DS-1 FACILITY

MAINTENANCE ACTIVITIES

DIGITAL DATA SYSTEM

1. GENERAL

1.01 ◆This section describes the maintenance activities for the DS-1 (1.544-Mb/s) facility of the Digital Data System (DDS). A DS-1 facility, as defined for DDS use, consists of two digital cross-connects (DSX-1) connected by a 1.544-Mb/s digital transmission line. Several DS-1 facilities may be connected in tandem to form a long-haul facility between digital serving areas (DSA). This section emphasizes the data under voice (DUV) and the T1 digital line (T1) since these are currently the primary facilities used in DDS.◆

1.02 This section is reissued for the following reasons:

(a) Add information about the Digital Transmission Surveillance System (DTSS)

(b) Add information about the DS-1 level signal access units (DSAUs), Automated Bit Access Test System (ABATS), and Bit Access Test System (BATS) which is also known as KS-21899 Data Test System

(c) Update terminology from serving test center (STC) or serving bureau (SVB) to centralized test center (CTC) or DDS hub office

(d) Update references in Part 4

(e) Update terminology in office environment to include Facility Management Administration Center (FMAC) for AT&T Interexchange (ATTIX) or for Bell Operating Companies (BOC)

(f) To add information on other approved short-haul (Table A) and long-haul (Table B) facilities for use in DATAPHONE® Digital Service

(g) To add information on a typical Intercity Digital Facilities Network (IDFN).

Revision arrows are used to emphasize the more significant changes.

1.03 The overall maintenance ◆quality of DATAPHONE Digital Service is stated at the 56-kb/s rate. For convenience, service requirements specified at the 56-kb/s rate are equated to the 64-kb/s rate (DS-0 level). Because DDS multiplexing equipment is not always available at facility terminals for the DS-0 level, the DS-1 level is used to provide performance criteria and evaluations. In cases where the acceptance criteria for the DS-1 level is met but the DS-0 level is exceeded, the DS-0 level is the controlling criteria.

1.04 Since DATAPHONE Digital Service comprises a small portion of the service provided by different transmission systems (short- and long-haul facilities), special maintenance arrangements cannot be adapted for DATAPHONE Digital Service. Thus, maintenance planning for DS-1 channels must
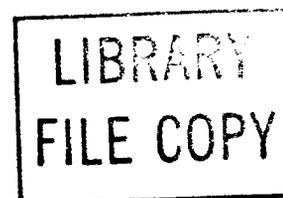
be fitted into present and planned maintenance arrangements for short- and long-haul facilities.

2. SYSTEM FACILITY AND OFFICE ENVIRONMENT

2.01 Short-haul DS-1 facilities within a DSA are provided primarily via T1 lines. Other short-haul facilities approved for use are listed in Table A. Long-haul routes will correspond initially to broadband radio routes. Other long-haul facilities approved for use are listed in Table B. As service expands, higher level channels will be handled by other facilities, such as L carrier and T2 lines.

2.02 The short- and long-haul facilities terminate in offices. The maintenance responsibilities of these offices are documented in Section 660-230-100.◀ Fig. 1 shows a diagram of a segment of a typical por-

▶TABLE A◀

SHORT-HAUL FACILITIES

TYPE OF FACILITY	DDS MILEAGE	PERCENT OF 56-KB/S ERROR FREE SECONDS	PERCENT OF DS-1 ERROR FREE SECONDS	PERCENT OF ERROR SECONDS PROPRATED BY MILEAGE	BELL SYSTEM PRACTICE
T1 Digital Line	50	99.975	99.73	No	365-200-300 365-228-500
T1C Digital Line	50	99.975	99.73	No	365-271-000
T1D Digital Line	50	99.975	99.73	No	365-272-000
T1/OS Outstate Digital Line	100	99.975	99.73	No	365-224-600
T2 Digital Line	250	99.975	*	No	365-500-501
T4M Digital Line	250	99.975	*	No	365-550-100
6-GHz Microwave Radio	125	99.975	99.81	Yes	421-200-135
11-GHz Microwave Radio	125	99.975	99.81	Yes	421-200-135

* Not available

◆TABLE B◆

LONG-HAUL FACILITIES

TYPE OF FACILITY	DDS MILEAGE	PERCENT OF 56-KB/S ERROR FREE SECONDS	PERCENT OF DS-1 ERROR FREE SECONDS	PERCENT OF ERROR SECONDS PROPRATED BY MILEAGE	BELL SYSTEM PRACTICE
Data Under Voice (DUV)	4000	99.75	99	Almost	356-454-510
Vidar 20 Mb/s	4000	99.75	*	Yes	356-456-300LL
Data Over Voice (DOV)	4000	99.75	*	Yes	—
Data on Master-Groups (DMG-1)	4000	99.75	*	Yes	356-460-000
Lightwave Digital Line (FT3)	4000	99.75	*	Yes	356-560-100
Microwave Radio 45 Mb/s	4000	99.75	*	Yes	422-501-100
Composite Digroup Facility	No Restriction	99.7 (260 ES)	Never exceed 260 error seconds	Sum of error seconds of each facility	314-903-200

* Not available

tion of the DDS network. Also shown are the maintenance responsibilities which are divided into seven distinct areas of activity. However, several of these functions might be combined and handled by a single administrative organization. These areas and their responsibilities are defined as follows:

(a) *Centralized Test Center:* The CTC is organized and equipped to provide rapid response to customer troubles in DATAPHONE Digital Service. It must:

(1) Receive trouble reports from the customer

(2) Advise the customer of status and outages of the DS-0 channels

(3) Perform isolation (loopback) tests and/or make tests with the customer or plant forces on local data facilities

(4) Coordinate the sectionalization of DS-0 and customer channel outages

(5) Coordinate the repair of local data facilities.
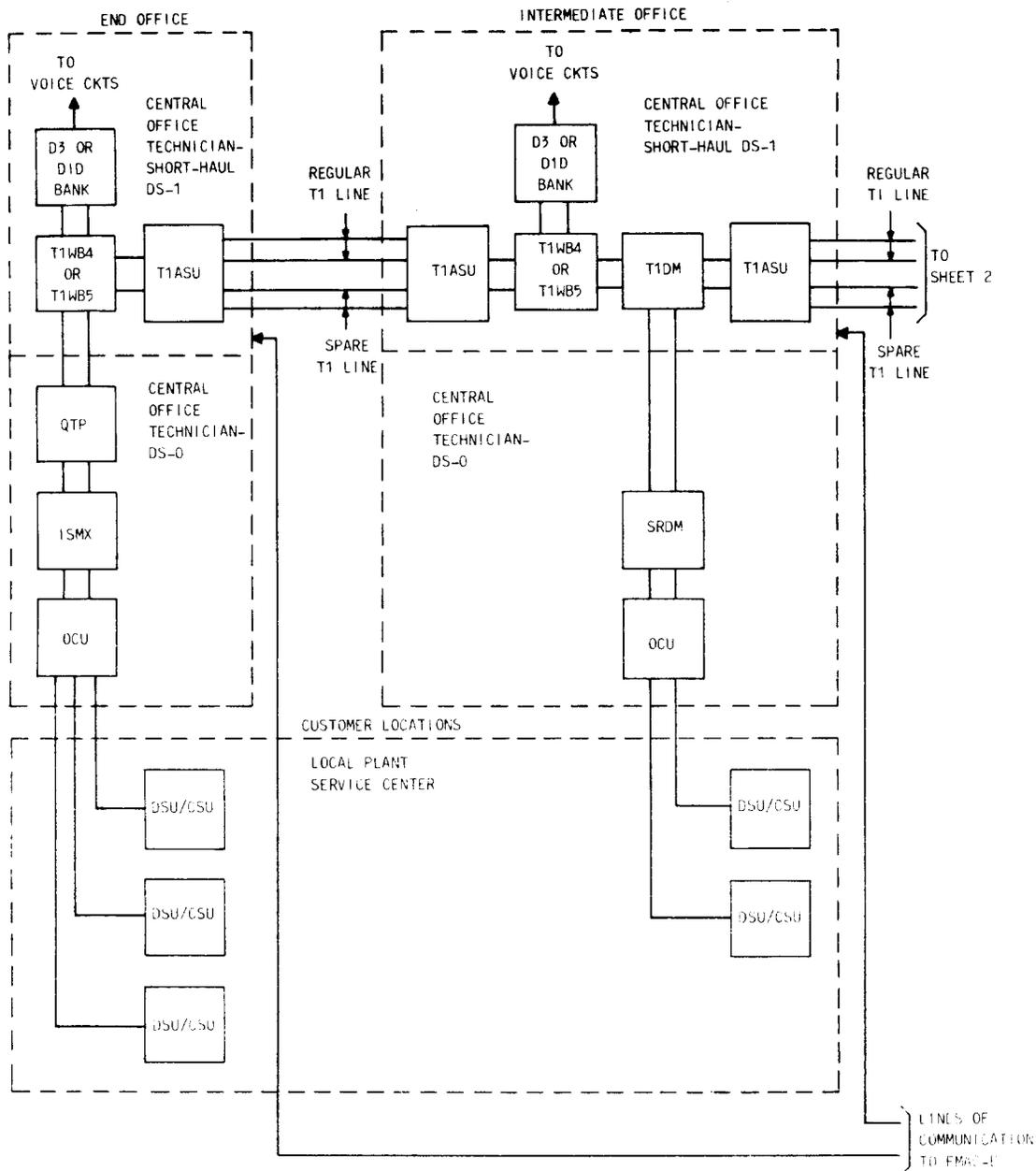
Fig. 1 — ♦Typical Area Maintenance Responsibilities and Equipment for DDS (Sheet 1 of 2)♦

(b) *Local Plant Service Center:* This organization is responsible for installing and repairing the local loops and station equipment on the DDS under direction of the responsible DDS hub office.

(c) *Central Office Technicians:* These technicians have three distinct areas of responsibility in the DDS—the terminal office, the short-haul exchange area, and the long-haul toll area. ♦The terminal office may be an end, intermediate, or hub office.

(1) Terminal Office—DS-0 Level:

● Test and repair under the direction of the hub office all integral subrate multiplexer
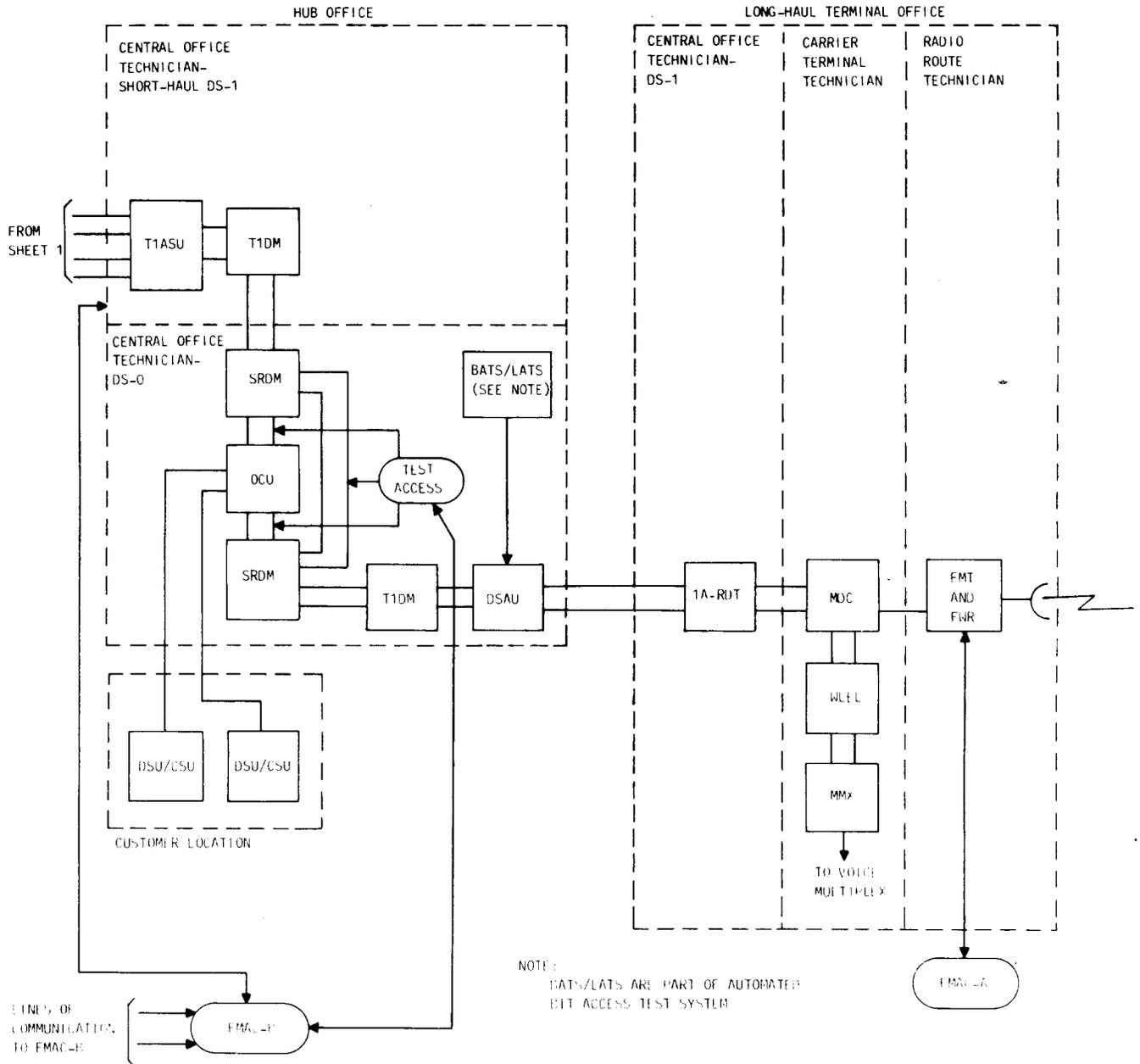
Fig. 1 —Typical Area Maintenance Responsibilities and Equipment for DDS (Sheet 2 of 2)

(ISMX) or subrate data multiplexer (SRDM) and office channel unit (OCU) or OCU dataport channel unit (OCU DP) equipment on DDS service

● Perform tests at the quad terminal panel (QTP) or the jack and connector panel (JCP)

as directed by the responsible hub office to sectionalize DS-0 facility failures between the ISMX and the associated second stage multiplexer, such as a T1 data multiplexer (T1DM)

- Test local loops from the OCU or OCU DP location, ♦or Line Access Test System (LATS I) equipment.♦

(2) Short-Haul Exchange Area—DS-1 Level:

- Respond to alarms on the DS-1 level equipment, such as the T1DM

- Sectionalize and repair failures of the DS-1 level equipment and report the status of the equipment to the facility control office (FCO)

- Report T1 line outages to the FCO, such as an FMAC, and follow directions on service restoration.

(3) Long-Haul Toll Area—DS-1 Level:

- Respond to alarms on the toll DS-1 equipment, such as the T1DM and the 1A radio digital terminal (1A-RDT) ♦or baseband digital modem (BDM) for cable

- Notify appropriate regional FMAC-ATTIX (FMAC-A) of all failures or service impairments incoming at the T1DM or modems.♦

(d) *Carrier Terminal Technicians:* These technicians are responsible for maintaining the voice multiplex equipment, the wire-line entrance link (WLEL), the message-data combiner (MDC), the 1A-RDTs or BDMs, and the digroup connector (DGC) in accordance with Bell System Practices. ♦An office containing this equipment is normally referred to as a technology office since different carrier technologies terminate or pass through the office.

(e) *Radio Route Technicians:* These technicians are responsible for maintaining the radio equipment in accordance with Bell System Practices. They must also report all radio failures to the regional FMAC-A as specified by present procedures.

(f) *Facility Management Administration Center-BOC:* The FMAC-B♦ is responsible for maintenance and restoration of T-carrier facilities. This center must:

(1) Provide administration and control of the restoration of T-carrier service in the metropolitan area

(2) Advise the local serving hub office of abnormal T-carrier outages that involve DATAPHONE Digital Service.

Note: If an FMAC-B is not established, the responsibility for coordinating sectionalization and restoration efforts and for informing the serving hub office of the status of DS-1 facilities reverts to the FCO.

(g) *Regional Facility Management Administration Center-ATTIX:* The FMAC-A is responsible for coordinating and restoring long-haul routes. It must:

(1) Perform broadband restoration and control activities in accordance with Bell System Practices

(2) Provide, upon request of the long-haul DS-1 technicians, the status of the broadband channels that carry DATAPHONE Digital Service

(3) Notify the long-haul DS-1 technicians of any broadband outage affecting DS-1 facilities that cannot be restored to service.

2.03 The CTC has overall responsibility for customer service and performs testing functions at the DS-0 and DS-1 levels. Since customer service is affected by outages at the DS-1 level, the CTC must be kept informed of all abnormal DS-1 facility outages. ♦One method used to accomplish this is the DTSS which monitors DS-1 digroup facilities.

2.04 The maintenance procedures followed by a CTC are described in Section 314-901-300. The overall DDS maintenance features and capabilities are described in Section 314-900-300. The CTC sectionalizes DDS trouble via an Automatic Bit Access Test System and these procedures are documented in Section 314-901-531.

3. MAINTENANCE ACTIVITIES

SHORT-HAUL DS-1 FACILITIES

3.01 The DATAPHONE Digital Service involves the connection of T1DM, T1 data-voice multiplexer (T1WB4), and T1WB5 terminals via short-haul facilities. In addition to showing maintenance areas, Fig. 1 shows the equipment involved in provid-

ing service which is maintained as a part of the metropolitan digital network or intra DSA.◀

3.02 Office alarm indications from DDS equipment are tied into the office alarm system and are responded to by central office (CO) technicians. The only special action required by the CO technicians and the FMAC-B technicians is notifying the CTC of any DDS equipment or facility failures causing service outages that cannot be restored within a reasonable timeframe.

3.03 ◀Table C provides a list of office alarms for DS-1 facilities depending on the equipment arrangement. For initial DDS service, only the office alarms will be used. When an automated alarm analysis system for the T-carrier is implemented in a metropolitan area, the remote office alarms (Table D)◀ will be used to provide automatic alarm analysis and sectionalization capability.

3.04 An examination of the maintenance features listed in Table C indicates that maintenance of DS-1 equipment can be aided by accurate analysis of the alarms and status indications provided by the equipment. Not all DS-1 equipment failures, however, generate alarms or light-emitting diode (LED) indications.

3.05 The analysis of alarms on DDS equipment can be examined from two viewpoints:

(a) A listing of possible failure conditions with the generated alarms at various locations and the probable actions of the technicians at each location (Table E)

(b) Detailed activities to be followed by the technicians responding to alarms at their locations (Fig. 2).

3.06 Both viewpoints are presented here, since each has distinct advantages as an overview of the maintenance capability provided in the DDS. The activities in Fig. 2 and the information in Table D are the basis for trouble analysis on short-haul DS-1 facilities. Neither viewpoint is intended to be all inclusive; rather, each provides the procedures that are most often used. Table D aids in establishing which locations have simultaneous alarms and, as a result, indicates the probable action or actions required of the technicians. Activities similar to those described here are required for some of the more obscure troubles.

3.07 To provide the grade of service desired on the DDS, the short-haul DS-1 facilities must be treated as high-priority, special service facilities. Frame terminations must be clearly indicated and access jacks marked to prevent inadvertent interruption of service. Technicians should be thoroughly familiar with the alarms and the analysis procedures. Local building of alarm displays may be used to alert the technicians quickly of DDS facility failures.

3.08 The FMAC-B technicians should be familiar with the short-haul facilities carrying DATAPHONE Digital Service so that the lines can be given a high priority for restoral. The FMAC-B and local hub technicians should work closely together so that information on the status of the DDS will be readily available to the customer via status reports.

3.09 ◀The DDS can be extended to an end office with only a small number of data customers by using dataport channel units. At present, the dataport channel unit is used only with D3B and D4B channel banks and a SLC*-96 Subscriber Loop Carrier System. The dataports provide an economical digital access to local T-carrier facilities for connection to DDS.

LONG-HAUL DS-1 FACILITIES

3.10 For DDS use, a long-haul DS-1 facility provides a carrier system between two DSAs. These DS-1 facilities make up the intercity digital facility network and terminate at hub office DSX-1 cross-connects (Fig. 3). Various long-haul carrier technologies such as DUV, data over voice (DOV), data on message (DOM), and 20 mb/s (Vidar) accommodate DS-1 facilities. Each technology has its own distinctive modulator/demodulator (modem); for example, DUV uses the 1A RDT and DOV uses a BDM. Figure 4 shows a typical DS-1 facility using a DUV arrangement.

3.11 As with short-haul DDS facilities, the long-haul DDS facilities will be maintained mostly as a part of the normal broadband maintenance plan. The DS-1 facilities will be restored at the discretion of an FMAC-A.

3.12 The broadband maintenance plan may be supplemented by the DTSS which monitors

* Trademark

♦TABLE C♦

OFFICE ALARMS

| EQUIPMENT ARRANGEMENT | OFFICE ALARMS | | SECTION REFERENCES |
	TYPE	ALARM CONDITIONS	
BCPA shelf and T1DM using a T1DM-PM	Major	Loss of both bipolar clock signals	314-912-100 314-983-100 314-916-100
		T1DM-PM indicates terminal failure but spare not available	
		Fuse failure in BCPA shelf	
		Failure to frame on incoming DS-1 signal	
	Minor	Loss of one bipolar clock signal	
		T1DM-PM indicates terminal failure and spare is switched in	
		T1DM-PM failure	
		Failure of T1DM power supply	
		Failure of spare T1DM	
BCPA shelf and T1WB4/5	Major	Loss of both bipolar clock signals	314-915-100 314-915-110 314-916-100
		BCPA shelf fuse failure — both regular and spare	
		Failure of regular and spare T1WB4/5 circuit packs Failure of incoming T1 line	
	Minor	Failure of incoming line from D-type bank	
		Loss of one bipolar clock signal	
		Failure of T1WB4/5 — spare switched in	
		Failure of T1WB4/5 shelf power converter—spare switched in	
		Regular or spare fuse failure on BCPA shelf	
1A-RDT	Major	Coding violations	356-454-101
		Signal and alarm battery fuse failures	
		Low power output from TRMTR	
		Loss of input DS-1 signal	
T1ASU	Major	Both lines fail	365-200-104 365-200-103
		Regular line and switch	
		Alarm unit fuse	
	Minor	Regular line failure and service switched	
		Standby line failure	
		Fuse failures	

◆TABLE D◆

REMOTE OFFICE ALARMS

EQUIPMENT ARRANGEMENT	REMOTE OFFICE ALARMS	
	INDICATION	ALARM CONDITIONS
BCPA shelf and T1DM using a T1DM-PM	Alarm	Any major alarm from BCPA shelf Any minor alarm from BCPA shelf
	Status*	T1DM-PM failure Clock failure Bay fuse alarm
	No Indications	Loss of frame on incoming line (red) Loss of frame at far-end terminal (yellow)
BCPA shelf and T1WB4/5	Alarm†	Major alarm — any failure affecting service Minor alarm — any failure not affecting service
	Status†	Failure of incoming T1 line Failure of incoming line from D-type bank
1A-RDT	Alarm‡	Signal battery failure Alarm battery failure Transmitter failure Receiver failure DS-1 signal failure
T1ASU	Alarm§	Either or both lines fail Alarm unit fuse Line monitor or LTU fuse
	Status§	Switch status

* Status indicated by CP HL34 of T1DM-PM.

† Alarm and status provided by T1WB4/B5 which has no terminal looping capability, but lines can be looped back on themselves.

‡ Alarm provided by 1A-RDT and requires manual restoration.

§ Alarm and status given for regular and standby lines.

DS-1 facilities between T1DMs. This system provides the means for monitoring the performance of DS-1 facilities used for DATAPHONE Digital Service. The performance information gathered on a digroup (24 channel) basis is used, in most cases, to identify trouble in both directions of transmission. Additional information about the DTSS is documented in the series of Sections 314-984-ZZZ.

3.13 Office responsibilities during trouble isolation and sectionalization is documented in Section 660-230-100.

3.14 An aid in localizing trouble is a DS-1 signal access unit. The DSAU provides full duplex access to a DS-1 signal to facilitate centralized maintenance and testing. The DSAUs are located at hub offices and are used in conjunction with a KS-21899 Data Test System or equivalent. Additional information on DSAUs is documented in Sections 314-960-100 and 314-960-300. Refer to Section 107-605-100 for a description of the KS-21899 Data Test System.◆

3.15 All long-haul DS-1 facility failures result in an alarm at the receiving T1DM and at the

♦TABLE E♦

DS-1 FACILITY FAILURES AND ALARMS WITH T1DM AND 1A-RDT AT SAME LOCATION

TYPE OF FAILURE	LOCATION AND TYPE OF ALARMS (NOTE)	PROBABLE TECHNICIAN ACTIONS
Regular or Standby T1 Line	Receiving T1ASU (M, N, G)	Observe that REG MON FAIL and SW indicators are lighted. Operate ACO switch. Report failure to FCO and FMAC-B.
Fuse failure on T1ASU, LTU, or T1DM-PMs	Affected T1ASU (N, A, R)	Locate and replace defective fuse.
Fuse failure on T1ASU alarm unit	Affected T1ASU (M, N, A, R, G)	Locate and replace defective fuse.
Both regular and standby T1 lines or failure of regular line and failure to switch to standby	(a) Receiving T1ASU (M, A, G) (b) Terminating T1DM or T1WB4/5 (M, A, G)	(a) Observe REG and STBY fail lamps. Operate ACO switch. Report failure to FCO and FMAC-B. (b) Observe major alarm lamp on BCPA shelf, and ☐ * on T1DM or RCV IN FAIL lamp on T1WB4/5. Operate ACO switch. Report failure to FCO and FMAC-B.
Unprotected portion of T1 line between T1ASU and terminal or failure of regular line and failure of T1ASU to detect it	Terminating T1DM or T1WB4/5 (M, A, G)	Observe major alarm lamp on BCPA shelf, and ☐ * on T1DM or RCV IN FAIL lamp on T1WB4/5. Operate ACO switch. Report failure to FCO and FMAC-B.
T1 line from D bank to T1WB4/5 or to D-bank transmitter	(a) Transmitting T1WB4/5 (N, A, G) (b) Terminating D bank (M, A)† (c) Originating D bank (M, A)‡	(a) Observe minor alarm lamp on BCPA shelf and TRMT IN FAIL lamp on T1WB4/5. Operate ACO switch. If D bank is in same office, check bank. If in different office, contact FCO and FMAC-B. (b) Observe red alarm. Loop terminal—alarms clear. Notify originating end and FMAC-B. (c) Observe yellow alarm. Loop terminal—alarms clear. Replace cable or notify FCO and FMAC-B.
T1DM or T1WB4/5 common equipment	Affected T1DM or T1WB4/5 (N, A, G)	Observe lamp indications on T1DM or T1WB4/5. Operate ACO switch. Replace defective circuit pack.

See footnotes at end of table.

♦TABLE E (Contd)♦

DS-1 FACILITY FAILURES AND ALARMS WITH T1DM AND 1A-RDT AT SAME LOCATION

TYPE OF FAILURE	LOCATION AND TYPE OF ALARMS (NOTE)	PROBABLE TECHNICIAN ACTIONS
Unprotected portion of T1 line on TRANSMIT IN leg of T1WB4/5 when chained	First downline T1WB4/5 from failure (M, A, G)	Observe TRMT IN FAIL lamp. Report failure to FCO and FMAC-B.
Transmitting portion of 1A-RDT or unprotected portion of T1 line when T1DM and 1A-RDT are at different locations	(a) Transmitting 1A-RDT (M, A, G) (b) Next downline 1A-RDT (M, A, G) (c) Terminating T1DM (M, A, G)	(a) Observe lamp indications of local transmitter failure. Operate ACO switch. Initiate protection switch. Initiate repair. (b) Observe lamp indications of incoming failure. Operate ACO switch. Contact next upline office to initiate sectionalization. (c) Observe major alarm lamp on BCPA shelf, and []* on T1DM. Operate ACO switch. If companion 1A-RDT has no alarm, refer to next 1A-RDT office.
Broadband failure	(a) Receiving 1A-RDT (M, A, G) (b) Terminating T1DM (M, A, G)	(a) Repeat (b) in adjacent item above. (b) Repeat (c) in adjacent item above.
Tip-ring turnover on 1A-RDS facility	(a) Terminating T1DM (M, A, G) (b) Transmitting T1DM (M, A, G)	(a) Make temporary restoration by operating turnover switch. (b) Look for RUS section containing restoration patch.
DS-1 facility loop around	None	Contained in Section 314-901-300.

Note: The letters in parentheses, which represent the types of alarms, are as follows:
- ` M = major alarm
- N = minor alarm
- A = audible alarm
- G = green aisle pilot alarm
- R = red aisle pilot alarm

* Represents the shape of the illuminated light-emitting diodes on the trouble display.

† The major and audible alarms equate to a red alarm.

‡ The major and audible alarms equate to a yellow alarm.

START → 1A-RDT ALARMED — YES → GO TO FIG. 5 → (2) YES

1A-RDT ALARMED — NO ↓

T1DM ALARMED — NO → T1ASU ALARMED — NO → T1WB4 OR T1WB5 IS ALARMED → (3)

T1DM ALARMED — YES ↓

DOES ALARM DISPLAY (SEE NOTE) — YES → OPERATE ACO BUTTON → COMPANION T1ASU ALARMING — NO

COMPANION T1ASU ALARMING — YES → (2)

DOES ALARM DISPLAY (SEE NOTE) — NO ↓

DOES ALARM DISPLAY (SEE NOTE) — YES → OPERATE ACO BUTTON → COMPANION T1ASU ALARMING — NO → NOTIFY FCO OF FAILURE AND REFER FAILURE TO FAR-END TERMINAL OFFICE

COMPANION T1ASU ALARMING — YES → BRIDGING REPEATER FUSE FAILURE → REPLACE FUSE, ALARM CLEARED

DOES ALARM DISPLAY (SEE NOTE) — NO ↓

T1DM FAILURE. OPERATE ACO ↓

NOTIFY FCO OF FAILURE ↓

INITIATE REPAIR (SECTION 314-912-300)

(1) ↓

T1DM CHAINED TO T1WB4 OR T1WB5 — YES → FAILURE ON ONE OF CHAINED LINKS. REFER FAILURE TO FCO → FCO CONTACTS PSC FOR CHAINED OFFICES TO ASCERTAIN WHICH OFFICE HAS A MAJOR ALARM → DISPATCH FOR REPAIR

T1DM CHAINED TO T1WB4 OR T1WB5 — NO ↓

FORCE T1ASU ONTO STANDBY (SECTION 365-200-504) ↓

TERMINAL ALARM CLEAR — NO → DOES FAR END HAVE A TERMINAL ALARM — YES → NOTIFY FCO OF FAILURE AND REFER FAILURE TO FAR-END TERMINAL OFFICE

DOES FAR END HAVE A TERMINAL ALARM — NO → CHECK INTRAOFFICE CABLING (TERMINAL TO T1ASU) → NOTIFY FCO AND INITIATE REPAIR

TERMINAL ALARM CLEAR — YES ↓

DEFECTIVE T1ASU AND LINE ↓

USING ERROR RATE TEST SET, CHECK REGULAR LINE INPUT (SECTION 365-200-504) ↓

REGULAR LINE OK — YES → PATCH TERMINAL TO REGULAR LINE

REGULAR LINE OK — NO ↓

RESTORE SERVICE BY PATCHING TERMINAL TO STANDBY LINE (SECTION 365-200-504) ↓

NOTIFY FCO OR FMAC-B OF LINE FAILURE ↓

REPAIR T1ASU (SECTION 365-200-504)

NOTIFY FCO OF CLEARED TROUBLE AND RETURN TO NORMAL DUTIES ↓

END

NOTE:
THIS SYMBOL REPRESENTS THE SHAPE OF THE ILLUMINATED LIGHT-EMITTING DIODES ON THE T1DM TROUBLE DISPLAY CP HL15.

Fig. 2—▶DDS Alarm Analysis Activities for Short-Haul DS1 Facility (Sheet 1 of 2)◀

② → TYPE OF ALARM
— MINOR → FUSE ALARM
— MINOR → REPLACE FUSE
— MAJOR ↓
— MAJOR → SINGLE LINE FAILURE

TYPE OF ALARM — MAJOR ↓ BOTH LINES FAILED (SEE TABLE D)
— YES → SILENCE ALARM, NOTIFY FCO, FOLLOW LOCAL PRACTICE FOR RESTORATION (SECTION 365-226-500)
— NO ↓

ALARM UNIT FUSE BLOWN
— YES → REPLACE FUSE
— NO ↓

REGULAR LINE FAILURE AND T1ASU FAILURE
↓
RESTORE SERVICE BY PATCHING TERMINAL TO STANDBY LINE (SECTION 365-200-504)
↓
NOTIFY FCO OR FMAC-B OF LINE FAILURE
↓
REPAIR T1ASU (SECTION 365-200-504)
→ NOTIFY FCO OF CLEARED TROUBLE AND RETURN TO NORMAL DUTIES
↓
END

SINGLE LINE FAILURE ↓ SILENCE ALARM, NOTIFY FCO, FOLLOW LOCAL PRACTICE FOR RESTORATION (SECTION 365-226-500)

③ ↓ COMMON EQUIPMENT FAILURE (SEE TABLE D)
— YES → REPLACE DEFECTIVE CIRCUIT PACK (SECTION 314-915-501)
— NO ↓

TYPE OF FAILURE
— OC FAIL → SILENCE ALARM, INITIATE SECTIONALIZATION PROCEDURES (SECTION 314-916-300)
— RCV IN FAIL → COMPANION T1ASU ALARMING — NO → ①
  — YES → ②
— TRMT IN FAIL OR TRMT IN ASYNC ↓

IND OP OR CHAIN OP LIGHTED
— YES →
— NO ↓

D BANK IN SAME OFFICE
— NO → CONTACT BANK OFFICE FOR AID IN SECTIONALIZATION (SECTION 365-110-500 FOR DID AND 365-150-505 FOR D3)
— YES ↓

LOOP D BANK (SECTION 365-110-500, 365-110-010, 365-150-505, OR 365-150-503)
↓
RED ALARM GENERATED
— YES → BANK FAILURE, INITIATE REPAIR → NOTIFY FCO OF CLEARED TROUBLE AND RETURN TO NORMAL DUTIES
— NO ↓
CHECK CROSS-CONNECT OR INTRAOFFICE CABLING

Fig. 2—♦DDS Alarm Analysis Activities for Short-Haul DS1 Facility (Sheet 2 of 2)♦

FACILITY
CONTROL
OFFICES

INTERCITY DIGITAL FACILITIES NETWORK

FACILITY
CONTROL
OFFICES

FUTURE
DS-1
OFFERINGS

DUV

DOV

T-CXR

FUTURE
DS-1
OFFERINGS

DS-1

DSX-1

1
A
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D
T

TD
OR
TH
RADIO

1
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OR
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DS-1

DSX-1

DS-1

HUB
OFFICE

HUB
OFFICE

T1DM

DS-1

DS-1

T1DM

DSX-0
(64Kb/s)

DSX-0
(64Kb/s)

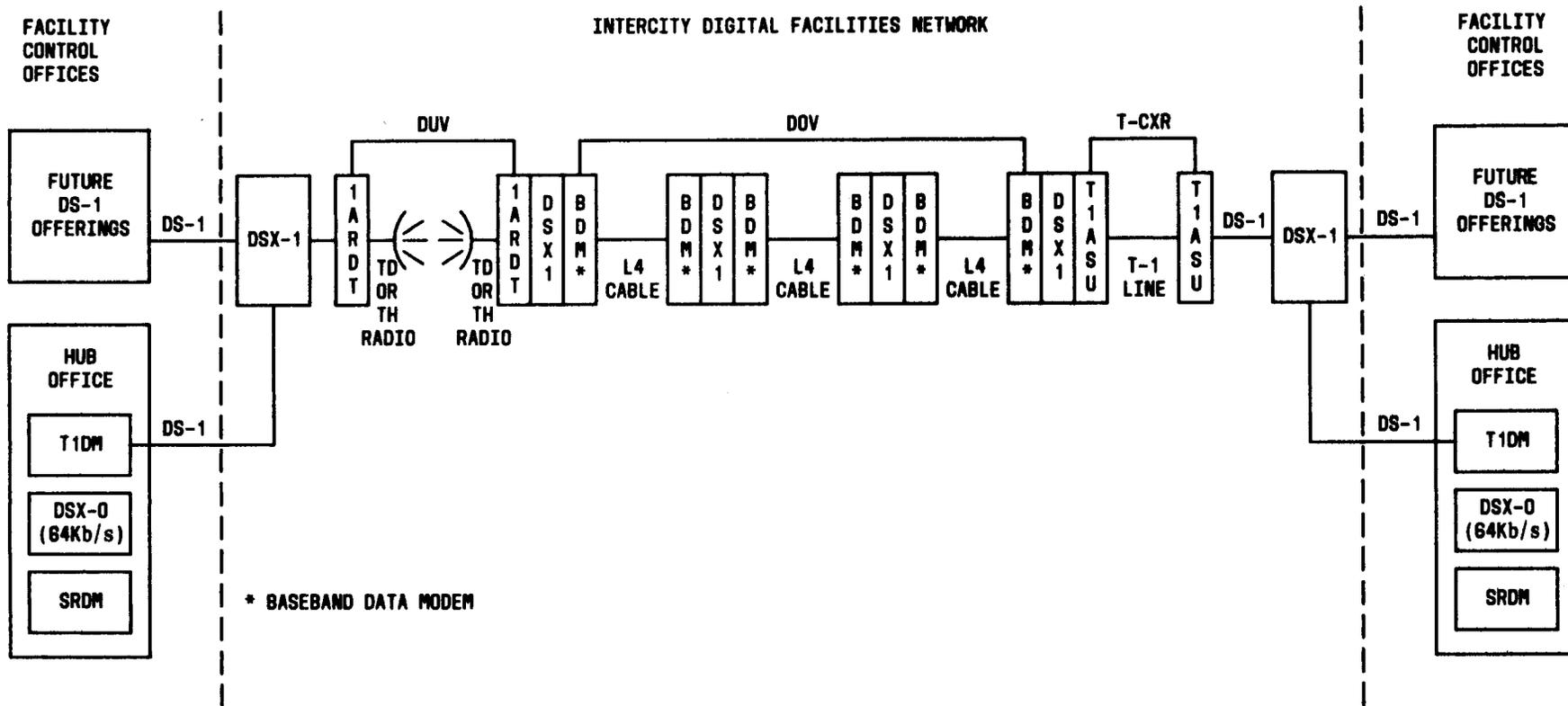SRDM

* BASEBAND DATA MODEM

SRDM

Fig. 3—♦Typical IDFN Arrangements♦

◗modem immediately downline from the failure. Therefore, personnel at the hub office in which the DS-1 facility terminates must: (1) respond to the T1DM and modem alarm indications, (2) contact the FMAC-A, and (3) follow sectionalization procedures for appropriate technology.◀

3.16 Alarm and maintenance features provided by the 1A-RDT and the T1DM are listed in Table C. Initial protection switching arrangements for modems must be manually initiated; therefore, the alarms from the modems must be terminated at a manned location so that prompt corrective action can be taken if a terminal fails.

3.17 As with the short-haul DS-1 level equipment, maintenance of long-haul system failures depends upon an analysis of the alarm and status indications provided by the equipment. This analysis can be made from two viewpoints, both presented here. The alarm analysis procedures for a long-haul DS-1 office are given in Fig. 5. Possible failures, the resulting alarms, and the probable actions taken by the technicians are listed in Table D.

3.18 The activity for isolation of high error rate troubles on long-haul DS-1 channels that are not alarmed is given in Fig. 6. The test arrangement for measuring the error rate is also shown. ◗Another method to isolate high error rate troubles on certain long-haul digroups is to use DTSS. The DTSS reports indicate which digroups are experiencing trouble, especially the Monthly Facility Report by Rank. A long-term test of 48-continuous hours is made during preservice testing and is documented in Section 314-903-200.◀

3.19 To provide the grade of service desired on the DDS, the long-haul DS-1 facilities must be treated as high-priority, special service facilities. Frame terminations must be clearly indicated and access jacks marked to prevent inadvertent interruption of service. The technicians responsible for the equipment should be thoroughly familiar with the alarms and the analysis procedures.

3.20 ◗The 1A-RDS Signal Monitor Test Set, called a phase I, enables monitoring of partial response violation seconds, also called line-errored seconds at points along a 1A-RDS route. Do not confuse DS-1 line-errored seconds with DS-0 channel-errored seconds. Information on the use of this test set is contained in Section 103-488-100.

3.21 The Digital Signal Monitor Test Set, called a phase II, enables monitoring of error bursts

on subrate channels. Monitoring is at the 64-kb/s rate and may be correlated on a 1-for-1 basis with DTSS readings at the receiving T1DM. The use of this test set is contained in Section 103-488-105 and must be used in conjunction with a phase I test set.◀

4. REFERENCES

4.01 Detailed maintenance, testing, and trouble-locating procedures for equipment used in DS-1 facilities are given in the following sections:

SECTION	DESCRIPTION
314-901-300	2-Point and Multipoint Private Line Circuit, Maintenance Procedures, Digital Data System
314-901-530	◗Bit Access Test System (BATS) and Line Access Test System (LATS), Manual Test Procedures, Digital Data System
314-901-531	Automated Bit Access Test System, Remote Test Procedures, Digital Data System◀
314-912-300	T1 Data Multiplexer, Maintenance and Troubleshooting, Digital Data System
314-915-300	T1WB4 Data-Voice Multiplexer, Initial Installation and Tests, Digital Data System
314-915-310	Digital Data System, T1WB5 Data-Voice Multiplexer Local Office Bay, Initial Installation and Tests
314-915-501	Digital Data System, T1WB4 Data-Voice Multiplexer, Trouble-Locating Procedures
314-915-510	Digital Data System, T1WB5 Data-Voice Multiplexer Local Office Bay, Trouble-Locating Procedures
314-916-300	Digital Data System, Bay Clock, Power, and Alarms Circuit, Maintenance and Troubleshooting
314-960-300	Digital Data System, DS-1 Signal Access Unit and Auxiliary Cir-

SECTION	DESCRIPTION
	cuits, Maintenance and Trouble Locating Procedures
314-983-300	Digital Data System, T1 Data Multiplexer Performance Monitor, Maintenance and Troubleshooting
314-984-100	Digital Transmission Surveillance System, General Description, Digital Data System
356-454-511	1A-Radio Digital System (1A-RDS), In Service Trouble-Locating Tests, Digital Transmission Terminals for Analog Facilities
365-200-504	Digital Transmission Systems, T1 Automatic Standby Unit, Trouble Location and Maintenance
365-227-500	Digital Transmission Systems, T1 Digital Line, Trouble-Locating Procedures
365-228-500	Digital Transmission Systems, T1 Digital Line, Digital Data System Qualification Tests

4.02 Detailed maintenance and trouble-locating procedures for the microwave radio are given in the appropriate sections in the 410 (TD2), 411 (TD3), 412 (TH1), or 413 (TH3) division.

5. GLOSSARY

5.01 ♦Listed below are some of the more common terms associated with the DS-1 maintenance activities.◀

Bay Clock, Power, and Alarms (BCPA) shelf: A DDS equipment shelf used in conjunction with the office timing supply for providing timing to equipment bays. It also furnishes power to equipment in the bays and combines alarms.

♦*Baseband Data Modem (BDM):* A modem that processes several signals for transmission and reception on coaxial cable.◀

Bipolar-With-6-Zero Substitution (B6ZS): A coding scheme, implemented by the M1-2, whereby any group of six or more consecutive zeros is converted into a known bipolar violation pattern at the DS-2 level.

Centralized Test Center (CTC): A test location established to control and maintain circuit layout records, to receive customer trouble reports, to assist in the checkout of newly installed stations, to perform trouble sectionalization, and to coordinate service restorals.

♦*Channel Service Unit (CSU):* A unit located on the customer premises that terminates a DDS channel and that is used with the customer's logic and timing recovery circuitry.◀

Data Over Voice (DOV): This type of facility derives two DS-1 digital channels from the spectrum in the mastergroup 7 slot (19.66 to 21.38 MHz) on L4 carrier. For L5 carrier, four DS-1 signals are encoded and modulated; two at 20.52 MHz and two at 22.28 MHz.

Data Under Voice (DUV): A system that provides for the transmission of one DS-1 signal over a microwave radio link.

Digital Data System (DDS): A system allowing discrete signal elements to be transmitted from one location to another. The DDS provides nonswitched, point-to-point and multipoint, full-duplex, synchronous data transmission over a 4-wire private line.

Digroup Connector (DGC): A unit used to provide gain, filtering, and equalization of the data signal between radios in tandem and at the receiving end of the 1A-RDS.

♦*DS-1 Signal Access Unit (DSAU):* A unit for each DS-1 facility in a hub office that allows full duplex access to facilitate maintenance and testing of the DDS.◀

Data Service Unit (DSU): A terminal located on the customer premises to access the DDS.

Digital Signal at the 0 Level (DS-0): A bipolar return-to-zero signal at the 64-kb/s rate.

DS-0 Facility: A transmission path, including terminals, capable of handling a single DS-0 level signal.

Digital Signal at the First Level (DS-1): A bipolar return-to-zero T1 signal at the 1.544-Mb/s rate.

SECTION	DESCRIPTION

DS-1 Facility: A transmission path, including terminals, capable of handling a single DS-1 level signal.

Digital Signal at the Second Level (DS-2): A bipolar return-to-zero signal at the 6.312-Mb/s rate in the B6ZS code format.

DSX-OB: The digital cross-connect at a DDS hub office used to connect multiplexed signals at the 64-kb/s rate, such as T1DM or T1WB4 ports with SRDMS; T1DM or T1WB4 ports together for through or bypass circuits.

Digital Cross-Connect (DSX-1): Used to interconnect equipment, to provide patch capability, and to provide test access at the DS-1 level.

♦Digital Transmission Surveillance System (DTSS): A system that monitors, transmits, centrally processes, and retrieves the performance data of DS-1 facilities equipped with T1DMs. This system enhances the sectionalization and identification of trouble in either direction of transmission.♦

Facility Control Office (FCO): On a DS-1 facility, the appropriate FMAC-A or FMAC-B office that has overall responsibility for sectionalization and restoration of DS-1 facilities.

♦Facility Management Administration Center (FMAC): An administrative center that coordinates the restoration of failed facilities. An FMAC-A is for interstate facilities and FMAC-B is for metropolitan facilities.

Integral Subrate Multiplexer (ISMX): A subrate multiplexer used primarily in end offices.

Intercity Digital Facility Network (IDFN): A network between facility control offices that usually consist of different carrier technologies such as DUV, data over voice (DOV), data on message (DOM), T-carrier, etc.♦

Jack and Connector Panel (JCP): A unit used in local offices to connect the various pieces of equipment and to provide test access with portable test sets.

Level: As used in the DDS, the bitrate. For example, the DS-1 level is a 1.544-Mb/s signal.

L Mastergroup Digital System (LMDS): A system allowing for the transmission of two DS-2 signals in a mastergroup band of an L4 or L5 carrier.

Long Haul: Transmission distances typically beyond 50 miles, using such facilities as the TD, TH, T2, L4, or L5.

Local Plant Service Center (LPSC): An organization having the responsibility, under the direction of the responsible DDS hub office, for testing and repairing local loops and station equipment on the DDS.

Line Terminating Unit (LTU): A miniature version of the T1 office repeater bay which can serve two T1 lines, designated regular and spare.

L4 and L5 Carrier: Long-haul broadband analog carrier systems using coaxial cable for transmission.

Message-Data Combiner (MDC): A unit used to combine and separate a message mastergroup and a 1A-RDS signal at baseband level.

Digital Multiplex-Demultiplex Circuit (M1-2): A multiplexer that can combine four DS-1 signals into a DS-2 signal.

Office Channel Unit (OCU): A ♦unit located in a DDS office that terminates the 4-wire local loop and provides remote loopback features.♦

Pulse Code Modulation (PCM): The process in which analog signals are sampled, quantized, and coded into a digital bitstream.

♦Quad Terminal Panel (QTP): A panel of a DSX-O cross-connect that provides routing of 64-kb/s signals to the ports of a T1WB5.

Radio Unit Section (RUS): A link in a digital DS-1 facility defined by the input of a DS-1 level signal to the message data combiner and the output of this signal at the receiving combiner.♦

Short Haul: Transmission distances typically less than 50 miles ♦exceptions are listed in Table A.♦

Subrate Data Multiplexer (SRDM): An equipment shelf combining a number of data streams at some basic rate (2.4, 4.8, or 9.6 kb/s) into a single 64-kb/s time division multiplexed signal.

TD and TH: Point-to-point microwave radio transmission systems.
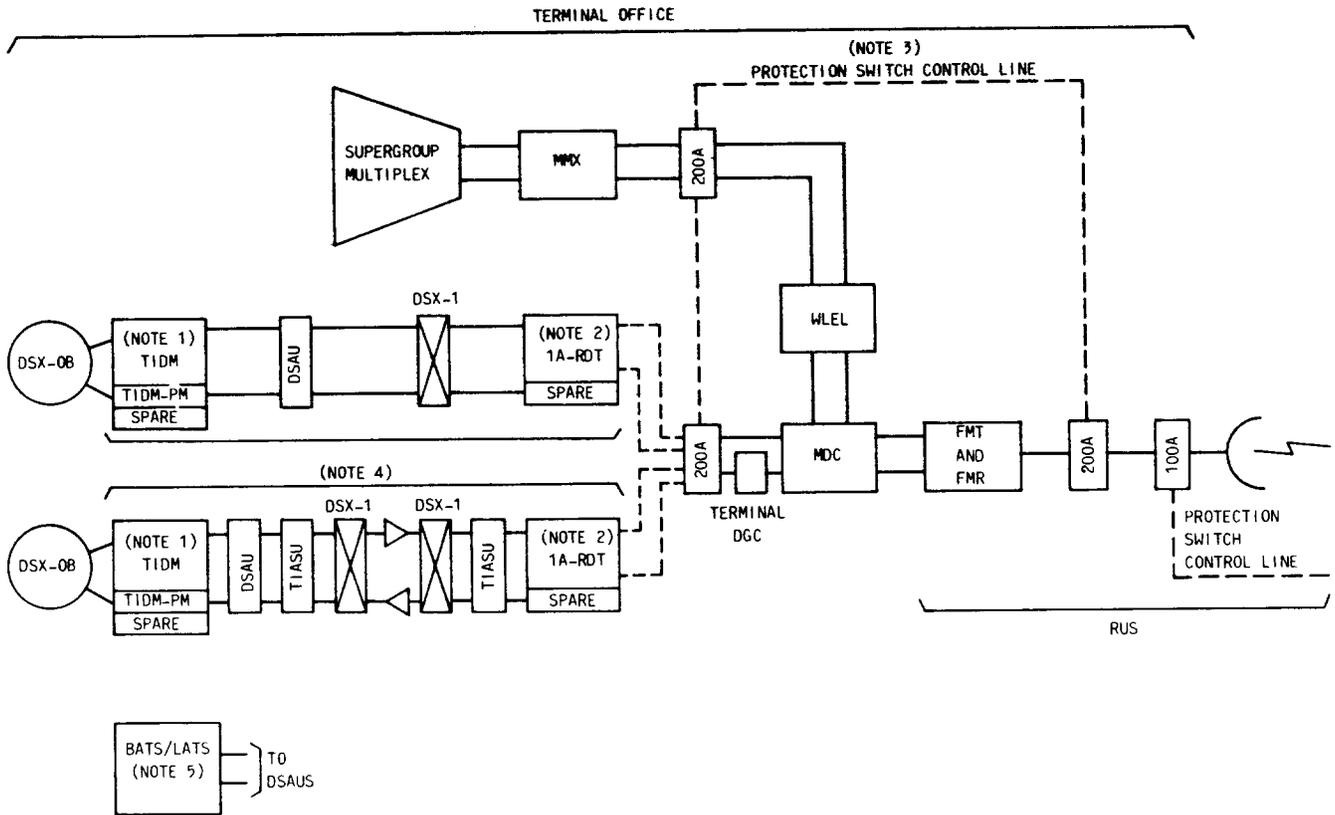
Fig. 4—▶Example of Long-Haul Equipment for DS-1 Facility (Sheet 1 of 2)◀
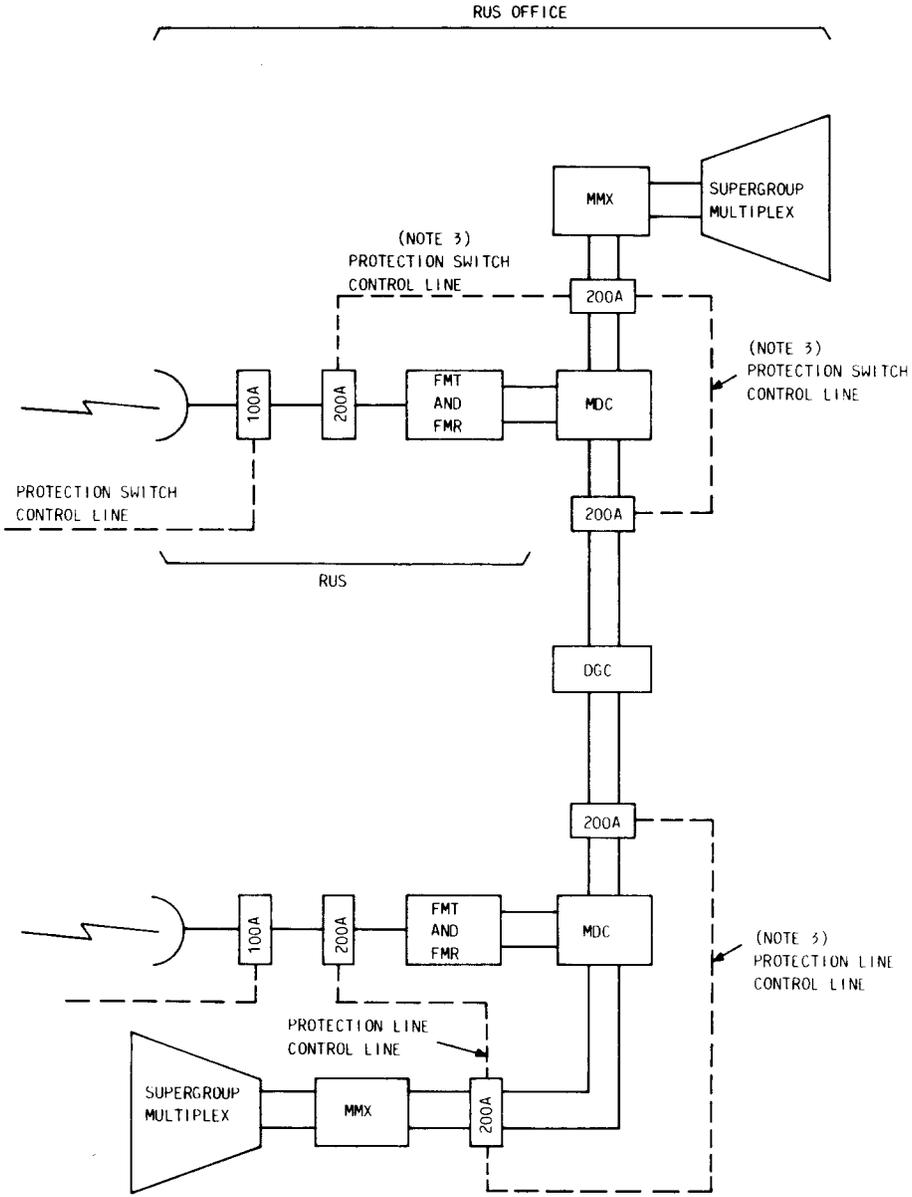
Fig. 4—▶Example of Long-Haul Equipment for DS-1 Facility (Sheet 2 of 2)◀

| SECTION | DESCRIPTION | SECTION | DESCRIPTION |

T-Carrier Restoration Control Center (TRCC): An organization responsible for maintenance and restoration of T-carrier facilities on a manual basis. This organization is also known as FMAC-M.

T1 Automatic Standby Unit (T1ASU): An equipment shelf that provides monitoring and automatic protection switching of the T1 lines on a 1-for-1 basis.

T1 Data Multiplexer (T1DM): A data multiplexer capable of time division multiplexing a maximum of twenty-three 64-kb/s data channels and one channel of synchronizing information into a DS-1 signal.

T1 Data Multiplexer Performance Monitor (T1DM-PM): A DDS equipment shelf used to monitor continuously the performance of a maximum of sixteen T1DMs.

T1 Line: A digital transmission line carrying data at the 1.544-Mb/s rate (DS-1 level). In the DDS, it is used primarily for short-haul links (less than 50 miles).

T1WB4 Data-Voice Multiplexer (T1WB4): A data-voice multiplexer capable of combining a maximum of 12 data channels at the 64-kb/s rate with PCM-encoded voice channels from a D3 or D1D channel bank. The result is a DS-1 signal.

T1WB5 Data-Voice Multiplexer (T1WB5): A data-voice multiplexer capable of combining a maximum of 24 data channels at the 64-kb/s rate with PCM-encoded voice channels from a D3 or D1D channel bank. The result is a DS-1 signal.

T2 Line: A digital transmission line carrying data at the 6.312-Mb/s rate (DS-2 level). In the DDS, it is used for long-haul links up to 500 miles.

1A Radio Digital System (1A-RDS): A system allowing for transmission of one DS-1 signal in addition to the normal voice message circuits over a microwave radio link. This system is also known as data under voice (DUV).

1A Radio Digital Terminal (1A-RDT): A terminal used in the 1A-RDS to convert a DS-1 signal to a 7-level partial response format. The resultant signal has a bandwidth of 0 to 500 kHz that can be transmitted below the message channels on a radio facility.

```
                    ┌─────────┐
                    │  START  │
                    └────┬────┘
            ┌────────────┴────────────┐
            ▼                         ▼
  ┌──────────────────┐   ┌──────────────────────┐
  │ MAJOR OFFICE ALARM│   │ TROUBLE HAS BEEN      │
  └──────────────────┘   │ REFERRED FROM CTC     │
            │             └──────────┬───────────┘
            │                        │        HIGH
            │                        │        ERROR
            │                        ▼        RATE    ┌──────────┐
            │              ⟨ TYPE OF TROUBLE ⟩──────▶│ REFER TO │
            │                        │                │ FIG. 5   │
            │                        │                └──────────┘
            │                   SEE NOTE I
            │                   FOR TROUBLE
            │                   DEFINITION
            │                        ▼
            │              ┌──────────────────┐
            │              │ CHECK STATUS OF TIDM│
            │              │ AND IA-RDT ALARMS   │
            │              └────────┬──────────┘
            │                       │          NO     ┌──────────────┐
            │                       ▼                 │ REFER TROUBLE│
            │              ⟨ ALARMS PRESENT ⟩────────▶│ BACK TO CTC  │
            │                       │                 └──────────────┘
            │                      YES
            │                       ▼           TIDM
            └─────────────▶⟨ SOURCE OF ALARM ⟩────────▶( 1 )
                                    │
                                  IA-RDT
                                    ▼
                                  ( 2 )
```

NOTES:
1. SRDM UNABLE TO DETECT INCOMING FRAMING SYNC, AS INDICATED BY ILLUMINATED DECIMAL POINT, □, OR ∪ ON SRDM DISPLAY.

2. THIS SYMBOL REPRESENTS THE SHAPE OF THE T1DM TROUBLE DISPLAY AT CP HL15.

3. IA-RDT ALARMS (SEE SECTION 356-454-300)

GENERAL TYPE OF ALARM	LOCATION OF INDICATORS	STATUS INDICATORS
FUSE	IA-RDT FUSE PANEL	FUSE ALM
TRMTR OR RCVR	J87378 DC-TO-DC CONVERTER SWITCH STATUS AND CONTROL PANEL	NO VOLT ALM FAILED A-H (TRMT OR RCV)
	RECEIVING DIGITAL PROCESSOR STATUS IND	TTI, TT2, OR TT5
	TRANSMITTING DIGITAL PROCESSOR STATUS IND	TT2, TT3, TT4, OR TT5
NO DS-I SIGNAL	TRANSMITTING DIGITAL PROCESSOR STATUS IND	TTI

Fig. 5—◆DDS Alarm Analysis Activities for Long-Haul DS-1 Facilities (Sheet 1 of 3)◀

①

DOES ALARM DISPLAY INDICATE ▯ (NOTE 2) —NO→ DOES ALARM DISPLAY INDICATE ▢ (NOTE 2) —YES→ COMPANION 1A-RDT ALARMING —YES→ ②

↓YES (from first decision)

COMPANION 1A-RDT ALARMING —YES→ ②

↓NO

ARE T1DM AND 1A-RDT IN SAME BUILDING —NO→

↓YES

USING TIP-RING TURNOVER PATCH CORD, MAKE TEST ON 1A-RDT ←NO— ASSOCIATED T1ASU ALARMING

↓ (ASSOCIATED T1ASU ALARMING) ↓YES

GO TO FIG. 2 ENTRY ②

DID TROUBLE CLEAR —YES→ TIP-RING TURNOVER IN 1A-RDT. CONTACT UPSTREAM RUS OFFICES TO LOCATE RESTORATION PATCH CONTAINING TURNOVER

↓NO

REMOVE TIP-RING TURNOVER PATCH CORD

↓

NOTIFY CTC OF OUTAGE. CONTACT FAR-END TERMINAL OFFICE

↓

FAR-END 1A-RDT ALARMING —YES→ REFER TROUBLE TO FAR-END OFFICE

↓NO

CONTACT UPSTREAM RUS OFFICES FOR STATUS OF DGC OR 1A-RDT

↓

INITIATE SECTIONALIZATION (SECTION 356-454-506)

--- second column ---

DOES ALARM DISPLAY INDICATE ▢ (NOTE 2) —NO→

T1DM FAILURE. OPERATE ACO BUTTON

↓

NOTIFY FCO OF FAILURE

↓

INITIATE REPAIR (SECTION 314-912-300)

↓

NOTIFY FCO OF TROUBLE CLEARED AND RETURN TO NORMAL DUTIES

↓

END

--- third column ---

COMPANION 1A-RDT ALARMING —NO→

NOTIFY CTC OF OUTAGE

↓

REFER TROUBLE TO FAR-END OFFICE
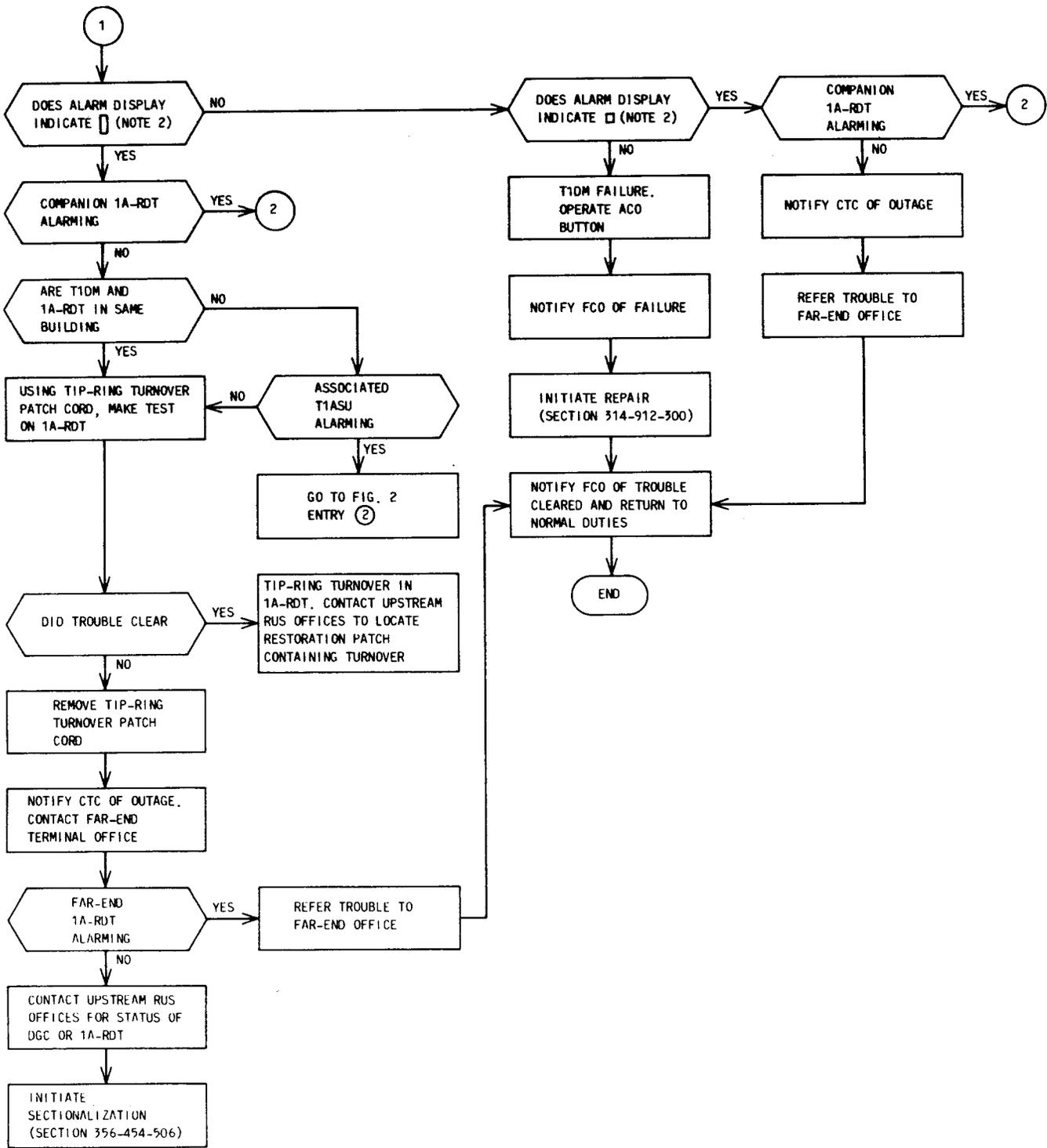
Fig. 5—▶DDS Alarm Analysis Activities for Long-Haul DS-1 Facilities (Sheet 2 of 3)◀

Fig. 5—♦DDS Alarm Analysis Activities for Long-Haul DS-1 Facilities (Sheet 3 of 3)♦
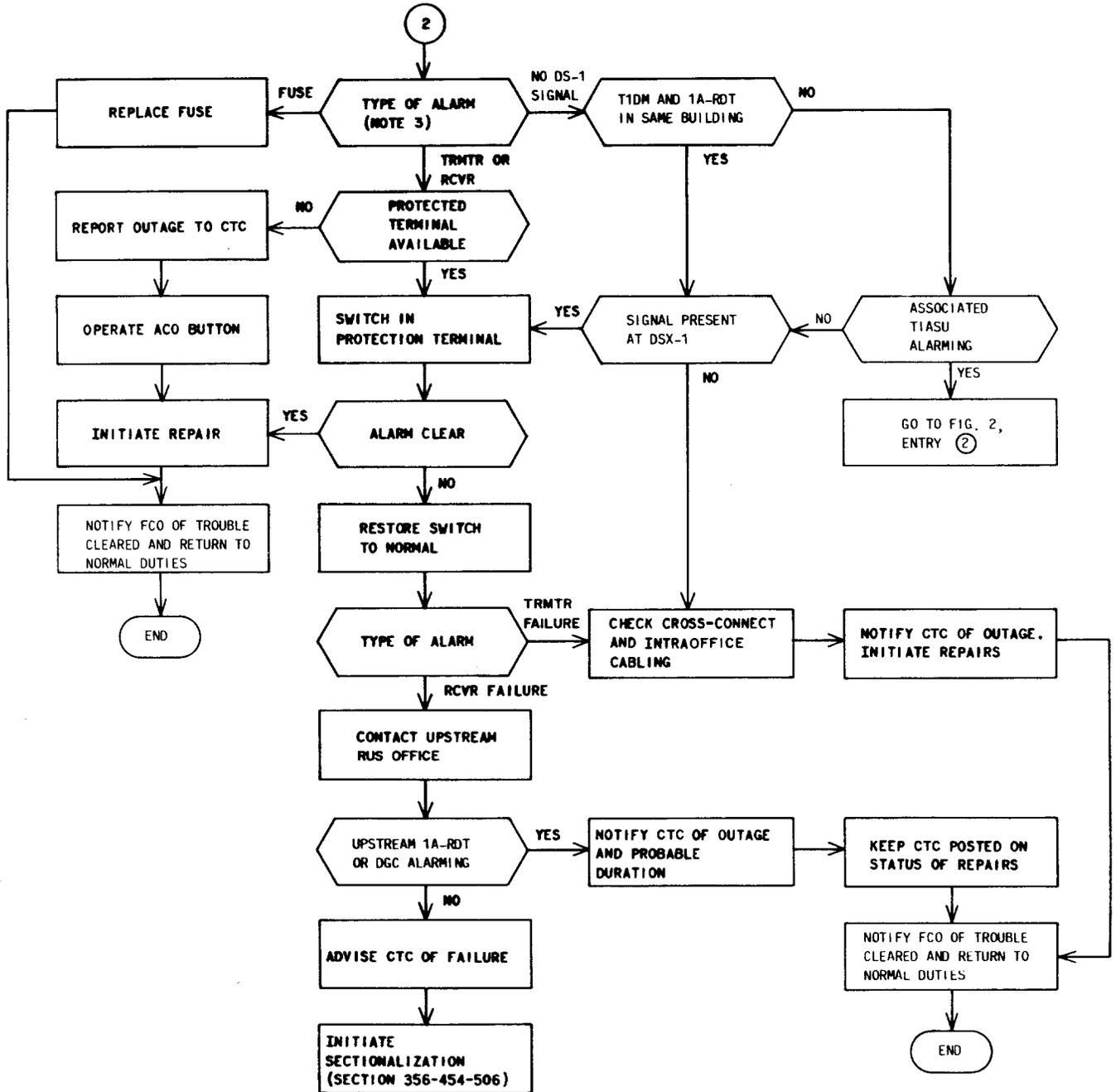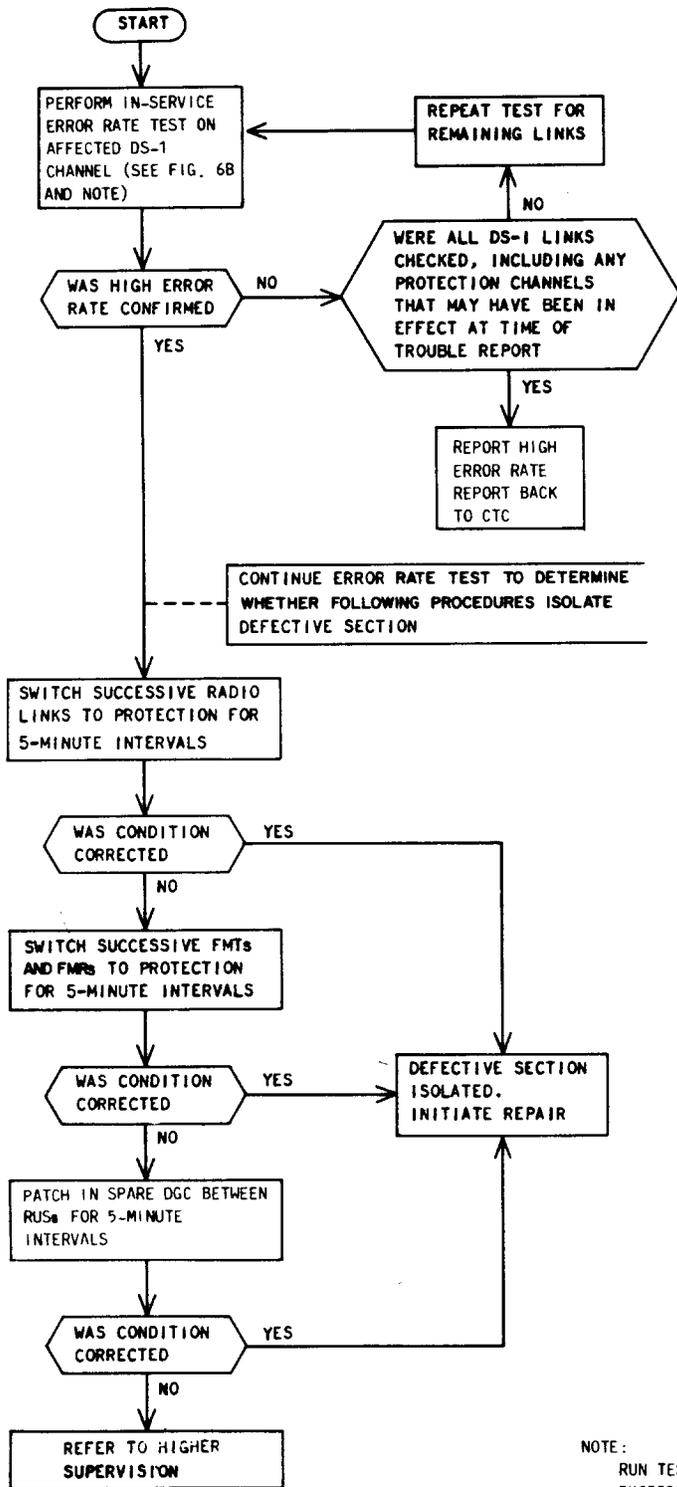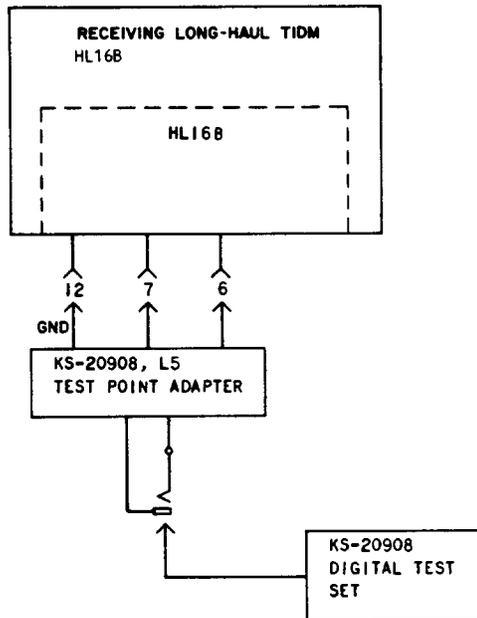
START

PERFORM IN-SERVICE
ERROR RATE TEST ON
AFFECTED DS-1
CHANNEL (SEE FIG. 6B
AND NOTE)

REPEAT TEST FOR
REMAINING LINKS

WAS HIGH ERROR
RATE CONFIRMED — NO

WERE ALL DS-1 LINKS
CHECKED, INCLUDING ANY
PROTECTION CHANNELS
THAT MAY HAVE BEEN IN
EFFECT AT TIME OF
TROUBLE REPORT

NO

YES

YES

REPORT HIGH
ERROR RATE
REPORT BACK
TO CTC

CONTINUE ERROR RATE TEST TO DETERMINE
WHETHER FOLLOWING PROCEDURES ISOLATE
DEFECTIVE SECTION

SWITCH SUCCESSIVE RADIO
LINKS TO PROTECTION FOR
5-MINUTE INTERVALS

WAS CONDITION
CORRECTED — YES

NO

SWITCH SUCCESSIVE FMTs
AND FMRs TO PROTECTION
FOR 5-MINUTE INTERVALS

WAS CONDITION
CORRECTED — YES

DEFECTIVE SECTION
ISOLATED.
INITIATE REPAIR

NO

PATCH IN SPARE DGC BETWEEN
RUSs FOR 5-MINUTE
INTERVALS

WAS CONDITION
CORRECTED — YES

NO

REFER TO HIGHER
SUPERVISION

A. HIGH ERROR RATE ISOLATION ACTIVITY

RECEIVING LONG-HAUL TIDM
HL16B

HL16B

12   7   6

GND

KS-20908, L5
TEST POINT ADAPTER

KS-20908
DIGITAL TEST
SET

SWITCH SETTINGS

INPUT - LOGIC, FAR
COUNTER - EXT PULSES
COUNTER MODE - RESET
POWER - ON

B. IN-SERVICE ERROR RATE TEST SETUP

NOTE:
RUN TEST FOR 5 MINUTES. IF COUNTER READING
EXCEEDS 5, HIGH ERROR RATE EXISTS.

Fig. 6—High Error Rate Isolation Activity and Last Setup