED AND NONCOMPANDORED FACILITY MIX (NOTE 2)	CIRCUIT LENGTH (MILES)							HOLD TONE DBM
	0 TO 100	101 TO 200	201 TO 400	401 TO 1000	1001 TO 1500	1501 TO 2500	2501 TO 4000	
Noncompandored Only	32	34	35	38	39	41	43	NONE
N1, D1A, D1B	48	48	48	48	48	48	49	-13.0
N2, N3, N4, D2, D3, D4 Carrier	41*	42*	42*	43	43	45	45	-13.0

* If LT1-B connectors are used, the measured value should be 43.

Notes:

1. Values listed are in maximum allowable dBrnc0. To obtain the maximum allowed dBrnc at TLPs other than TLP 0, subtract the absolute value of the TLP from the value given.
2. For mixed compandored/noncompandored VFL facilities greater than 200 miles, the compandored section is assumed to be 50 to 100 miles in length.

TABLE C
SINGLE FREQUENCY INTERFERENCE REQUIREMENTS
(NOTE)

CIRCUIT LENGTH IN MILES	LEVEL OF MEASURED TONE	
	DBRNC @ -2 TLP	DBRNC @ -4 TLP
0 through 50	26	24
51 through 100	29	27
101 through 400	32	30
401 through 1000	36	34
1001 through 1500	38	36
1501 through 2500	40	38
2501 through 4000	42	40
4001 through 8000	45	43
8001 through 16000	48	46
Satellite Channel	39	37

Note: If listening test indicates signal frequency interference.

TABLE D

P/AR VALUES FOR SINGLE AND MULTIFACILITY CHANNELS

TYPE	MAXIMUM (NOTE 1)	MINIMUM (NOTE 2)	TYPICAL VALUE (NOTE 3)
N1	98	86	92
N2	101	93	97
N3	94	86	90
2N1	93	85	89
2N2	96	88	92
2N3	93	83	88
T1	102	93	97
2T1	97	88	92
L or Radio A-Carrier*	99	87	93
N1 + N2	95	87	91
N2 + N3	97	87	92
N1 + N3	97	87	92
T1 + N1	96	87	91
T1 + N2	96	88	92
T1 + N3	95	87	91

* A-Carrier is considered to L or R channel.

Notes:

1. Highest allowable value
2. Maintenance Limit
3. Expected value

TABLE E
ENVELOPE DELAY DISTORTION REQUIREMENTS

TRANSMIT FREQUENCY (HZ) -13.0 DBM LEVEL	MAXIMUM LOOPED BACK ENVELOPE (MICROSECONDS)
804	3500
1004	3500
1404	3500
1804	3500
2204	3500
2504	3500
2604	3500

TABLE F
**NONLINEAR DISTORTION NOISE
CORRECTION FACTORS**

DIFFERENCE VALUE (NOTE 1)	CORRECTION FACTOR (NOTE 2)
0	*
1	7
2	4
3	3
4-5	2
6-8	1
OVER 8	0

* Zero difference indicates that distortion level is buried in noise. This can mean either extremely low distortion or extremely high noise. Further investigation is required.

Note:

1. DB difference between normal test signal and check signal readings.
2. DB relative to 0 dB reference level.