

Review of Special Report For DS0 Digital Data Testing

August 8, 1991

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Attached is a copy of a Special Services Report for DS-0 Digital Data testing. Per Mr. Gibson, the attached will become our guidelines for Stress testing in the near future. As indicated in the attachment, the Wiltron Digital test head we trialed will support the digital test requirements.

Please review the attached and forward your questions or comments, if any, directly to Mr. Chuck Gibson at 708-248-4387. I will be on vacation until the 26th and will be following up with Chuck after I return. As far as the due date for comments is concerned, I have made arrangements to extend the due date until the 19th.



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July 30, 1991

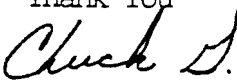
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Attached is a "draft" copy of a Special Report for DSO Digital Data Testing which is being circulated for comments. This report incorporates the latest testing agreements made at the Network Operations Forum/Digital Testing Workshop (NOF/DTW). The testing parameters and patterns were officially accepted at the July 23, 1991 NOF meeting held in Chicago. The agreements were made on the testing patterns and parameters (time intervals and measurement requirements).

Two figures are missing: 1) 56Kb/s with repeaters and 2) 64Kb/s with repeaters. These will be added in the final document which I expect to be completed by mid to late August.

Please provide comments or suggestions by August 12, 1991 either by E-mail or on 708-248-4387.

Thank You

  
Chuck Gibson

cc B. Kemp

AMERITECH SERVICES  
AMERITECH SPECIAL REPORT

AM SR-CSO-000051  
DSO DIGITAL DATA TESTING  
ISSUE A, AUGUST 1991

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DSO DIGITAL DATA TESTING

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ATTACHMENT I - DSO Level Digital Testing Procedures for Provisioning and Maintenance.

TABLE A - Provisioning and Maintenance Matrix

LIST OF FIGURES

- Figure 1 - Local Loop Testing for 2.4 Kb/s
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## 1.0 INTRODUCTION

### 1.1 Purpose

The primary purpose of this document is to define the basic testing functions for DSO level digital services. The Network Operations Forum/Digital Testing Workshop (NOF/DTW) have identified a need to perform additional stress testing for digital data services. Agreements between the Interexchange Carriers (IC) and the Local Exchange Carriers (LEC) have been reached and are identified in this document. Stress testing will play an important role in the provisioning and maintenance processes of digital data services. Stress tests are used in several ways: 1) for preservice testing to assure that a digital data facility meets objectives for characteristic parameters before it is turned up for service, 2) for trouble verification in response to a trouble report or indication, 3) for sectionalizing confirmed faults and 4) for verification of repair.

The functions performed in a central office that pertain to installation and maintenance stress testing are performed using five (5) specific bit patterns. These tests are time dependent with stipulated performance parameters. The testing functions described in Attachment I should be used for installation and maintenance test procedures for all DSO level digital services.

### 1.2 Scope

The functions described are primarily low-level or basic functions. A basic function is comprised of five operations or steps. A single installation test session on a typical circuit will require the use of these five operations or steps to ensure proper turn-up. For maintenance, the choice of a useful sequence must be made by the tester and is dependent upon the trouble reported or an indication. Similarly, decision logic for trouble isolation is not defined to allow the tester to choose the next function to be performed based on previous results. Trouble isolation logic or sequence may vary by AOC, thus, local methods and procedures should be used to perform trouble isolation and repair functions. The functions included are intended for use in providing testing support for installation and maintenance of digital data service.

The stress testing functions are performed in addition to local facility test which include, foreign voltage, insulation resistance, loop resistance, insertion loss, background noise and impulse noise.

These testing functions are valid for the following services and bit rates:

<u>OPTINET</u>	<u>DDS</u>	<u>BDS</u> (where applicable)
2.4 Kb/s	2.4 Kb/s	2.4 Kb/s
4.8 Kb/s	4.8 Kb/s	4.8 Kb/s
9.6 Kb/s	9.6 Kb/s	9.6 Kb/s
19.2 Kb/s	56 Kb/s	56 Kb/s
56 Kb/s		
64 Kb/s		

## 2.0 RECOMMENDATIONS

### 2.1 Test Patterns

Ameritech Services supports and recommends the NOF/DTW agreement for stress testing digital data services using the five test patterns as described below.

On a forward looking basis, new test sets and test systems should incorporate the bit specific patterns described in this paragraph. Current test sets and test systems should be upgraded as economics permit.

The following test patterns will be used for stress testing DS0 level digital services:

Pseudo Random Bit Stream (PRBS)- 2047 test pattern

Test Pattern 1 - A general pattern that stresses timing recovery for all synchronous protocols and network components. This is a repeated pattern. Hex FF00.

100 BYTES of 1111 1111  
100 BYTES of 0000 0000

Test Pattern 2 - Used to test the Flag for X.25, X.75, SNA, HDLC, SDLC and SS7. This is a repeated pattern. Hex 7E00

100 BYTES of 0111 1110  
100 BYTES of 0000 0000

Test Pattern 3 - Used to test Bisync EBCDIC protocol (used by most IBM or compatible equipment. This is a continuous pattern. Hex 32.

0011 0010

Test Pattern 4 - Used to test ASCII Space (used in DEC VT type or compatible terminal equipment). This is a continuous pattern. Hex 40

0100 0000

## 2.2 Optional Test Pattern

The following is an optional test pattern and may be used in lieu of Test Patterns 1-4. The AOCs current test sets and test systems will not support this pattern configuration.

Test Pattern 5 - A combination of Test Patterns 1-4

```
100 BYTES OF 1111 1111
100 BYTES OF 0000 0000
100 BYTES OF 1111 1111
100 BYTES OF 0000 0000
100 BYTES OF 1111 1111      (Test Pattern 1)
100 BYTES OF 0000 0000
100 BYTES OF 1111 1111
100 BYTES OF 0000 0000
```

```
100 BYTES OF 0111 1110
100 BYTES OF 0000 0000
100 BYTES OF 0111 1110
100 BYTES OF 0000 0000      (Test Pattern 2)
100 BYTES OF 0111 1110
100 BYTES OF 0000 0000
100 BYTES OF 0111 1110
100 BYTES OF 0000 0000
```

```
200 BYTES OF 0011 0010      (Test Pattern 3)
```

```
200 BYTES OF 0100 0000      (Test Pattern 4)
```



### 3.0 TEST SYSTEMS AND TEST SETS

#### 3.1 Hekimian Laboratories, Inc. (HLI) REACT System

The Hekimian Laboratories, Inc (HLI) REACT system will support the four (4) stress patterns. They are identified as Stress Pattern 1, Stress Pattern 2, Stress Pattern 3, Stress Pattern 4 and are in the same sequence as described in paragraph 2.1. HLI REACT does not support "Pattern 5". A Macro command for test patterns 1 - 4 may be available in the future.

#### 3.2 Switched Access Remote Test System (SARTS) RTS 5A

SARTS RTS 5A will not support the four (4) stress patterns. The D06 command allows for a user defined pattern but is restricted to 8 bits and will not support test patterns 1 and 2. Also, the D08 command does not provide for a time interval of measurement. SARTS RTS 5A will not support stress test pattern 5.

#### 3.3 Switched Access Remote Test System (SARTS) RMS-D

SARTS RMS-D will support the four (4) stress patterns. The D14 command (customer data option) is used to access the four (4) test patterns. The test patterns in the RMS-D are not in the same sequence as described in paragraph 2.1. SARTS RMS-D will not support stress test pattern 5.

RMS-D sequence of the stress test patterns in relationship to the test patterns defined in paragraph 2.1 are as follows:

<u>RMS-D</u>	<u>Stress Test Pattern paragraph 2.1</u>
Pattern 1 (Hex 32)	Test Pattern 3
Pattern 2 (Hex 40)	Test Pattern 4
Pattern 3 (Hex FF00)	Test Pattern 1
Pattern 4 (Hex 7E00)	Test Pattern 2
Pattern 5 - user defined, not applicable	to Test Pattern 5

#### 3.4 Telepath Industries Test Set

The TPI 95 will support the four (4) stress test patterns. The stress test patterns are identified using the Pattern Sensitivity Test option. The test patterns are in the same sequence as paragraph 2.1. The TPI 95 will not support stress test pattern 5.

#### 4.0 OPERATIONAL IMPACTS

Stress testing will be a new concept to most of the field technicians located in the AOCs. The actual testing time required for the installation and maintenance stress testing will increase over the conventional testing being performed today. It is important that the technicians understand the capabilities of their respective test sets and test systems. The technicians should understand the functions of the test set and test system and have the ability to interpret the information they provide.

The testing procedures described in Attachment I are to be used for initial provisioning (preservice and turn-up) and maintenance processes for DS0 level digital data services. Many of Ameritech's customers perform longer test durations which range from 2 hours to 24 hours and may also use additional test patterns. The AOCs should work cooperatively with our customers to resolve any trouble conditions.

## DSO Level Digital Testing Procedures for Provisioning and Maintenance

### 1.0 TESTING

This section provides test requirements for the provisioning and maintenance processes of digital data services. These requirements are in accordance with the national agreements made at the Network Operations Forum/ Digital Testing Workshop (NOF/DTW) between the Interexchange Carriers (IC) and the Local Exchange Carriers (LEC).

These test requirements should be used for all DSO level digital services which include OPTINET base rate, DDS and BDS (where applicable) and include bit rates 2.4 Kb/s, 4.8 Kb/s, 9.6 Kb/s, 19.2 Kb/s, 56 Kb/s and 64 Kb/s. These tests are in addition to the local loop tests (see Figures 1 -6) which include foreign voltage, insulation resistance, loop resistance, insertion loss, background noise and impulse noise.

Local loop test requirements for each bit rate are identified in Figures 1 through 6. AT&T practice 314-410-510 issue 5 July 1986 provides a detailed procedure for testing local loops. Local procedures will determine which local loop test should be performed.

The following test patterns should be used to perform initial provisioning and maintenance tests:

- 1) 2047
- 2) Test Pattern 1 (100 BYTES of 1111 1111 followed by 100 BYTES of 0000 0000) \*\*.
- 3) Test Pattern 2 (100 BYTES of 0111 1110 followed by 100 BYTES of 0000 0000) \*\*.
- 4) Test Pattern 3 (continuous series of 0010 0010) \*\*.
- 5) Test Pattern 4 (continuous series of 0100 0000) \*\*.

\*\* Test Patterns 1 through 4 must be used with a "latching loopback".

\*\* These tests are not valid for Secondary Channel. Secondary Channel testing should use the 2047 test pattern to a "latching loopback".

- 6) Test Pattern 5 (combination of test patterns 1 through 5. This is an optional test pattern that can be performed in lieu of test patterns 1 through 4.

Test Pattern 5 must be used with a "latching loopback".

When testing 64 Kb/s service the "latching loopback" must be used for all test patterns including the 2047 pattern.

## 2.0 PROVISIONING

### 2.1 End-To-End Office Testing

From a digital test access point, establish end-to-end office continuity using the 2047 test pattern to an Office Channel Unit (OCU) loopback. A 30 second test duration is recommended for continuity testing. Once end-to-end continuity has been established, perform the following tests using a "latching loopback".

Recommended Tests:

#### Step 1

Perform a one (1) minute test using the 2047 test pattern.

Requirement:

Zero (0) Errored Seconds (ES). If the requirement is not met, sectionalize the trouble and repair the facilities or equipment, then repeat step 1.

#### Step 2

Perform a one (1) minute test using Test Pattern 1 \*  
Perform a one (1) minute test using Test Pattern 2 \*  
Perform a one (1) minute test using Test Pattern 3 \*  
Perform a one (1) minute test using Test Pattern 4 \*

Requirement:

Zero (0) Errored Seconds (ES). If the requirement is not met, sectionalize the trouble and repair the facilities or equipment, then repeat step 2.

\* Must be used with a "latching loopback". Not a valid test pattern for Secondary Channel.

## 2.2 Central Office to Network Interface

From a digital test access point, establish Central Office to Network Interface (NI) continuity using the 2047 test pattern to a CSU/DSU loopback at the NI. A 30 second test is recommended for continuity testing. Once continuity has been established, perform the following tests. Use a "latching loopback" for step 2 tests.

### Recommended Tests:

#### Step 1

Perform one, 15 minute test using the 2047 test pattern.

#### Requirement:

Less than two (2) Errored Seconds (ES). If the requirement is met, proceed to step 2. If the requirement is not met, sectionalize the trouble and repair the facilities or equipment, then repeat step 1.

#### Step 2

Perform one, 3 minute test using Test Pattern 1 \*  
Perform one, 3 minute test using Test Pattern 2 \*  
Perform one, 3 minute test using Test Pattern 3 \*  
Perform one, 3 minute test using Test Pattern 4 \*

#### Requirement:

Less than two (2) accumulative Errored Seconds (ES). If the requirement is met, the circuit shall be considered acceptable and ready for turn-up to the customer. If the requirement is not met, sectionalize the trouble and repair the facilities or equipment, then repeat step 2.

\* Must be used with a "latching loopback". Not a valid test pattern for Secondary Channel.

2.3 Network Interface to Network Interface (where no CO access is available)

From the Network Interface (NI), establish continuity using the 2047 test pattern to a CSU/DSU loopback. A 30 second test is recommended for continuity testing. Once continuity has been established, perform the following tests. Use a "latching loopback" for step 2 tests.

Recommended Tests:

Step 1

Perform one, 15 minute test using the 2047 test pattern.

Requirement:

Less than two (2) Errored Seconds (ES). If the requirement is met, proceed to step 2. If the requirement is not met, sectionalize the trouble and repair the facilities or equipment, then repeat step 1.

Step 2

Perform one, 3 minute test using Test Pattern 1 \*  
Perform one, 3 minute test using Test Pattern 2 \*  
Perform one, 3 minute test using Test Pattern 3 \*  
Perform one, 3 minute test using Test Pattern 4 \*

Requirement:

Less than two (2) accumulative Errored Seconds (ES). If the requirement is met, the circuit shall be considered acceptable and ready for turn-up to the customer. If the requirement is not met, sectionalize the trouble and repair the facilities or equipment, then repeat step 2.

\* Must be used with a "latching loopback". Not a valid test pattern for Secondary Channel.

### 3.0 MAINTENANCE

Maintenance testing procedures will vary depending upon the type of trouble reported. The initial test pattern used for trouble isolation should be at the discretion of the tester. The customer should provide circuit failure information and which "test pattern" was used to identify the trouble condition. After the trouble has been isolated and repaired the following tests should be performed.

#### Step 1

Perform a one minute test using a 2047 pattern

Requirement:

Zero (0) Errored Seconds (ES). If the requirement is met, proceed to step 2. If the requirement is not met, sectionalize the trouble and repair the facilities or equipment, then repeat step 1.

#### Step 2

Perform a one minute test using Test Pattern 1 \*

Perform a one minute test using Test Pattern 2 \*

Perform a one minute test using Test Pattern 3 \*

Perform a one minute test using Test Pattern 4 \*

Requirement:

Zero (0) Errored Seconds (ES). If the requirement is met, the circuit shall be considered acceptable. If the requirement is not met, sectionalize the trouble and repair the facilities or equipment, then repeat step 2.

\* Must be used with a "latching loopback". Not a valid test pattern for Secondary Channel.



TABLE A

PROVISIONING TEST MATRIX

<u>TEST PATTERN</u>	<u>TEST DURATION</u>	<u>ERRORED SECOND (ES) LIMIT</u>
2047	15 Minutes	Less than 2 ES
Test Pattern 1	3 Minutes	
Test Pattern 2	3 Minutes	Less than 2 accumulative
Test Pattern 3	3 Minutes	ES
Test Pattern 4	3 Minutes	
Optional test in lieu of Test Patterns 1-4		
Test Pattern 5	10 Minutes	Less than 2 ES

MAINTENANCE TEST MATRIX

<u>TEST PATTERN</u>	<u>TEST DURATION</u>	<u>ERRORED SECOND (ES) LIMIT</u>
2047	1 Minute	0 ES
Test Pattern 1	1 Minute	0 ES
Test Pattern 2	1 Minute	0 ES
Test Pattern 3	1 Minute	0 ES
Test Pattern 4	1 Minute	0 ES
Optional test in lieu of Test Patterns 1-4		
Test Pattern 5	1 Minute	0 ES

## LOCAL LOOP TESTS FOR 2.4 Kb/s

### INSTALLATION TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than + 1 vdc or -1 vdc
Insulation Resistance	More than 300K ohms
Loop Resistance	Less than 4200 ohms
Insertion Loss @ 1.2 kHz	Less than or equals 34 db and equals EML +5 or -2.5
Insertion Loss @ 4.8 kHz	Less than or equals twice AML at 1.2 KHz
Background Noise	Maximum of 49 dbrn
Impulse Noise 7 or less counts	65 dbrn for 15 minutes with

### MAINTENANCE TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than 1 vdc (if DSU is powered and connected, requirement is less than 4 V ac)
Insulation Resistance	Greater than 120k ohms
Loop Plus Terminal Resistance	Less than 4200 ohms without terminal and repeater(s) resistance
Open Loop Capacitance *	Increases with cable length

\* Required only if "Loop Plus Terminal Resistance" test is greater than 200K ohms.

FIGURE 1

## LOCAL LOOP TESTS FOR 4.8 KB/S

### INSTALLATION TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than + 1 vdc or -1 vdc
Insulation Resistance	More than 300K ohms
Loop Resistance	Less than 4200 ohms
Insertion Loss @ 2.4 kHz	Less than or equals 34 db and equals EML +5 or -2.5
Insertion Loss @ 4.8 kHz	Less than or equals AML @ 2.4 kHz
Background Noise	Maximum of 46 dbrn
Impulse Noise 7 or less counts	62 dbrn for 15 minutes with

### MAINTENANCE TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than 1 vdc (if DSU is powered and connected, requirement is less than 4 V ac)
Insulation Resistance	Greater than 120k ohms
Loop Plus Terminal Resistance	Less than 4200 ohms without terminal and repeater(s) resistance
Open Loop Capacitance *	Increases with cable length

\* Required only if "Loop Plus Terminal Resistance" test is greater than 200K ohms.

FIGURE 2

## LOCAL LOOP TEST FOR 9.6 KB/S

### INSTALLATION TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than + 1 vdc or -1 vdc
Insulation Resistance	More than 300K ohms
Loop Resistance	Less than 4200 ohms
Insertion Loss @ 4.8 kHz	Less than or equals 34 db and equals EML +5 or -2.5
Background Noise	Maximum of 38 dbrn
Impulse Noise 7 or less counts	54 dbrn for 15 minutes with

### MAINTENANCE TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than 1 vdc (if DSU is powered and connected, requirement is less than 4 V ac)
Insulation Resistance	Greater than 120k ohms
Loop Plus Terminal Resistance	Less than 4200 ohms without terminal and repeater(s) resistance
Open Loop Capacitance *	Increases with cable length

\* Required only if "Loop Plus Terminal Resistance" test is greater than 200K ohms.

FIGURE 3

## LOCAL LOOP TEST FOR 19.2 Kb/s

### INSTALLATION TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than + 1 vdc or -1 vdc
Insulation Resistance	More than 300K ohms
Loop Resistance	Less than 4200 ohms
Insertion Loss @ 9.6 kHz	Less than or equals 34 db and equals EML +5 or -2.5
Background Noise	Maximum of 37 dbrn
Impulse Noise	53 dbrn for 15 minutes with 7 or less counts

### MAINTENANCE TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than 1 vdc (if DSU is powered and connected, requirement is less than 4 V ac)
Insulation Resistance	Greater than 120k ohms
Loop Plus Terminal Resistance	Less than 4200 ohms without terminal and repeater(s) resistance
Open Loop Capacitance *	Increases with cable length
* Required only if "Loop Plus Terminal Resistance" test is greater than 200K ohms.	

FIGURE 4

LOCAL LOOP TESTS FOR 56.0 Kb/s

INSTALLATION TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than + 1 vdc or -1 vdc
Insulation Resistance	More than 300K ohms
Loop Resistance	Less than 4200 ohms
Insertion Loss @ 28.0 kHz	Less than or equals 34 db and equals EML +5 or -2.5
Insertion Loss @ 82.0 kHz	Less than or equals AML at 28 kHz +20
Insertion Loss @ 48.0 kHz	AML equals the sum of the AML at 28.0 kHz plus the AML at 82.0 kHz divided by 2, +2.5 or -2.5
Background Noise	Maximum of 35 dbrn
Impulse Noise	51 dbrn for 15 minutes with 7 or less counts

MAINTENANCE TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than 1 vdc (if DSU is powered and connected, requirement is less than 4 V ac)
Insulation Resistance	Greater than 120k ohms
Loop Plus Terminal Resistance	Less than 4200 ohms without terminal and repeater(s) resistance
Open Loop Capacitance *	Increases with cable length
OCU Simplex Voltage (required for repeaters only)	-40v to -54v for -48 -10v to -29v for -24

\* Required only if "Loop Plus Terminal Resistance" test is greater than 200K ohms.

FIGURE 5

## LOCAL LOOP TESTS FOR 64.0 Kb/s

### INSTALLATION TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than + 1 vdc or -1 vdc
Insulation Resistance	More than 300K ohms
Loop Resistance	Less than 4200 ohms
Insertion Loss @ 36.0 kHz	Less than or equals 34 db and equals EML +5 or -2.5
Insertion Loss @ 82.0 kHz	Less than or equals AML at 36.0 kHz +20
Insertion Loss @ 48.0 kHz	AML equals the sum of the AML at 36.0 kHz plus the AML at 82.0 kHz divided by 2, +4.5 or -4.5
Background Noise	Maximum of 34 dbrn
Impulse Noise	50 dbrn for 15 minutes with 7 or less counts

### MAINTENANCE TESTS

<u>TEST</u>	<u>REQUIREMENT</u>
Foreign Voltage	Less than 1 vdc (if DSU is powered and connected, requirement is less than 4 V ac)
Insulation Resistance	Greater than 120k ohms
Loop Plus Terminal Resistance	Less than 4200 ohms without terminal and repeater(s) resistance
Open Loop Capacitance *	Increases with cable length

\* Required only if "Loop Plus Terminal Resistance" test is greater than 200K ohms.

FIGURE 6

## GLOSSARY

<u>ACRONYM</u>	<u>DESCRIPTION</u>
AC	Alternating Current
AML	Actual Measured Loss
AOC	Ameritech Operating Company
ASCII	American National Code for Information Interchange
AT&T	American Telephone & Telegraph
BDS	Basic Digital Service
CSU	Channel Service Unit
DB	Decibel
DBRN	Decibels Relative to Noise
DDS	Digital Data Service
DEC	Digital Equipment Corporation
DSU	Data Service Unit
DTW	Digital Testing Workshop
EBCDIC	Extended Binary Coded Decimal Interchange Code
EML	Estimated Measured Loss
ES	Errored Seconds
HDLC	High-level Data Link Control
HLI	Hekimian Laboratories, Inc.
IBM	International Business Machine
IC	Interexchange Carrier
K	Thousand
Kb/s	Kilobit per Second
kHz	KiloHertz
LEC	Local Exchange Carrier
NI	Network Interface
NOF	Network Operations Forum
OCU	Office Channel Unit
PRBS	Pseudo Random Bit Stream
RMS-D	Remote Measuring System - Digital
RTS	Remote Test System
SARTS	Switched Access Remote Test System
SDLC	Synchronous Data Link Control
SNA	System Network Architecture
SS7	Signaling System # 7
TPI	TelePath Industries
V	Volts
VDC	Volts Direct Current