DIGITAL DATA SYSTEM
PRIVATE LINE SERVICE
OVERALL MAINTENANCE

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1. GENERAL

1.01 This section provides information on the overall maintenance of the Digital Data System (DDS). General maintenance features and capabilities are emphasized here. Detailed information on testing procedures and on use of test equipment is given in other sections.

1.02 This section is reissued to include information on dataport channel units (DP), T1 line protection, the 921A data test set and KS-21899 data test system, and additional BSP references. Revision arrows are used to emphasize the more significant changes.

2. INTRODUCTION

A. Performance and Maintenance Objectives

2.01 The DDS has been designed with several performance and maintenance objectives, including quality, availability, and maintainability. The objective for efficiency of data channels is at least 99.5-percent error-free seconds (EFS) at 56 kb/s and better performance at the subrates (2.4, 4.8, and 9.6 kb/s). Availability of a station-to-station circuit should average at least 99.96 percent (that is, annual downtime should not exceed 0.04 percent). The design goal is to minimize interruptions exceeding 2 hours.

2.02 The more important maintenance objectives for service outages in the DDS network are a maximum of 20 minutes for long-haul facilities, 30 minutes for short-haul facilities, and 120 minutes for loop facilities. After a trouble has been reported to the appropriate serving test center, the cause should be isolated within 15 minutes to one of the stations or loops or to the DDS network.

B. Maintenance Features

2.03 The DDS maintenance plan contains several features to help achieve the performance and maintenance objectives. These are: (a) administrative maintenance centers which give customers in a certain geographical area one location for reporting troubles, (b) full-time, in-service performance monitoring and protection switching for most transmission facilities and multiplexer terminals, (c) alternate routing to restore failed circuits, (d) one-tester sectionalization of trouble through centralized test access to all circuits, (e) a unique system of network signaling and control codes, and (f) strategic test access using portable test equipment. A summary of the maintenance features for DDS multiplexing and terminal equipment is given in Table A.

C. Trouble Recognition

2.04 Trouble recognition can occur in different ways. The customer may be receiving errors, garbled data, or no data at all. In addition, transmission terminals and multiplexing equipment provide alarm indications at the offices in which they are located.

3. ADMINISTRATIVE MAINTENANCE CENTERS

A. Serving Test Center

3.01 The serving test center (STC) serves as a centralized maintenance location for the DDS. It is responsible for receiving trouble reports from the customer and for coordinating fault location and network restoration. All circuit and equipment location records are kept at the STCs, which are located at STC hub offices in metropolitan areas so that they can have access to many stations.

B. T-Carrier Restoration Control Center

3.02 The T-Carrier restoration control center (TRCC) provides centralized coordination of restoration activities for T-Carrier facilities in a metropolitan area. Its functions include the administration of maintenance lines used for restoration, the centralized analysis of failure reports from many offices, and the provision of centralized T-Carrier expertise. Use of the TRCC in metropolitan areas is necessary to meet the overall maintenance objectives of the DDS.

T-Carrier Administration System

3.03 The T-Carrier Administration System (TCAS) is an extension of the TRCC design that uses an automated E-type telemetry system to provide the central location with the up-to-date status of the T-Carrier network. Administrative activities are carried out at the TRCC; however, system failures are detected and analyzed automatically as they occur, thereby minimizing the outage time between the failure and the start of restoration activities.

C. Regional Operations Control Center

3.04 Restoration of failed radio facilities providing long-haul service for the DDS is coordinated by the regional operations control center (ROCC). Operation of the ROCC is independent of the DDS, but information on the status of the broadband network is often useful to maintenance centers involved directly with the DDS.

4. AUTOMATIC MONITORING AND PROTECTION SWITCHING

4.01 Performance monitoring is used at various points in the DDS to ensure that each piece

of equipment is performing at or above its required level of performance. If this threshold is not met, a switch to a spare is initiated. Usually the switch is automatic.

A. T1 Line Protection

4.02 ▶Protection for DDS local access is recommended when (1) the working line is longer than 15 miles or (2) the working line carries more than 20 stations. The 15 miles refers to actual route and not airline miles. The 20 stations refer to the total of all actual working stations (not forecasted) on interstate, intrastate, and official DDS services. The objective on systems is to defer the expense of protection until the station load is large enough to bear the expense.

4.03 Existing protection should be removed from all systems in the DDS network that do not meet the above protection criterion. Span lines reserved for protection of pending TRCC controlled systems up to 15-mile lengths should be released. Where the working and protection lines have different lengths, the longer line should be released unless it is better adapted for easy restoration.

4.04 Complete engineering information is provided in Sections 880-601-100, "Facility Engineering—DS-1 Signal Connections," and 880-602-102, "Network Engineering—Intradigital Serving Area Planning."

4.05 When T1 line protection is justified, it is provided on a 1-for-1 basis.◀ The working and protection lines are double fed at the transmitting terminal, and the decision to switch is made and executed only at the receiving terminal. Each direction of transmission is monitored independently.

4.06 The T1 line is monitored by the T1 automatic standby unit (T1ASU), using two detectors. One detects bipolar violations (BPVs), and the other recognizes the absence of a pulse in 16 or more time slots. A continuous output from either detector initiates a protection switch in 1 second when a line fails or when the BPV rate is greater than about one a second (1 error in 10^6 bits). The T1ASU is set to lock onto the protection line; it may be manually (preferred) or automatically reset.

B. 1A Radio Digital System Protection

4.07 The 1A radio digital terminal (1A-RDT) monitors its own performance internally. When a failure is detected, an office alarm is sounded to alert maintenance personnel. Service is restored by a manual switch to a spare terminal. ▶The radio routes employed in the 1A Radio Digital System (1A-RDS) use their normal protection switching arrangements in which the microwave channel may be automatically switched to an alternate radio facility.◀

C. T2 Line Protection

4.08 The T2 line protection arrangements generate a minor alarm when performance drops below 10^{-6} (one error in 10^6 bits). A switch to a spare line occurs when the performance drops below 10^{-3}.

D. Multiplexing Equipment Monitoring and Protection

4.09 All digital multiplexing equipment is monitored in such a way that errors generated by other parts of the DDS do not influence protection switching for the multiplexing equipment.

4.10 The T1 data multiplexer performance monitor (T1DM-PM) scans a maximum of 16 T1DMs, depending upon the bay arrangements. Both the input ports and the outputs of each T1DM (including the spares) are monitored. A switch to a spare is initiated if more than one out of three bytes are in error, if the T1DM sync detector is faulty, or if locally generated timing or outgoing framing synchronization is lost.

4.11 The T1WB4 data-voice multiplexer (T1WB4) or the T1WB5 data-voice multiplexer (T1WB5) operates either in conjunction with or independent of D-type channel banks. If the associated D bank fails, the T1WB4 or T1WB5 automatically switches to independent operation and transmits the D-bank alarm information to the other end. Both multiplexers automatically return to combined data-voice operation upon restoral of the failed D bank. The T1WB4 or T1WB5 has a built-in monitor and redundant common and timing circuitry. Port protection is not provided.

4.12 When T1WB4s and T1WB5s are chained, D banks are excluded. If both the regular and standby lines fail, the T1WB4s and T1WB5s preserve service at offices between the faulty link

and the hub office. Alarm indications are confined to the T1WB4 or T1WB5 that terminates the faulty link, thus preventing undesirable alarms in other offices in the chain.

4.13 The subrate data multiplexer performance monitor (SPM) scans a maximum of 48 subrate data multiplex (SRDM) terminals and automatically switches to the proper rate spare if a failure is detected. A switch is initiated if seven consecutive bytes are in error, if the SRDM incoming framing sync detector is faulty, or if the outgoing data stream contains incorrect framing. The 5-channel integral subrate multiplexer (ISMX) is not monitored and is not provided with a spare. The 10-channel ISMX is protected by internal redundancy.

4.14 Whenever a protection switch to spare multiplexing equipment is made, the office minor alarm system is activated. If the equipment is either a T1DM or an SRDM, the cause of failure is indicated by an alphanumeric display. If both the working and the spare multiplexing equipment fail, the office major alarm system is activated. Restoral of primary equipment that has been repaired is initiated manually except for the T1WB4 and T1WB5, which switch back to their primary circuitry automatically.

5. MAINTENANCE METHODS

5.01 All customer channels are brought to the STC for test access. ▶Either the KS-21899 data test system (DTS) or the 950A testboard and KS-20908/KS-20909 digital test sets◀ can be used to monitor the digital signal or to transmit coded test patterns useful for isolating failures and for verifying transmission quality. The customer bitstream may contain data originated by the customer terminal or control bytes useful for locating trouble conditions.

5.02 In the byte-organized portion of the DDS network, control codes are recognized by a 0 rather than a 1 in the eighth bit position of the byte. Figure 1 includes a listing of the DDS control codes. Examples of their use are: (1) when digital multiplexers detect out-of-frame conditions or disconnected ports, the appropriate code is forwarded on each affected channel; (2) when not sending customer data, a DSU sends an idle code; and (3) when no digital signal is detected from the loop, an office channel unit (OCU) ▶or OCU dataport (OCU DP)◀ generates the idle code toward the network.

5.03 Transmission terminals and multiplexing equipment provide alarm indications at the offices in which they are located. The appropriate arrangements for relaying DDS office alarms to the STC via E2 telemetry have been provided, since the information must be available to the STC for efficient fault isolation. No alarms are provided for the portion of the DDS from the customer to the OCU or OCU DP, including the 5-channel ISMX (with the exception of a power supply alarm in the OCU).

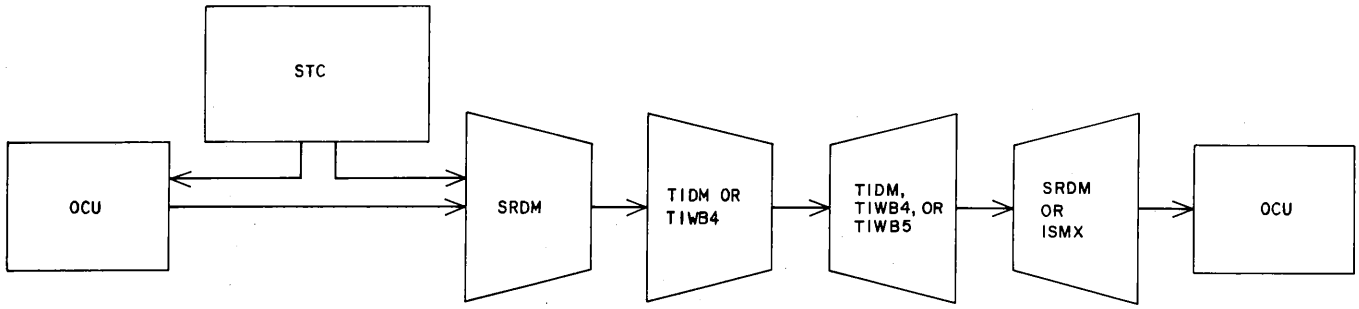
5.04 An analysis of information obtained from the customer trouble report, alarm indications, and monitoring tests suggests the sequence of loopback tests to be performed at the STC. Figure 2 shows the points at which a digital test signal can be automatically looped back toward the DDS testboard. Points A, B, and C represent the DSU, channel, and OCU or OCU DP loopback tests, respectively. In general, the loopback tests can be used to isolate the trouble to either the DSU, loop (OCU/OCU DP-to-DSU/CSU), or exchange network (STC-to-OCU/DS0 DP) segment of the DDS network. ▶The DS0 DP allows 64 kb/s, or DS0 rate, and is used for intraoffice bipolar nonreturn-to-zero signal format.◀ Detailed information on the loopback tests can be found in Section 314-901-300.

5.05 When loopback tests have isolated a trouble to the STC-to-OCU/OCU DP segment of a digital circuit, further test methods are required to determine which transmission facility, multiplexer terminal or channel unit, is at fault. Alarm indications locate most of these troubles, but troubles in OCUs, 5-channel ISMXs, T1WB4 or T1WB5 port circuitry, and office wiring are not indicated by alarms. The tests may require portable test equipment, using jack access at jack and connector panels or on the equipment between the OCU or OCU DP and the STC.

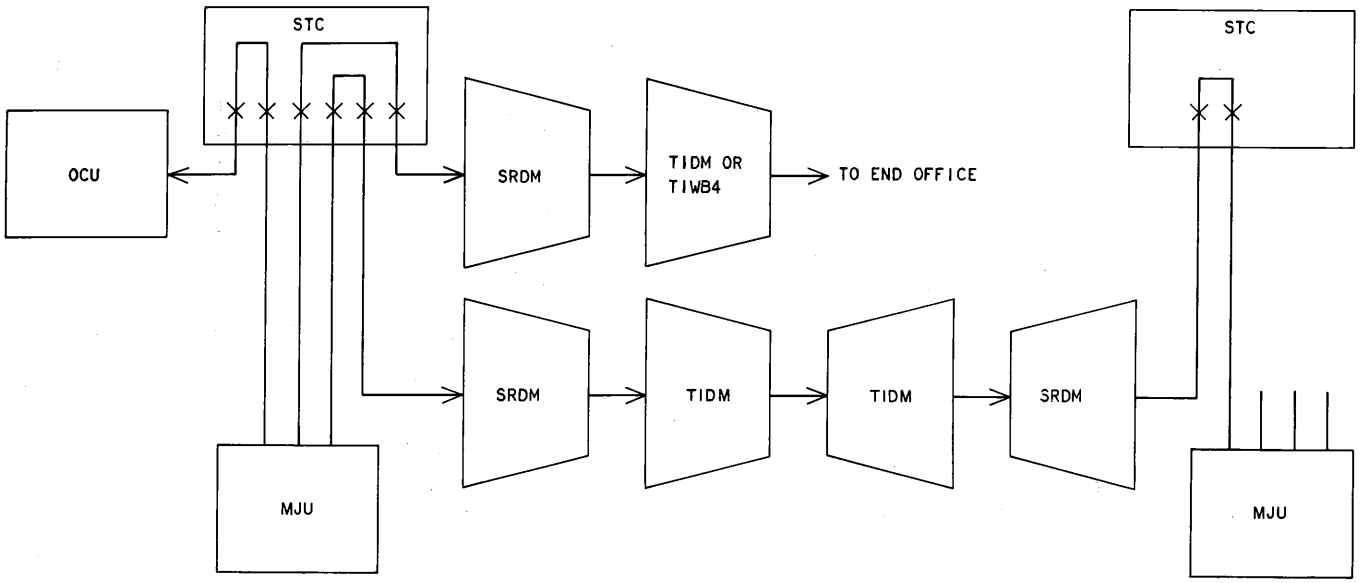
6. TEST EQUIPMENT

A. Centralized Equipment

6.01 The DDS testboard (950A), shown in Fig. 3A, is located at the STC hub offices and provides centralized access to all customer circuits in a digital serving area (DSA). (A DSA may eventually



A. 2-POINT ARRANGEMENT



B. MULTIPOINT ARRANGEMENT

CONDITION	SIGNAL FROM OCU TO SRDM OR ISMX	SIGNAL FROM SRDM OR ISMX TO T1DM, T1WB4, OR T1WB5	SIGNAL BETWEEN T1DMs, T1WB4s, OR T1WB5s	SIGNAL FROM T1DM, T1WB4, OR T1WB5 TO SRDM OR ISMX	SIGNAL FROM SRDM TO OCU
Idle Code	01111110*	S1111110	S1111110	S1111110	01111110
DSU Loopback	00101100‡	S0101100†	S0101100	S0101100	00101100
Channel Loopback	00101000‡	S0101000	S0101000	S0101000	00101000
OCU Loopback	00101010‡	S0101010	S0101010	S0101010	00101010
Multiplexer Out of Sync				00011010	00011010
Test Code	00011100‡	S0011100	S0011100	S0011100	00011100
Unassigned Multiplexer Channel			00011000	00011000	00011000
Test Alert (MJU)	01101100‡	S1101100	S1101100	S1101100	01101100§
MJU Alert	01110010	01110010	01110010	01110010	01110010

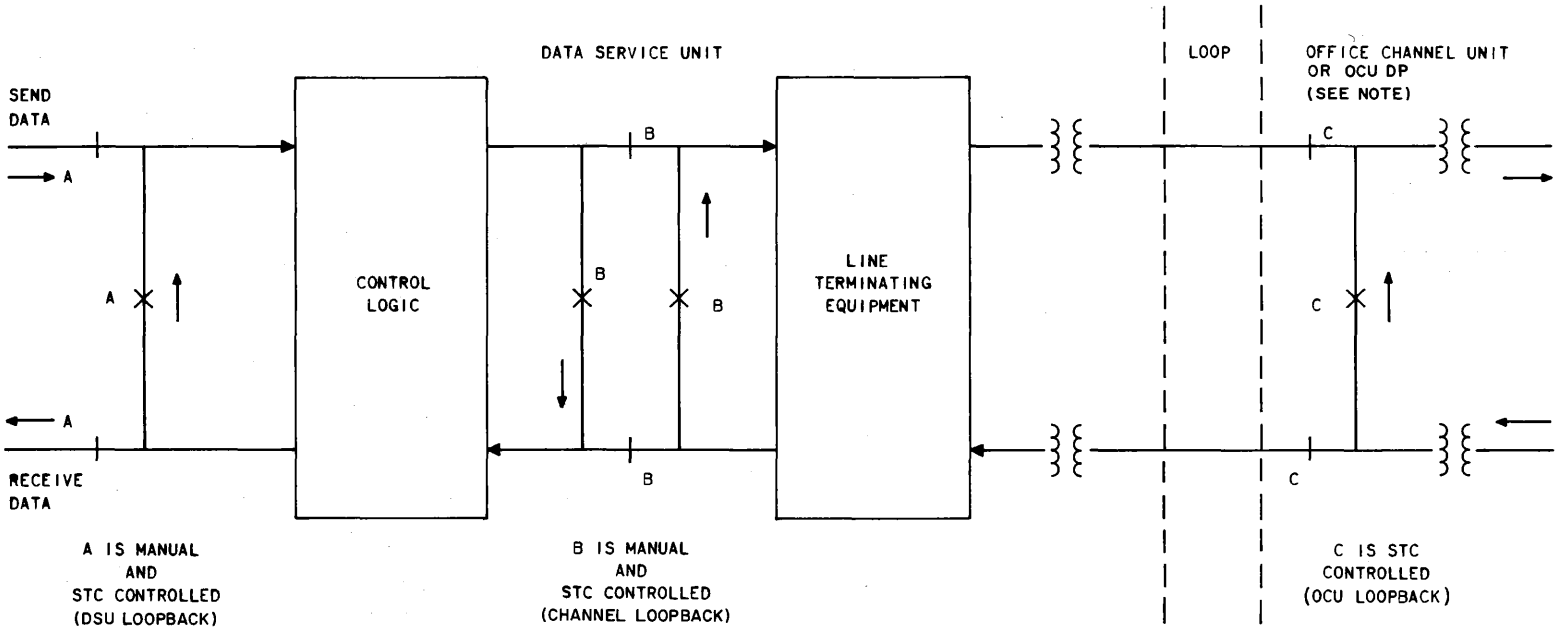
* For a 56-kb/s OCU in the idle mode, the first bit is a 1.

† The presence of an "S" bit indicates that an SRDM or ISMX is used; otherwise, S is a 0.

‡ This code is generated by an STC, not by an OCU.

§ The signal terminates at an MJU, not at an OCU.

Fig. 1—DDS Control Codes



NOTE:
LOOPBACK PORTION ONLY IS SHOWN.

Fig. 2—Loopback Tests

contain more than one STC.) Included in the testboard is a jack field accommodating a maximum of 450 circuits. The jack field is arranged in groups of six jacks each and provides transmit, receive, and monitor capability in both directions. As many as 12 telephone circuits, each having its own pickup key, can be provided to enable communication with DDS equipment bays, other testboards, installation/repair personnel in the field, and customers. Two supplemental jack bays are available. One version (Fig. 3B) contains 15 jack panels and a writing shelf. A second version (Fig. 3C) contains 26 jack panels. Both versions must be located adjacent to fully equipped testboards. The capabilities of the test equipment contained in the 950A testboard are summarized in paragraphs 6.02 through 6.05.

6.02 The digital receiver (KS-20908 data test set) is used to monitor signals and to detect errors. It operates at the 64-kb/s office level and accepts bipolar signals. Light-emitting diodes indicate the received byte pattern and the presence of any of the seven DDS control codes. The receiver can generate 511- and 2047-bit test words for comparison with a received signal.

6.03 The digital transmitter (KS-20909 data test set) is used to generate test signals and the seven DDS control codes for loopback and straightaway (for example, STC-to-customer station) tests. A 2047-bit test word is used for loopback tests, and a 511-bit test word can also be generated for tests.

6.04 The control and test code generator can supply seven control codes at four outputs. It also provides a special (one of the seven) test code, 00011100, at six outputs continuously. This special code has a strong 4-kHz tone in bipolar format that can be heard through earphones. The generator frees the digital transmitter for other duties during prolonged testing.

6.05 The multipoint signaling unit (MSU) is used in conjunction with the digital transmitter and receiver to test various segments of a digital multipoint circuit. When a release of the entire multipoint circuit is obtained, a test connection to any selected remote station can be established from the STC serving the control station.

B. Portable Equipment

6.06 Portable test equipment is required for use not only in hub and local offices but also on customer premises. This equipment includes the digital receiver and digital transmitter described in paragraphs 6.02 and 6.03 and the equipment described in paragraphs 6.07 and 6.08.

6.07 ▶Several portable data test sets are available◀ for use in the DDS. The 914B data test set generates a 511-bit, quasi-random test word for tests at data rates of 2.4, 4.8, and 9.6 kb/s. Error tests can be made at the customer location having a DSU, using the transmitting and receiving sections of the test set. The 914C data test set performs the same functions as the 914B but in the duplex mode (transmitting and receiving simultaneously). The 912A data test set generates a 2047-bit, quasi-random test word for tests at the 56-kb/s data rate. Test use of the 912A data test set for the DDS is similar to that of the 914B. An adapter cable is required to permit the 912A data test set to mate with the DSU. ▶The 921A data test set provides serial testing capability for data sets, data service units, and channel service units.◀

6.08 The KS-20775 error rate test set is used for testing DS-1 channels at the DSX-1. It generates or receives a 1,048,575-bit, quasi-random test word at the 1.544-Mb/s rate in the bipolar format. End-to-end tests may be made through either the long- or short-haul facilities in a metropolitan area.

7. MAINTENANCE ACCESS ARRANGEMENTS

A. Hub Offices

7.01 A hub office, which contains an STC, offers centralized test access at the 950A testboard ▶or KS-21899 DTS◀ and access for portable test equipment at the transmission and multiplexer terminals.

7.02 The 950A testboard is wired to the DSX-0A, where all single-customer circuits for which the STC has maintenance responsibility are made available. At the cross-connect, the customer signals are at the 64-kb/s rate. Access points 1, 2, and 5 in Fig. 4 indicate appearances at the testboard of circuits whose loops terminate at the STC office. Circuits having loops terminating in local offices appear at the hub for testing at the testboard, as

indicated by access points 3 and 4. Circuits appearing at a hub for long-haul routing only do not have appearances at the testboard.

7.03 ▶The KS-21899 DTSs primary application is as a testing device with access to either the DS-1 (1.544-Mb/s) signal or the DS-0A (64 kb/s) signal. The KS-21899 DTS may operate under manual control or by an external controller (user-supplied). Signal access at the DS-1 level is via a DS-1 signal access unit (DSAU) and at the DS-0 level is via the DS-0 interface. Testing of DS-0A signals consists of examining data at various points on a customer channel for errors or control codes or inserting test signals on a customer channel and retrieving those signals for comparison. The DSAU is plugged into a shelf assembly between the second stage multiplexer (T1DM, T1WB4, or T1WB5) and the DS-1 cross-connect (DSX-1).◀

7.04 Centralized test access is provided for testing multipoint circuits. Multipoint junction units (MJUs) are located only at STC hub offices; therefore, the main and branch ports of an MJU are accessed by the splitting jacks mounted on the 950A testboard.

7.05 Other test access at the hub office is available at bridging bipolar access points on transmission and terminal equipment. The T1DM, T1WB4, T1WB5, MJU, and SRDM have input and output test points on each of their 64-kb/s ports. Test access at the office side of the OCU is also available. When the 64-kb/s stream contains more than one customer, the digital receiver can isolate the desired single-customer signal. A special jack-equipped extender board gives access at the OCU to the local loop for performing analog-type tests, and the DSX-1 provides monitoring and splitting test access to DS-1 channels used in the DDS. ▶The dataport channel units have splitting jack access for use in unusual cases of trouble, plus loopback via manual insertion of a loopback test plug. Loopback of the OCU occurs using the normal OCU LOOPBACK TEST pattern from the data test sets.◀

7.06 Although a collection hub has no STC responsibility, it is provided with the same test access points as an STC hub office.

B. Local Offices

7.07 Portable test equipment is used for all digital testing at local offices. As at the hub office, monitor test points at the DS-0 signal level are available at the multiplexers and channel units. In addition, splitting (transmit and receive) and bridging (monitor only) jacks are provided at the 64-kb/s level in every signal path at the multiplexer jack and connector panels (M-JCP and SM-JCP). The ISMX connects at logic level with the OCU and provides splitting and bridging jack access to each customer circuit at logic level.

7.08 ▶The M-JCP and SM-JCP are used in local offices with T1DMs and T1WB4s. Very large local offices use the digital system cross-connect (DSX-0). T1WB5 offices use quad terminal panels (QTPs). The QTP is one DSX-0 panel and provides routing of 64 kb/s DS-0 level signals to the ports of a T1WB5. The QTP allows for T1WB5 port assignment but does not provide monitoring or test access.◀

8. MAINTENANCE TESTING

A. Service Verification

8.01 Normal service verification after repair consists of an STC-coordinated, point-to-point transmission of data. For initial DDS service, central office equipment is installed and tested by WECo Installation. The appropriate steps for providing the customer with DDS service are found in Section 314-901-200.

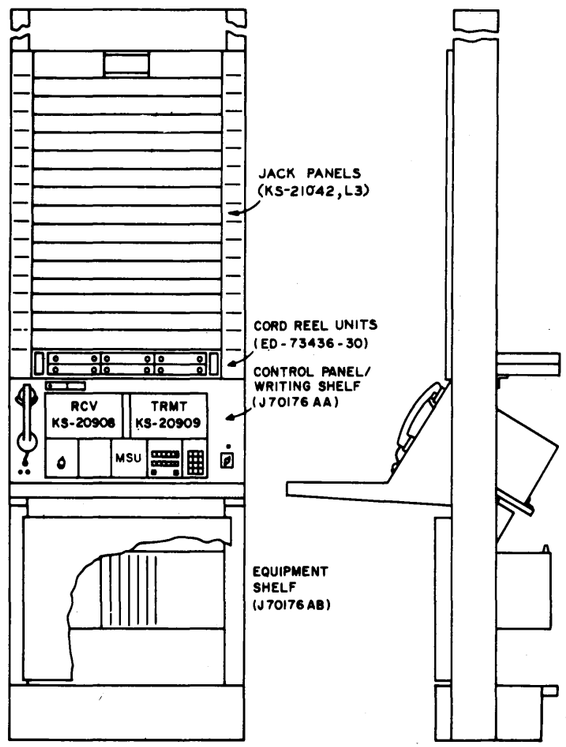
B. Routine Tests

8.02 The normal routine test procedures associated with analog transmission systems are not recommended for the DDS. Rapid means of fault detection and location ensure that service objectives are met.

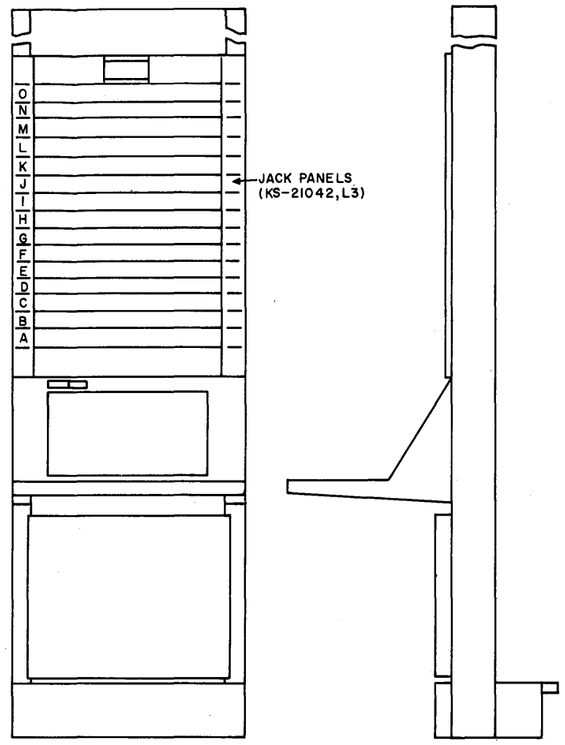
C. Trouble Isolation

8.03 The first step in trouble isolation is a careful analysis of trouble report information. Trouble reports may originate from the customer, from system alarms, or from operating company communications.

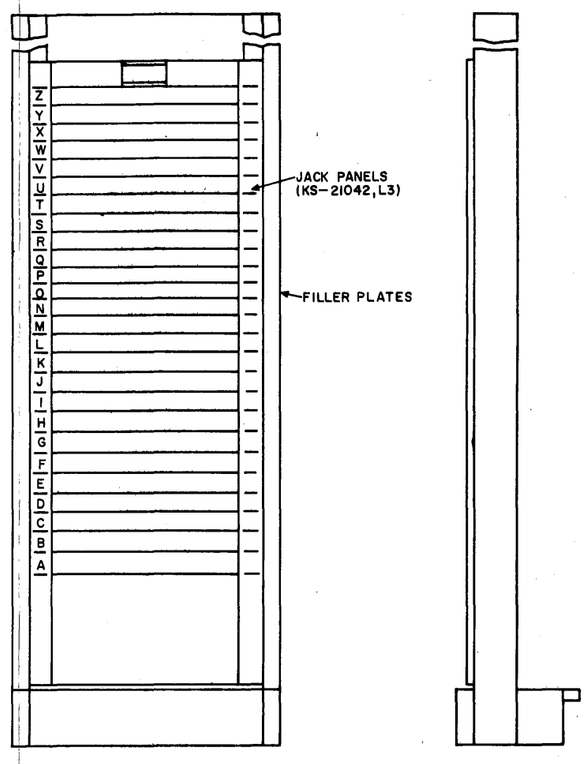
8.04 An example of the DDS philosophy of trouble isolation is given in Fig. 5. More detailed



A. 950A TESTBOARD



B. 15-PANEL SUPPLEMENTAL JACK BAY
(WITH WRITING SHELF BUT
NO TEST EQUIPMENT)



C. 26-PANEL SUPPLEMENTAL JACK BAY
(NO TEST EQUIPMENT OR WRITING SHELF)

Fig. 3—950A Testboard and Supplemental Jack Bay Arrangements

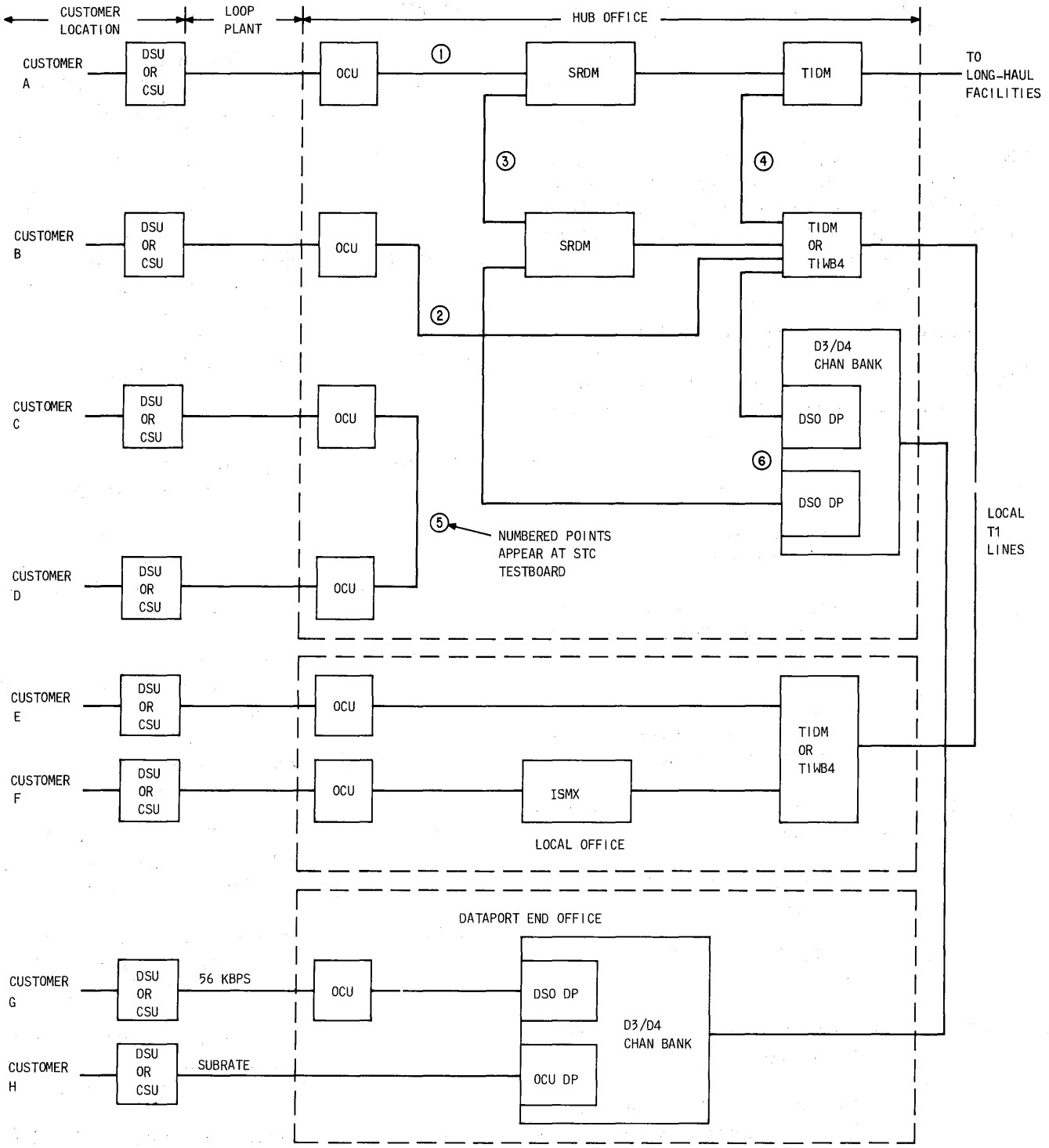


Fig. 4—STC Access Points

trouble-locating procedures are given in Section 314-901-300.

D. End-to-End Testing

8.05 Normal testing procedures will reveal most troubles. In the unusual event that customer satisfaction cannot be achieved, ▶DATEC or Engineering help should be obtained through normal lines of organization.◀

E. Equipment and Line Maintenance References

8.06 The following sections provide detailed maintenance and trouble-locating information for the various parts of the DDS.

SECTION	TITLE
107-402-100	▶921A Data Test Set—Description and Operation◀
107-600-100	Digital Data System—KS-20909 Data Test Set (Transmitter)—Description and Operation
107-601-100	Digital Data System—KS-20908 Data Test Set (Receiver)—Description and Operation
107-605-100	▶KS-21899 Data Test System—Description
107-605-200	KS-21899 Data Test System—Installation
107-605-300	KS-21899 Data Test System—Operation
107-605-500	KS-21899 Data Test System—Maintenance◀
314-410-310	Digital Data System—Private Line Local Channel—Maintenance Procedures
314-901-300	Digital Data System—Two-Point Private Line Circuit—Maintenance Procedures
314-903-300	Digital Data System—DS-1 Maintenance Plan
314-910-300	Digital Data System—Office Channel Unit and Auxiliary Circuits—Maintenance Procedures
314-911-300	Digital Data System—Subrate Data Multiplexer—Maintenance and Trouble Location Procedures
314-912-300	Digital Data System—T1 Data Multiplexer—Maintenance and Troubleshooting
314-913-300	Digital Data System—Master Timing Supply—Maintenance and Troubleshooting
314-913-310	Digital Data System—Nodal Timing Supply—Maintenance and Troubleshooting
314-913-315	Digital Data System—Secondary Timing Supply—Maintenance and Troubleshooting
314-913-320	Digital Data System—Local Timing Supply—Maintenance and Troubleshooting
314-914-300	Digital Data System—DSX-0 Cross-Connect—Maintenance
314-915-300	Digital Data System—T1WB4 Data-Voice Multiplexer—Initial Installation and Tests
314-915-310	Digital Data System—T1WB5 Data-Voice Multiplexer—Initial Installation and Tests
314-916-300	Digital Data System—Bay Clock, Power, and Alarms Circuit—Maintenance and Troubleshooting
314-917-300	Digital Data System—Multipoint Junction Unit and Auxiliary Circuits—Maintenance and Troubleshooting Procedures
314-960-300	▶Digital Data System—DS-1 Signal Access Unit and Auxiliary Circuits—Maintenance and Trouble-Locating Procedures◀

SECTION	TITLE
314-983-300	Digital Data System—T1 Data Multiplexer Performance Monitor—Maintenance and Trouble-shooting
314-983-310	Digital Data System—Subrate Data Multiplexer Performance Monitor—Maintenance and Trouble-shooting
356-454-500	Digital Transmission Terminals for Analog Facilities—1A Radio Digital System (1A-RDS)—General Test Information
365-150-107	D3 Channel Bank Dataport Operation—Description, Installation, and Tests—D3 Channel Bank—Digital Transmission Systems
365-200-504	Digital Transmission Systems—T1 Automatic Standby Unit—Trouble Location and Maintenance
595-100-300	Digital Data System—550-A Type Channel Service Unit—Maintenance
595-200-300	Digital Data System—500-A Type Data Service Unit—Maintenance
666-600-100	Digital Data System—950A Testboard (J70176A and B)—Description and Operation
666-600-300	Digital Data System—950A Testboard (J70176A and B)—Maintenance Procedures

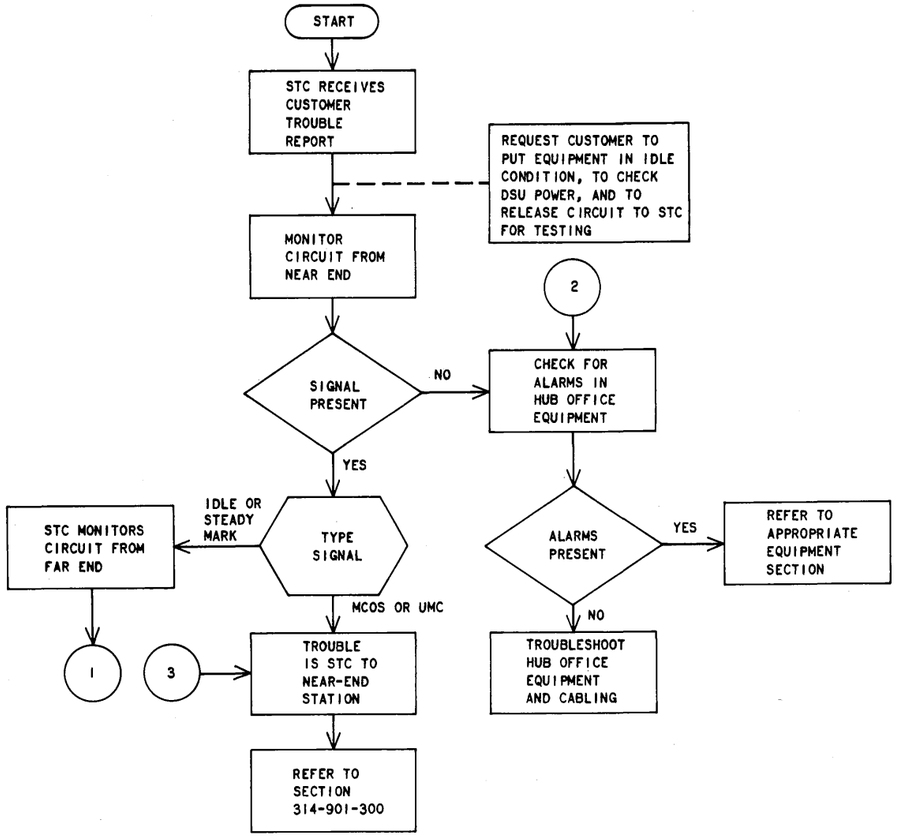
8.06 Detailed maintenance and trouble-locating information on the microwave radio equipment used in DDS transmission is given in the appropriate sections in the 410 (TD2) and 411 (TD3) divisions.

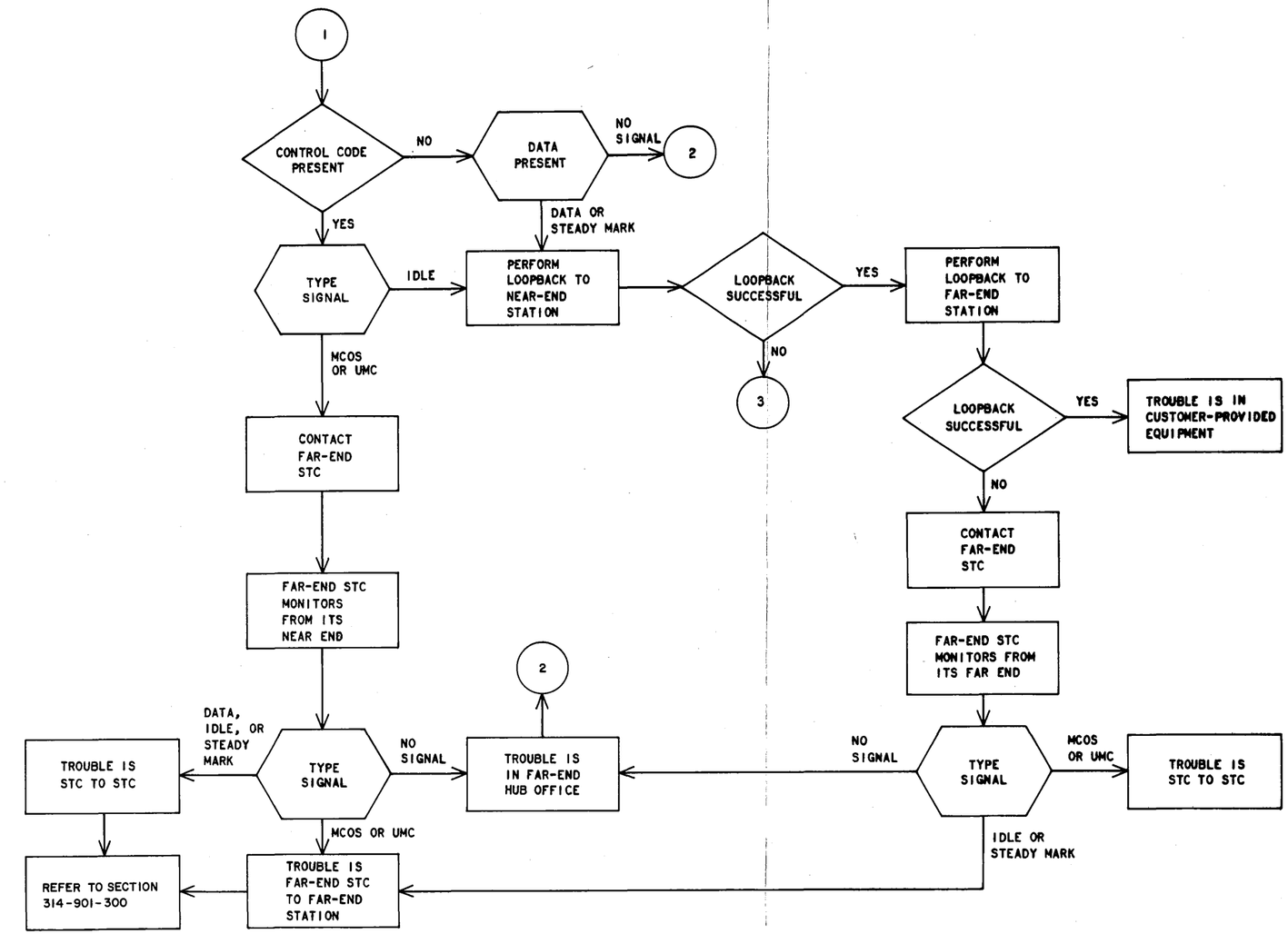
9. SERVICE RESTORATION

9.01 The primary defense against service outage in the DDS is automatic protection systems. These systems may fail to provide adequate protection if the protection channel is not available or has itself failed, if the performance monitor has malfunctioned, or if the performance of the facility has deteriorated gradually. When system alarms or customer reports indicate any of these conditions, the second line of defense is restoration of service by patching or switching in alternate facilities.

9.02 Restoration of DDS circuits on TD or TH radio routes is performed using current administrative procedures set up by the ROCCs.

9.03 Restoration of DDS circuits involving T1 Carrier is also performed using current methods. To meet DDS service objectives, a TRCC must be established to coordinate restoration activity.





MCOS - MUX OUT OF SYNC CODE, 00011010
UMC - UNASSIGNED MUX CHANNEL CODE, 00011000
IDLE - IDLE CODE, X1111110
STEADY MARK - CODE, X1111111

X = 1 FOR SUBRATE,
0 FOR 56 KB/S

Fig. 5—DDS General Trouble-Locating Procedure

→TABLE A←

COMPARISON OF DDS EQUIPMENT MAINTENANCE FEATURES

FEATURE	T1DM	T1WB4 OR T1WB5	MJU	SRDM	ISMX	OCU OR DP	DSU	CSU	DSAU
Protection	(a) T1DM-PM self-checking (b) All T1DM circuits (includes per channel circuitry) (c) Manual return	(a) Integrated monitoring (b) Common circuits (ports not protected) (c) Automatic return	None	(a) SPM partial self-checking (b) All SRDM circuits (includes per channel circuitry) (c) Manual return	(a) 5-channel: None (b) 10-channel: Redundancy	None	None	None	Switches to bypass mode
Network Signaling	(a) Out of sync (b) Unassigned channel	(a) Out of sync (b) Unassigned channel (c) Coded bytes in voice slots to D-type bank†	Identifies hub office and branch in response to MSU command‡	None	None	(a) OCU or DP to station: Reverses simplex current for channel loopback test and generates bipolar format violations for zero suppression, idle, out of service, and DSU loopback § (b) OCU or DP to multiplexer: Idle	(a) Idle (b) Zero suppression**	None	Extracts timing for proper signal regeneration
Alarms	(a) T1DM-PM controlled (b) Single failure: Minor (c) Multiple failure: Major	(a) Single failure: Minor (b) Multiple failure: Major	Timing and power	(a) SPM controlled (b) Single failure: Minor (c) Multiple failure: Major	(a) 5-channel: None (b) 10-channel: Alarmed	None ¶	None	None	Signal or power failure: Minor
Lamp Indications	(a) T1DM-PM controlled (b) Alphanumeric indication of common circuits, ports, or transmission failures	(a) No input from voice bank (b) T1WB4 or T1WB5 failure (c) Spare T1WB4 or T1WB5 failure (d) Transmission failure (e) Timing supply failure (f) Power failure	Timing and power failures	(a) SPM controlled (b) Alphanumeric indication of common circuits, ports, or transmission failures	Loss of framing	None ¶	(a) Power (b) Remote Test A (c) Local and Remote Test B (d) Loss of signal	(a) Power (b) Remote Test B	Bypass mode indicated
Test Access	Monitor only*: DS-1, DS-0	Monitor only*: DS-1, DS-0	Monitor Only*	Monitor only*: Single and multiple ports	(a) Test (insertion) ISMX-OCU interface (logic level signal) (b) Monitor only*: Single port of ISMX	OCU: DS-0 (a) Monitor only* (b) Dataport: Split jack access (c) Loop pair access via jack-equipped plug-in board	None	None	Use KS-21899 Data Test System
Protection Switching Criteria	(a) More than one out of three bytes in error (b) Loss of synchronization (c) Outgoing framing (d) Loss of local timing	(a) Loss of synchronization (b) Local timing (c) Outgoing framing	None	(a) Seven consecutive bytes in error (b) Loss of synchronization (c) Outgoing framing	None	None	None	None	None

*Splitting access is available at STCs and JCPs.
†If an improper signal is received from the associated D bank, a code is inserted in the voice slots to provide alarm information to the far-end D bank.
‡The MJU message sent to the MSU consists of both control and data bytes.
§ Simplex current reversal causes channel loopback. Zero suppression, idle, and out-of-service codes (represented by bipolar violation sequences on a loop) are decoded by the DSU.
¶T-Carrier system alarms and lamps for DATAPORT, on 24 or 48 channel basis.
**Long zero sequences and idle conditions cause the DSU to send bipolar violation codes on the loop which are translated by the OCU or DP.