DIGITAL TRANSMISSION SYSTEM

828AF DIGITAL MULTIPLEXER

GENERAL DESCRIPTION

1.   GENERAL

1.01   This section is a cover sheet for the Telco Systems Fiber Optics Corporation Digital Transmission System 828AF Digital Multiplexer General Description. This section is reproduced with permission of Telco Systems Fiber Optics Corporation and is the equivalent of Telco practice 830-102-001, Issue 2.

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

1.03   This section describes the basic functions and features of the 828AF Digital Multiplexer.

1.04   If corrections are required in the attached document, use Form-3973 as described in Section 000-010-015.

1.05   If equipment design and/or manufacturing problems should occur, refer to Section SW 010-522-906 for procedures on filing an Engineering complaint.

2.   ORDERING PROCEDURE

2.01   For information concerning equipment and parts availability contact Telco Systems, Order Administration Department, in Norwood, Massachusetts, at:

1-800-44-SALES

1-617-551-0300

2.02   To order additional copies of this practice, use TELC 365-407-849SW as the section number.

3.   <u>REPAIR/RETURN</u>

    3.01   For defective modules and assemblies contact the Repair and Return Department at the following number:

        8:00 a.m. - 5:00 p.m. (617) 551-0300 - Ext. 2778

        Attachment: Telco Systems Fiber Optics Corporation
                      Digital Transmission System
                      828AF Digital Multiplexer
                      General Description

DIGITAL TRANSMISSION SYSTEM
828AF DIGITAL MULTIPLEXER
GENERAL DESCRIPTION

CONTENTS

Figure 1-1. 828AF Digital Multiplexer

1. SCOPE

A. General

1.01 This section describes the basic
functions and features of the
828AF Digital Multiplexer. Figure 1-1
shows the 828AF with its front cover
installed. Figure 1-2 illustrates the
unit with front cover removed to
display the circuit card layout and
unit-level design of the 828AF.

1.02 This section was reissued to
include information on increased
applications of the 828AF, including
DS-3 Optical Extension application,
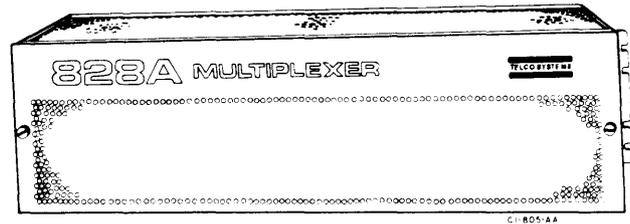DS-2 Fiber-Optic Hubbing application,
and TELTRAC extension application.

2. MANUAL ORGANIZATION

2.01 This manual contains the follow-
ing sections:

SECTION 1. GENERAL DESCRIPTION -
provides an overview of the 828AF
operation with emphasis on features
and functions incorporated into
equipment design.

SECTION 2. THEORY OF OPERATION -
presents a detailed discussion of
828AF equipment subsystems and circuit
card operation to block diagram level.

SECTION 3. ORDERING INFORMATION -
provides guidelines for subassembly
and circuit card ordering.

SECTION 4. SPECIFICATIONS - details
unit-level physical and electrical
specifications.

SECTION 5. INSTALLATION - provides
instruction on unit installation,
cabling, and equipment configuration.

SECTION 6. INITIAL OPERATION TESTING – details all procedures required for circuit card optioning, unit turn-up, and equipment testing and alignment.

SECTION 7. MAINTENANCE – details all procedures required for unit-level maintenance including fault isolation, card and module replacement, and the procedures necessary for return and repair of equipment.

SECTION 8. SPECIAL TEST CARDS – provides a description of the Manual Control Interface card and its various functions.

SECTION 9. DRAWINGS – provides equipment reference drawings, motherboard wiring schematics, and assembly prints to be used as an aid for detailed troubleshooting or installation, as required.

3. GENERAL INFORMATION

A. Safety Precautions

3.01 As with any product, care must be exercised when working near the –48 Vdc power source and connections. Potentially high electrical currents might flow if the –48 Vdc terminals of TB-1 are inadvertently shorted to ground. Terminals TB-2, TB-3, and TB-4 of the 828AF, and Terminal TB-2 of the Fuse and Alarm Panel should be connected to the site ground system to reduce T1 line noise and provide electrical protection.

3.02 All cards and modules contained in the 828AF unit, with the exception of the Power Supply modules, are designed to enable removal or installation without defusing the equipment.

3.03 Circuit cards can be damaged by electrostatic discharge. Before handling any circuit cards, connect your wrist to an equipment frame ground, using an approved antistatic wrist strap (EMX031-1). Ensure that all circuit cards removed from the equipment are properly stored in anti-static packing material (PKG033-1). When working with circuit cards, always place the card on an electrically grounded approved antistatic mat.

B. References

3.04 Since the 828AF may interface to a FOX-2R or FOX-2 wall-mount unit, as part of a DS-2 optical extension span, Channel Bank, M560 Fiber-Optic Multiplexer (via a DOX, Dual Optical Tranceiver, card for DS-3 optical extension), TELTRAC, or another 828AF, other reference material may be

SET JUMPERS IN ELEC POSITION FOR LOW-SPEED CARDS.
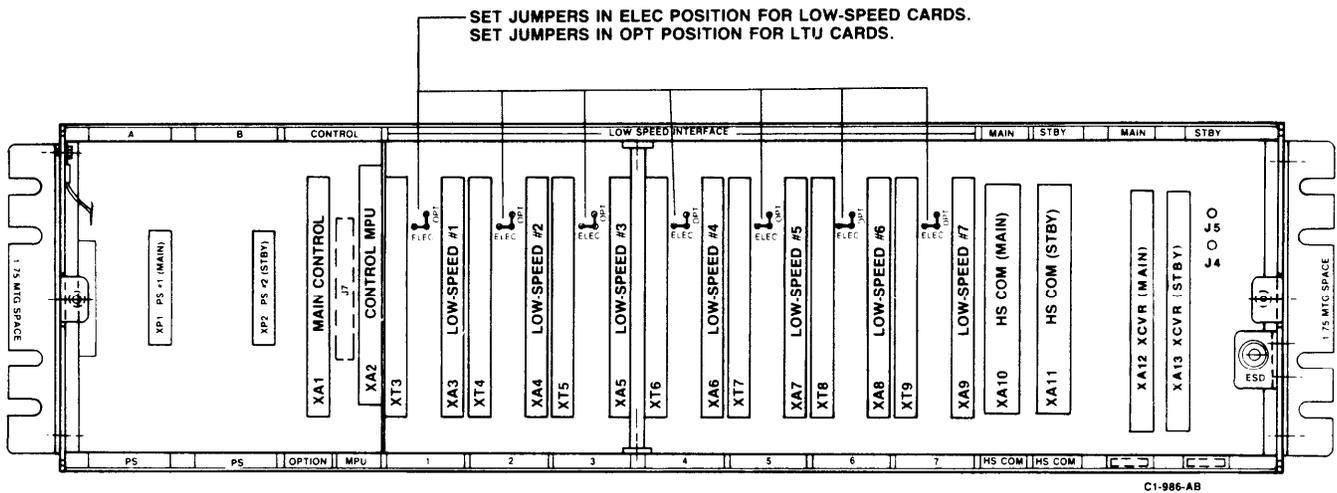SET JUMPERS IN OPT POSITION FOR LTU CARDS.

Figure 1-2. 828AF Digital Multiplexer (Cover Removed)

required for system-level installation and test. The following is a list of Operation and Maintenance manuals and practices that may be useful in the planning or installation phases of the 828AF unit in conjunction with other Telco Systems transmission products.

TELCO SYSTEMS FIBER OPTICS CORPORATION:

FOX-2 DS-2 Optical Extension Operation and Maintenance Manual

FOX-2R DS-2 Optical Extension Operation and Maintenance Manual

M560/FOX-3 Fiber-Optic Multiplexer Operation and Maintenance Manual

TELTRAC Users Manual

TELTRAC Configuration Manual

TELCO SYSTEMS NETWORK ACCESS CORP:

DCB-24 Channel Bank:
  Description/Installation/
   Maintenance Practice
   Section 2424-00-101
  Installation/Maintenance Practice
   Section DCB-24-200

DDI-24 Digital Drop/Insert System:
  Description Practice
   Section 2400-00-101
  Installation Practice
   Section 2400-00-200

TPS-4002 Digital Time slot Processing System
  System Practice
   Section 4002-100

NDI-2000 Network Digital Interface
   Sections 2010-00-100,
   2020-00-100, and 2030-00-101

4. PRODUCT OVERVIEW

A. Unit Description

4.01 The 828AF is a self-contained
       multiplexer capable of combining
DS-1, DS-1C, and/or DS-2 electrical
signals in any combination up to the
equivalent of 28 DS-1 channels into a
single DS-3, 1:1 protected optical
signal, and demultiplexing a DS-3
optical signal into its DS-1, DS-1C,
or DS-2 electrical components. The
unit is constructed as a single
23-inch rack-mountable cage which can
be installed in standard equipment
racks or within custom cabinetized
systems. The 828AF can be employed as
a point-to-point DS-3 optical trans-
mission system, or as part of a DS-3
optical extension from an M560 Fiber-
Optic Transmission system through use
of the M560 DOX card. Equipped with
LTU (Line Terminating Unit) cards in
the low-speed section, the 828AF can
be used as a DS-2 fiber-optic hub,
which interfaces to remote FOX-2/FOX-2R
units via up to six optical data chan-
nels. Each DS-2 optical channel,
coded as a 12.624 Mb/s data stream,
also accommodates an overhead channel
for MPU-to-MPU (Microprocessor Unit)
communications. The 828AF carries up
to 672 64 kb/s channels per unit, in
any combination of DS-1, DS-1C, and/or
DS-2 signals up to the equivalent of
28 DS-1 channels.

4.02 The low-speed interface cards
       contain all circuitry necessary
to interface with DS-1, DS-1C, or DS-2
electrical signals, or 3B6B encoded
DS-2 optical signals; and multiplex
them to the DS-2 level with full 1:1
redundancy of the M12 MULDEM (DS-1 to
DS-2 Multiplexer/Demultiplexer)
circuitry.

4.03 The M23 MULDEM (DS-2 to DS-3)
       circuitry within 828AF HS COM
card time-division multiplexes the
seven DS-2 outputs of the Low-Speed
Interface cards into a single DS-3
data stream, which is used to modulate
a single-mode laser or LED transmitter
of the high-speed XCVR (Transceiver)
circuitry. The M23 MULDEM also demulti-
plexes the recovered electrical signal
from the received DS-3 optical data
stream to provide DS-2 channels to the
low-speed interface cards.

4.04 High-speed transceiver circuitry
       converts the DS-3 electrical
output from the M23 MULDEM into a DS-3
optical signal, and the received DS-3
optical signal into a DS-3 electrical
data and timing signals.

4.05 The Control MPU card monitors
       all cards and modules within the
828AF, and illuminates the corresponding
fault indicators in event of a failure.
Hardware failures result in LED indica-
tions on the faulty card. The micro-
processor also monitors the quality of
transmission, calculates the DS-3 BER
(Bit Error Rate), and illuminates an
LED when the BER exceeds a predetermined
threshold. Through the use of lockout
software, sympathetic alarms that may
illuminate are masked or "locked" out.
This prevents multiple alarms, and
assists in fault isolation.

B. Features

   Equipment Size

4.06 A single 828AF measures 23-inches
       wide by 6-inches high by
11.5-inches deep, allowing up to ten
units to be mounted in a standard
7-foot rack, with a Fuse and Alarm
Panel and appropriate air baffles.

State-of-the-Art Technology

4.07　Circuit cards used in the 828AF
　　　employ the latest VLSI technol-
ogy, including the use of programmable
gate arrays, thin-film, and surface-
mount technology for superior reli-
ability and lower power consumption.

Transmission Capacity

4.08　The 828AF is capable of carry-
　　　ing the equivalent of 28 DS-1
channels.　With the proper Low-Speed
Interface card, traffic can be
accepted as a DS-1 (1.544 Mb/s), DS-1C
(3.152 Mb/s), or DS-2 (6.312 Mb/s)
signal or any combination thereof.

Selectable Low-Speed Interface

4.09　Each 828AF unit can be equipped
　　　for T1, T1C, or T2 channel
interface by installing the appro-
priate Low-Speed Interface card.

4.10　User selectable AMI (Alternate
　　　Mark Inversion) or B8ZS (Bipolar
with 8 Zero Substitution) can be
optioned on a per T1 channel basis via
a four-pole front-mounted DIP switch
on the T1 Low-Speed Interface card
(CCA161G1).

Equipment Protection

4.11　All power, low-speed and high-
　　　speed multiplexing, line coding,
and optical interface circuitry can be
1:1 protected.　The T1 and T1C Low-
Speed Interface cards employ inte-
grated 1:1 circuit protection, while
the other cards are protected by a
redundant card.　The Control MPU card
initiates automatic switching to the
STBY circuitry when a hardware failure
occurs, or when the predetermined BER
switching threshold is exceeded.　For
maintenance purposes, the multiplexer
can be switched manually via the
Control MPU card, the Manual Control
Interface card, or an external moni-
toring system such as the TELTRAC
(Telco Telecommunications Remote
Alarm and Control) system.

Remote Alarm Reporting

4.12　Through mux-to-mux (Multiplexer-
　　　to-Multiplexer) communication,
remote monitoring and control functions
are possible.　Mux-to-mux communication
is carried by a user-definable X-bit
in one of the DS-2 data channels.　A
local 828AF is capable of reporting
the presence of a MAJOR or MINOR alarm
in a multiplexer at the far end.　This
is accomplished by illuminating the
BAY indicator alarm on the local 828AF
Fuse and Alarm Panel.　If the 828AF
system has been appropriately config-
ured and is equipped with RAC-II
(Remote Alarm Card II) cards, the
REMOTE indicator on the ACX025 Fuse
and Alarm Panel will also be illu-
minated to indicate that the fault is
at the remote end.　Remote switching
and status reporting are possible if
the 828AF is equipped with a Manual
Control Interface card or with TELTRAC.

Separate Fuse and Alarm Panel

4.13 A separate Fuse and Alarm Panel
      (see Figure 1-3) mounted in the
rack provides individually fused power
lines for up to twelve units. In addi-
tion to power distribution, the panel
provides wire-wrap pin blocks for
alarm reporting, and TELTRAC inter-
face connectors. On the ACX025 Fuse
and Alarm Panel, BAY, FUSE, ACO (Alarm
Cutoff), INT FUSE, and REMOTE alarm
indicator lights are provided for
visible indications (See Figure 1-3).
Form A relays are provided for visual
and audible MAJOR and MINOR alarms.
Form C FUSE, ACO, and REMOTE closures
are available as separate closures.

In place of relay contact closures, the
ACX043 Fuse and Alarm Panel provides
wire-wrap pin blocks which interface
with the eight opto-isolator inputs and
output contacts of RAC-II cards in the
828AF units in the bay (see Figure 1-4).

External Alarm Reporting

4.14 Each 828AF is equipped with two
      relays (MAJOR and MINOR) used to
report the corresponding alarms to the
Fuse and Alarm Panel. From the Fuse
and Alarm Panel, these alarms can be
connected to on-premises customer
alarm reporting equipment. During
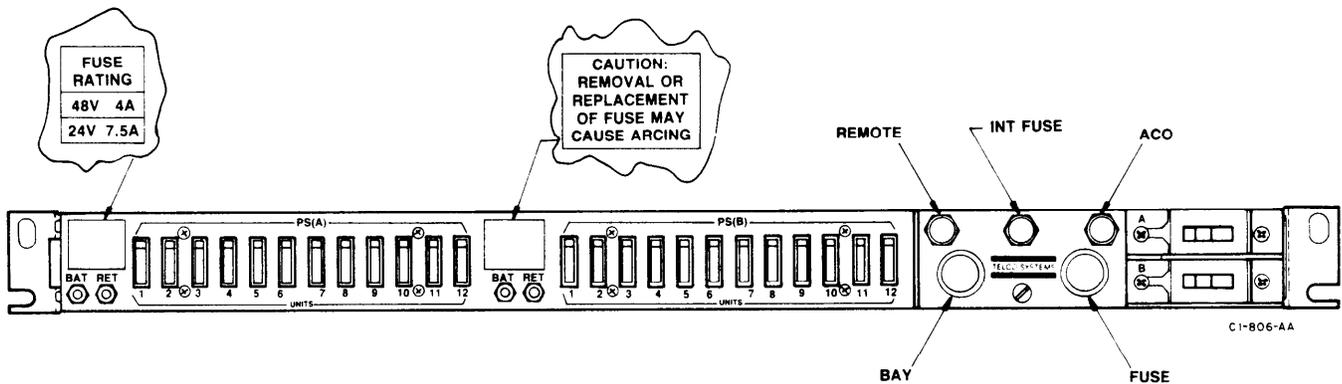maintenance procedures the audible
alarms may be silenced or cut off.

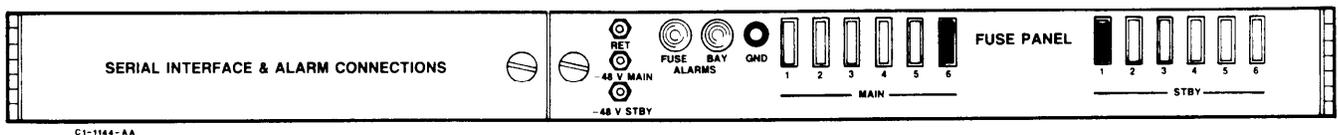Figure 1-3. ACX025 Fuse and Alarm Panel

Figure 1-4. ACX043 Fuse and Alarm Panel

1-6

Maintenance Interface Card

4.15 The Maintenance Interface card
      (see Figure 1-5) provides for
off-line testing of spare T1 or T1C
Low-Speed Interface cards before
placing them in service. Test data is
inserted into the spare cards through
test jacks built into the Maintenance
Interface card. The card provides for
either T2 loopback of the test data or
bridging to on-line traffic in the RX
direction. The Maintenance Inter-
face card is also used to disable the
MPU data bus during MPU replacement
procedures. Through use of the
Maintenance Interface card, changeout
of T1, T1C, and Control MPU cards is
possible without disrupting traffic.

Manual Control Interface Card

4.16. The Manual Control Interface card
      is an I/O (Input/Output) board,
allowing immediate and direct access
to the Control MPU card. This access
is used to initiate test functions,
and provide status through interroga-
tion of the local and remote terminals.

Remote Monitoring System

4.17 The Control MPU card can inter-
      face with a TELTRAC network.
TELTRAC provides comprehensive network
remote alarm and status reporting. In
addition, diagnostic fault isolation
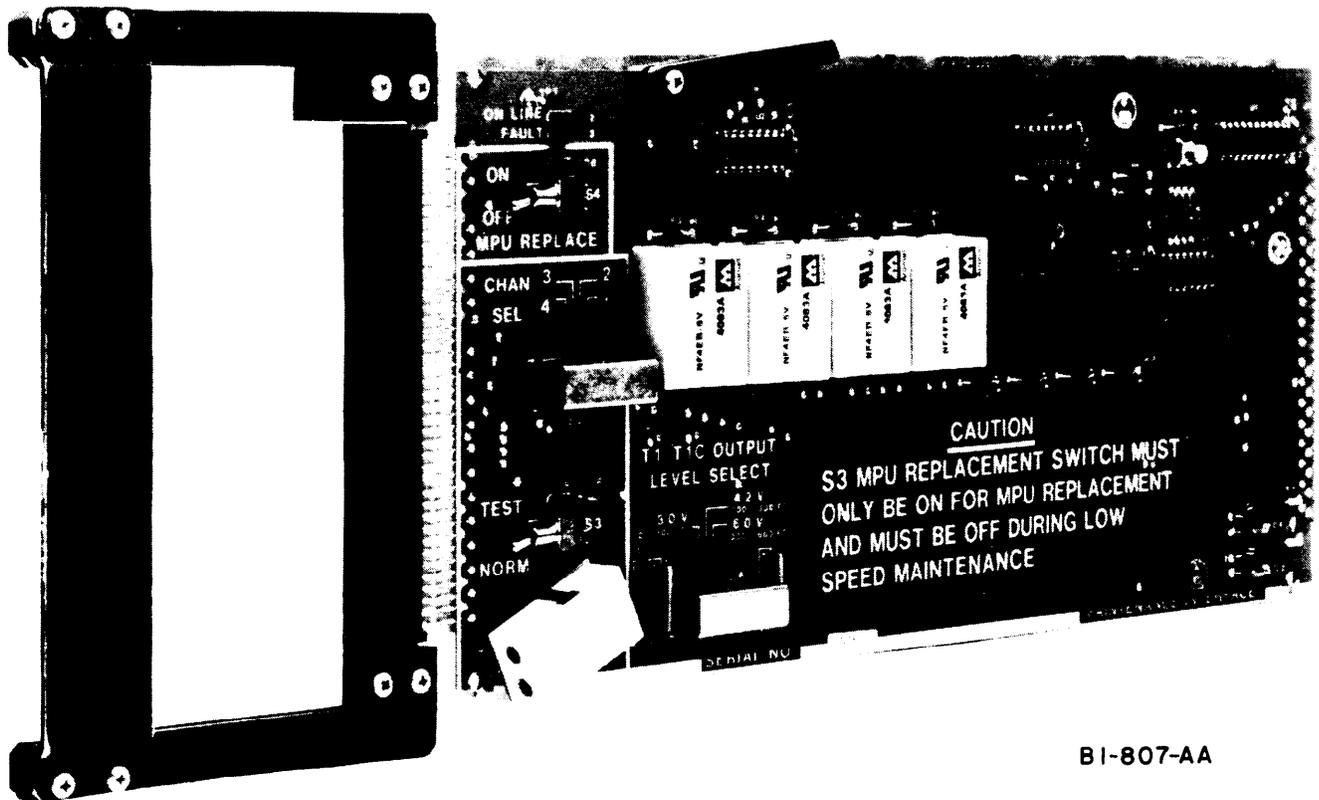and remote controlled switching are
provided.

BI-807-AA

Figure 1-5. Maintenance Interface Card

5. SYSTEM APPLICATIONS

5.01 The following section explores
system application possibilities
of the 828AF to address specific net-
work requirements.

A. Multiplexer Terminal

5.02 Figure 1-6 illustrates the 828AF
in a fiber-optic terminal appli-
cation. Incoming DS-1, DS-1C, or DS-2
data streams are multiplexed to the
DS-3 level. The DS-3 optical signal
is interfaced to a fiber cable span
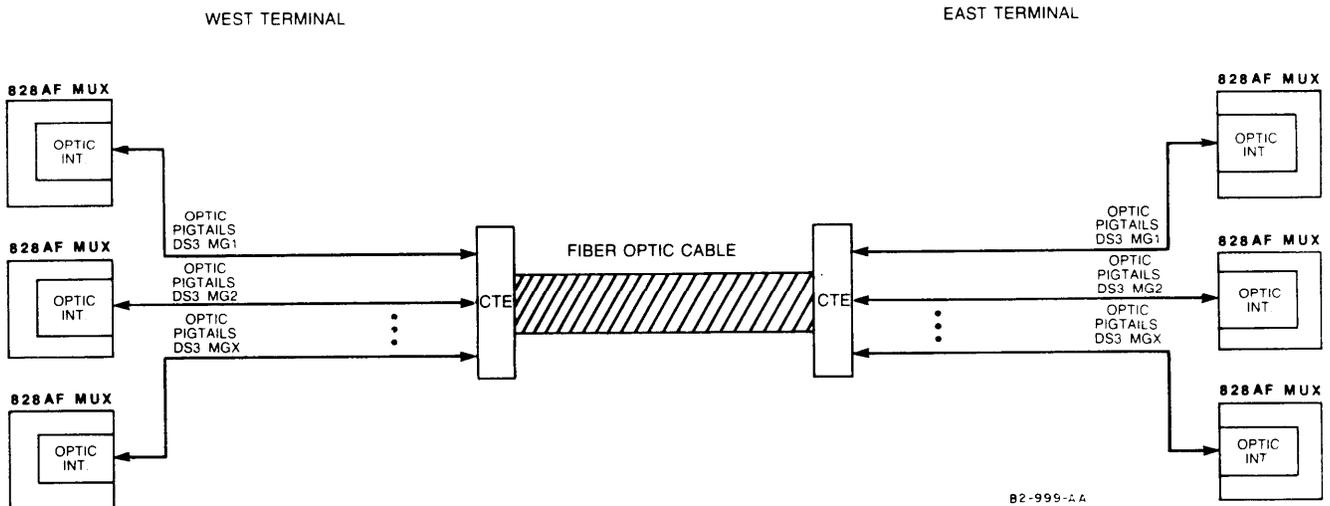and transmitted as a 45 Mb/s optical
carrier.

WEST TERMINAL   EAST TERMINAL

Figure 1-6. 828AF Digital Multiplexer Fiber-Optic Terminal Application

B. DS-3 Optical Extension

5.03 Figure 1-7 illustrates the 828AF
in a DS-3 optical extension
application. Individual DS-3 channels
demultiplexed from an incoming 560 Mb/s
trunk can be optically coded as 45 Mb/s

optical spans for remote site inter-
face to 828AF/828AFXT multiplexers.
This cost-effective system application
eliminates the need for back-to-back
45 Mb/s terminals to provide DS-3
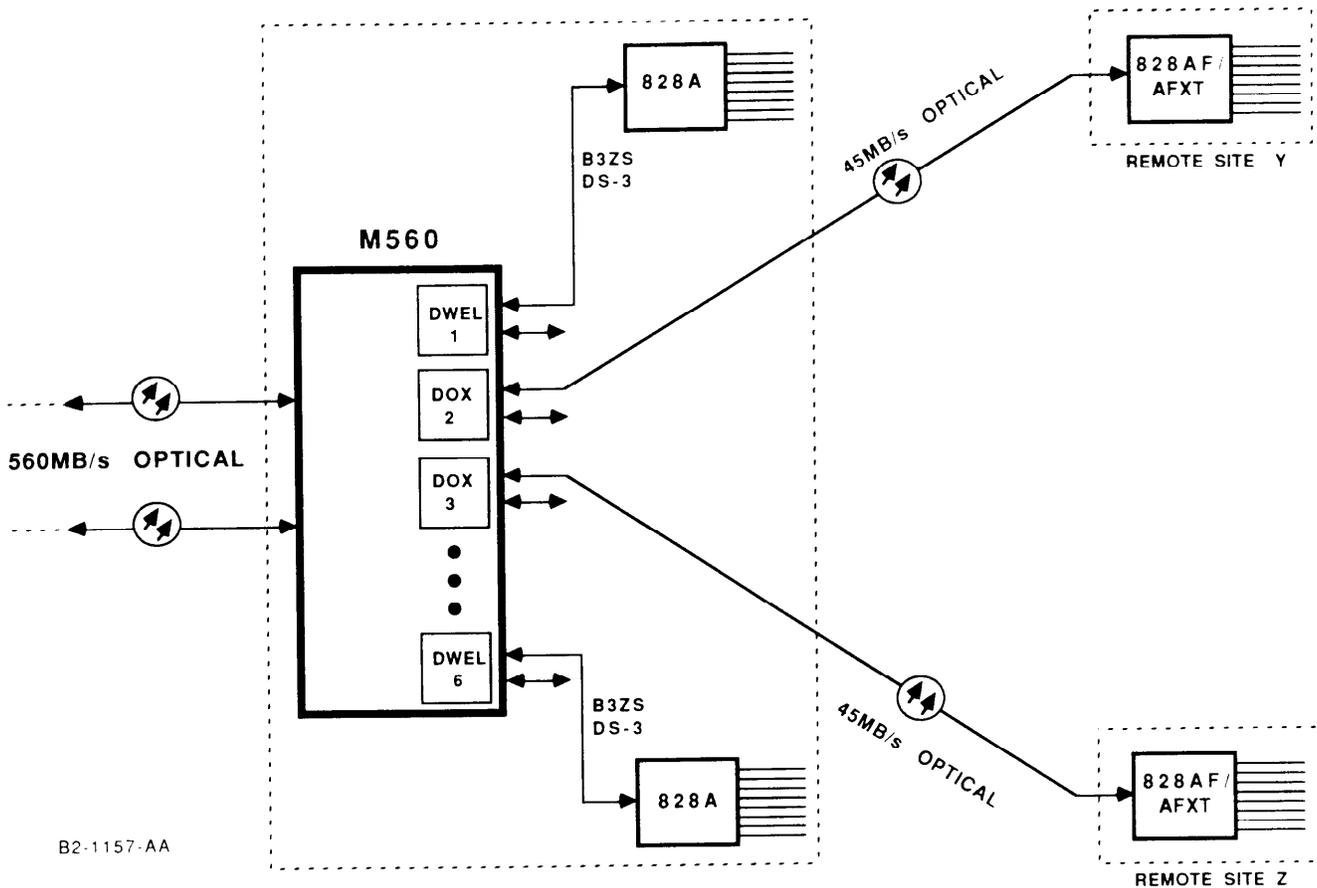optical hubbing.

Figure 1-7. 828AF/FOX-3 DS-3 Optical Extension Application

C. DS-2 Fiber-Optic Hubbing

5.04 Figure 1-8 illustrates the 828AF in a DS-2 fiber-optic hubbing application. The optical DS-3 transmission trunk interconnecting a central office and hub distribution center can be subdivided into six DS-2 optical

extensions to provide high-capacity transmission to individual terminal end users. LTU cards in the low-speed section of the 828AF multiplexer, as required, provide independent DS-2 optical spur links from the central hubbing location to remote FOX-2/FOX-2R units.
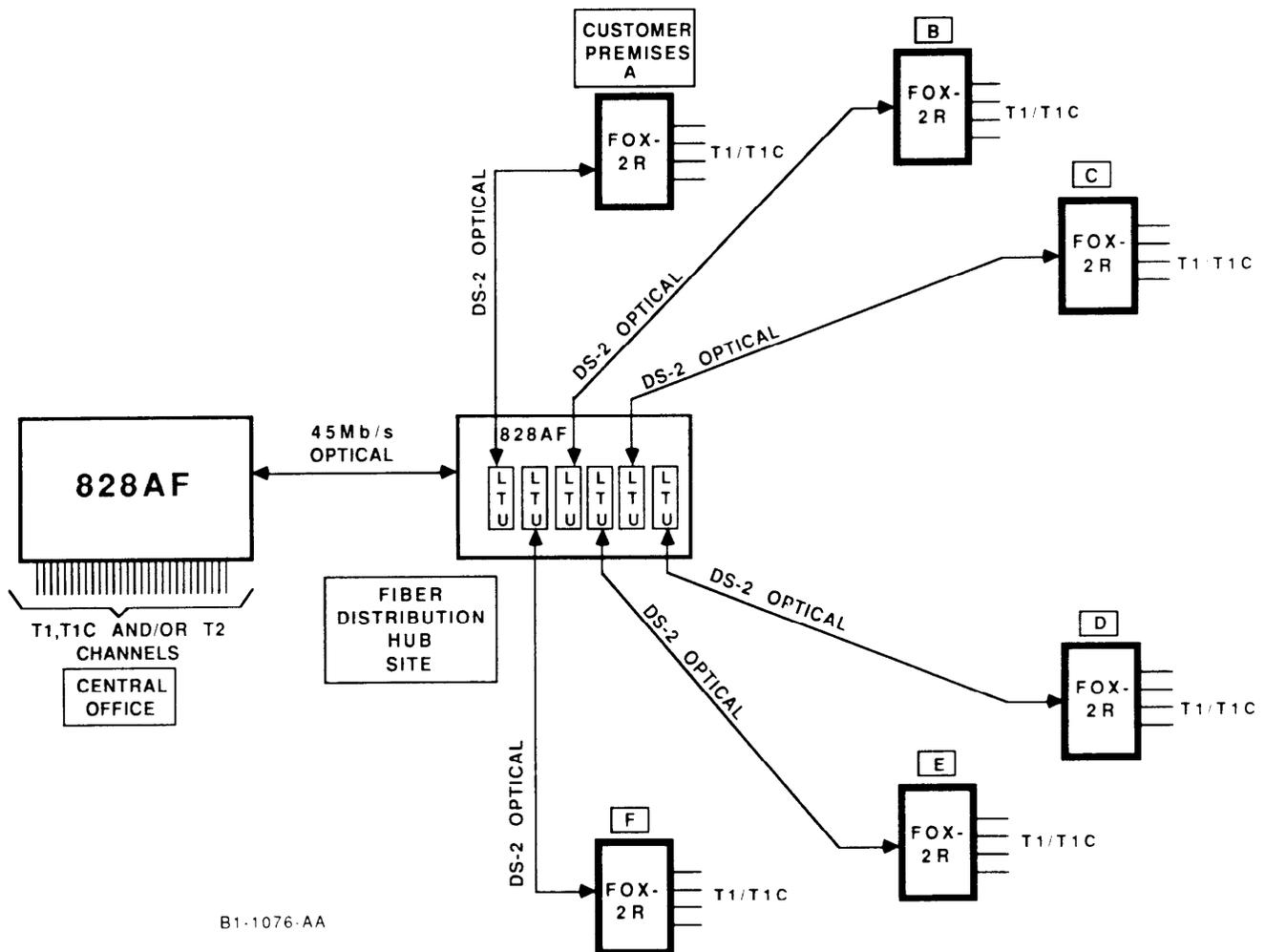

B1-1076-AA

Figure 1-8. 828AF/FOX-2/FOX-2R DS-2 Fiber-Optic Hubbing Application

D. TELTRAC Extension

5.05 Figure 1-9 illustrates the 828AF
      in a TELTRAC extension applica-
tion. Use of the RAC-II card enables
the TELTRAC signal to be bridged onto

the 828AF optical carrier, utilizing
a user-definable DS-3 X-bit, and to be
transported to and from the remote
site without requiring use of a modem,
Service Channel or other communication
channel facility.

LOCAL

TELTRAC

MASTER
SLAVE

REMOTE

F A P

F A P

RAC II | 828AF | XCVR

RAC II | 828AF | XCVR

SLAVE
MASTER

828AF | XCVR

TELTRAC DATA

TELTRAC DATA
CARRIED BY DS-3X-BIT
IN OPTICAL DATA STREAM

* HIGH SPEED COMMON (CCA120G2) MUST
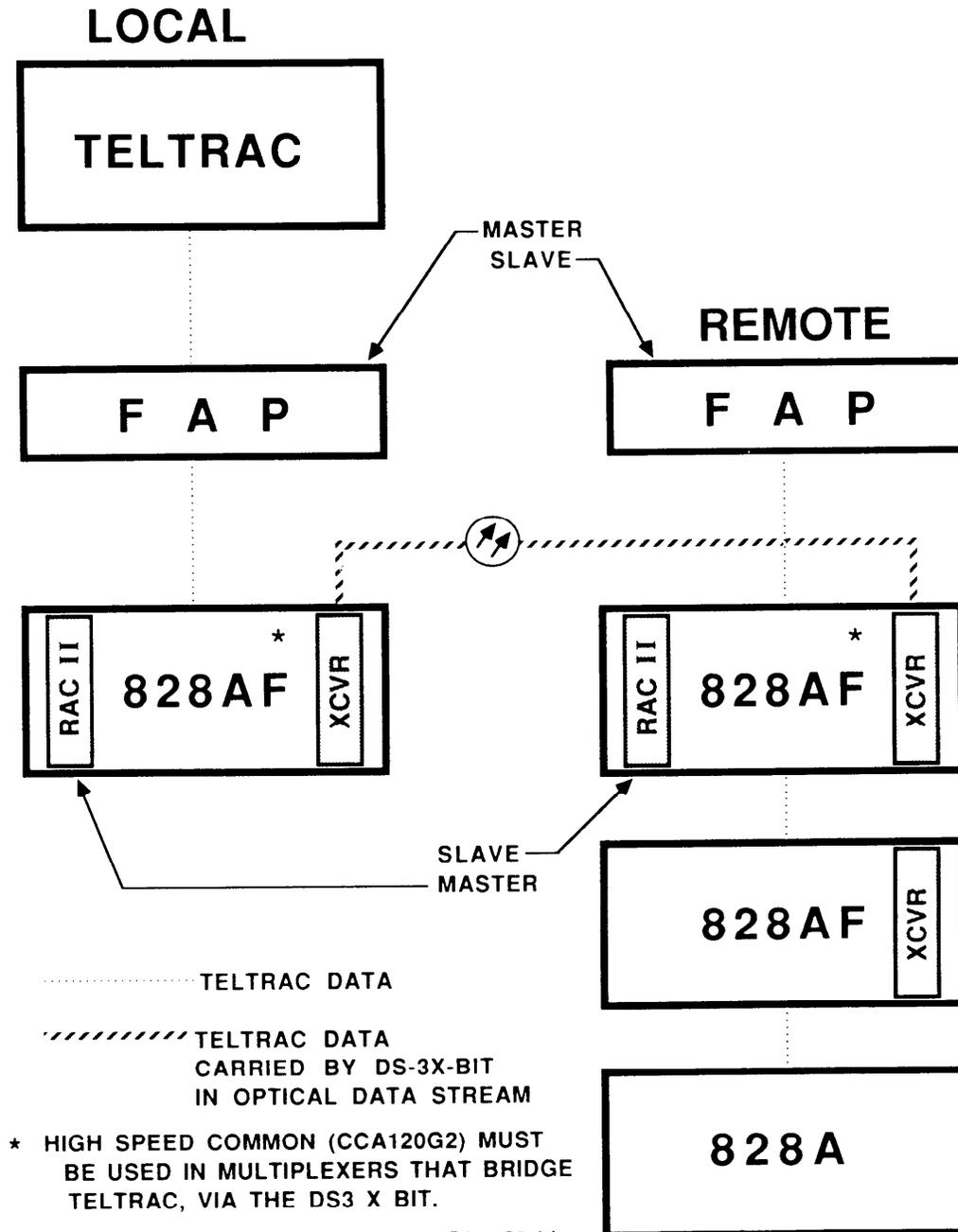 BE USED IN MULTIPLEXERS THAT BRIDGE
  TELTRAC, VIA THE DS3 X BIT.

828A

B2-1175-AA

Figure 1-9. 828AF TELTRAC Extension Application

1-11