AUTOMATED REPAIR SERVICE BUREAU EQUIPPED WITH AUTOMATIC LINE VERIFIER DIAGNOSE LOOP TESTING FRAME/LINE FAULT DETECTOR FAULT

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FIGURES AND EXHIBITS

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1. GENERAL

1.01 This section describes the procedures for using the diagnostic software to localize malfunctions in the loop testing equipment used by an Automated Repair Service Bureau (ARSB) equipped with the Automatic Line Verifier (ALV).

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 The equipment used by the ALV system for automated testing of a customer loop is composed of the Loop Testing Frame (LTF) and Line Fault Detector (LFD). The LTF (Fig. 1) provides for automatically accessing the customer loop while the LFD (Fig. 1) performs the automated testing. Maintenance of the LTF/LFD is accomplished through the employees who perform each of the following positions:

- Check LTF/LFD Readiness (Section 660-168-370)
- Diagnose LTF/LFD Fault (Section 660-168-371)
- Troubleshoot LTF/LFD Fault (Section 662-527-300)

1.04 The Check LTF/LFD Readiness position uses trouble counters and sanity check transactions to perform routine maintenance and preliminary maintenance tests. The sanity check exercises the LTF/LFD hardware to verify if a malfunction actually occurs and determines which device is not functioning properly. The Diagnose LTF/LFD Fault position uses the diagnostic software to isolate trouble to a location where replacing a single circuit pack or group of circuit packs will repair the malfunction. The Troubleshoot LTF/LFD Fault position has the responsibility to correct faults which are not corrected by replacing circuit packs. The primary tool used to troubleshoot a fault is the control panel on the LTF. This panel provides a means to manually simulate the diagnostic tests that failed. An oscilloscope may be used to check the inputs and outputs of individual circuit packs.

1.05 The diagnostic software is used by this position (Diagnose Loop Testing Frame/Line Fault Detector Fault) to make an extensive series of off-line checks of the LTF/LFD. The off-line checks exercise all the equipment, detect failures and provide a printout of any diagnostic test that failed.

2. DESCRIPTION

A. Hardware

2.01 From an ***operational standpoint,*** the hardware associated with the LTF/LFD may be considered to be in three groups: ports, equipment and trunks. For discussion the term ***device*** will be used in a general manner to apply to any individual piece of hardware associated with the LTF/LFD.

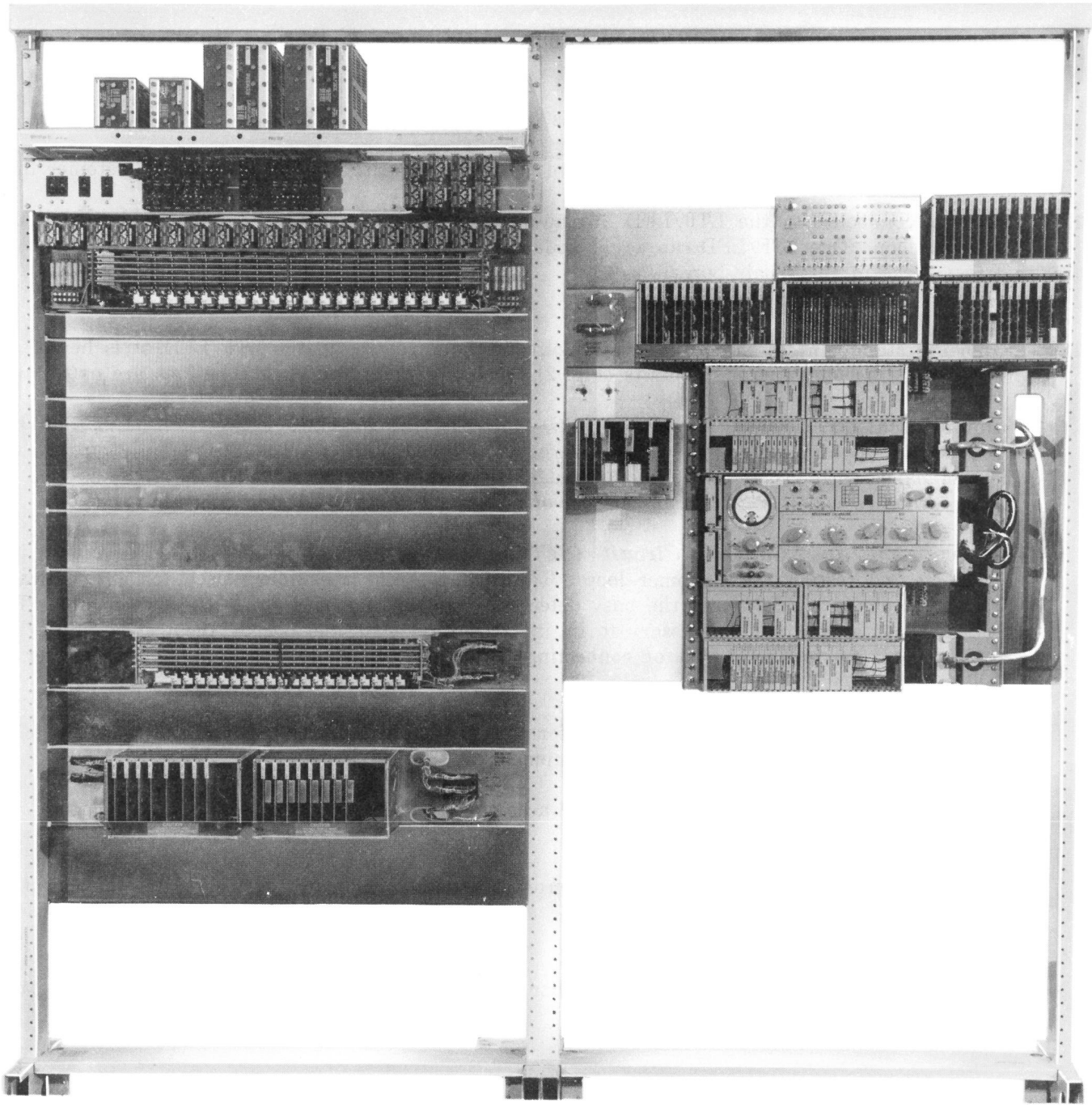


Fig. 1—Loop Testing Frame Equipped With Line Fault Detectors (LTF/LFD) and the Minimum Support Equipment

2.02 Ports are the circuits in the LTF which provide for connection of various pieces of test equipment to the test trunks (no-test type) and for supervision of the testing process. There may be from two to nine ports in one LTF/LFD.

2.03 The equipment of an LTF/LFD consists of the following:

- Dialers (a maximum of two multifrequency and two dial pulse)—For automatic dialing of a telephone number
- Busy Detectors (two)—For detecting various busy conditions on a line
- Line Fault Detectors (two and the associated reference capacitors)—For testing the customer line.

2.04 ***Trunks*** connected to the LTF/LFD are no-test type trunks used in accessing and testing the customer loop. One LTF/LFD can accommodate up to 98 trunks, 78 of which may be shared with the local test desks in the repair bureau.

2.05 From the standpoint of the ***physical layout*** of the hardware in the LTF/LFD, it is helpful to think of there being five major units (Fig. 2). The five units and their functions are as follows:

- ***Communication Control Circuit (CCC)***—Provides the interface between the LTF and the ALV minicomputer (controller) which controls automated testing. The CCC (Fig. 3) includes a control panel with visual displays of the data between the controller and the LTF, as well as toggle switches which control transmission of commands to the LTF and controller.
- ***Supervision and Control Circuit (SCC)***—Performs a number of functions required for accessing and testing the customer loop. The SCC contains the dialers used for automatically dialing telephone numbers and the busy detectors for detecting busy conditions on the line. The SCC also contains circuits necessary to initiate the LFD tests and encode the test results. The SCC provides up to nine ports for connecting any no-test trunk to any dialer, busy detector or LFD.
- ***Access Switch Controller (ASC)***—Performs control functions related to the crossbar switches that connect the various pieces of test equipment to the test trunks.
- ***Switches***—Perform functions required for accessing and testing customer loops as follows:

  (a) Equipment Access Switch (EAS)—A crossbar switch which provides a means of connecting test equipment to the ports.

  (b) Trunk Access Switch (TAS)—A crossbar switch which provides a means of connecting test trunks (no-test type) to the ports.

  (c) Trunk Selector Switch (TSS)—Consists of one to four modular relay circuits which facilitate sharing test trunks (no-test type) with the local test desk positions.

- ***Line Fault Detector (LFD) Units (two)***—Perform electronic measurements on a customer loop to identify certain types of trouble conditions within specific ranges. A calibrator is provided for use with the LFD units. The calibrator provides a means of aligning the circuit packs in the LFD units.

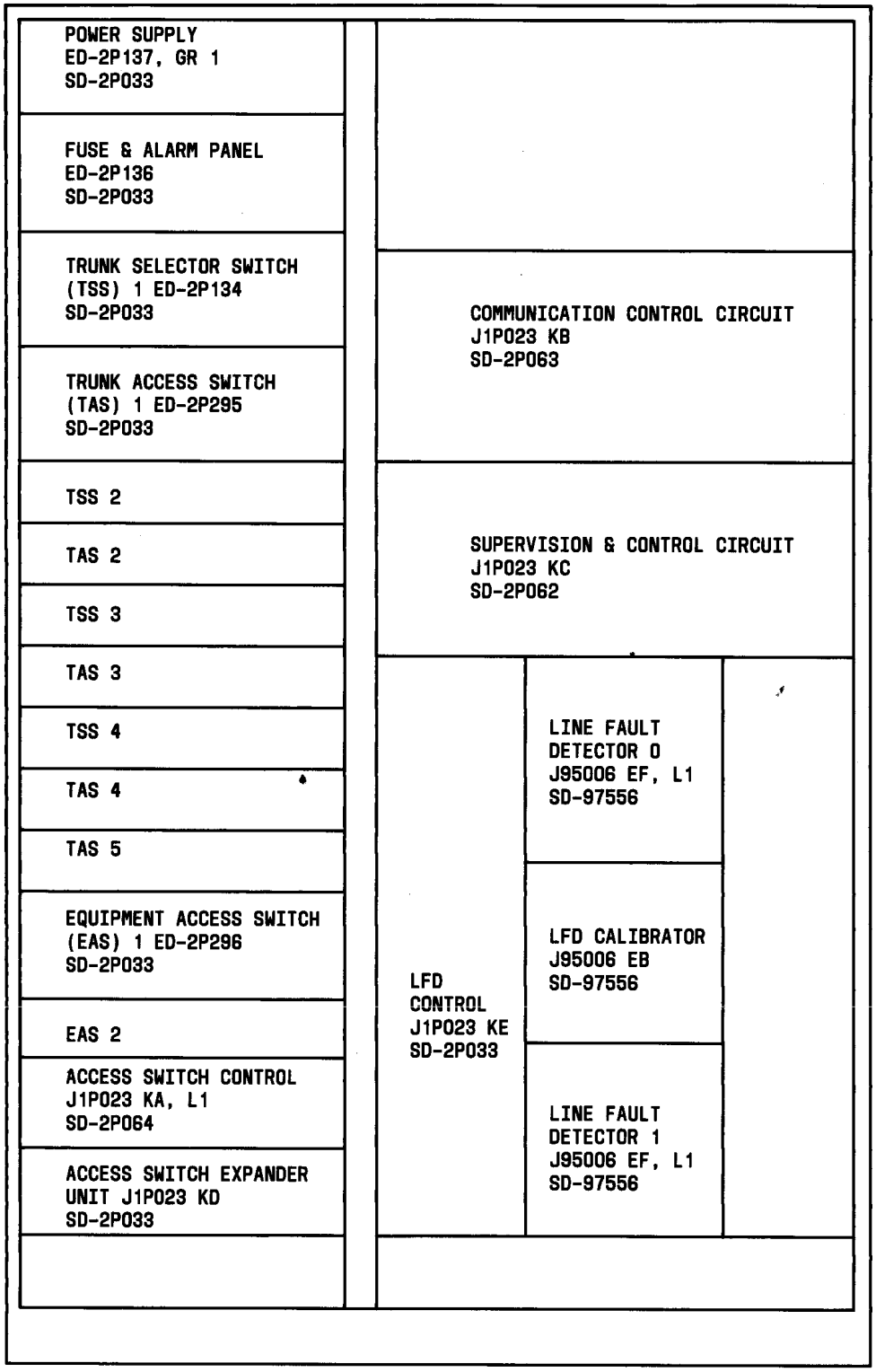


Fig. 2—Functional Units of a Fully Equipped Loop Testing Frame/Line Fault Detector

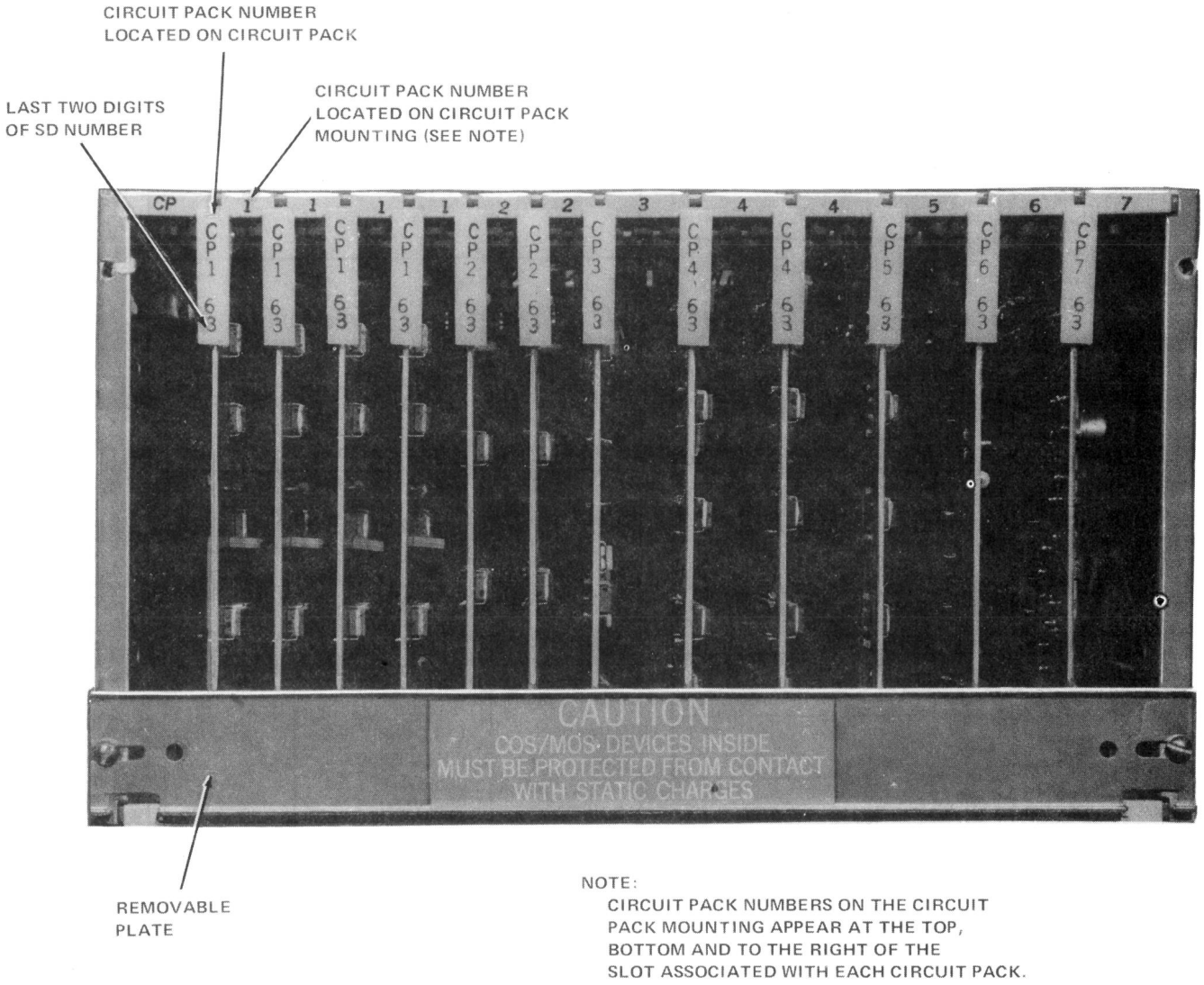


Fig. 3—Communication Control Circuit With Circuit Packs Installed

B. System Operations

2.06 The step-by-step sequence with which a trouble report is processed by the Loop Maintenance Operations System (LMOS) equipped with the Automatic Line Verifier (ALV) subsystem is as follows:

(1) Entry of a trouble report into the LMOS/ALV results in an automatic request to verify the condition of the line associated with the trouble report.

(2) The request is processed by the LMOS/ALV front-end computer which selects the proper controller and relays the request.

(3) The controller then selects the appropriate LTF for accessing the line.

(4) A test trunk (no-test type) is selected by the loop testing frame, and a dialer is connected to it via one of the ports.

(5) The digits of the telephone number are automatically dialed.

(6) A busy detector is connected to the trunk via the same port, and tests for busy conditions on the line are made.

(7) If a busy condition is found (eg, D.C. busy, speech busy), the verification procedure is terminated and the busy results are returned to the front-end computer for display at the CRT.

(8) If the loop is not busy, an LFD unit is connected to the trunk via the port and the testing sequence is initiated.

(9) If the LFD identifies a fault, a retest is automatically initiated (up to a total of seven tests) until two identical results are received.

(10) The testing functions are completed and the results are returned to the front-end computer for display at the CRT.

3. TROUBLE LOCATING PROCEDURES

A. Required Tools and Information

3.01 To perform the procedures outlined in this section, the following equipment is required:

- Portable teleprinter terminal with acoustic coupler.
- A complete set of spare circuit packs for the LTF/LFD.
- Pen or pencil.
- Conductive shorting bars. The shorting bar is placed over the terminals of any circuit pack which is removed from the LTF/LFD. The conductive shorting bar from spare circuit packs may be used during replacement procedures.
- Electrically conductive bags. Circuit packs are stored and shipped in the conductive bags to prevent damage to the circuit packs from electrostatic discharge. The conductive bag from a spare circuit pack may be reused on the replaced circuit pack.

3.02 ***Information required*** before the procedures for the diagnostic tests may be initiated is as follows:

- Location of the particular LTF/LFD requiring maintenance
- Any NNX (CO code) associated with the LTF/LFD requiring maintenance
- Telephone number where the person performing the Check LTF/LFD Readiness position may be contacted
- Telephone number of the dial-up data set for the controller.

B. Preliminary Preparation

3.03 Certain preliminary preparation is required before the diagnostic tests outlined in this section may be initiated. Set-up procedures are as follows:

- Locate a telephone set close to the LTF/LFD.
- Place the portable terminal in the area of the LTF/LFD and near the telephone. Connect terminal to an electrical outlet and turn the power on.
- Contact the person performing the Check LTF/LFD Readiness position and request that the diagnostic software be downloaded.

C. Operating Procedures for Diagnostic Mode

3.04 The operational procedures included in this section require certain actions to be performed only when a certain condition exists. The optional condition is described in a statement which begins with the word ***If.*** Each conditional statement is followed by lettered steps which are performed only when the condition related to the statement is true. If the conditional statement is true, all of the lettered steps following the statement are performed. Unlettered steps are always performed. As an example, locate Steps 3, 4a, 5a, 6a, 7a and 8. Steps 3 and 8 are always performed, while Steps 4a through 7a are only performed if the computer response is not ALV DIAGNOSTIC READY.

3.05 Once a connection is established between the acoustic coupler of the portable terminal and the controller associated with the LTF/LFD requiring maintenance, the computer will respond by printing short messages. An appropriate reply to the messages from the computer may be entered from the terminal. If no entry is to be made to a particular message, the carriage return key may be operated to initiate the next message. In order to restart the procedures for operating in the diagnostic mode, an asterisk (*) may be typed and the RETURN key operated at any time. Once the asterisk is entered, the computer prints ALV DIAGNOSTIC READY and is ready to restart the diagnostic mode of operation. If an asterisk is transmitted anytime after the CHORE = response is received, the computer will return to the CHORE = response and the diagnostic test may be restarted from that point or a second asterisk may be entered to restart the procedures from the beginning.

3.06 The procedures for operating in the diagnostic mode are as follows:

STEP	ACTION	VERIFICATION
1	Call the telephone number of the dial-up data set for the controller.	High-pitch tone will be heard.
2	Place handset in the acoustic coupler. Position handset as indicated on the coupler unit.	
3	Depress RETURN, SEND or TRANSMIT key on the terminal. ***Note:*** The key designation may vary between different manufacturers of the portable terminals. Throughout these operating procedures the term RETURN key will be used for the key used to transmit information.	Computer response is ALV DIAGNOSTIC READY DATE =

STEP	ACTION	VERIFICATION
	If computer response is not ALV DIAGNOSTIC READY:	
4a	Verify diagnostic software has been downloaded.	
5a	Disconnect and redial the telephone number of the data set for the controller.	
6a	Listen for tone.	High-pitch tone is heard.
7a	Place telephone handset in the acoustic coupler for the terminal.	
8a	Depress RETURN, SEND or TRANSMIT key on the terminal.	Computer response is ALV DIAGNOSTIC READY
9	Enter current date in the DATE = field, eg, 08-10-77.	
10	Operate the RETURN key.	Computer response is TIME =
11	Enter present time in the TIME = field, eg, 1110A or 0345P.	
12	Operate RETURN key.	Computer response is EC =
13	Enter your employee code or other identification in the EC = field.	
14	Operate the RETURN key.	Computer response is NNX =
15	Enter the NNX number (central office code) associated with the loop testing frame requiring maintenance.	
16	Operate the RETURN key.	Computer response is CHORE = ***Note:*** If the wrong NNX number is entered or no NNX number is entered, the response will be LTF # =
	If response is LTF # =	
17b	Enter the LTF (loop testing frame) number requiring maintenance.	

STEP	ACTION	VERIFICATION
18b	Operate the RETURN key.	Computer response is CHORE = ***Note:*** If no LTF number is entered, the response will be DL11 # =
If response is DL11 # =		
19c	Enter the DL11 communications number requiring maintenance.	
20c	Operate the RETURN key.	Computer response is CHORE =
21	Type TPF ***Note:*** The TPF (test and print failures) mode of diagnostics provides a printout with the test number of the test which failed, the switch section (location of equipment that failed on the crossbar switch) and some miscellaneous test result data.	
22	Operate RETURN key.	Computer response is LIST DEVICES YOU DO NOT WANT TO TEST DEVICE =
If there are devices you do not want to test:		
	Note: The option is provided where the identification number of devices which are not to be tested may be entered into the computer. Most times the diagnostic test should be made on all devices. If a device is known to be bad and is not to be repaired, it should not be tested. A defective device could affect test results for other devices.	
23d	Enter identification number of one device which is not to be tested. Refer to Table A for proper device identifications.	
24d	Operate RETURN key.	Computer response is DEVICE =
25d	Repeat Steps 23d and 24d for each device which is ***not*** to be tested.	
26d	When all devices not to be tested are entered in the computer, the DEVICE = field is left	

STEP	ACTION	VERIFICATION
	blank and the RETURN key for Step 28 is operated.	
	If all devices are to be tested:	
27e	Make no entry in the DEVICE = field.	
28	Operate RETURN key. (Refer to 3.07.)	Diagnostic testing begins.

3.07 After all computer responses requiring an entry to proceed with the diagnostic testing have been transmitted, the software begins testing the LTF. The testing is done in groups of devices and when the computer begins testing a group of devices, it will print a message indicating which group of devices is being tested (Exhibit 3). After the group of devices is tested, the computer will print the messages indicating the test number, device number (Table A) and test data ***for any tests that failed*** for that group of devices. After information is printed on the tests which failed, the phrase TEST GROUP COMPLETE followed by a ? (question mark) is printed. If no tests failed, only the phrase TEST GROUP COMPLETE and the ? will be printed. Once the ? has been printed, a decision has to be made concerning how to proceed with the diagnostic testing. If no tests failed, the computer will automatically proceed with testing the next group of devices in 20 seconds. If a test failed message is printed or an entry will be made before the 20-second interval, one of the following decisions has to be made:

- To continue with the next group of tests
- Rerun the group of tests just completed
- Place the computer on wait
- Return to the CHORE = transaction
- Start the diagnostic testing over.

The procedures for completing each of these options are as follows:

STEP	ACTION	VERIFICATION
	If there are no test failures and the computer is to wait 20 seconds before proceeding with the diagnostic testing:	
29f	No entry is made following the printing of a ?.	Computer waits approximately 20 seconds before printing the following: (1) Message indicating which group of devices is being tested. Refer to Exhibits 1 and 3. (2) Test failed messages for any devices within the group which failed the diagnostic test. Refer to Exhibit 2.

STEP	ACTION	VERIFICATION
		(3) The phrase TEST GROUP COMPLETE will be printed followed by a question mark (?) which appears along the left margin of the printout (Exhibit 3).
	If computer is to immediately continue to the next group of diagnostic tests:	
30g	Operate RETURN key.	Computer immediately begins to test next group of devices and prints the following: (1) Message indicating which group of devices is being tested. Refer to Exhibits 1 and 3. (2) Test failed messages for any devices within the group which failed the diagnostic test. Refer to Exhibit 2. (3) The phrase TEST GROUP COMPLETE will be printed followed by a question mark (?) which appears along the left margin of the printout (Exhibit 3).
	If computer is to retest the devices just tested:	
	Note: A retest of devices may be required after replacing a circuit pack to determine if a malfunction was corrected.	
31h	Type ***R***	
32h	Operate RETURN key.	Computer immediately begins to retest group of devices tested prior to entering the retest transaction and prints the following messages: (1) Message indicating which group of devices is being tested. Refer to Exhibits 1 and 3. (2) Test failed messages for any devices within the group which failed the diagnostic test. Refer to Exhibit 2. (3) The phrase TEST GROUP COMPLETE will be printed followed by a question mark (?) which appears along the left margin of the printout (Exhibit 3).
	If the computer software is to return to the CHORE = entry:	
33i	Type *	

STEP	ACTION	VERIFICATION
34i	Operate the RETURN key.	Computer response is CHORE = ***Note:*** By returning to the CHORE = entry, the diagnostic testing may be restarted and the software may be programmed not to test certain devices. To restart the diagnostic testing from the beginning, a second asterisk must be entered into the system.
If the computer is to be placed in a waiting condition:		
35j	Type ***W***	
36j	Operate the RETURN key.	Computer will not proceed with diagnostic testing until the options for Steps 31h and 32h or 33i and 34i are initiated.
If all testing is completed:		
37k	Remove handset from acoustic coupler and disconnect.	
38k	Contact person performing Check LTF/LFD Readiness position to request the on-line software be reloaded.	

D. Trouble Analysis and Correction Procedures

3.08 The computer will print test data for each test in the group which failed. The failed test message indicating the test number, device number and test data is printed as each failure is identified. A set-up error message (Exhibit 4) will be printed instead of a failed test message when the equipment or other conditions prevent the diagnostic tests from being made. The phrase TEST GROUP COMPLETE is printed after each group of diagnostic tests is completed. The format for failed test messages is described in Exhibit 2. Exhibit 5 provides the information to be interpreted from the failed test message. A typical failed test message is

0D003 004 177777 000000 100003

In this example D003 is the failed test number. Since there are four sets of circuit packs associated with this test, the 004 indicates the equipment location is number 4. The circuit packs associated with equipment 4 and their locations are as follows:

CP18 62-32

CP17 62-34

CP7 63-12

CP2 63-6

CP4 63-8

CP6 63-11

CP2 63-5

The test failed number (for example, D003) and the equipment location (for example, 004) provide the information needed for the Diagnose LTF/LFD Fault position. The last three groups of six digits in the failed test message are not useful to diagnosing trouble by craft personnel.

3.09 Any malfunctions which are detected should be repaired before the diagnostic testing is resumed.

3.10 When a failed test is indicated and the ? (question mark) is printed (Exhibit 3), type a ***W*** and operate the RETURN key in order to make the computer wait while repair work is being performed.

3.11 By using the information in Exhibit 3, the circuit packs associated with a device which failed the test may be determined. Once the group of circuit packs which may be causing the trouble is determined, a system of replacing the circuit packs must be used to isolate the trouble to a specific circuit pack. As each circuit pack is replaced, the diagnostic test for the respective devices must be rerun to determine if the malfunction has been corrected. When a circuit pack is replaced and the diagnostic test is rerun, the following action should be taken:

- ***If none of the diagnostic tests failed***—Mark the original circuit pack as defective and proceed to the next group of diagnostic tests.
- ***If the same test failed in the diagnostic test***—Restore the original circuit pack and continue to make diagnostic tests after replacing each circuit pack on the list.
- ***If a different test failed in the diagnostic test***—Mark the original circuit pack as defective and continue to make the diagnostic tests while replacing the other circuit packs on the list.
- ***If the fault is not corrected after all circuit packs in the group are replaced***—Check the test failed messages to see if there have been test failures on other devices. If other failures were detected, attempt to correct the fault by making the diagnostic test and replacing circuit packs.
- ***If all suspected circuit packs associated with a given test and device have been replaced without correcting the fault***—Refer information pertaining to the fault and diagnostic test results to the person performing the Troubleshoot LTF/LFD Fault position (662-527-300) for further repair effort.

Circuit packs designated with an asterisk in Exhibit 3 should be replaced first when all devices of a particular kind failed a test. The remaining circuit packs should be replaced by starting at the top of the circuit pack list and continuing down the list until the malfunction is corrected.

3.12 Circuit packs should be handled with care to prevent physical and electrical damage. ***The person replacing circuit packs should be grounded to eliminate static discharges which could damage circuit packs.*** Handle circuit packs by the plastic tab on the end of the circuit pack. Circuit packs should be shipped and stored with a conductive shorting bar over the contacts and packaged in an electrically conductive bag.

3.13 If a test failed message indicating a failed test number of A001 is printed for the testing DL11 Communications group of tests, refer the failed test to the Check LTF/LFD Readiness position as a possible computer problem. Refer to Exhibit 5 for any other failed test numbers.

TABLE A

DEVICE IDENTIFICATIONS

DEVICE		IDENTIFICATION NUMBER
PORTS		POR.00 THROUGH POR.08
LINE FAULT DETECTORS		LFD000 LFD001
DIALER (DIAL PULSE)		DPD002 DPD004
DIALER (MULTIFREQUENCY)		MFD003 MFD005
BUSY DETECTORS		BYD007 BYD008
TRUNK ACCESS SWITCH	GROUP 0	TAS100
	GROUP 1	TAS101
	GROUP 2	TAS102
	GROUP 3	TAS200
	GROUP 4	TAS201

TESTING DL11 COMMUNICATIONS

TESTING LTF COMMUNICATIONS

TESTING CCC COMMUNICATIONS

TESTING DEVICE COMMUNICATIONS

INITIAL TESTING EAS

TESTING PORTS

TESTING BUSY DETECTORS

TESTING DIALERS

TESTING LINE FAULT DETECTORS

TESTING LFD REFERENCE CAPACITORS

FINAL TESTING EAS

TESTING TAS GROUP 0

TESTING TAS GROUP 1

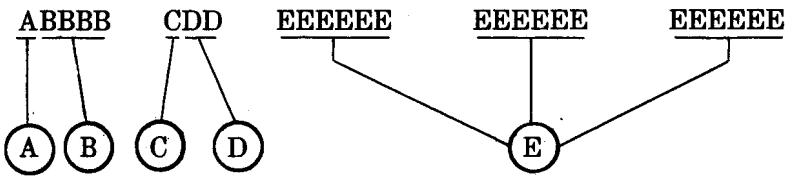
TESTING TAS GROUP 2

TESTING TAS GROUP 3

TESTING TAS GROUP 4

TPF TESTING COMPLETE

Exhibit 1—Messages Printed While Testing in the Diagnostic Mode



FEATURE	DESCRIPTION
A	Identifies the port used in performing the diagnostic test. This field may remain blank if no port was used in the test.
B	Identifies the test that failed. Refer to Exhibit 5 for alphanumeric test numbers.
C	A decimal point or number will appear in this field. A number is used to indicate the switch section of the equipment that failed the test. A decimal point in this field indicates the succeeding 2-digit number is the number of a port which failed the test.
D	This field provides the specific switch location of the equipment that failed the test or the number of the port which failed the test. A number will appear on this field indicated by Feature C if this field provides a specific switch location. A decimal point will appear in the field indicated by Feature C if this field provides a port number.
E	Miscellaneous test data (not useful to diagnosing trouble by craft personnel).

Exhibit 2—Interpretation of the Test Failed Message

```
ALV DIAGNOSTIC READY
DATE = 02-01-77

TIME = 1000P

EC = 123

NNX # = 311

CHORE = TPF

LIST DEVICES YOU DO NOT WANT TO TEST
DEVICE =

TESTING DL11 COMMUNICATIONS
A001                        100003    177400    000017
TEST GROUP COMPLETE
?
TESTING LTF COMMUNICATIONS
B001                        100003    177400    000000
TEST GROUP COMPLETE
?
TESTING CCC COMMUNICATIONS
OC0001    .01               100003    177400    000001
TEST GROUP COMPLETE
?
TESTING DEVICE COMMUNICATIONS
OD003     000               177777    000000    000017
TEST GROUP COMPLETE
?
INITIAL TESTING EAS
OE001     002               000011    000360    000017
TEST GROUP COMPLETE
?
TESTING PORTS
OF001     .00               000000    000100    000001
TEST GROUP COMPLETE
?
TESTING BUSY DETECTORS
OG001     007               177777    000000    000000
TEST GROUP COMPLETE
?
TESTING DIALERS
OH001     002               000011    000360    000001
TEST GROUP COMPLETE
?
TESTING LINE FAULT DETECTORS
SET UP ERROR                TEST J001
NO GOOD LINE FAULT DETECTOR AVAILABLE
?
```

Exhibit 3—Typical Printout of Test Failed Messages From the ALV Diagnostic Program Operating With the Test and Print Failures (TPF) Option (Sheet 1 of 2)

```
TESTING LFD REFERENCE CAPACITORS
OH001     018          000011     000000     000000
TEST GROUP COMPLETE
?
FINAL TESTING EAS
OK001     009          177777     000000     000017
TEST GROUP COMPLETE
?
TESTING TAS GROUP 0
OM001     101          000011     000360     000001
TEST GROUP COMPLETE
?
```

Note: Test messages in this example indicate one failure in each of the test categories except for testing the Line Fault Detectors, which indicates a set-up error

Exhibit 3—Typical Printout of Test Failed Messages From the ALV Diagnostic Program Operating With the Test and Print Failures (TPF) Option (Sheet 2 of 2)

COULD NOT COMMUNICATE WITH LTF — DATA SET NOT CLEAR TO SEND OR NO CARRIER DETECTED.

THE REQUIRED LFD WAS NOT AVAILABLE AND GOOD

NO GOOD PORT AVAILABLE

NO GOOD LINE FAULT DETECTOR AVAILABLE

NO GOOD DIALER AVAILABLE

NO GOOD BUSY DETECTOR AVAILABLE

COULD NOT SET UP SELF-CHECK CIRCUIT

COULDN'T SET X POINT "EXTRA NUMBER TERMINATION" TO PORT (PORT NUMBER) NO SWITCH READY MESSAGE

COULDN'T SET X POINT "BUSY DETECTOR" TO PORT (PORT NUMBER) NO SWITCH READY MESSAGE.

EAS PORT (PORT NUMBER) DID NOT RELEASE.

SELF-CHECK CIRCUIT DID NOT ANSWER POLL

NO CCC COMMUNICATION

POWER FAILURE

UNEXPECTED POWER CLEAR

SWITCH NOT READY

INVALID CCC RESPONSE.

EAS PORT (PORT NUMBER) DID NOT RELEASE OR LFD BAD.

Exhibit 4—Automatic Line Verifier Set Up Errors

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER	CIRCUIT PACK LOCATION (See Note)
TESTING LTF COMMUNICATIONS	B001	CP3	64-8
		CP7	63-12
		CP6	63-11
TESTING CCC (COMMUNICATIONS CONTROL CIRCUIT) COMMUNICATIONS	C001	CP7	63-12
		CP3	63-7
		CP4	63-8
		CP6	63-11
		CP1	63-1
		CP2	63-5
		CP2	63-6
	C002	CP6	63-11
		CP1	63-2
		CP7	63-12
	C003 or C004	CP4	63-9
		CP1	63-4
		CP1	63-2
		CP7	63-12
	C005	CP2	63-5
		CP2	63-6
	C006	CP4	63-9
		CP1	63-2
		CP1	64-4
		CP2	64-5

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 1 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER	CIRCUIT PACK LOCATION (See Note)
TESTING CCC (COMMUNICATIONS CONTROL CIRCUIT) COMMUNICATIONS	C007 or C008	CP5	63-10
		CP1	63-1
		CP4	63-9
	C009	CP6	63-11
		CP1	63-2
	C010	CP4	63-9
		CP1	63-2
		CP1	64-4
		CP2	64-5
	C011 through C026	CP1	62-1
		CP7	63-12
		CP2	63-6
		CP4	63-8
		CP6	63-11
		CP2	63-5
TESTING DEVICE COMMUNICATIONS	D001 or D002	CP1	62-1
		CP7	63-12
		CP2	63-6
		CP4	63-8
		CP6	63-11
		CP2	63-5
		CP2	62-#

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 2 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER		CIRCUIT PACK LOCATIONS
TESTING DEVICE COMMUNICATIONS	D003 or D004	EQUIP 2 (DPD) (#1)	CP18 *	62-32
			CP17	63-33
			CP7	63-12
			CP2	63-6
			CP4	63-8
			CP6	63-11
			CP2	63-5
			CP1	62-1
		EQUIP 3 (MFD) (#1)	CP18 *	62-32
			CP19	62-30
			CP7	63-12
			CP2	63-6
			CP4	63-8
			CP6	63-11
			CP2	63-5
			CP1	62-1

* Circuit packs within a group which should be replaced first, when all devices of a particular type (e.g., dialers), failed the test.

\# Dash number depends on the port in trouble; numbers 2, 5, 8, 11, 14, 17, 20, 23 and 26 for ports 0 through 8, respectively.

Glossary:
DPD — Dial pulse dialer
MFD — Multifrequency dialer

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 3 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER		CIRCUIT PACK LOCATIONS
TESTING DEVICE COMMUNICATIONS	D003 or D004	EQUIP 4 (DPD) (#2)	CP18 *	62-32
			CP17	62-34
			CP7	63-12
			CP2	63-6
			CP4	63-8
			CP6	63-11
			CP2	63-5
			CP1	62-1
		EQUIP 5 (MFD) (#2)	CP18 *	62-32
			CP19	62-31
			CP7	63-12
			CP2	63-6
			CP4	63-8
			CP6	63-11
			CP2	63-5
			CP1	62-1

* Circuit packs within a group which should be replaced first, when all devices of a particular type (e.g., dialers), failed the test.

\# Dash number depends on the port in trouble; numbers 2, 5, 8, 11, 14, 17, 20, 23 and 26 for ports 0 through 8, respectively.

Glossary:
DPD — Dial pulse dialer
MFD — Multifrequency dialer

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 4 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER	CIRCUIT PACK LOCATION
TESTING DEVICE COMMUNICATIONS	D005	CP13	62-35
		CP7	63-12
		CP2	63-6
		CP4	63-8
		CP6	63-11
		CP2	63-5
	D006	CP10	62-39
		CP7	63-12
		CP2	63-6
		CP4	63-8
		CP6	63-11
		CP2	63-5
INITIAL TESTING EAS (EQUIPMENT ACCESS SWITCH)	E001 or E003 (See Exhibit 6)	CP1	64-4
		CP2	64-5
		CP3	64-8
		CP5	64-1
		CP5	64-6
		CP5	64-7
		CP5	64-20
		CP6	64-2
		CP6	64-10
		CP6	64-12
		CP6	64-13
		CP6	64-14
		CP6	64-16
		CP20	62-38
	E002	CP20	62-38

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 5 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING PORTS	F001	PORTS	0	CP2	62-2
				CP1 *	62-1
			1	CP2	62-5
				CP1 *	62-1
			2	CP2	62-8
				CP1 *	62-1
			3	CP2	62-11
				CP1 *	62-1
			4	CP2	62-14
				CP1 *	62-1
			5	CP2	62-17
				CP1 *	62-1
			6	CP2	62-20
				CP1 *	62-1
			7	CP2	62-23
				CP1 *	62-1
	F002	PORTS	0	CP16	62-3
				CP2	62-2
				CP20 *	62-38
			1	CP16	62-6
				CP2	62-5
				CP20 *	62-38

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 6 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING PORTS	F002	P O R T S	2	CP16	62-9
				CP2	62-8
				CP20 *	62-38
			3	CP16	62-12
				CP2	62-11
				CP20 *	62-38
			4	CP16	62-15
				CP2	62-14
				CP20 *	62-38
			5	CP16	62-18
				CP2	62-17
				CP20 *	62-38
			6	CP16	62-21
				CP2	62-20
				CP20 *	62-38
			7	CP16	62-24
				CP2	62-23
				CP20 *	62-38
			8	CP16	62-27
				CP2	62-26
				CP20 *	62-38

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 7 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING PORTS	F003 through F007	PORTS	0	CP4	62-4
			1	CP4	62-7
			2	CP4	62-10
			3	CP4	62-13
			4	CP4	62-16
			5	CP4	62-19
			6	CP4	62-22
			7	CP4	62-25
			8	CP4	62-28
	F008 F010 F013 F015 and F016	PORTS	0	CP16	62-3
				CP2	62-2
				CP1 *	62-1
			1	CP16	62-6
				CP2	62-5
				CP1 *	62-1
			2	CP16	62-9
				CP2	62-8
				CP1 *	62-1
			3	CP16	62-12
				CP2	62-11
				CP1 *	62-1

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 8 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING PORTS	F008 F010 F013 F015 and F016	P O R T S	4	CP16	62-15
				CP2	62-14
				CP1 *	62-1
			5	CP16	62-18
				CP2	62-17
				CP1 *	62-1
			6	CP16	62-21
				CP2	62-20
				CP1 *	62-1
			7	CP16	62-24
				CP2	62-23
				CP1 *	62-1
			8	CP16	62-27
				CP2	62-26
				CP1 *	62-1
	F009 F011 F012 and F014	P O R T S	0	CP16	62-3
				CP2	62-2
				CP1 *	62-1
				CP20 *	62-38
			1	CP16	62-6
				CP2	62-5
				CP1 *	62-1
				CP20 *	62-38

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 9 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING PORTS	F009 F011 F012 and F014	PORTS	2	CP16	62-9
				CP2	62-8
				CP1 *	62-1
				CP20 *	62-38
			3	CP16	62-12
				CP2	62-11
				CP1 *	62-1
				CP20 *	62-38
			4	CP16	62-15
				CP2	62-14
				CP1 *	62-1
				CP20 *	62-38
			5	CP16	62-18
				CP2	62-17
				CP1 *	62-1
				CP20 *	62-38
			6	CP16	62-21
				CP2	62-20
				CP1 *	62-1
				CP20 *	62-38

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 10 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING PORTS	F009 F011 F012 and F014	P O R T S	7	CP16	62-24
				CP2	62-23
				CP1 *	62-1
				CP20 *	62-38
			8	CP16	62-27
				CP2	62-26
				CP1 *	62-1
				CP20 *	62-38
	F017	P O R T S	0	CP18 *	62-32
				CP16	62-3
				CP2	62-2
				CP20 *	62-38
			1	CP18 *	62-32
				CP16	62-6
				CP2	62-5
				CP20 *	62-38
			2	CP18 *	62-32
				CP16	62-9
				CP2	62-8
				CP20 *	62-38

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 11 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING PORTS	F017	PORTS	3	CP18 *	62-32
				CP16	62-12
				CP2	62-11
				CP20 *	62-38
			4	CP18 *	62-32
				CP16	62-15
				CP2	62-14
				CP20 *	62-38
			5	CP18 *	62-32
				CP16	62-18
				CP2	62-17
				CP20 *	62-38
			6	CP18 *	62-32
				CP16	62-21
				CP2	62-20
				CP20 *	62-38
			7	CP18 *	62-32
				CP16	62-24
				CP2	62-23
				CP20 *	62-38

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 12 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING PORTS	F017		8	CP18 *	62-32
				CP16	62-27
				CP2	62-26
				CP20 *	62-38
TESTING BUSY DETECTORS	G001	EQUIPMENT	7	CP14	62-36
				CP13 *	62-35
				CP5 *	64-3
			8	CP14	62-37
				CP13 *	62-35
				CP5 *	64-3
	G002 and G003		7	CP14	62-36
				CP13 *	62-35
			8	CP14	62-37
				CP13 *	62-35
TESTING DIALERS	H001	EQUIPMENT	2	CP18	62-32
				CP17	62-33
				CP20 *	62-38
			3	CP18	62-32
				CP19	62-30
				CP20 *	62-38

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 13 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING DIALERS	H001	EQUIPMENT	4	CP18	62-32
				CP17	62-34
				CP20 *	62-38
			5	CP18	62-32
				CP19	62-31
				CP20 *	62-38
	H002 H003 AND H005	EQUIPMENT	2	CP17	62-33
				CP18 *	62-32
			3	CP19	62-30
				CP18 *	62-32
			4	CP17	62-34
				CP18 *	62-32
			5	CP19	62-31
				CP18 *	62-32
	H004	EQUIPMENT	2	CP17	62-33
				CP1 *	62-1
			3	CP19	62-30
				CP1 *	62-1
			4	CP17	62-34
				CP1 *	62-1
			5	CP19	62-31
				CP1 *	62-1

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 14 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING DIALERS	H006	EQUIPMENT	2	CP17	62-33
				CP18 *	62-32
				CP1 *	62-1
			3	CP19	62-30
				CP18 *	62-32
				CP7 *	62-29
				CP1 *	62-1
			4	CP17	62-34
				CP18 *	62-32
				CP1 *	62-1
			5	CP19	62-31
				CP18 *	62-32
				CP7 *	62-29
				CP1 *	62-1
	H007	EQUIPMENT	2	CP17	62-33
				CP18 *	62-32
			3	CP19	62-30
				CP18 *	62-32
			4	CP17	62-34
				CP18 *	62-32
			5	CP19	62-31
				CP18 *	62-32

* Circuit packs within a group which should be replaced first when all devices of a particular type failed.

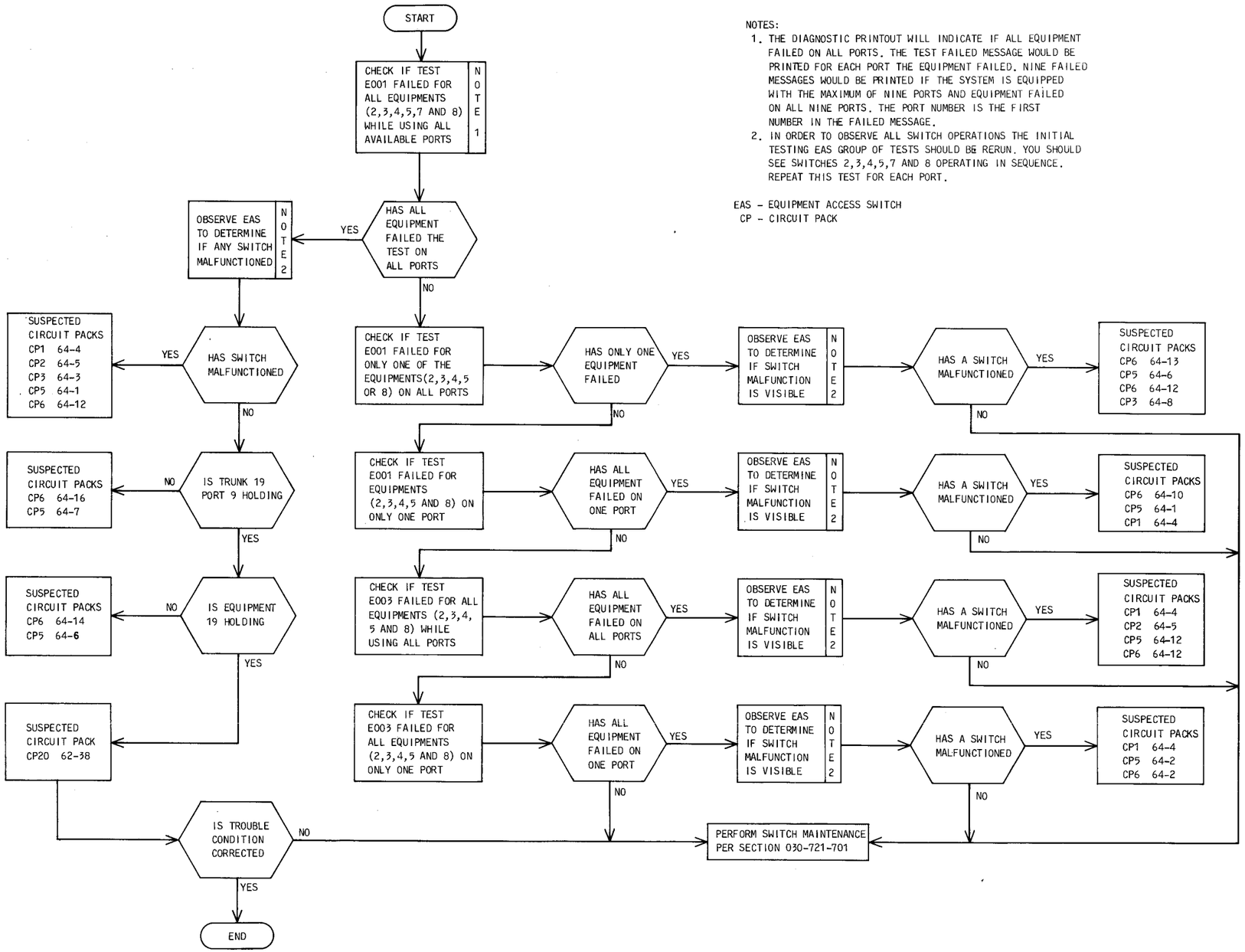
Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 15 of 16)

TEST PERFORMED	TEST NUMBER	CIRCUIT PACK NUMBER			CIRCUIT PACK LOCATION
TESTING LINE FAULT DETECTORS	I001 through I020	CP1			64-4
		CP2			64-5
		CP6			64-12
		CP5			64-2
		CP15			62-43
		CP10			62-39
		CP11			62-40
		CP6			64-13
		CP21			Line Fault Detector
TESTING REFERENCE CAPACITORS OF THE LINE FAULT DETECTORS	J001 through J012	EQUIP	0	CP12	62-41
				CP11 *	62-40
			1	CP12	62-42
				CP11 *	62-40
FINAL TESTING EQUIPMENT ACCESS SWITCH	See Exhibit 7				
TESTING TRUNK ACCESS SWITCHES FOR GROUP 0 GROUP 1 GROUP 2 GROUP 3 AND GROUP 4	See Exhibit 8				

* Circuit packs within a group which should be replaced when all devices of a particular type failed.

Note: The first two digits of the location number indicate the Schematic Diagram (SD) number for the part of the associated LTF. The second two digits of the location number indicate the slot number of the circuit pack within the part of the LTF.

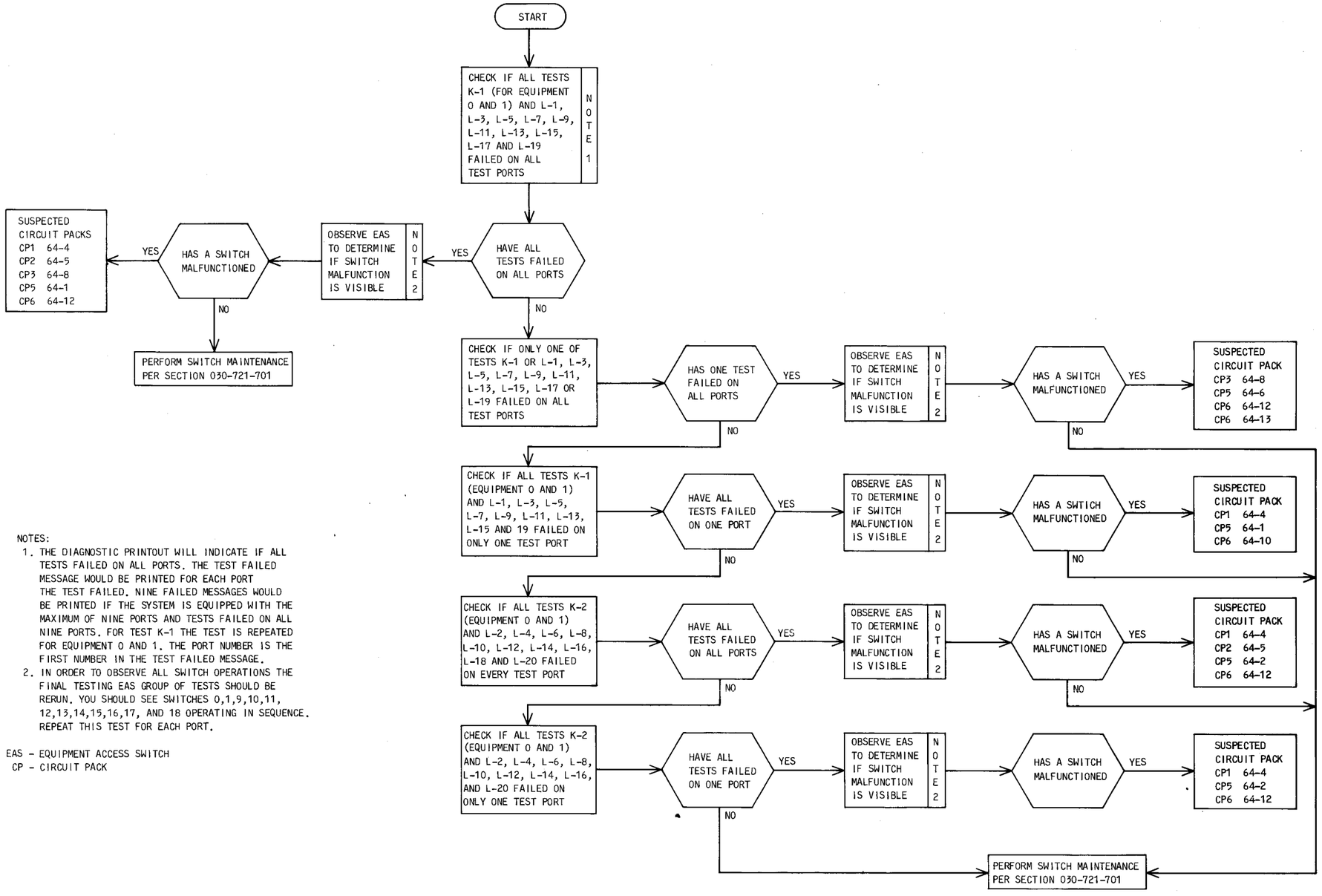
Exhibit 5—Testing Numbers and Circuit Packs Associated With Device Groups Being Tested (Sheet 16 of 16)



NOTES:
1. THE DIAGNOSTIC PRINTOUT WILL INDICATE IF ALL EQUIPMENT FAILED ON ALL PORTS. THE TEST FAILED MESSAGE WOULD BE PRINTED FOR EACH PORT THE EQUIPMENT FAILED. NINE FAILED MESSAGES WOULD BE PRINTED IF THE SYSTEM IS EQUIPPED WITH THE MAXIMUM OF NINE PORTS AND EQUIPMENT FAILED ON ALL NINE PORTS. THE PORT NUMBER IS THE FIRST NUMBER IN THE FAILED MESSAGE.
2. IN ORDER TO OBSERVE ALL SWITCH OPERATIONS THE INITIAL TESTING EAS GROUP OF TESTS SHOULD BE RERUN. YOU SHOULD SEE SWITCHES 2,3,4,5,7 AND 8 OPERATING IN SEQUENCE. REPEAT THIS TEST FOR EACH PORT.

EAS - EQUIPMENT ACCESS SWITCH
CP - CIRCUIT PACK

Exhibit 6—Trouble Locating Procedures for Initial Testing EAS (Equipment Access Switch)

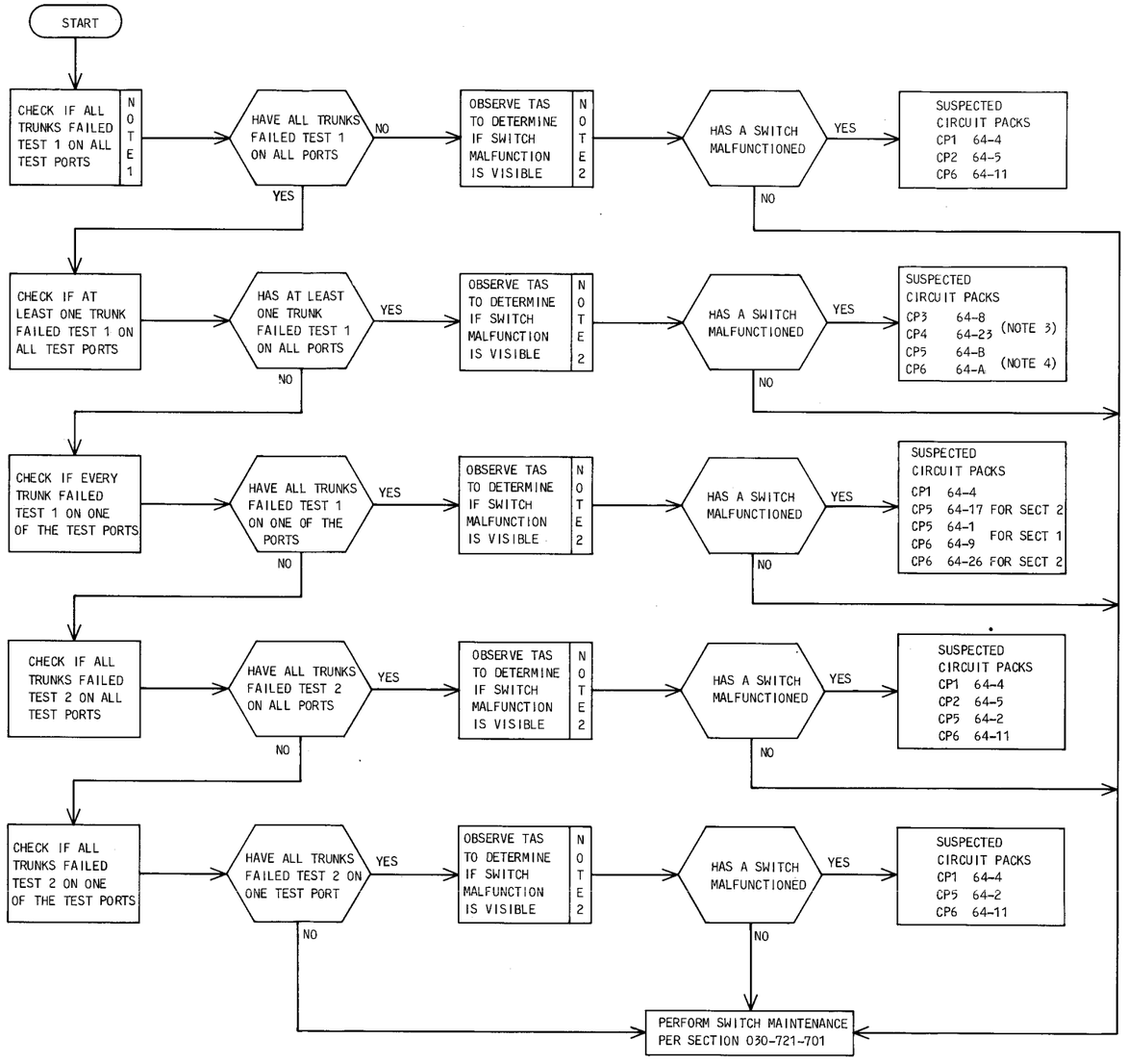


NOTES:

1. THE DIAGNOSTIC PRINTOUT WILL INDICATE IF ALL TESTS FAILED ON ALL PORTS. THE TEST FAILED MESSAGE WOULD BE PRINTED FOR EACH PORT THE TEST FAILED. NINE FAILED MESSAGES WOULD BE PRINTED IF THE SYSTEM IS EQUIPPED WITH THE MAXIMUM OF NINE PORTS AND TESTS FAILED ON ALL NINE PORTS. FOR TEST K-1 THE TEST IS REPEATED FOR EQUIPMENT 0 AND 1. THE PORT NUMBER IS THE FIRST NUMBER IN THE TEST FAILED MESSAGE.
2. IN ORDER TO OBSERVE ALL SWITCH OPERATIONS THE FINAL TESTING EAS GROUP OF TESTS SHOULD BE RERUN. YOU SHOULD SEE SWITCHES 0,1,9,10,11, 12,13,14,15,16,17, AND 18 OPERATING IN SEQUENCE. REPEAT THIS TEST FOR EACH PORT.

EAS - EQUIPMENT ACCESS SWITCH
CP - CIRCUIT PACK

Exhibit 7—Trouble Locating Procedures for Final Testing (Equipment Access Switch)



NOTES:

1. THE DIAGNOSTIC PRINTOUT WILL INDICATE IF ALL TRUNKS FAILED ON ALL PORTS. THE TEST FAILED MESSAGE WOULD BE PRINTED FOR EACH PORT THE TEST FAILED. NINE FAILED MESSAGES WOULD BE PRINTED IF THE SYSTEM IS EQUIPPED WITH THE MAXIMUM OF NINE PORTS AND TEST 1 FAILED ON ALL NINE PORTS. THE PORT NUMBER IS THE FIRST NUMBER IN THE TEST FAILED MESSAGE.
2. IN ORDER TO OBSERVE ALL SWITCH OPERATIONS THE TESTING TPS GROUP (0,1,2,3 OR 4 – WHICHEVER GROUP FAILED) OF TESTS SHOULD BE RERUN. SWITCHES FOR EACH TRUNK INSTALLED SHOULD OPERATE IN SEQUENCE. REPEAT THIS TEST FOR EACH PORT.
3. USE CP3 64-8 IF:
   - THE TRUNK NUMBER IS GREATER THAN 100, BUT SMALLER THAN 132

   OR
   - THE TRUNK NUMBER IS GREATER THAN 200, BUT SMALLER THAN 232

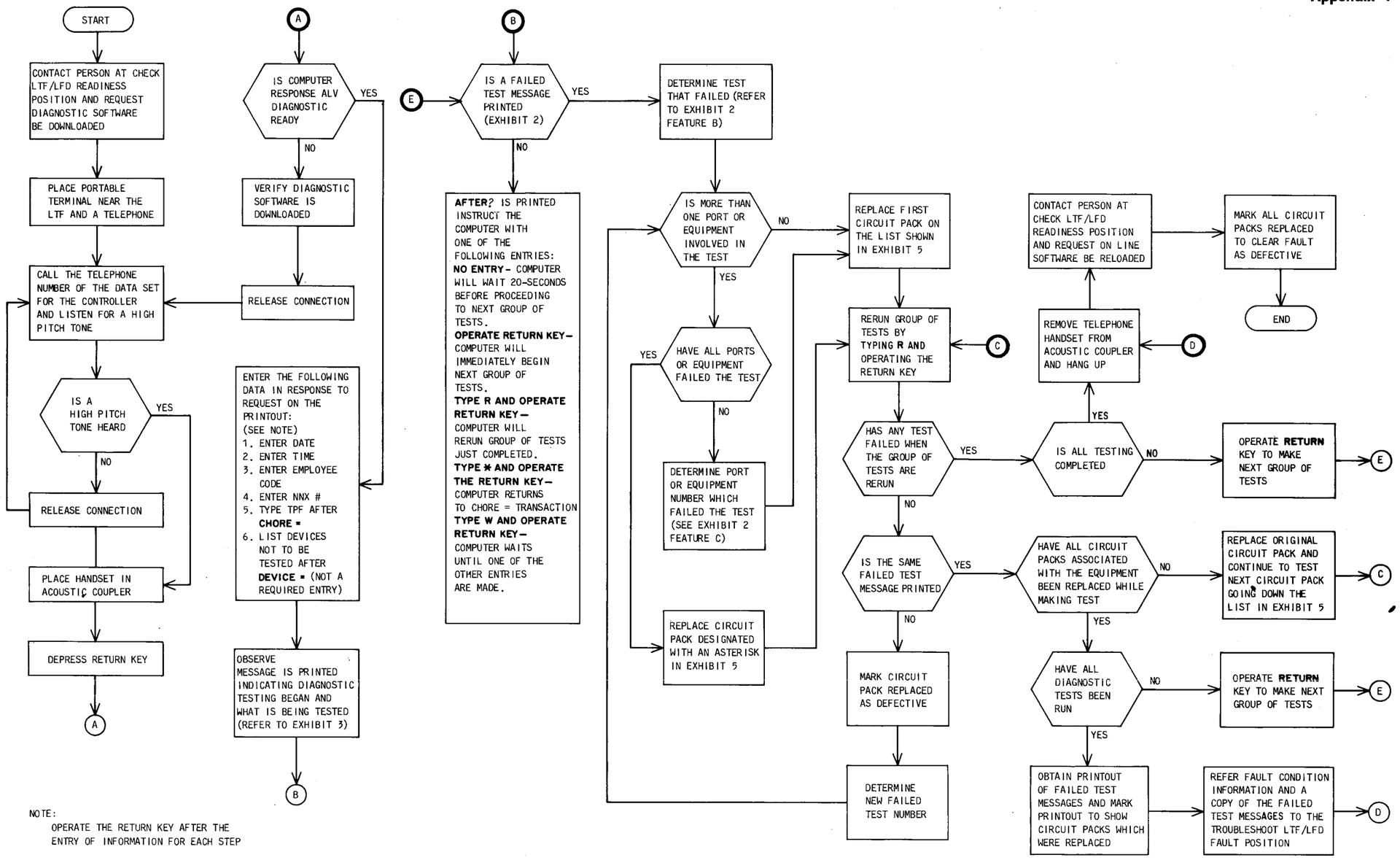
   USE CP4 64-23 IF:
   - THE TRUNK NUMBER IS GREATER THAN 131, BUT EQUAL TO OR SMALLER THAN 159

   OR
   - THE TRUNK NUMBER IS GREATER THAN 231, BUT EQUAL TO OR SMALLER THAN 239.
4.

SECTION NUMBER	TRUNK NUMBER	SLOT NUMBER	
		A	B
1	0-9	15	7
	10-19	16	
	20-29	34	20
	30-39	33	
	40-49	30	22
	50-59	29	
2	0-9	28	18
	10-19	27	
	20-29	25	21
	30-39	24	

GLOSSARY:
TAS – TRUNK ACCESS SWITCH
CP – CIRCUIT PACK
SECT – SECTION

Exhibit 8—Trouble Locating Procedures for Testing TAS (Trunk Access Switch)



NOTE:
OPERATE THE RETURN KEY AFTER THE ENTRY OF INFORMATION FOR EACH STEP