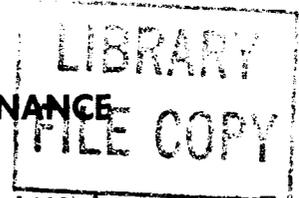


**MUX/VERTER**  
**DESCRIPTION, INSTALLATION, TESTING, MAINTENANCE**



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**1. GENERAL DESCRIPTION**

1.01 This section covers the description, installation, testing, and maintenance application of the General DataComm Industries, Inc., (hereafter referred to as GDC) Multiplexer/Converter (MUX/VERTER) terminal. The MUX/VERTER terminal converts the 43-type telegraph carrier frequencies to

the 100 series (101, 103, and 108) data set using F<sub>1</sub> and F<sub>2</sub> data frequencies. A typical application providing this service would use a 108-type data set at each customer location. Hereafter, reference to the 108-type data set will be used in this section. This section also covers the use of F<sub>1</sub> and F<sub>2</sub> channel modules.

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

1.03 Included in this section are excerpts from GDC Publication No. 017R323, Operating and Installation Instructions for Frequency Division Multiplexer Models MS-FT1 and MS-FT2, Copyright 1980 by GDC. The page number, paragraph number, or table designation from which the material was excerpted and the paragraph number of this section where the material is used is as follows:

- (a) Information from GDC Publication No. 017R323, page 120-1, paragraph 1.0 is used in paragraph 2.01 of this section.
- (b) Information from GDC Publication No. 017R323, page 120-4, Table 120.2 is used in Table B of this section.
- (c) Information from GDC Publication No. 017R323, page 120-6, Table 120.3 is used in Table C of this section.
- (d) Information from GDC Publication No. 017R323, page 120-8, Table 120.4 is used in Table D of this section.
- (e) Information from GDC Publication No. 017R323, page 200-20, paragraph 4.0 is used in paragraph 2.03 of this section.
- (f) Information from GDC Publication No. 017R323, page 300-2, paragraph 2.1.3 is used in paragraph 4.04 of this section.
- (g) Information from GDC Publication No. 017R323, page 300-2, paragraph 2.2 is used in paragraph 4.05 of this section.

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**1.04** The MUX/VERTER is used as a terminal for a 43-type Voice-Frequency Carrier Telegraph or Data (VFCT or VFCD) System. The existing sections on 43A-type and 43B-type line facilities apply to these facilities used with the MUX/VERTER terminal. Typical Bell System applications will have the telegraph serving test center (STC) hub office equipped with the 43-type terminal and the end office equipped with MUX/VERTER equipment. The MUX/VERTER terminal consists of a shelf or shelves to accommodate the following plug-in modules.

- (a) Power Supply (DPS-3A)
- (b) Frequency Division Multiplex (FDM) Common Module (017 P001-001)
- (c) Channel Module (FDM/F<sub>1</sub>F<sub>2</sub>).

**1.05** The MUX/VERTER is compatible with either a 43A-type or 43B-type terminal at the distant end. Channel assignments follow the existing rules for the 43A-type or 43B-type distant terminal. The F<sub>1</sub>F<sub>2</sub> data frequencies are compatible with the 108-series of private line data sets.

**1.06** Complete test and diagnostic features allow rapid sectionalization of trouble conditions. Tests are performed by actuating test switches built into the MUX/VERTER common and channel modules. The test and diagnostic features can be used for both installation and maintenance activities. Figure 1 presents a synopsis of the test features. Line status and alarm conditions are indicated by light emitting diodes (LEDs).

**1.07** Instruction manuals provided by GDC with each MUX/VERTER installation are acceptable, except as noted in this section, for use in all central office circuit order and maintenance activities. The following manuals are supplied:

- (a) FDM Multiplexer MS-FT1 and MS-FT2, Publication No. 017R323, Issue 9 or later
- (b) FDM Common Module, Publication No. 017R403, Issue 1 or later
- (c) DPS-3A Power Supply, Publication No. 017R406, Issue 3 or later.

**Note:** References to vendor contact in the manuals are to be disregarded. Any question about equipment, method or procedure that cannot be resolved locally should be referred through normal channels to appropriate Telco staff or engineering groups.

### A. Terminal Arrangements

**1.08** Two shelf arrangements are available, both designed to mount in standard 19- and 23-inch equipment bays. The mounting shelves measure 7 inches high by 19 inches wide (flanges end-to-end) by 10 3/4 inches deep.

**1.09** The MS-FT1 shelf accommodates up to 12 channel modules, one common module, and one DPS-3A dc inverter power supply.

**1.10** The MS-FT2 shelf accommodates up to 16 channel modules and one or two common modules. External power provided by the DPS-3A power supply is required for the necessary +5V, +12V, and -12 Vdc. The shelf may be equipped with one common module to provide a single system, or two common modules to provide two independent systems of up to eight channels each. Optional line and equipment jacks may be provided for access to the FDM and F<sub>1</sub>F<sub>2</sub> sides of the MUX/VERTER equipment. Additional optional bantam jacks are available from GDC to provide drop and insert capability at an EIA RS-232C level between the FDM common module and the F<sub>1</sub>F<sub>2</sub> module.

### B. Plug-In Modules

#### DPS-3A Power Supply (GLDC DPS 3A/—)

**1.11** The power supply module (DPS-3A) provides the +5V, +12V, and -12 Vdc required by the MS-FT1 or MS-FT2 shelf. The DPS-3A/24 requires 24V ±3 Vdc at 4 amps and the DPS-3A/48 requires 48V ±6 Vdc at 2 amps.

**1.12** The DPS-3A plugs directly into the MS-FT1 shelf or can be plugged into a separately mounted DPS-3 power shelf for powering the MS-FT2 shelf. The DPS-3 power shelf can accommodate up to three DPS-3A power supply modules. These can be connected to the MS-FT2 shelf using a GDC power cable assembly 024H201-002 plug-to-plug or 016H002 plug-to-wire.

### Frequency Division Multiplex Common Module (GLDC CC-9)

1.13 The FDM common module provides for termination of the 43-type carrier line and connection to the individual channel modules. Alarm circuitry to monitor channel alarms and master alarm status is included. Alarm relay contacts to activate external devices are also provided. This allows connections to central office alarm arrangements to be made.

1.14 Test access to the 43-type carrier line is provided by means of bantam jacks on the face of the FDM common module. Use of these lines or equipment jacks will open the carrier line, while the monitor jacks provide bridging connections to the 2- or 4-wire, 600-ohm send and receive line.

1.15 The LEDs are provided as part of the transmitting and receiving 43-type carrier detectors to provide alarm indication when the transmitted or received carrier fails.

1.16 A loop around circuit provides a method to loop the transmitted 43-type carrier signal back to the carrier detector circuit. This loop is controlled by means of a shorting pin (supplied by GDC) in the ANALOOP\* jack. All channels associated with the system are looped back toward the MUX/VERTER when this shorting pin is used. In addition, the MASTER ALARM indicator light is lit. Alarm cutoff (ACO) is provided by means of a shorting plug in the ACO jack.

### FDM/F<sub>1</sub>F<sub>2</sub> Channel Module (GLDC CT-1 ARN-1 CH--)

1.17 One FDM/F<sub>1</sub>F<sub>2</sub> channel module is required for each 43-type channel being established. The module generates the F<sub>1</sub> mark or space signal when the assigned 43-type channel mark or space signal is being received from the voice-frequency (VF) line. The FDM Norm LED indicator is lit when the 43-type carrier channel frequency is present above a predetermined level. In the other direction, the module generates the 43-type channel mark or space signal when the F<sub>2</sub> mark or space signal is being received from the data line. The F<sub>1</sub>F<sub>2</sub> Norm LED indicator is lit when the F<sub>2</sub> data signal level is above -35 dBm at the data line.

1.18 The FDM/F<sub>1</sub>F<sub>2</sub> channel module connects the F<sub>1</sub>F<sub>2</sub> data signal to the 2-wire line using a bal-

anced 600-ohm impedance. Test points A, B, and C provide for measuring the transmitted (A and C) F<sub>1</sub> and received (B and C) F<sub>2</sub> data signal levels.

**Note:** The test points mentioned above refer to the banana-type jacks found on the front panel of the FDM/F<sub>1</sub>F<sub>2</sub> channel module.

1.19 Test switches are provided for trouble sectionalization tests. The test switches consist of an F1F2 ANALOOP/Norm/FDM ANALOOP switch and an FDM LOOPBACK/Norm switch.

(a) The F1F2 ANALOOP/Norm/FDM ANALOOP switch in the F1F2 ANALOOP position effectively loops transmitted F<sub>1</sub> to the F<sub>2</sub> receiver of the FDM/F<sub>1</sub>F<sub>2</sub> channel module so that the distant 43-type terminal can test through the MUX/VERTER terminal. The FDM ANALOOP position loops the circuit at the 43-type line side back toward the data set.

(b) The FDM LOOPBACK/Norm switch in the FDM LOOPBACK position effectively loops the channel back to the distant 43-type terminal. This loopback is at the junction of the FDM/F<sub>1</sub>F<sub>2</sub> circuitry of the FDM/F<sub>1</sub>F<sub>2</sub> channel module.

1.20 The transmit level potentiometer provides adjustment for the F<sub>1</sub> data signal transmitting level. The range is continuously variable from 0 to -16 dBm (600 ohms).

### C. Frequency Allocation and FDM/F<sub>1</sub>F<sub>2</sub> Channel Module Marking

1.21 The channel frequencies follow the present frequency assignments of the 43A-type and/or 43B-type systems. The single bandwidth (SW) and double bandwidth (DW) channel designations are given in Table A. Note that the resistor network (RN-), RN-1 through RN-8, markings for SW channels are 47-x-x and for DW channels are 41-x-x. The 43-type channel frequencies are determined by these networks.

1.22 Each SW FDM/F<sub>1</sub>F<sub>2</sub> channel module is marked "GLDC Card CT-1 ARN-1 (ch 1 through 17)". The DW FDM/F<sub>1</sub>F<sub>2</sub> channel modules are marked "GLDC Card CT-1 ARN-2 (ch 1 through 8)". See Table A for cross reference to 43A-type or 43B-type channel frequencies.

\*Trademark of GDC

## 2. INSTALLATION AND CONNECTIONS

**2.01** Initial equipment installation (shelf assembly, backplane wiring, and cabling to distributing frame location) is normally performed by Western Electric Company, Inc. Equipment acceptance testing should be performed following the steps given in the preoperational check.

**CAUTION: Do not insert or extract DPS-3A module with power on.**

**2.02** Special equipment is needed to install the shelf assembly and for testing at particular jacks. A miniature pin switch comes packaged separately with each shipment of shelf-assembly equipment to be installed. Standard transmission test equipment (Northeast Transmission Test Set 4 or equivalent) should be used at MUX/VERTER locations for all installation and maintenance work. However, testing at the common module 4W SEND, 2W S/R, or 4W RCV jack requires a special bantam tip-to-310 plug patch cord. This cord may be a KS-21161, List 4, 6 ft length. Any equivalent cord is acceptable, such as one available from ADC Telecommunications. To order from ADC:

Order Wording: Conversion Patch Cord, Model No. PJ-946

Order From: ADC Telecommunications, 4900 West 78th Street, Minneapolis, MN 55435

### A. Preoperational Check

#### System Test

**2.03** Before placing the FDM unit in system operation, perform a preoperational check to assure performance within specification. If any requirements of the check cannot be obtained, refer to GDC Publication 017R323, Issue 9 or later, Section 300, Maintenance, for corrective action. Proceed with the preoperational check which follows.

- (a) Verify that all cable connections are secure at channels, data devices, shelf assemblies, and at VF telephone lines.
- (b) Check that line fuse F1 (MS-FT1 models only) is in place and operable.
- (c) On DPS-3A or appropriate power supply, set power On switch to On position.

(d) Insert a miniature tip plug into the FDM common module front panel ANALOOP jack, and check that the MASTER ALARM indicator is lighted and that the central office alarm is activated. All channels are now looped back on themselves via common module circuitry.

(e) On FDM/F<sub>1</sub>F<sub>2</sub> channels, sequentially perform the following steps for each active (programmed) channel:

- (1) Check that all switches are set to Norm position.
- (2) Check that F<sub>1</sub>F<sub>2</sub> Norm and FDM Norm indicators are lighted.
- (3) Using a high impedance RMS meter without termination, place one test lead into test point A on the front panel (connected to the circuit side of the F<sub>1</sub>F<sub>2</sub> transformer through a loading resistor), and place the other lead in test point C (ground reference). The signal measured at that point is the combined receive and transmit signal; the level of that combined signal should be 0 dBm. The level may be adjusted using the Xmt Lvl potentiometer located directly above the test points.

**Note:** These test points refer to banana-type jacks on the front panel of the channel module.

(4) Remove the test lead from test point A, and place it into test point B which is connected to the receive signal circuitry past the bandpass filter to allow isolations of the receive signal. The presence of the receive signal is verified by the reading. The signal level will be determined by the transmitting source.

(f) Remove miniature tip plug from the FDM common module front panel ANALOOP jack.

**2.04** Plug-in units (MUX/VERTER modules) as listed in Table A are orderable through the Plug-In Inventory Control System (PICS) or equivalent inventory control or supply system.

**Note:** Channel modules are orderable for channel frequency desired. Local programming of resistor network RN-1 through RN-8 or diode matrix is not recommended.

## B. Wiring and Adjustments at MUX/VERTER Equipment Bay

**2.05** The following connections and adjustments are made at the MUX/VERTER equipment bay. Normally, these connections are made as part of the engineering and installation effort.

**2.06** The carrier line is connected with the frame block tip to ring, T1R1, to VF line terminal transmit or receive.

**2.07** The local station is connected with the frame block to the channel INPUT/OUTPUT with pin 5 as the tip and pin 6 as the ring connection.

**2.08** The alarms are connected with the power supply (PS) ALM to VF ALM "NO to NO", "C to C", and "NC to NC". The office alarm is connected to VF ALM "NO". The office ground is connected to PS ALM "C". The "NO" refers to normally open, "NC" to normally closed, and "C" to common.

### Level Adjustments

**2.09** The following level adjustments are made at the MUX/VERTER equipment bay during initial circuit order activities to establish the system. Refer to Fig. 2.

**2.10** To adjust the VF transmit level, adjust switches 1-5 to -26 dB at the 4W send monitor on the FDM common unit.

**2.11** To adjust the  $F_1$  transmit level, adjust the transmit level to -9 dB at the 2W jack or pin 5 and 6 on the channel output.

**2.12** The  $F_2$  is needed to drive the FDM/ $F_1F_2$  channel module to transmit VF channel frequency, or  $F_1F_2$  ANALOOP must be operated with the receive carrier frequency at the far-end office.

## C. Indicator Lamps, Jacks, and Switches

**2.13** Tables B, C, and D provide functional description of lamps, indicators, jacks, and switches for the power supply, FDM/ $F_1F_2$  channel module, and the FDM common module.

**2.14** When there is an office alarm, the MASTER ALARM indicator lamp is lit indicating the following conditions.

- (a) Loss of any or all voltages

- (b) Loss of all  $F_2$  tones (FDM common xmit LED indicator off)

- (c) Loss of all VF channel receive (FDM common receive LED indicator off)

- (d) FDM ANALOOP switch operated on FDM  $F_1F_2$  channel module, or ANALOOP switch operated, or FDM common unit operated (FDM common xmit LED indicator off).

**Note:** Insert pin switch into ACO to silence office audible alarms.

## D. MUX/VERTER Options

**2.15** Both the common module and channel unit module require option settings that must be performed locally.

### Transmit Level Selection

**2.16** Option selection is discussed in detail in GDC Publication No. 017R323, Section 200. However, the tables referred to in the GDC section should be disregarded. Refer to Tables E and F of this section for option selection.

**2.17** The common module options are shown in Table E. The common module transmit level selection switch (S1) should be set for -26 dB. Set S1 switches 1, 2, and 4 to ON position to obtain -26-dBm attenuation. The composite signal level will be -13 dBm with an individual SW of -26 dBm and DW of -23 dBm. A 19-dB pad is required to meet the proper composite level at the voice-frequency carrier, mode-in jacks (-16 TLP).

**2.18** The channel module options are shown in Table F. The  $F_1F_2$  channel module transmit level should be adjusted to obtain the level specified on the circuit layout record card. Level adjustments are made through potentiometer R85, which is located on the front panel of the channel module. The potentiometer is variable from 0 dBm to -16 dBm. (Potentiometer is factory set at 0 dBm.)

## 3. TEST METHODS

**3.01** Test persons at both MUX/VERTER equipped locations and the telegraph STC hub location should become familiar with test and diagnostic methods in order to sectionalize and isolate trouble

conditions. When performing installation and maintenance tests, refer to Fig. 1.

**Note:** The hub office 43-type channel will have to be placed in the full-duplex mode to be able to perform loopback tests of the far-end MUX/VERTER or data set. However, end-to-end tests or straight-away tests can be made with the hub office 43-type channel in the half-duplex mode.

**A. Line Facility**

**3.02** The VF line facility is tested between the hub (or STC) and the MUX/VERTER site using standard procedures. A typical office layout is illustrated in Fig. 3.

**B. Common Module**

**3.03** Testing at the MUX/VERTER location involves the following:

- (1) Select the applicable option(s) from Table E and insert common module and power supply units into the shelf assembly.
- (2) Select a channel (channel choice optional) for testing the common module.
- (3) Insert channel card.
- (4) Activate the FDM LOOPBACK/Norm switch on the channel module to FDM LOOPBACK position.

**Note:** The hub will send a signal to test the common module. The signal will pass over the line facility through the common module through FDM circuitry in the channel card and back to the hub.

**C. Channel Module**

**3.04** Testing at the MUX/VERTER location involves the following:

- (1) The F1F2 ANALOOP/Norm/FDM ANALOOP switch on the FDM F<sub>1</sub>F<sub>2</sub> channel module in the F1F2 ANALOOP position will loopback individual channels to check out the FDM common and FDM F<sub>1</sub>F<sub>2</sub> sections of the channel module.
- (2) The station loopback switch checks out the VF line (hub to MUX/VERTER), common and

channel modules, and the local facility. Operation of the station loopback switch does not always check out the station equipment.

**3.05** Testing of the local facility involves the following:

- (1) The FDM ANALOOP checks out station equipment, local facility, and FDM/F<sub>1</sub>F<sub>2</sub> unit. A test signal generated at the customer location is looped through the FDM/F<sub>1</sub>F<sub>2</sub> unit and received at the customer location.
- (2) The station loopback checks out toll facility and equipment from the hub location to the station location. (Loopback does not check out station equipment.)

**4. MAINTENANCE METHODS**

**Troubleshooting Concept**

**4.01** The troubleshooting concept and the methods for troubleshooting the MUX/VERTER system are briefly discussed. Detailed maintenance instructions for the MUX/VERTER system are contained in GDC Publication 017R323, Sections 300 and 500.

**4.02** Troubleshooting the FDM consists of isolating a fault by the process of elimination. The technique of signal loopback is used to isolate faults to specific areas in the FDM system.

**4.03** If a channel module fails to operate properly, it may be necessary to check that the baud rate has been properly selected. Normally, channel module baud rate is programmed to telephone company specifications by the GDC Customer Service Center. If the baud rate must be verified, refer to GDC Publication 017R323, Section 300.

**4.04** Figure 1 shows the resultant signal paths when each of the diagnostic tests is initiated for an FDM/F<sub>1</sub>F<sub>2</sub> module. The diagnostic tests are as follows:

- (a) When an FDM ANALOOP test is initiated, the signal lines are opened as in Fig. 1 shown at points labeled 1. A test message from the business machine interfaced to the remote F<sub>1</sub>F<sub>2</sub> data set may be looped back from the local transmit line to the local receive line. A successful printout of the

test message at the remote data device indicates that all the local circuit elements shown in the test path are functioning correctly.

(b) When an  $F_1F_2$  ANALOOP test is initiated, the signal line is altered as shown in Fig. 1 by arrow 2. A test message from the business machine interfaced to the remote FDM channel equipment may be looped back through both FDM and  $F_1F_2$  modulators and demodulators. A successful printout of the test message at the remote data device indicates that all the local circuit elements shown in the test path are functioning correctly.

(c) When an FDM loopback test is initiated, as shown in Fig. 1, the input signal path to the FDM modulator is opened at point 3 and the loopback indicated by arrow 3 is formed. A test message from the business machine interfaced to the remote FDM channel equipment may be looped back through the FDM modulator and demodulator circuits only. A successful printout of the test message at the remote data device indicates that the circuit elements shown in the test path are functioning correctly.

(d) When a common ANALOOP test is initiated, using FDM  $F_1F_2$  modules, the output of the common VF transmit line interface is looped back to the common VF receive line interface. This test does not loop VF lines back to the hub location. Testing cannot be performed locally unless the "data drop and insert" feature has been implemented.

**Note:** Use of the common ANALOOP test stops all FDM data traffic on the particular system under test.

#### Diagnosing FDM Troubles

**4.05** Two preliminary checks must be made prior to the start of fault analysis. The following preliminary checks must be performed.

- (a) Visually inspect the integrity of all local connections such as: data device cables, VF telephone cables, and FDM power cables.
- (b) Observe the status of the front panel indicators.

#### Tests

**4.06** The tests which are performed at installation (circuit order work), during trouble investiga-

tion, after a repair has been made, or periodically when performance must be verified are as follows. The tests should be conducted under control of the telegraph STC following the steps outlined in the subsequent paragraphs.

**4.07** A flowchart of the trouble clearing process is shown in Fig. 4. Possible trouble indications are:

- (a) No channel frequency received at the hub office; ie, absence of  $F_2$  frequencies
- (b) No channel frequency received at the far-end station; ie, absence of  $F_1$  frequencies, no copy, or running open at the business machine
- (c) Indication of garble, distortion, hits or errors at the far-end station or hub office, or both.

Recommended maintenance spare plug-in modules are listed in Table G. The power supply (GLDC DPS-3-48) and the FDM common module (GLDC CC-9) are recommended maintenance spares at all MUX/VERTER locations. If channel 1 is used as the maintenance spare (SPX) patching channel, channel 1-card (GLDC CT-1 ARN-1 Ch 1) should be authorized at all MUX/VERTER locations. If channel 1 is not used as the SPX, channel 1-18 cards should be authorized on a ratio of one for each 24 channels in service. For MUX/VERTER locations with DW channels in service, channel 51-56 cards should be authorized SPX on a ratio of one for 24 DW channels in service.

**4.08** Possible sources of trouble conditions are:

- (a) No power at far-end station
- (b) No power at MUX/VERTER
- (c) Defective business machine
- (d) Defective data set
- (e) Open, noisy, or faulty local loop
- (f) Defective MUX/VERTER FDM/ $F_1F_2$  module (channel unit)
- (g) Defective MUX/VERTER FDM common module
- (h) Defective VF line facility between MUX/VERTER location and hub office

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- (i) Defective 43-type carrier/channel at hub office
- (j) Open jumper at any telephone company cross-connect frame
- (k) Improper option settings on MUX/VERTER equipment
- (l) Testing techniques, including faulty test equipment, test jacks, and level settings.

**4.09** The trouble source can be sectionalized by employing logical testing techniques and using the test and diagnostic features built into the MUX/VERTER equipment and/or certain Bell System data sets. Referring to Fig. 1 and 4, proceed as follows:

**CAUTION: Avoid use of the MUX/VERTER common ANALOOP loopback test. Operation of this test switch disrupts all traffic and does not result in loopback toward the hub.**

- (1) The 43-type channel must be placed in the full-duplex mode at the telegraph STC in order to observe far-end (MUX/VERTER or data set) loopback test results. When an  $F_1$  mark is transmitted toward the far-end MUX/VERTER or data set in the loopback test mode, an  $F_2$  mark should be received at the telegraph STC.
- (2) Operate far-end data set loopback test switch. If test results are satisfactory, trouble may be in the business machine. If test results are not satisfactory, proceed to Step 3.
- (3) Check MUX/VERTER system office alarms. If the office alarms are in alarm condition, repair the source of trouble. If office alarms are satisfactory, proceed to Step 4.
- (4) Operate MUX/VERTER FDM  $F_1F_2$  module ANALOOP loopback test switch. If the test results are satisfactory, trouble is in the local loop or the far-end data set. If test results are not satisfactory, proceed to Step 5.
- (5) Operate the MUX/VERTER FDM common module FDM ANALOOP loopback test switch. If the test results are satisfactory, trouble may be in the FDM/ $F_1F_2$  module. Replace the module. If trouble still exists, the trouble may be in the FDM common module.

**Note 1:** There may be more than one channel causing trouble in the system.

**Note 2:** All traffic in the system is disrupted when the FDM common module is replaced.

- (6) The VF line facilities can be tested using standard techniques. If an emergency patching spare VF facility is available between the STC hub and the MUX/VERTER location, the system should be patched and the regular VF line facility repaired.
- (7) The 43-type system and channel at the telegraph STC can be tested using standard techniques outlined in Section 314-410-510.
- (8) Restore the 43-type channel at the telegraph STC to half-duplex operation, if required.

**4.10** A maintenance spare patching channel must be reserved in case the regular channel module is defective. Channel 1 is recommended for use as the maintenance spare patching channel. The channel is patched at MUX/VERTER locations by removing the defective regular channel module and inserting the maintenance spare module in place of the regular module, while hub locations patch to the maintenance spare (channel 1) via jack arrangement.

## 5. REFERENCES

**5.01** The following references provide additional information on the 43A-type and 43B-type Carrier Telegraph Systems.

SECTION	TITLE
312-700-100	(J70112) Description and Operation
312-700-200	(J70112) Installation and Connection
312-700-300	(J70112) Maintenance Procedures
312-700-500	(J70112) Test Procedures
312-710-100	Central Office Arrangement, General Description
312-710-200	Out of Service and Installation Tests
312-710-201	2- and 4-wire Connections, Description and Installation

312-710-500      Trouble Locating Tests

**5.02** The following references are generally supplied with each MUX/VERTER installation. Additional copies should be ordered through the appropriate Bell Operating Company staff organization.

GDC PUBLICATION NO.	TITLE
017R323	Operating & Installation Instructions for Frequency Division Multiplexer Modules MS-FT1 and MS-FT2, General DataComm Industries, Inc.
017R403	Frequency Division Multiplexers Common Module, General DataComm Industries, Inc.

GDC PUBLICATION NO.	TITLE
017R404	FDM/F <sub>1</sub> F <sub>2</sub> Channel Module, General DataComm Industries, Inc.
017406	DPS-3A Power Supply, General DataComm Industries, Inc.
017R407	High Level (62 1/2 mA) Loop Channel Module, General DataComm Industries, Inc.
017R414	Low Level (20 mA) Loop Channel Module, General DataComm Industries, Inc.
017R402	T & R Base Module, General DataComm Industries, Inc.

TABLE A

## MUX/VERTER CHANNEL CARD IDENTIFICATION

COMMON LANGUAGE IDENTIFICATION CODE	NOMENCLATURE	RN-1 THROUGH RN-8 NETWORK MARKING (NOTE 1)	FREQUENCY	CPR (NOTE 2)	43-TYPE CARRIER CHANNEL NO.
43TBG391AA	GLDC Card CT-1 ARN-1 (Ch-1)	47-1-1	425 Hz	273825	1
43TBG401AA	GLDC Card CT-1 ARN-1 (Ch-2)	47-2-2	595 Hz	273826	2
43TBG411AA	GLDC Card CT-1 ARN-1 (Ch-3)	47-3-3	765 Hz	273827	3
43TBG421AA	GLDC Card CT-1 ARN-1 (Ch-4)	47-4-4	935 Hz	273828	4
43TBG431AA	GLDC Card CT-1 ARN-1 (Ch-5)	47-5-5	1105 Hz	273829	5
43TBG441AA	GLDC Card CT-1 ARN-1 (Ch-6)	47-6-6	1275 Hz	273830	6
43TBG451AA	GLDC Card CT-1 ARN-1 (Ch-7)	47-7-7	1445 Hz	273831	7
43TBG461AA	GLDC Card CT-1 ARN-1 (Ch-8)	47-8-8	1615 Hz	273832	8
43TBG471AA	GLDC Card CT-1 ARN-1 (Ch-9)	47-9-9	1785 Hz	370097	9
43TBG481AA	GLDC Card CT-1 ARN-1 (Ch-10)	47-10-10	1955 Hz	370098	10
43TBG491AA	GLDC Card CT-1 ARN-1 (Ch-11)	47-11-11	2125 Hz	370099	11
43TBG501AA	GLDC Card CT-1 ARN-1 (Ch-12)	47-12-12	2295 Hz	370100	12
43TBG511AA	GLDC Card CT-1 ARN-1 (Ch-13)	47-13-13	2465 Hz	370101	13
43TBG521AA	GLDC Card CT-1 ARN-1 (Ch-14)	47-14-14	2635 Hz	370102	14
43TBG531AA	GLDC Card CT-1 ARN-1 (Ch-15)	47-15-15	2805 Hz	370103	15

See note(s) at end of table.

TABLE A (Contd)

MUX/VERTER CHANNEL CARD IDENTIFICATION

COMMON LANGUAGE IDENTIFICATION CODE	NOMENCLATURE	RN-1 THROUGH RN-8 NETWORK MARKING (NOTE 1)	FREQUENCY	CPR (NOTE 2)	43-TYPE CARRIER CHANNEL NO.
43TBG541AA	GLDC Card CT-1 ARN-1 (Ch-16)	47-16-16	2975 Hz	370104	16
43TBG551AA	GLDC Card CT-1 ARN-1 (Ch-17)	47-17-17	3145 Hz	370105	17
43TBG561AA	GLDC Card CT-1 ARN-1 (Ch-18)	47-18-18	3315 Hz	273833	None
43TBG331AA	GLDC Card CT-1 ARN-2 (Ch-3)	41-3-3	1360 Hz	270199	51
43TBG341AA	GLDC Card CT-1 ARN-2 (Ch-4)	41-4-4	1700 Hz	270426	52
43TBG351AA	GLDC Card CT-1 ARN-2 (Ch-5)	41-5-5	2040 Hz	270424	53
43TBG361AA	GLDC Card CT-1 ARN-2 (Ch-6)	41-6-6	2380 Hz	270425	54
43TBG371AA	GLDC Card CT-1 ARN-2 (Ch-7)	41-7-7	2720 Hz	270197	55
43TBG381AA	GLDC Card CT-1 ARN-2 (Ch-8)	41-8-8	3060 Hz	270198	56
43TBG311AA	GLDC Card CT-1 ARN-2 (Ch-1)	41-1-1	680 Hz	270768	57*
43TBG321AA	GLDC Card CT-1 ARN-2 (Ch-2)	41-2-2	1020 Hz	270769	58*

**Note 1:** RN—Resistor network

**Note 2:** CPR—Continuing property record

\*43B-type only

TABLE B

**FDM POWER SUPPLY DPS-3A  
INDICATORS, JACKS, AND SWITCH**

INDICATORS, JACKS, AND SWITCH	FUNCTIONAL DESCRIPTION
INPUT Dc Indicator	Lights when battery power is applied to the input of the power supply and ON switch is in the up position. Will not light if the fuse is blown.
OUTPUT Dc Indicator	Lights only when all outputs are present.
ON Switch	Energizes power supply when in up position, OFF when switch is down.
INPUT Dc Test Points*	
—	Enables monitoring of negative side of station battery input (resistor isolated).
+	Enables monitoring of positive side of station battery input (resistor isolated).
OUTPUT Dc Test Points*	Enable monitoring of regulated DC output voltage.
+12V	Resistor isolated test point.
+5V	Resistor isolated test point.
COM	Power supply circuit ground.
-12V	Resistor isolated test point.

\* Measurements on resistor isolated test points should be made with an instrument greater than or equal to 20,000 ohms per volt sensitivity in order to ensure a valid reading.

TABLE C

**FDM COMMON MODULE  
INDICATORS AND JACKS**

INDICATORS AND JACKS	FUNCTIONAL DESCRIPTION
CARRIER Rcv Indicator Xmt Indicator	Indicates presence of aggregate receive carrier when lit. Indicates presence of aggregate transmit carrier when lit.
MASTER ALARM Indicator	Indicates presence of FDM system alarm. Lights for any channel module alarm condition, loss of aggregate receive carrier (option), loss of aggregate transmit carrier (option), and common module ANALOOP diagnostic test.
ACO Jack	Cancels common alarm relay action, when pin switch is inserted.
ANALOOP Jack	Places the common module into ANALOOP test mode when pin switch is inserted, causing the following: <ul style="list-style-type: none"> <li>(a) Data transmission to remote end is stopped.</li> <li>(b) VF telco lines are disconnected from FDM common card.</li> <li>(c) Transmitted FDM signal is looped back to receiver input via a 16-dB attenuator.</li> <li>(d) An alarm signal is generated.</li> </ul> <p><b>Caution: Use of the common ANALOOP test stops ALL FDM data traffic.</b></p>
4W SEND 2W S/R Mon Jack	Bantam-type jack (0.175 inch ID). Provides bridging access to 2-wire send/receive or 4-wire send line.
Line Jack	Bantam-type jack (0.175 inch ID). Insertion of plug into jack disconnects the transmit pair equipment side from the line and provides access to telco line for monitoring or testing.
Eqpt Jack	Bantam-type jack (0.175 inch ID). Insertion of plug into this jack disconnects the transmit pair line side, and provides access to aggregate FDM signal generated by the equipment.
4W RCV Mon Jack	Bantam-type jack (0.175 inch ID). Provides bridging access to 4-wire receive line.

TABLE D

**FDM F<sub>1</sub>F<sub>2</sub> CHANNEL MODULE  
INDICATORS, JACKS, AND SWITCHES**

INDICATORS, JACKS, AND SWITCHES	FUNCTIONAL DESCRIPTION
F <sub>1</sub> F <sub>2</sub> Norm Indicator	Indicates presence of received carrier from the remote data set. The threshold level is at least -38 dBm ±3 dB at the F <sub>1</sub> F <sub>2</sub> VF line interface.
Xmt Lvl Potentiometer	Provides adjustment of F <sub>1</sub> F <sub>2</sub> carrier transmit level from 0 to -16 dBm, as measured between test jacks A and C.
Xmt Lvl A and C Jacks	Provides test points across line side of F <sub>1</sub> F <sub>2</sub> two-wire line transformer to allow measurement of transmit output level as an aid in making transmit level adjustments.
Xmt Lvl B and C Jacks	Provides test points past bandpass filter, for measurement of the isolated received F <sub>2</sub> line signal level.
F <sub>1</sub> F <sub>2</sub> ANALOOP-Norm-FDM ANALOOP Switch	Three-position switch used to initiate F <sub>1</sub> F <sub>2</sub> ANALOOP or FDM ANALOOP tests.
F <sub>1</sub> F <sub>2</sub> ANALOOP Position	Forces the F <sub>1</sub> F <sub>2</sub> circuits into ANALOOP operation.
Norm Position	Allows the FDM/F <sub>1</sub> F <sub>2</sub> channel module to operate normally.
FDM ANALOOP Position	Forces the FDM circuits into ANALOOP operation.
FDM Norm Indicator	Indicates presence of received carrier from the remote FDM; threshold level is at least -39 dBm ±3 dB at the common module VF line interface, or at least -25.5 dBm ±3 dB at the common module/FDM/F <sub>1</sub> F <sub>2</sub> channel module interface.
FDM LOOPBACK/Normal Switch	Two-position switch used to initiate LOOPBACK test or to permit normal operation.
LOOPBACK Position	FDM demodulated data are returned to the FDM transmitter input as well as being routed to the F <sub>1</sub> transmitter. The F <sub>2</sub> demodulated signals are ignored.
Normal Position	FDM demodulated data are connected to the F <sub>1</sub> transmitter and F <sub>2</sub> demodulated data are connected to the FDM transmitter.

TABLE E

## COMMON MODULE STRAP OPTIONS

OPTION	STRAP
Transmit Carrier Alarm	E7 to E8
Receive Carrier Alarm	E9 to E10
4-Wire Aggregate VF Line	E12 to E13
2-Wire Aggregate Line	E11 to E12
	E14 to E15
	E16 to E17

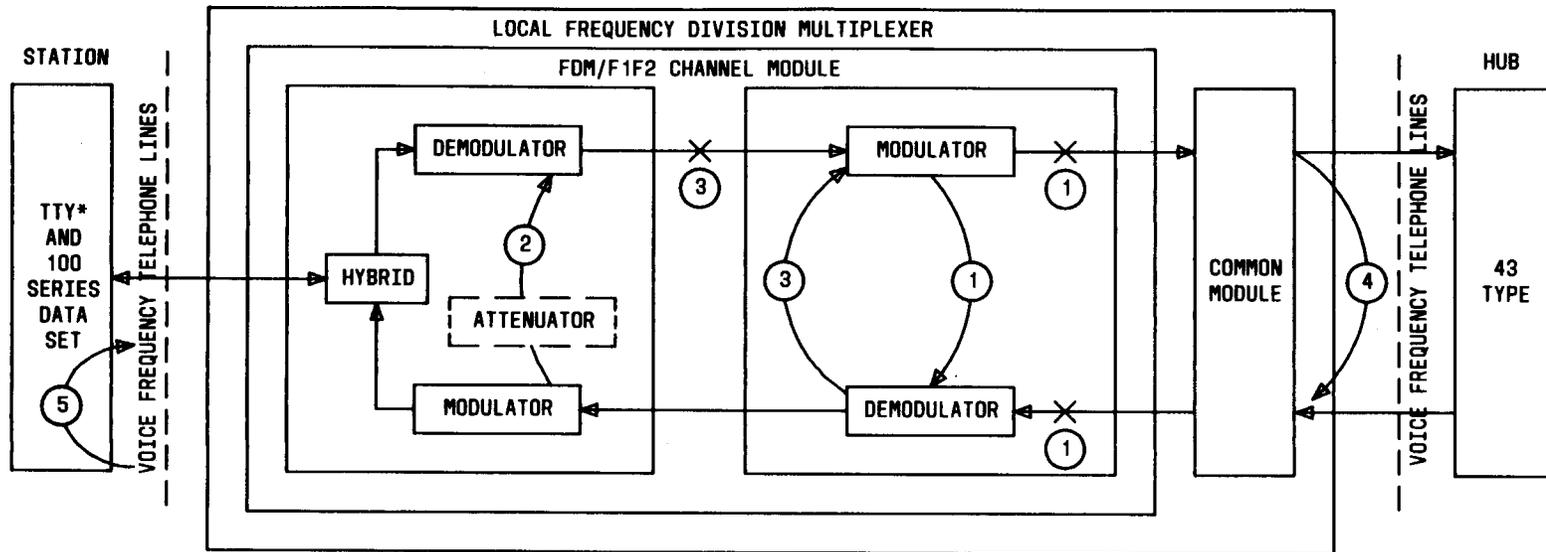
TABLE F

## CHANNEL MODULE STRAP OPTIONS

OPTION	STRAP
Alarm On	X1
WEC0 Frequency	X3, X5
Drop and Insert	Where "drop and insert" bantam jacks are not used, do not remove straps X7 and X8.

**TABLE G**  
**RECOMMENDED MUX/VERTER MAINTENANCE SPARE**  
**PLUG-IN UNITS**

AUTHORIZATION	PLUG-IN UNIT DESCRIPTION	PLUG-IN UNIT ORDERING INFORMATION
1	Power Supply	Supply, GLDC DPS-3-48
1	FDM Common Module	Card, GLDC CC-9
1	Ch #1 - Card	Card, GLDC CT-1 ARN-1 (Ch-1)
1	Ch #2 - Card	Card, GLDC CT-1 ARN-1 (Ch-2)
1	Ch #3 - Card	Card, GLDC CT-1 ARN-1 (Ch-3)
1	Ch #4 - Card	Card, GLDC CT-1 ARN-1 (Ch-4)
1	Ch #5 - Card	Card, GLDC CT-1 ARN-1 (Ch-5)
1	Ch #6 - Card	Card, GLDC CT-1 ARN-1 (Ch-6)
1	Ch #7 - Card	Card, GLDC CT-1 ARN-1 (Ch-7)
1	Ch #8 - Card	Card, GLDC CT-1 ARN-1 (Ch-8)
1	Ch #9 - Card	Card, GLDC CT-1 ARN-1 (Ch-9)
1	Ch #10 - Card	Card, GLDC CT-1 ARN-1 (Ch-10)
1	Ch #11 - Card	Card, GLDC CT-1 ARN-1 (Ch-11)
1	Ch #12 - Card	Card, GLDC CT-1 ARN-1 (Ch-12)
1	Ch #13 - Card	Card, GLDC CT-1 ARN-1 (Ch-13)
1	Ch #14 - Card	Card, GLDC CT-1 ARN-1 (Ch-14)
1	Ch #15 - Card	Card, GLDC CT-1 ARN-1 (Ch-15)
1	Ch #16 - Card	Card, GLDC CT-1 ARN-1 (Ch-16)
1	Ch #17 - Card	Card, GLDC CT-1 ARN-1 (Ch-17)
1	Ch #18 - Card	Card, GLDC CT-1 ARN-1 (Ch-18)
1	Ch #51 - Card	Card, GLDC CT-1 ARN-2 (Ch-3)
1	Ch #52 - Card	Card, GLDC CT-1 ARN-2 (Ch-4)
1	Ch #53 - Card	Card, GLDC CT-1 ARN-2 (Ch-5)
1	Ch #54 - Card	Card, GLDC CT-1 ARN-2 (Ch-6)
1	Ch #55 - Card	Card, GLDC CT-1 ARN-2 (Ch-7)
1	Ch #56 - Card	Card, GLDC CT-1 ARN-2 (Ch-8)
1	Ch #57 - Card	Card, GLDC CT-1 ARN-2 (Ch-1)
1	Ch #58 - Card	Card, GLDC CT-1 ARN-2 (Ch-2)

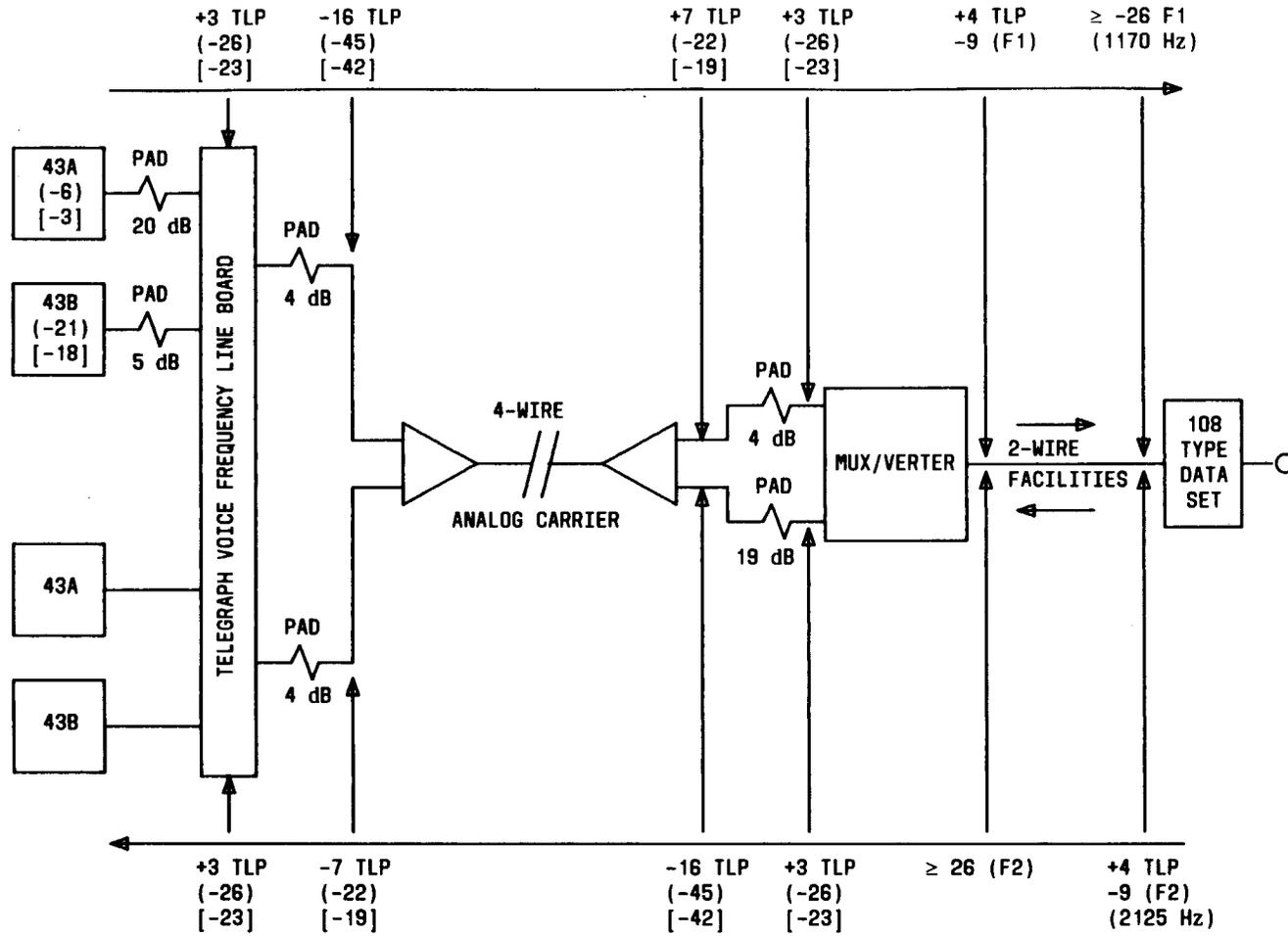


LOOPBACK LOCATIONS:

- ① FDM ANALOOP - WHEN ACTUATED, THE TEST MESSAGE OR SIGNAL FROM CUSTOMER IS LOOPED THROUGH ① BACK TO CUSTOMER.
- ②  $F_1 F_2$  ANALOOP - WHEN ACTUATED, THE TEST MESSAGE OR SIGNAL FROM HUB LOCATION IS LOOPED THROUGH  $F_1 F_2$  CIRCUITRY ② BACK TO HUB.
- ③ FDM LOOPBACK - WHEN ACTUATED, THE TEST MESSAGE OR SIGNAL FROM HUB LOCATION IS LOOPED THROUGH FDM CIRCUITRY ③ BACK TO HUB.
- ④ COMMON ANALOOP - CAUTION: ALL VOICE FREQUENCY TRAFFIC BETWEEN MUX/VERTER AND HUB IS DISRUPTED. WHEN ACTUATED, THE COMMON VOICE FREQUENCY TRANSMIT LINE IS LOOPED ④ TO THE COMMON VOICE FREQUENCY.
- ⑤ STATION LOOPBACK - STATION EQUIPMENT CAN BE LOOPBACK TESTED ⑤ DEPENDENT UPON TELETYPE WIRING OR OPTION, DATA SET USED AND LOCATION OR ACCESS TO DATA SET TEST SWITCH.

\* TELETYPEWRITER FRAME

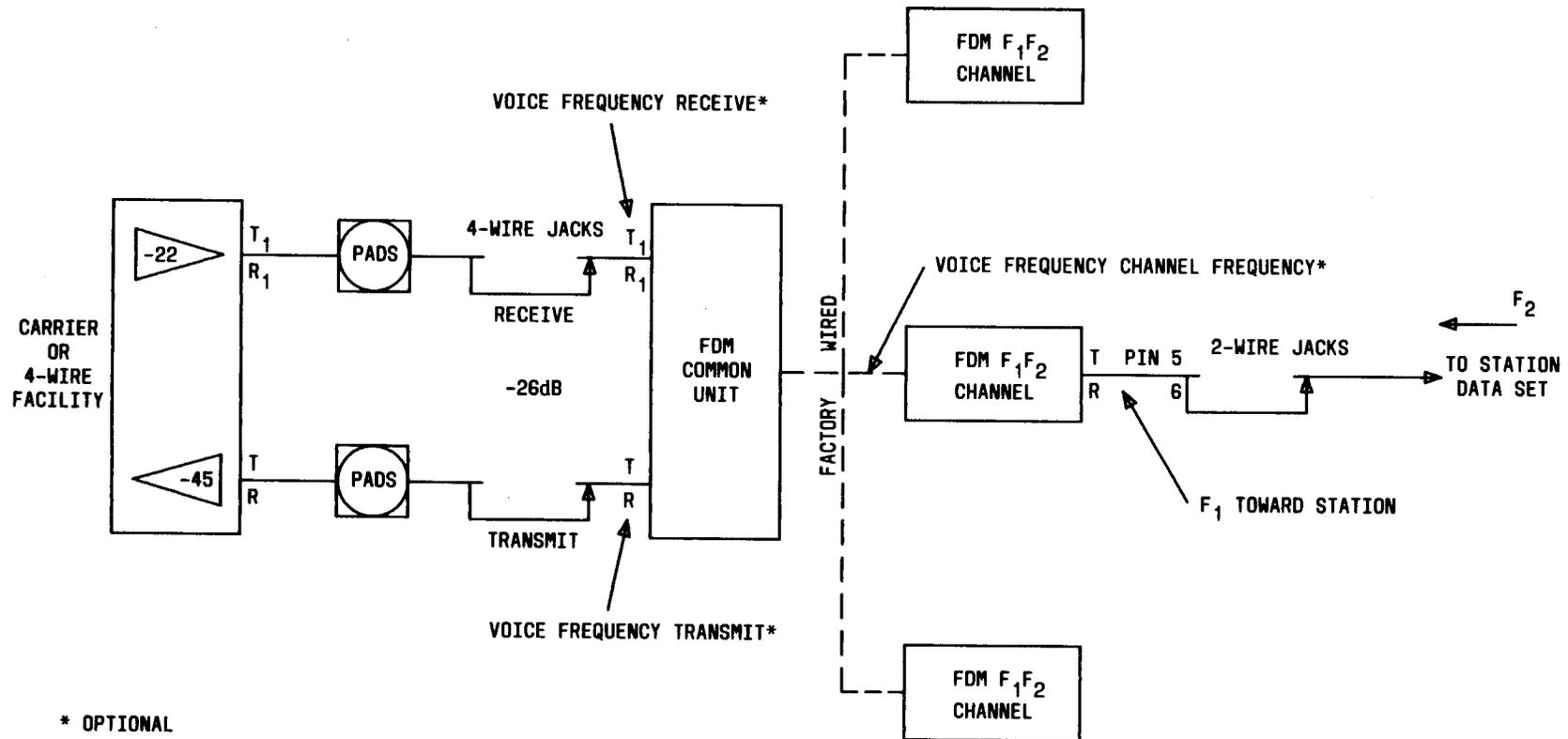
Fig. 1—Test Switch Settings



NOTES:

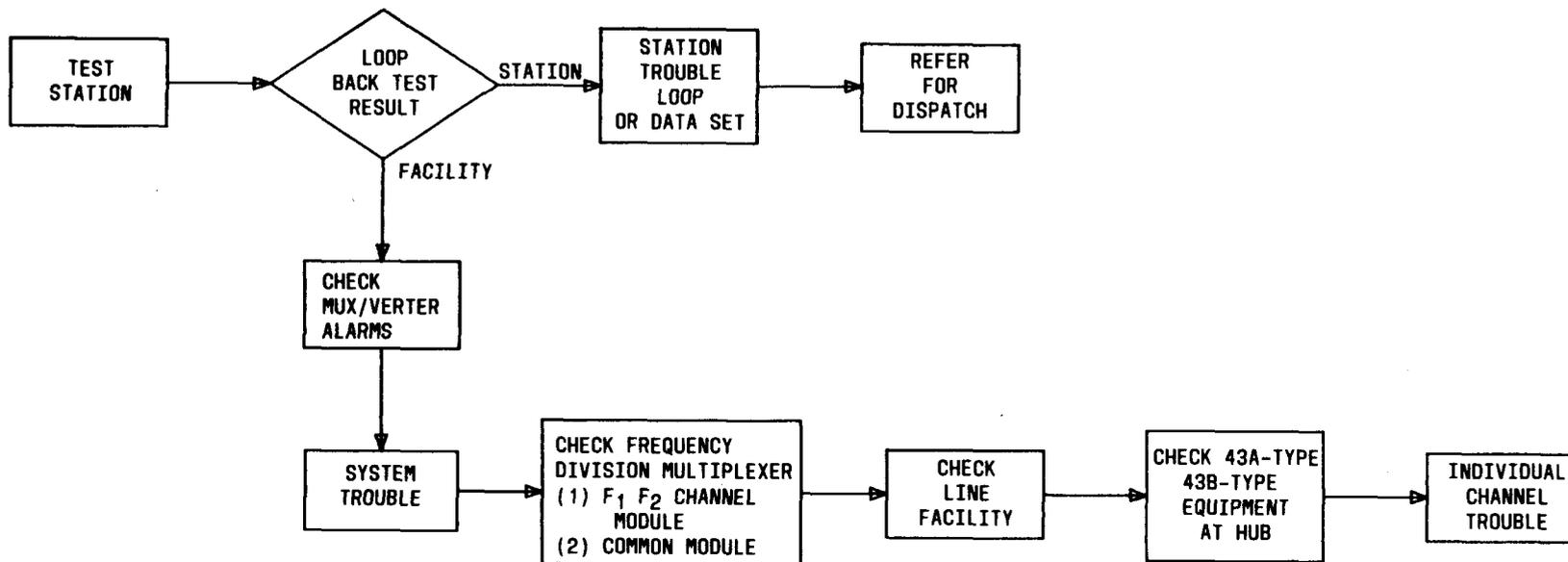
1. (XX) SINGLE BANDWIDTH 43-TYPE CHANNEL LEVEL
2. [XX] DOUBLE BANDWIDTH 43-TYPE CHANNEL LEVEL

Fig. 2—Typical Transmission Plan 43-Type Telegraph Carriers—MVX/VERTER Operation



\* OPTIONAL

Fig. 3—Office Layout



NOTE:  
THE 43-TYPE SYSTEM AT THE TELEGRAPH  
STC MUST BE PLACED IN THE FULL-DUPLEX  
MODE TO OBSERVE LOOPBACK TEST RESULTS.

Fig. 4—Diagram Trouble Clearing Process