T1D DIGITAL LINE
GENERAL DESCRIPTION
DIGITAL TRANSMISSION SYSTEMS

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1. GENERAL

1.01 This section contains a general description of the T1D digital line and its associated equipment. The T1D line is used in conjunction with any DS1C signal source, such as the D4 channel bank, the M1C multiplex, or the MX3 multiplex. ▶Figure 1 shows the basic T1D/M1C or T1D/D4 facility in block diagram. The T1D digital line is intended to be used to supplement the T1 and T1C digital lines and provide greater cable fill. The T1D digital line is also intended to be used to convert existing T1 lines (as outlined in the

engineering rules) from 24 channels to 48 channels. T1D is a 3.152 megabits per second (mb/s), 48-channel system, and uses a duobinary line format instead of the bipolar format of T1 and T1C.◀

1.02 The reasons for reissuing this section are listed below. Revision arrows are used to denote significant changes.

(a) To show that T1D can be used to retrofit T1 lines

(b) To add automatic protection switching.

1.03 T1D will be used where 48-channel operation is needed and T1C cannot be used because of near-end crosstalk (NEXT) limitations. The NEXT limitation occurs when more capacity is desired for single cable installations on large pulp or PIC cables, and older or very small screened cables.

2. GENERAL DESCRIPTION OF T1D DIGITAL LINE

2.01 The T1D digital line transmits a 3.152 mb/s duobinary signal over two exchange grade cable pairs, one for each direction of transmission of 48 pulse code modulation (PCM) voice or data channels. The M1C multiplex provides the interface between DS1 and DS1C signals as shown in Fig. 1. The M1C combines two DS1 level signals, adds appropriate framing information, and performs required pulse coding for the resulting DS1C level signal. The D4 channel bank in modes 1 and 2 generates the DS1C level signal from 48 separate input channels. The MX3 demultiplexes DS3 level signals to DS1C level signals for transmission by the T1D line. The DS1C signal is applied via a DSX-1C, or equivalent, cross-connect panel to an office repeater bay (ORB). The T1D office repeater in the ORB converts the DS1C bipolar signal to a duobinary format which the T1D line repeaters regenerate. The duobinary signal is received by the office repeater and converted back to a DS1C bipolar signal. At each end of the digital line, an ORB in conjunction with an M1C equipped with the proper equalizer network or D4 channel bank (mode 1 or 2) or MX3 multiplex is used as a terminal. The span lines terminate in the office repeaters mounted in the ORB. Interconnecting facilities include entrance cabling, intraoffice cabling, main distributing frame (MDF), and DSX-1C or cross-connect panel.

2.02 The T1D line uses regenerative repeaters (Fig. 1 and Table A). The maximum and minimum space between repeaters varies with the type cable used, whether it is an underground or aerial installation, and whether it is an intermediate or end section. For example, the maximum length between repeaters for an underground intermediate section using 22-gauge copper unitized pulp cable is 6100 feet plus a maximum layout error of 200 feet. The repeater spacing at end sections is shorter due to central office impulse switching noise. Each line repeater consists of two regenerators which make use of hybrid integrated circuit technology for low cost, small size, and high reliability. An automatic line build-out (ALBO) network provides pulse equalization which enables optimum repeater performance on PIC, DEPIC, or pulp cable over a wide variation in cable loss. Quartz crystal filters are used to ensure timing accuracy and long-term reliability over wide temperature variations. Each office repeater (Table B) has conversion networks for the transmit and the receive sides which allow a DS1C bipolar signal on the office side of the repeater and a T1D duobinary signal on the line side of the repeater. Office repeaters and 259-, 285-, and 289-type line repeaters are provided with secondary lightning protection.

2.03 T1D and T1 are compatible in the same cable sheath but not in the same unit (binder group). Special crosstalk filters are required when service pairs (order wire, fault locating, etc) are used in the same unit with a T1D line. The order-wire and fault-locating pairs carry only low-frequency information and are normally assigned to VF pairs.

2.04 ▶Growth applications (new installations) of T1D are engineered in blocks of 25 bidirectional lines in either a screened or nonscreened one-cable mode with a maximum range of 200 regenerative sections. A T1D line that is retrofitted to a T1 line is based on T1D engineering in Section 855-351-115. This is normally 25 bidirectional or 50 unidirectional lines in either a one-cable, two-cable, or screened-cable mode. In this case, the maximum range of the T1D line depends on the design of the T1 facility.◀

2.05 For T1D, 25 line repeaters (50 regenerators), a fault-locating filter, an order-wire terminal, through connectors, a VF loading coil, and a silica gel desiccant are housed in each apparatus case.

These cases are usually located in manholes or at pole-mounted repeater locations. ▶The 466- and 468-type apparatus cases (only on a T1 line retrofitted to a T1D line) provide one stub which can be spliced into the main cable.◀ The 475-, 479-, 818-, and 819-type apparatus cases all provide two stubs which are spliced into the main cable. One stub is for low-level incoming signals, the other for high-level regenerated signals. The 818- and 819-type cases can also have a quad-screened stub for splicing into the main cable. A quad-screened stub on an 818- and 819-type case must be used to wire for bidirectional operation. Either two stubs or a quad-screened stub is necessary to ensure adequate crosstalk isolation between input and output signal levels. The J98725J express office repeater panel (EORP), which is used in intermediate central offices for through-office routing, performs the same function as the apparatus cases in manholes.

2.06 The 475-type apparatus case can be retrofitted for T1D operation only if the case is modified with the D181050 kit of parts. This kit provides new extended-length top covers which accommodate the 288 or 289 repeaters. These repeaters are longer than the 208 or 209 repeaters which they replace.

3. ▶MODES OF OPERATION

3.01 The T1D line can be constructed for either of two modes of cable-repeater operation, while a T1 line retrofitted to a T1D line can consist of any one of four modes of cable-repeater operation. These are as follows:

(a) One cable using bidirectional operation for both new installation [J98725( ) bay] or retrofitting a T1 line [J98710J, K, or L bay or J98725( ) bay] (Fig. 2)

(b) One cable using unidirectional operation, only for a T1 line retrofitted to a T1D line [using J98710J, K, or L bay or J98725( ) bay] (Fig. 3)

(c) Two cables using unidirectional operation, only for a T1 line retrofitted to a T1D line [using J98710J, K, or L bay or J98725( ) bay] (Fig. 4)

(d) Screened-cable operation.

Both directions of transmission are carried in a single cable sheath in modes (a) and (b), while each direction of transmission is carried in a separate cable sheath in mode (c). The fourth type of operation, which uses screened cable, is interchangeable with two-cable operation. Screened cable makes use of a shield which bisects the cable and adds significant isolation between the two halves.

A. One Cable Using Bidirectional Operation

3.02 With this arrangement, bidirectional line repeaters are used with a single cable for both directions of transmission. Both repeater inputs and outputs appear at the same point in a cable, making near-end crosstalk (NEXT) the limiting factor in digital line design. This arrangement is shown in Fig. 2. The number of lines which are used in a single cable is largely controlled by the physical and electrical separation of the pairs used for the two directions of transmission. A screen or physical separation decreases the near-end crosstalk coupling and hence the interference from other T1D lines. The number of lines which are used in a single cable also depends on the cable section loss, since this determines the difference in the signal level between the input and the output. The two sides of a single repeater serve both directions of transmission for a single line; therefore, each repeater is associated with one particular line.

3.03 When 258- or 259-type repeaters are used, bidirectional operation is accomplished by reversing the repeater's input and output for side 2 at the splice case and not on the repeater's printed circuit board. The input and output pins of the repeater are the same for both unidirectional and bidirectional operation. There is no separate bidirectional code. Repeaters intended for retrofit applications (281/285 or 288/289) have separate unidirectional and bidirectional codes. In all cases, power looping is accomplished via an option switch on the repeater.

B. One Cable Using Unidirectional Operation, Only For a T1 Line Retrofitted to a T1D Line

3.04 With this arrangement, unidirectional line repeaters are housed in two apparatus cases and spliced into only one cable so that a line is served by two regenerators in separate apparatus cases (Fig. 3). Each repeater in one apparatus case serves two T1D lines in one direction of

transmission, and each repeater in the other apparatus case serves two lines in the other direction of transmission. The use of unidirectional power option determines the powering scheme and requires two maintenance lines in each direction to restore the two T1D digital lines associated with each repeater.

C. Two Cables Using Unidirectional Operation, Only For a T1 Line Retrofitted to a T1D Line

3.05 With this arrangement, unidirectional line repeaters are used with a separate cable for each direction of transmission. The signal levels at every corresponding point in the cable are the same for all T1D lines; thus, NEXT ceases to be a controlling factor and does not limit the number of lines which can be used on the cables. Figure 4 shows this cable-repeater arrangement. Since the two sides of a repeater are used for two span lines in the same direction of transmission, the two sides are always associated with two different T1D lines, and one repeater cannot be associated with one particular line. In this arrangement the two apparatus cases serving the two directions of transmission must be spliced into the cables differently. For example, if the inputs to side 1 of the repeaters in one apparatus case are connected to the office A side of the cable, then the inputs to side 1 of the repeaters in the other apparatus case must be connected to the office B side of the cable so that both directions of transmission are obtained. The use of unidirectional line repeaters determines the powering scheme and also requires two maintenance lines in each direction to restore the two T1D lines associated with each repeater.

D. Screened Cable Operation

3.06 Screened cable is full-fill no matter what type and size cable is used. The different types of screened cable are labeled Nonstandard-Limited-Availability (NSLA) or Manufacture Discontinued (MD) or standard cable. As a general rule, the VF service pairs (fault-locating, order-wire, and gas pressure alarm pairs) should not share the same binder group with carrier pairs and should be assigned to units with other VF pairs. Standard cable is an odd count cable that reserves a binder group dedicated to the VF service pairs. NSLA or MD cable is an even count cable that must have a dedicated binder group assigned for the service pairs, which results in inefficient use of cable. For example, standard cable with 616 pairs has 16 pairs reserved for service pairs, whereas NSLA or MD cable is still 600-pair with no reserved service pairs. Even though it is not recommended, a fault-locate or order-wire pair may share the same binder group with T1D pairs if the special crosstalk suppression filters are used on each of these pairs.

3.07 Each cable unit of T1D requires at least one associated fault-locating pair. Where fault-locating spans exceed their maximum number of sections, a second pair must be provided. One order-wire pair per cable route is usually sufficient. Likewise, only one pressure alarm pair is needed and this can be an interstitial pair if a filter is used. Crosstalk filtering is required for any non-T-Carrier pair which shares a binder group with carrier pairs. (This requirement is waived for retrofit installations in 475 or 466/468 cases.) When new repeater cases are installed, filtering for the fault-locate and order-wire pairs can be done in either the repeater case or the splice case. Filtering for pressure alarm or other VF-like maintenance pairs must be done in the splice case.◀

4. SPAN CONCEPT

4.01 There are three types of spans: powering, maintenance, and protection (Fig. 5). A powering span is the total of all T1D lines between two central office buildings from the ORB in one office to the ORB in another office, with no intervening office with ORBs. A powering span could contain one or two powering loops. A powering loop extends from the ORB to a looping repeater and back to the same ORB. A maintenance span consists of one or more contiguous powering spans which can be fault-located from the DSX-1C or ORB of the transmitting end. A protection span consists of one or more contiguous maintenance spans which both ends of the protection span terminate with an automatic protection switch or device.

4.02 For T1D, span lines may be connected in tandem to the design limit of 200 regenerator sections. ▶The design limits for T1 span lines retrofitted to T1D span lines depend on the T1D span design numbers.◀ Selection of routes and spans is part of the general trunk plan. Any span line from one office to another may act as a maintenance line for any other span line between those offices in the same direction. However, the

maintenance line provided in the cable with the faulty line should be used if available. Span lines may be in different cable sheaths and lie along different geographical routes. They may be rerouted and interchanged between terminals to restore failures or support changes in traffic requirements. Because of the zero transmission-loss characteristic of the span line, it is much less important for a trunk route to be the shortest distance between two terminals than it is with cable routes. This feature can reduce total spans required in a metropolitan trunk network. Also, in connection with substitution and rearrangement of span lines between terminals, no changes in lineup or adjustments are necessary.

5. ◗J98710J, K, L, AND J98725( ) OFFICE REPEATER BAYS

5.01 The following paragraphs will explain the two office repeater bays (ORBs) and associated equipment (Table C) that are used for T1D lines. The J98710J, L, and K ORBs (206 ORB) can be used to retrofit T1 lines to T1D. The J98725-( ) ORB can be used for either new T1D or T1 lines retrofitted to T1D.

A. J98710J, K, and L Office Repeater Bays (206 ORB)

5.02 Concerning T1D, the 206 ORB is only used when T1 lines are being retrofitted to T1D. T1 span lines being retrofitted to T1D lines enter the office through a distributing frame and are terminated in the 286-type office repeaters at the ORB (Fig. 6). The 206 ORB can be either 7-, 9-, or 11-1/2 foot heights with 13 repeater plug-ins mounted on each bay shelf.

Office Repeaters

5.03 The 286-type office repeaters provide the span terminating circuitry required in the 206 ORB. Each repeater provides PCM pulse regeneration for one incoming span line. The 286 A and B repeaters contain jacks for access to the repeater output and to the input of the outgoing span line. These jacks are used for patching maintenance lines and other maintenance facilities. Jack access is provided at the DSX when using 286C and D repeaters which do not have jacks. The 286C and D office repeaters have the extended cross connect package (EXCP) with equalizers mounted on the circuit board. These equalizers are shown in Table D.

5.04 The 286E bridging repeater should be mounted in position 13 of even-numbered shelves, next to the repeater for the maintenance line. Power for the bridging repeaters is always obtained locally from -48 volt battery through the power distribution panel in the ORB.

Span Cross-Connect Field

5.05 The span cross-connect field is provided in the 206 ORB for cross-connecting intraoffice transmission pairs between the office side of the 286-type repeaters and other units within the same bay or other bays. Its location on the repeater bay is shown in Fig. 7.

5.06 An optional feature, the bay cross-connect field, is used in the 206 ORB for cabling intraoffice transmission pairs from the span cross-connect field to other repeater bays, DS1 terminals, central cross-connect fields, or DSX cross-connects.

Fuse and Alarm Panel

5.07 The fuse and alarm panel is used to distribute the required voltages and ground to the 286-type repeaters with regulators via the power distribution unit, when the local office is supplying power for the repeatered lines. The local office repeaters may be powered either separately or from the span lines. If powered separately, the local fuse and alarm panel will be used to supply the required power. The fuse and alarm panel provides a complement of three fuses for each shelf in the ORB (one each for the -48, -130, and +130 supplies). Alarm relays are also included which permit connections for audible and visible alarm indications of fuse failure. In addition, -48 volt miscellaneous voltage for the order-wire panel, telephone set panel, and test set powering jacks is supplied by this unit.

Fault-Locate Filter

5.08 The fault-locating filter panel is used for mounting three 598-type filters for fault locating in the office repeaters. Jacks for terminating the filters are located on the repeater bay jack field. This unit mounts on the 206 ORB as shown in Fig. 7. If a 206 ORB is used, active fault-locating

can be used by installing the ED-553-30 fault-locate filter panel. Active filters must also be installed in the apparatus cases and far-end ORB.

Jack Field

5.09 The 206 ORB contains one or more jack mountings which are equipped with test set power jacks, order-wire jack and lamp circuits, fault-locating jacks, the telephone set jack appearances, jacks bridged across transmission pairs, jacks for QRSS outputs, and jacks arranged for cross-connecting in tandem with maintenance lines. The jack mountings are shown on the 206 ORB in Fig. 7. If the DSX is part of the installation, these jacks are not required at the ORB.

Power Distribution Panel

5.10 The power distribution panel is provided to drop the -48 volt office battery to the level required for local powering of office repeaters or to drop the -130 volt battery to the level required for powering of the T1D digital line, as required. One unit is supplied for each repeater shelf and the unit is mounted on the rear of the bay to minimize heating of other units in the bay.

Power Dissipation Units

5.11 The high-dissipation resistors associated with the 130-volt line current regulator in the 286A or C repeaters are grouped in the J98710M power dissipation unit. This plug-in unit is mounted in a shelf at the top of the 206 ORB (Fig. 7) to minimize temperature rise in the active units in this bay.

Order-Wire Panel

5.12 The order-wire panel may be mounted in the 206 ORB as shown in Fig. 7. This panel provides talking facilities between the repeater bay location and any repeater location along the span. For short spans, it is necessary to provide an order-wire panel (List 6 or later) at only one end of the span. For longer spans, an order-wire panel is required at both ends of the span. The order-wire panel provides talking and signaling battery for the order-wire pair and also makes connections to the switching equipment in the office.

5.13 The J98769AJ telephone set panel is provided for use with the order-wire circuits. Power is supplied from the fuse and alarm panel.

5.14 TCAS interface equipment for the 206 ORB can be ordered as part of the bay or added to an existing bay. This equipment monitors fuse and alarm indications and the receive side output of the office repeater for signal absence or bipolar violations. This information is transmitted by the TCAS interface equipment to the TCAS center for trouble isolation.

B. J98725( ) Office Repeater Bay

General

5.15 T1D spans terminate at central offices in office repeaters mounted in shop-wired office repeater bays (ORBs). Six J98725 ORB letter codes (A through F) are used by the T1D line (see Table C). There are two types of ORBs: the DSX-optional ORB (A, B, and C bays) which can be used with the DSX-1C or ORB jack panel and the DSX-dedicated bay (D, E, and F bays) which is always used with the DSX-1C (Fig. 8). There are three sizes of DSX-optional or dedicated ORBs (11-foot 6-inch, 9-foot, and 7-foot). This ORB can be used for growth T1D or for retrofitting T1 lines.

5.16 Table C lists the subassemblies contained in each type of ORB. Both the 11-foot 6-inch DSX-optional ORB and the 9-foot T1C/T1 DSX-dedicated ORB contain eight repeater shelves. The 9-foot and 7-foot DSX-optional ORBs contain four repeater shelves. The 11-foot 6-inch DSX-dedicated ORB contains 12 repeater shelves. Each of the repeater shelves is an 8-inch high by 23-inch wide front-mounted unit containing 13 repeater slots. Shelves are numbered bottom to top. The odd numbered repeater shelf slots are numbered 1 through 13, left to right. The even numbered repeater shelf slots are numbered 14 through 26, left to right. Repeater slot 25 is dedicated to the maintenance line. Repeater slot 26 is reserved for the bridging repeater (Fig. 9).

Office Repeaters

5.17 Table B lists the 260-type office repeaters used with T1D in the J98725( ) ORB. There are three types of office repeaters: regulating, looping, and bridging. The power regulating

repeaters contain regulator circuits which simplex power to the line. With the exception of the current regulating circuits, the looping repeaters perform the same function as the regulating repeaters. The bridging repeater provides a regenerated signal and enables in-service patching with no interruption of service.

Equalizers

5.18 In the J98725A, B, and C ORBs, a connector assembly for a discrete component plug-in equalizer is associated with each office repeater. In the J98725D, E, and F ORBs, a plug-in equalizer card is mounted on the left side of each repeater shelf, and a single equalizer is mounted with each bridging repeater. Each repeater regenerator output is dedicated to an equalizer input. On the J98725A, B, and C ORBs, the output of the equalizer is connected back to a connector on the associated repeater as an outgoing tie point. Table E lists the equalizers used in J98725 ORBs. The equalizers provide pulse equalization over the interoffice cable lengths listed in Table E. All 260-type office repeaters provide 6-volt DS1C output levels.

5.19 When no DSX-1C bay is provided and the ultimate growth is not expected to exceed four adjacent office repeater bays, jack appearances can remain on the ORB. In this case, the equalizers are engineered as if there were a DSX-1C located within the bay itself. That is, the equalizer code for 0- to 133-foot cross-connect distances would be used for every repeater in the ORB, regardless of the distance to the bay to which the cross-connection was made. This arrangement minimizes flat-loss mismatch when systems are looped and provides test set compatibility at the jacks on both bays.

Jack and Cross-Connect Panels

5.20 Patching and cross-connect functions are provided by the jack and cross-connect panels which are mounted on a single shelf assembly in the J98725A, B, and C ORBs when a DSX-1C is not provided. The jack field provides jack appearances for patching and testing office repeaters, fault-locating circuits, -48 volt test set power, and miscellaneous jacks. Order-wire jacks do not appear in the jack field but are on the self-contained order-wire panel. For small installations and locations requiring fewer than four ORBs, the jack and cross-connect facility is a panel on the ORB. However, if the ultimate T1C/T1D growth capacity in the central office exceeds four office repeater bays, a centrally located DSX-1C cross-connect bay should be installed initially. Figure 10 shows typical cross-connect arrangements.

5.21 In the 11-foot 6-inch J98725A ORB, the jack panel contains jacks for eight shelves of office repeaters plus miscellaneous jacks. In the J98725B (9-foot) and J98725C (7-foot) bays, jacks are provided for four shelves of office repeaters plus miscellaneous jacks. The jacks for each repeater provide a normally-through connection at the regenerator output (R OUT, X IN). A similar connection is on the transmitting side (X OUT, L IN). Likewise, there is an arrangement for bridging jacks. Cross-connections within a bay and between adjoining bays are made via the span cross-connect field. Cross-connections to other bays, M1C or MX3 multiplex bays, or D4 channel banks, are made via the bay cross-connect field.

5.22 The jack field interface terminal strip (JTS) is the interface between the repeater connectors and the jack and cross-connect panels. Regenerated (received) signals at the regenerator output are connected via JTS to regenerate jacks (R OUT) which are connected normally-through to the input jacks (X IN) and then to span cross-connect terminals. The R OUT jacks provide access to the regenerator output, while the X IN jacks provide access to the span cross-connect input (to M1C, MX3, T1C, T1D, or D4 receiver). In-service signal monitoring for regenerated signals appears at the MON jacks associated with the R OUT—X IN jacks.

5.23 Transmitted signals (from M1C, MX3, T1C, T1D, or D4 bank) are connected from the span cross-connect to the X OUT jacks which are connected normally-through to the L IN jacks. From the L IN jacks, signals are connected to the repeaters via JTS. The X OUT jacks provide access to the span cross-connect output (from M1C transmitter), while the L IN jacks provide access to the outgoing line. In-service signal monitoring jacks for the transmit direction are also provided.

5.24 In addition, there are connections for bridging jacks. Jack field position 26 is always dedicated to the inputs and outputs of the bridging repeater. A signal from a QRSS or working line may be placed on a maintenance line by use of the bridging repeater and associated jacks. The circuit also provides a means for putting a signal source on a maintenance line or a line that is

powered but not yet placed in service. The input of the bridging repeater is accessible at the BRDG IN jack. The output of the bridging repeater appears at the BRDG OUT jacks. The X IN jacks provide access to the cross-connect input (to maintenance line repeater). The BRDG OUT jack and the X IN jacks are connected normally-through. The bridging repeater never interfaces directly with a span line but is always used in conjunction with the maintenance repeater. Monitor jacks (MON) associated with BRDG OUT—X IN jacks are provided for the bridging signals.

Jack Field Interface Terminal Strip and Digital Cross-Connect Terminal Strip

5.25 The jack field interface terminal strip, used in the J98725A, B, and C ORBs, and the digital cross-connect terminal strip, used in the J98725D, E, and F ORBs, perform the same function in their respective ORB. That is, each interfaces the office side of the office repeaters to the jack field. In the case of the J98725A, B, and C ORBs, the jack field is either the jack and cross-connect panel in the ORB or the jack panels in the DSX-1C. In the case of the J98725D, E, and F ORBs, the jack field is always the DSX-1C. The terminal strip is divided into two sections: one for outgoing signals from the equalizer connector to the jack field and the other for incoming signals from the jack field to the transmit side of a repeater. For example, a regenerated output signal at a repeater connector position is connected to its associated equalizer connector position. Then, this signal is connected to the terminal strip where now the signal may be connected to the jack field. The other part of the terminal strip provides tie points for the signals that are connected to the office repeater transmit direction. These signals are connected to the terminal strip from the jack field. As is the case for regenerated signals (outgoing) connected to the terminal strip, pins are connected to corresponding repeater connector position terminals.

Fuse and Alarm Panel

5.26 In the J98725A, B, and C ORBs, the fuse and alarm circuits are contained in the fuse, alarm and fault-locate filter panel. In the J98725D, E, and F ORBs, the fuse and alarm circuits are contained in the fuse and alarm panel. In both cases, the fuse and alarm circuits perform identical functions.

5.27 The fuse and alarm circuits distribute -48, -130, and +130 volt battery power to the office repeater shelves as required. The power delivered to each shelf is separately fused. Alarm relays are provided to indicate fuse failure. A shelf fuse failure causes a pair of relay contacts to operate and light the red (major alarm) lamp. A repeater fuse failure causes another pair of relay contacts to operate and light the white (minor alarm) lamp. The fuse and alarm circuits in the J98725A, B, and C ORBs contain eight separate fuse positions to protect the order-wire circuit, QRSS, -48 volt convenience jacks, or any other equipment used at the ORB that may require -48 volt battery power. The -48 volt convenience jacks are three 310-type jacks on a miscellaneous panel. The fuse and alarm circuits supply -48 volts to the tip of jack J1. Ground is connected to the sleeve of jack J1. Jacks J2 and J3 are multipled to jack J1. The -48 volt convenience jacks supply power for test sets that operate from -48 volt power. Since the QRSS and other test equipment requiring miscellaneous -48 volt power are located at the DSX-1C when the J98725D, E, and F ORBs are used, the fuse and alarm panel on the J98725D, E, and F ORBs contains only one miscellaneous -48 volt power fuse for the order wire circuit.

5.28 The fuse and alarm circuits distribute -48 volt shelf power to the repeaters via the -48 volt power distribution circuit. The -48 volt power distribution circuit supplies the -48 volt power directly to each repeater as -48V and through a 422-ohm series dropping resistor as -RPT power. The -RPT power is used to power the repeater when it is powered separately from the line. The +130 volt shelf power is supplied to each repeater through a 110-ohm resistor in the ohm-per-volt circuit as +RPT. The 110-ohm resistor, in conjunction with the current regulator in the repeater, provides current limiting for the +130V supplied to the regulator.

5.29 The alarm circuitry makes connection to the central office audible and visual alarms. Connections to the E2 remote alarms are available on an optional basis.

Fault-Locate Filters

5.30 On the J98725A, B, and C ORBs, the fault-locate filters are part of the fuse, alarm, and fault-locate filter panel. On J98725D, E, and

F ORBs, the fault-locate filters are mounted on a separate panel. In the J98725A, B, and C ORBs, the fault-locate filter assembly contains receptacles for four 1068-type or 1114-type plug-in fault-locating filters and four microswitches which short circuit the associated filter receptacle when no filter is installed. The J98725D, E, and F ORBs fault-locate panels contain receptacles to accommodate a maximum of six 1068-type or 1114-type fault-locate filters with six associated shorting switches.

Power Dissipation Units

5.31 Dissipation resistors are grouped into power dissipation units located at the top of the ORB. These resistors are associated with the line current regulator circuit in current regulating office repeaters. The power dissipation resistors prevent overload of the regulator transistor during high dissipation conditions. Each plug-in resistor unit is dedicated to a particular shelf of repeaters. Table C lists the number of power dissipation plug-in units used by each ORB code. These units are not required when powering the lines with -48 volts and ground, or in bays housing power looping repeaters.

Order-Wire Panel

5.32 The order-wire panel provides connectors to accommodate two order-wire plug-in units (Fig. 11). There are four order-wire plug-in units which can be used (Fig. 12). The four plug-in units are as follows:

(a) Order-wire and telephone set (OW & TEL SET) circuit which contains all the circuitry necessary to power and talk over the line, connect to the central office dial system, and to provide timing and alarm circuitry to call the central office.

(b) Telephone set (TEL SET) circuit which contains the circuitry necessary to talk over a given order-wire line powered from another location.

(c) Multiple circuit (MULT CKT) which enables additional appearances of the same order wire within a central office.

(d) Bridging and coupling circuit (BRDG & CPLG CKT) which provides a means to ac-couple two individually powered lines. It also provides a bridge connection that, in conjunction with a TEL SET circuit, enables personnel to talk over the joined order-wire lines.

T Carrier Administration System (TCAS) Plug-In

5.33 TCAS interface equipment for the T1C/T1 ORB can be ordered as part of the bay or added to an existing bay. This equipment monitors fuse and alarm indications and the receive side output of the office repeater for signal absence or bipolar violations. This information is transmitted by the TCAS interface equipment to the TCAS center for trouble isolation.

6. J98725AF QUASI-RANDOM SIGNAL SOURCE

6.01 The J98725AF quasi-random signal source (QRSS) performs the following functions:

(a) Provides a controlled error-free test signal used during troubleshooting

(b) Provides a far-end office with a standard signal source for bit error-rate measurement

(c) Provides stress testing signals for spans suspected of being marginal

(d) Drives maintenance and backbone lines through bridging repeaters

(e) Drives unassigned lines

(f) Drives idle lines during system turn-up.

6.02 The QRSS is a 1-3/4 inch high by 23 inch wide panel and includes brackets for mounting in either 1-3/4 or 2-inch rack space. The QRSS is normally mounted in the DSX. If no DSX is available, the QRSS can be mounted in the upper part of the ORB. The QRSS panel assembly houses three plug-in units: one power and alarm unit and two signal source plug-ins. The power and alarm plug-in is always required. One or both signal source plug-ins may be used to provide up to 25 outputs each (Fig. 13).

7. J98725J EXPRESS OFFICE REPEATER PANEL

7.01 The express office repeater panel (EORP) (Fig. 14) is a bay-mounted unit which performs a function similar to a manhole apparatus case. The EORP is engineered as if it were a central

office ORB but is administered as a manhole. The EORP which is used at intermediate central offices for through-office routing on a T1D carrier span provides facilities to accommodate 25 line repeaters.

8. DSX-1/DSX-1C BRIDGING REPEATER PANEL

8.01 The bridging repeater panel (Fig. 15) contains facilities to accommodate two bridging repeaters with associated connecting jacks and equalizers. The bridging repeaters are used when a disabled span is replaced first by a backbone line and later by a maintenance line.

9. AUTOMATIC PROTECTION SWITCH (APS)

9.01 The APS is a maintenance span-by-maintenance span-type switch. If T1D maintenance spans are connected in tandem, a service-line failure occurring in one maintenance span will cause a transfer to occur only within that maintenance span and not on any tandem span. This allows sectionalized independent use of the protection span line by the protected service lines. The equipment in the APS contains two protection lines for 48 service lines (2/48) or one protection line for 24 service lines (1/24). The APS can handle three 2/48 or six 1/24 modules or any combination of modules for a total of 144 service lines.

10. OFFICE CABLING

10.01 T1D interbay cabling arrangements provide the following:

(a) Compatibility for arrangements with or without DSX bays

(b) Maximum interbay cabling distances

(c) Test set compatibility at all jack interfaces

(d) Minimum within-unit signal level variations

(e) No significant flat-loss mismatch in transmitted signal levels

(f) Facility for interfacing with system performance monitors (TCAS, etc).

10.02 Figures 16 and 17 show a typical cabling and cross-connect arrangement when a DSX is ***not*** provided. Figures 18 and 19 show a typical interbay cabling arrangement when a DSX is used for centralized patching, cross-connection, monitoring, and fault location. The DSX provides maximum flexibility for ORB-to-ORB, D4-to-ORB, and M1C-to-ORB separations of up to 1310 feet. The maximum distance to the DSX from ▶206 ORB with 286C and D (EXCP) repeaters,◀ T1C/T1 ORB, M1C, or D4 is 655 feet. An additional 50 feet of cabling may be used for cross-connection on DSX. When a DSX is used, no jack appearances except order-wire jacks are permitted on the office repeater bay. ▶The maximum distance from the DSX to a 206 ORB with 286A and B repeaters is 85 feet.◀ The DSX is engineered as a common level (3-volt) point for all DS1C signals.

10.03 The interconnecting facilities include the entrance cabling, intraoffice cabling, main distributing frame, office repeater bays, and either a DSX or cross-connect panel. The entrance cable must be the same gauge, type, and cross-section as the outside plant cable to which it is attached. This cable matching is required to maintain unit integrity from end to end on all T1D span lines. T1D installations can use 19-, 22-, or 24-gauge copper, screened or unscreened, pulp, PIC or DEPIC insulated, unitized cable. Aluminum DEPIC (17- or 20-gauge) cable can be used also.

10.04 Because of the office switching noise, the cable length is limited for an office end section. This length is measured from the office repeater bay out to the first line repeater. In effect, the line repeater sees the shorter section plus the DSX to ORB wiring.

11. SIGNAL TRANSMISSION

11.01 The office repeater bay equipment and the line equipment provide facilities for transmitting and receiving the 3.152-Mb/s signals of the M1C multiplexer or D4 channel bank. Cross-connections between D4 channel banks or M1Cs and ORBs or between ORBs in an intermediate office are provided.

11.02 Incoming (received) signals from the T1D line arrive at the MDF via tip cable from the cable vault. At the MDF the tip cable connects to office cable. The office cable carries the signal to the distributing terminal strip (DTS) at the top of the ORB. From the DTS the incoming signal appears on the repeater input connector terminals. Regenerated signals then emerge from the repeater (output connector terminals) and pass through the

equalizer circuit. The signal then flows to the terminal strip JTS or ▶cross-connect◀ for distribution to the DSX, the jack and cross-connect panels, or to another ORB. Finally, the T1D incoming signal is applied to the M1C or D4 for demultiplexing.

11.03 Outgoing (transmitted) signal flow is from the M1C multiplex, or another ORB, to the DSX or the ORB jack and cross-connect panels. From the DSX (or the jack and cross-connect panels), the transmitted signal is applied through the transmit side of the repeater to terminals on the DTS. The DTS connects the signal to office cable, which ties into the MDF for cross-connects to tip cable. The tip cable then carries the signal to the cable vault and on to the outside line.

12. POWERING OF ▶J98710J, K, L, AND◀ J98725( ) OFFICE REPEATER BAYS

12.01 The line repeaters (Table A) designed for use in the T1D digital line are powered from the central office. The office repeaters are housed in the ORB. The regulating office repeater contains a line-current regulator which supplies 120-mA nominal simplex current to the line repeaters. The looping repeater provides for looping power but no regulator circuitry. The office repeaters can be powered either locally or in series with the line repeaters.

12.02 The ORB is powered from the battery distribution fuse board, battery control board, or from the power equalizing center in the central office. Each office repeater bay has two separate power feeders for each office battery voltage used. These power feeders are referred to as the A and B feeders. A maximum of three bays may be powered from a common feeder. The fuse and alarm circuit provides the -48 volt, +130 volt, -130 volt, ground, and alarm connections required for the ORB. The ORB shelves are powered from the fuse and alarm panel such that all odd-numbered shelves are connected to feeder A and all even-numbered shelves are connected to feeder B. Each battery voltage supplied to the repeater bay shelves is separately fused in the fuse and alarm panel. In addition, -48 volt miscellaneous voltage is provided for powering such equipment as the order wire tel set, test sets, and signal sources. These equipments are also separately fused at the fuse and alarm panel. Two lamp indicators are provided as part of the fuse and alarm panel. The white lamp, when lighted, indicates a fuse failure for the equipment that is powered from the -48 volt miscellaneous voltage (order wire tel set, test jacks, signal sources, etc). This lamp also indicates a repeater fuse failure; while the red lamp, when lighted, indicates a repeater shelf failure. Alarm relays permit connections to the central office alarm circuits. These relays give audible and visual indications of a fuse failure on the office repeater bay. When these alarm relays are operated, either the MINOR alarms are activated and the white lamp lights or the MAJOR alarms are activated and lights the red lamp.

12.03 The office repeaters supply power to the line repeaters in the apparatus cases as previously stated. Since the power requirements are dependent on the length of the span, this information is carefully calculated for each office and is contained in the power notes section of the ORB applications schematic or engineering Section 855-351-115. By using looping repeaters, selecting series or separate powering of office repeaters as needed, and correctly choosing line repeaters, power dissipation within an office repeater bay can be minimized.

13. POWERING OF T1D DIGITAL LINES

13.01 T1D repeaters are powered by transmitting dc power over the cable pair simplex. Line current is fed through two zener diodes to generate the voltage for repeater operation. Both regenerators in the repeater package are powered from the same source. Depending on the repeater option, the line current can be through-connected for powering the next repeater or it may be looped back over the cable pair simplex associated with the second regenerator. Power can be looped back at office repeaters but not through-connected. Various powering options are available, and care should be given to ensure that an optimal configuration is engineered.

13.02 The voltage levels available for powering are ground (GRD) and -48, +130, 178 (-48V and +130V) and 260 (+130V and -130V). The office repeater should be powered in series with the line repeaters if the battery voltage does not have to be increased. This minimizes power dissipation in the ORB. If powering the office repeater in series would increase the required battery voltages, then the office repeater should be powered independently using the -48 volt battery

through the voltage dropping resistor provided in the ORB. In general, the voltage levels selected should be the minimum levels which will meet the line powering requirements.

14. MAINTENANCE

14.01 The T1D maintenance plan consists of trouble isolation and trouble locating. A trouble isolation chart is shown in Fig. 20. When the M1C or D4 channel bank detects trouble, an alarm occurs and the terminal equipment is checked. If the terminal is not the source of trouble, the failed line is taken out of service and then restored on a backbone line. When the trouble is located, a maintenance line is used to bypass the troubled section and the troubled line is restored to service. If the T1D lines are protected with the Automatic Protection Switch (APS), the line affected by trouble is kept in service on the protection line and takes the troubled line out of service for trouble locating. The troubled section can be repaired without affecting service. When the troubled line is repaired, the line is automatically restored to service. The following paragraphs explain the maintenance equipment.

A. Local Alarm (LA) Conditions

14.02 LA conditions are obtained by monitoring the incoming 3.152-Mb/s signal for absence of signal, loss of frame for a specified interval, or power failure. The LA condition is transmitted to the far end by modifying the framing pattern to bring up a remote alarm (RA). Troubles are isolated by first checking the terminal equipment (D4 channel bank or M1C). If the terminal equipment is functioning properly, the line, including associated office equipment, is checked. Channel banks are checked by looping the bank. The bay-type M1C is checked by switching the signals from the alarmed muldem(s) to the hot standby muldem using the SW to STBY key located on the muldem alarm circuit pack. The shelf-type M1C is checked by looping the muldem.

B. Fault-Locating System

14.03 The fault-locating system (Fig. 21) provides the means to remotely detect faulty repeater locations from the central office. It consists of a fault-locating test set and an inductively loaded (VF) cable pair connecting 1068-type passive fault-locating filters or 1114-type active fault-locating filters. A single audio-frequency tone filter is installed in each apparatus case and in each ORB at repeater locations included in the fault-locating plan. A different filter is assigned to each repeater location (apparatus case or ORB). The fault-locating output of each regenerator is coupled to the filter input. The output of the filter at each location is bridged to a fault-locating cable pair. This cable pair returns the audio-frequency tones picked off the line during the fault-locating procedures to the DSX-1C bay or ORB test jacks for evaluation.

14.04 The 1068-type filters permit particular tone assignments and fault identification of up to 12 repeater locations on the same fault-locating cable pair. When there are more than 12 repeater locations in a span, a separate fault-locating pair must be provided for each additional group of 12 locations. Thus, longer maintenance spans can be fault-located by repeating the series of filters along the line and sequentially reassigning the 12 interrogation tones on each additional pair. However, only one apparatus case per repeater location is bridged to the fault-locating pair.

14.05 The 1114-type active filters improve signal-to-noise (S/N) performance of the FL lines. Selection of powering polarity to the FL line is determined by the polarity switch on the fault line powering module and ***the maintenance of T-R integrity to the filter locations.*** Dual use of the twelve 1114A through M codes may be obtained by placing a tip-ring turnover between two filter groups. Reversing the polarity of the power at the powering module activates one or the other group of filters and this, in effect, provides a maximum 24-filter configuration.

14.06 Fault location must be in the direction of transmission (both-end testing) of the repeatered line. Both-ends testing means that only one direction of transmission, the outgoing direction, can be tested from a given office; thus, the need exists to test a span from both ends. If unidirectional operation is used, the FL system will be inherently directive because separate FL pairs are assigned to each direction of digital transmission. Both-ends testing in T1D can be accomplished by using the 1114-type active filters or the 1068-type passive filters. T1 lines that have been retrofitted to T1D lines may also use 598-type passive filters. The fault-locate jacks provide test equipment access to the output of any selected FL line. When active fault-locating (1114-type filters) is used, the logic

circuitry in the J98725AJ fault-line powering module prevents dual access to the FL line. Integral to the fault line selection, the module provides power to the FL line for the active filters selected for interrogation and power for activating the logic circuitry of other offices on the unused part of the FL line when it appears in other span terminating offices.

C. Order-Wire Pair

14.07 An order-wire pair must be provided for communications between the various repeater locations within a span or between any repeater location within a span and the ORB or DSX at either end of the span. This order-wire pair should be a loaded pair which will appear, through a bridging arrangement, in every apparatus case in the span as well as on the ORB or DSX at each end of the span. The order-wire pair may be loaded within the apparatus case, if necessary. The order-wire terminals are accessible without opening the apparatus case, and only one order-wire pair is necessary per route, regardless of the number of span lines making up the span.

14.08 At each order-wire appearance along the cable route, personnel using a 1013-type handset have the option of contacting the office by activating the office alarm or calling over the office switching network. When order-wire panel J98725H is used, the maximum working length of this order wire is 40 miles when 22-gauge cable and 96 volts are used or 20 miles when 22-gauge cable and 48 volts are used. Order-wire panel J98710E can only be used for 20 miles with 48 volts. When used with a central office at each end, spans up to 20 or 10 miles can be serviced by using a blocking capacitor in the center of the span and an order-wire circuit at each end. For those situations where the order wire shares a binder group, a suppression filter is installed to prevent interference with voice communications on digital transmission from interaction crosstalk.

D. Maintenance Lines

14.09 Maintenance line repeaters must be provided in position 25 and assigned on a span basis. Since all span lines in a given span are equivalent, it is not necessary to assign maintenance lines to a particular facility. If bidirectional operation is used, one maintenance line providing both directions of transmission for one facility will be necessary. For unidirectional operation, however, two maintenance lines will be necessary: one to provide one direction of transmission for two facilities and the other to provide the other direction of transmission for two facilities.

14.10 The T Carrier Restoration Control Center (TRCC) is responsible for assigning the backbone and maintenance lines used for service restoration. The TRCC also dispatches the personnel when it has been determined that the line fault is outside the office.

14.11 As explained before, the APS is a maintenance span-by-maintenance type switch which automatically switches when a service line is in trouble. If T1D maintenance spans are connected in tandem, a service line failure occuring in one maintenance span will cause a transfer to occur only within that maintenance span and not on any tandem span. This is done without affecting service and allows sectionalized independent use of the protection span line by the protected service lines. Two failures are illustrated in Fig. 22, and each failure caused independent transfer to the protection line. When the failed service line is restored, the APS automatically resets the service from the protection line to the service line. This automatic switching is done by the APS monitoring and sensing equipment.

15. REFERENCES AND ASSOCIATED DRAWINGS

15.01 Following is a list of general reference practices and other T1D carrier practices.

SECTION	TITLE
103-494-100	J98725 Office Bipolar Violation Detector
103-494-104	J98725 Pair Loss Test Set
103-494-105	T1C/T1 Quasi-Random Signal Source (QRSS)
103-494-107	KS-22424 Fault Location and Repeater Test Set
103-494-108	KS-22423 T1D Test Set (Manhole Violation Detector)
103-494-109	J98725AJ Fault Line Powering Module

365-170-100	D4 Channel Bank
365-200-120	Automatic Protection Switch (APS)
365-250-105	Express Office Repeater Panel (EORP)
365-272-000	T1D Line (TOP)
365-280-101	T1D Line Repeater Description
365-320-100	J98710E Order Wire Panel
365-325-100	J98725 Order Wire Facility
365-330-110	Remote Office Equipment
365-604-100	M1C Digital Multiplex
365-605-100	M1C-A Digital Multiplex
640-525-210	466 and 468-Type Apparatus Case
640-525-307	800-Type Apparatus Case
640-527-107	479-Type Apparatus Case
865-201-110	TCAS Engineering Rules
855-351-115	T1D Engineering Rules

15.02 The following is a list of drawings which provide additional information:

DRAWING NUMBER	TITLE
SD-97080-02	J98710J, K, and L ORB (206 ORB)
SD-97085-01	J98710E-( ) Order Wire Panel
SD-3C252-01	T1C/T1 DSX-Optional ORB
SD-3C254-01	Order Wire Circuits
SD-3C348-01	QRSS Circuit
SD-3C371-01	T1C/T1 DSX-Dedicated ORB
ED-97442-50	Span Cross-Connect Field
ED-97443-30	Fuse and Alarm Panel
ED-3C009-30,G1	Power Distribution Panel
ED-3C569-30,G1	QRSS Power Alarm Plug-in
ED-3C590-30,G1	TCAS Plug-in Unit
ED-3C655-30	DSX-Optional ORB Equalizers
ED-3C767-30	DSX-Dedicated ORB Equalizers

→TABLE A←

T1D LINE REPEATERS

REPEATER CODE	CABLE TYPE	APPARATUS CASE
258A	Pulp	479A or 818A1C, A2C, or C1C Unprotected
258B	PIC/DEPIC	
259A	Pulp	479B or 819A1C, A2C, B1C, B2C, or C1C Protected
259B	PIC/DEPIC	
281A	Pulp	466 Unprotected
281B	Pulp	
281C	PIC/DEPIC	
281D	PIC/DEPIC	
285A	Pulp	468 Protected
285B	Pulp	
285C	PIC/DEPIC	
285D	PIC/DEPIC	
288A	Pulp	475 Unprotected (Case must be modified with D-181050 Kit of Parts)
288B	Pulp	
288C	PIC/DEPIC	
288D	PIC/DEPIC	
289A	Pulp	475 Protected (Case must be modified with D-181050 Kit of Parts)
289B	Pulp	
289C	PIC/DEPIC	
289D	PIC/DEPIC	

◗ TABLE B ◖

T1D OFFICE REPEATERS

REPEATER CODE	TYPE	APPLICABLE SD-/CD- OR APS	TRANSMIT SIDE ARTIFICIAL LINE (dB)
260A	Current Regulating	3C414-01	12
260B	Current Looping	3C414-01	12
260C	Current Regulating	3C414-01	0
260D	Current Looping	3C414-01	0
250C	Bridging	3C378-01	—
286A	Current Regulating	578105	0 or 12
286B	Current Looping	578106	0 or 12
286C	Current Regulating	578107	0 or 12
286D	Current Looping	578108	0 or 12
286E	Bridging	578091	—

→ TABLE C ←

ORB SUBUNIT SUMMARY

UNITS/MODULES	T1 J98710 ORB			T1C/T1 DSX OPTIONAL ORB			T1C/T1 DSX DEDICATED ORB		
	J	K	L	J98725A	J98725B	J98725C	J98725D	J98725E	J98725F
	11′ 6″ BAY	9′ BAY	7′ BAY	11′ 6″ BAY	9′ BAY	7′ BAY	11′ 6″ BAY	9′ BAY	7′ BAY
Office Repeaters	72	48	48	96	48	48	144	96	72
Maintenance Repeaters	3	2	2	4	2	2	6	4	3
Bridging Repeaters	3	2	2	4	2	2	6	4	3
Equalizer Modules	*	*	*	104	52	52	6†	4†	3†
Equalizer Cards	—	—	—	Not Used	Not Used	Not Used	12*	8*	6*
Jack & Cross-Connect Panel	1	1	1	1	1	1	Not Used	Not Used	Not Used
Fuse, Alarm, & Fault Locate	—	—	—	1	1	1	Not Used	Not Used	Not Used
Fuse & Alarm Panel	1	1	1	Not Used	Not Used	Not Used	1	1	1
Fault Locate Panel	1	1	1	Not Used	Not Used	Not Used	1	1	1
Power Dissipation Units	6	4	4	8	4	4	12	8	6
Order Wire Panel	1	1	1	1	1	1	1	1	1
TCAS Plug-In	1	1	1	Not Used	Not Used	Not Used	12	8	6

* Equalizers are located in repeater
† Used at bridging repeater position

♦ TABLE D ♦

EQUALIZERS REQUIRED FOR
286C AND D (EXCP) REPEATERS

EQUALIZER CODE	RANGE (IN FT)
ED-3C655-30,G1	0-133
ED-3C655-30,G2	133-267
ED-3C655-30,G3	267-400
ED-3C655-30,G4	400-533
ED-3C655-30,G5	533-655

TABLE E

T1D EQUALIZERS

EQUALIZER CODE	TYPE J98725 ( ) ORB USED IN	RANGE (IN FT)
ED-3C767-30,G1	DSX-dedicated	0-133
ED-3C767-30,G2	DSX-dedicated	133-267
ED-3C767-30,G3	DSX-dedicated	267-400
ED-3C767-30,G4	DSX-dedicated	400-533
ED-3C767-30,G5	DSX-dedicated	533-655
*ED-3C655-30,G1	DSX-optional	0-133
ED-3C655-30,G2	DSX-optional	133-267
ED-3C655-30,G3	DSX-optional	267-400
ED-3C655-30,G4	DSX-optional	400-533
ED-3C655-30,G5	DSX-optional	533-655

* Also used in DSX-dedicated bay with bridging repeater.

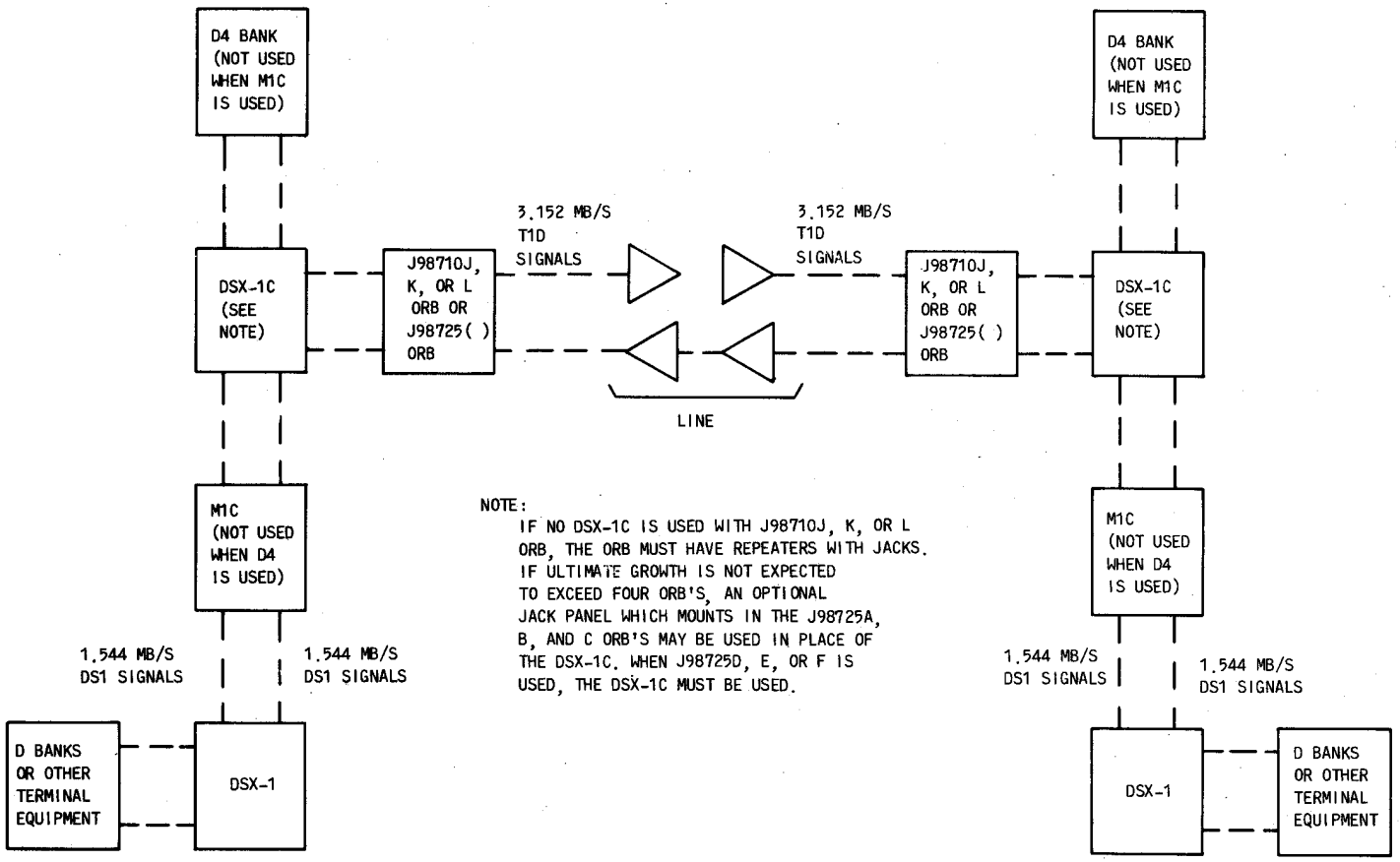


Fig. 1—T1D/M1C or T1D/D4 Facility—Block Diagram

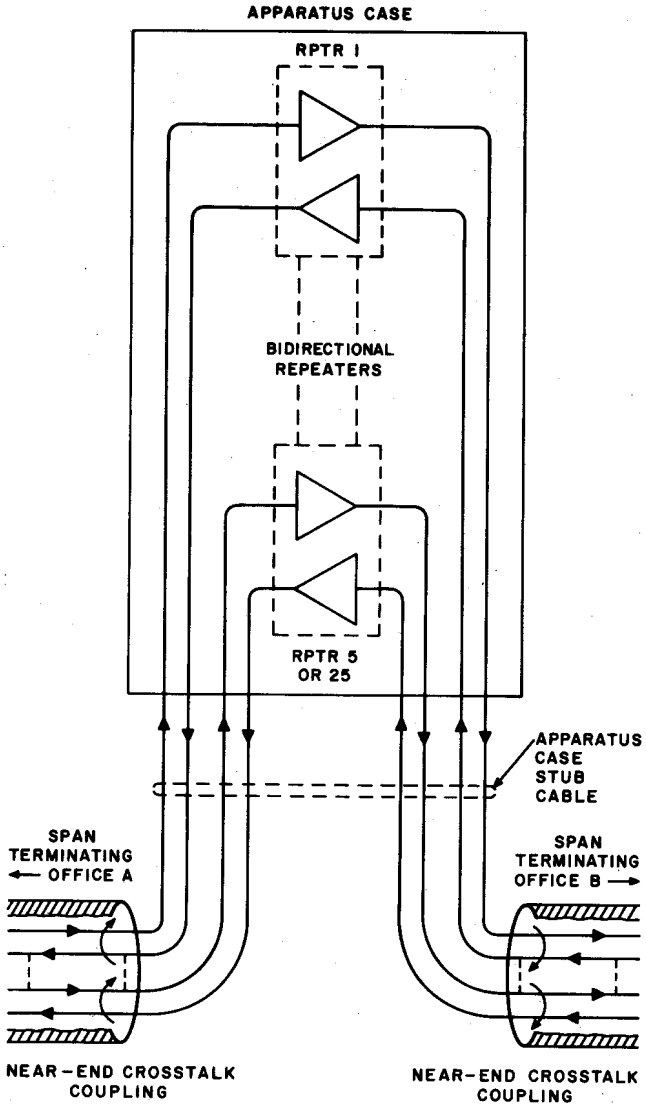


Fig. 2—One Cable Using Bidirectional Operation

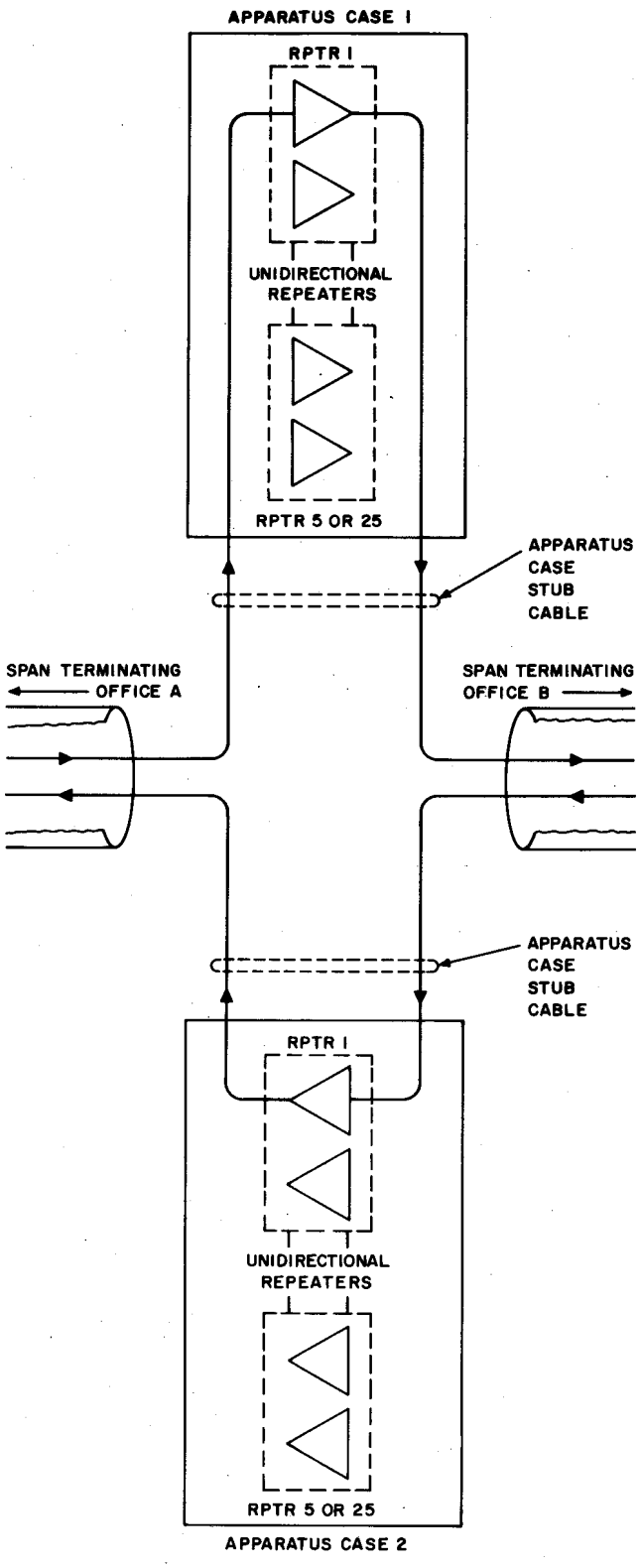


Fig. 3—One Cable Using Unidirectional Operation

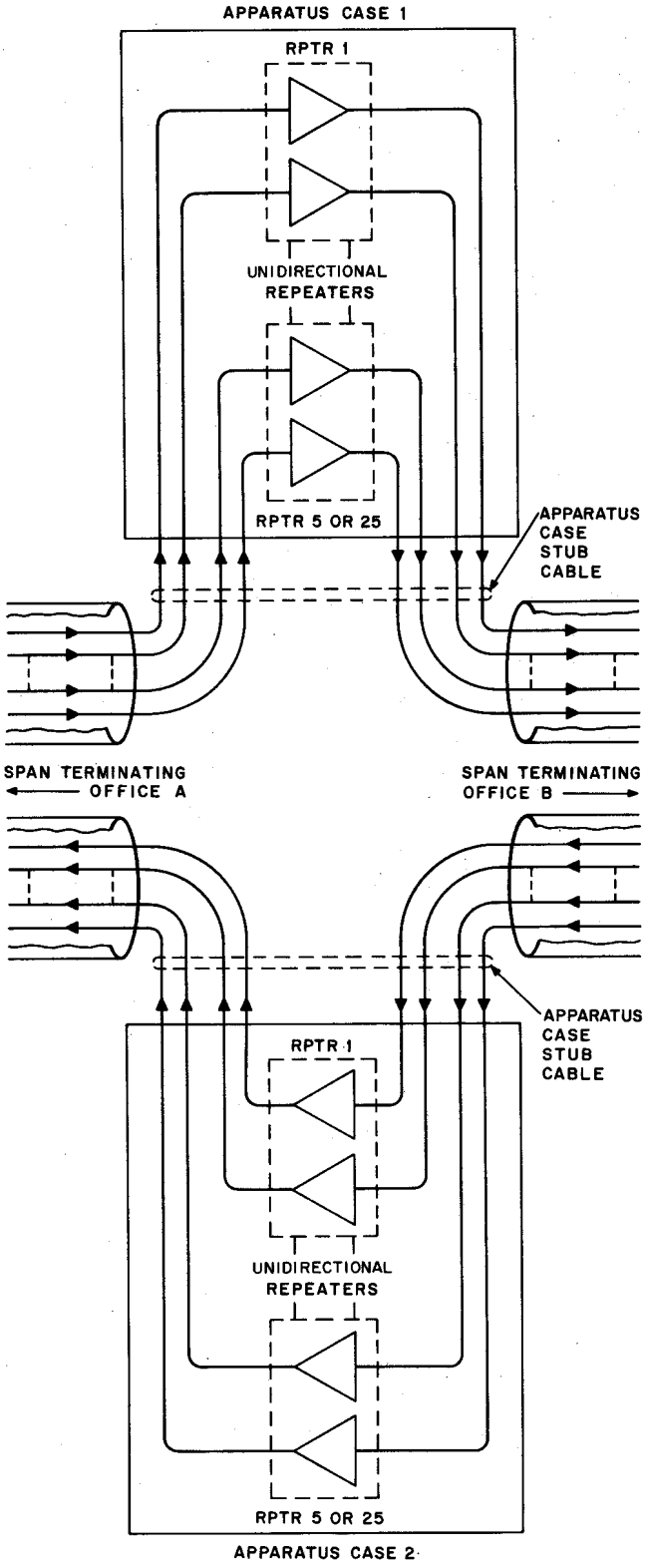
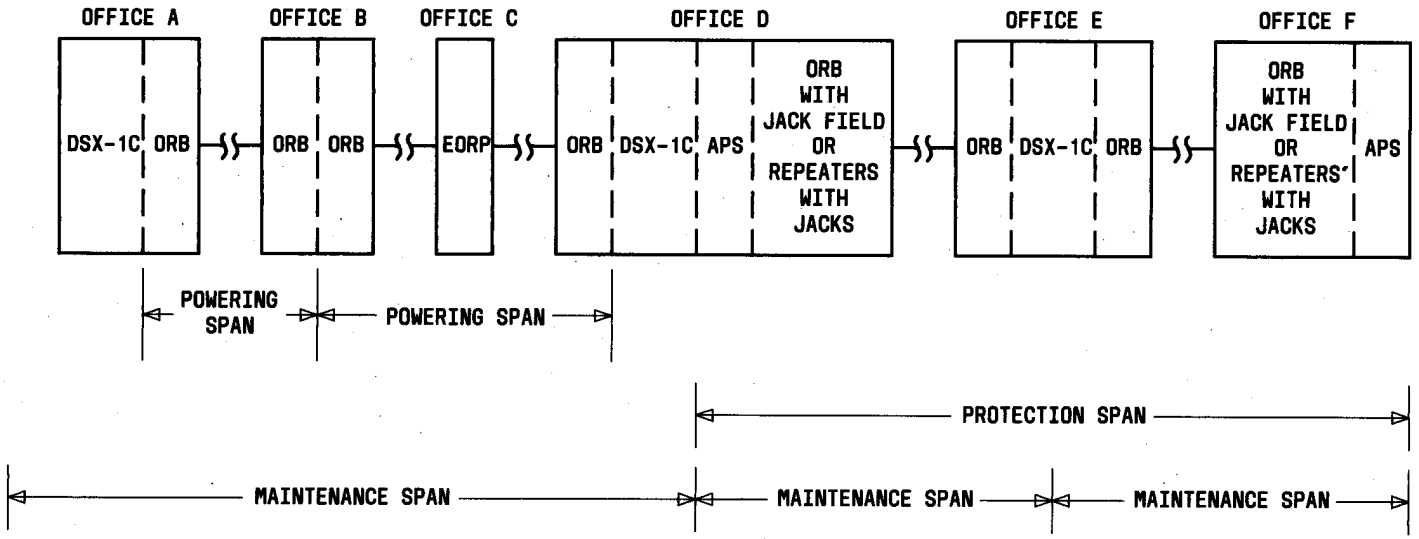


Fig. 4—Two Cables Using Unidirectional Operation



NOTES:

1. OFFICES NOT EQUIPPED WITH APS MAY OR MAY NOT BE EQUIPPED WITH DSX-1C.
2. OFFICES EQUIPPED WITH APS MUST BE EQUIPPED WITH EITHER JACK FIELD ON ORB SIDE OF APS [J98725-() BAYS] OR REPEATERS WITH JACKS (206 ORB WITH 286A AND B REPEATERS.
3. 206 ORB WITH DSX-1 MUST RETROFIT DSX-1 TO DSX-1C.

Fig. 5—Span Concept

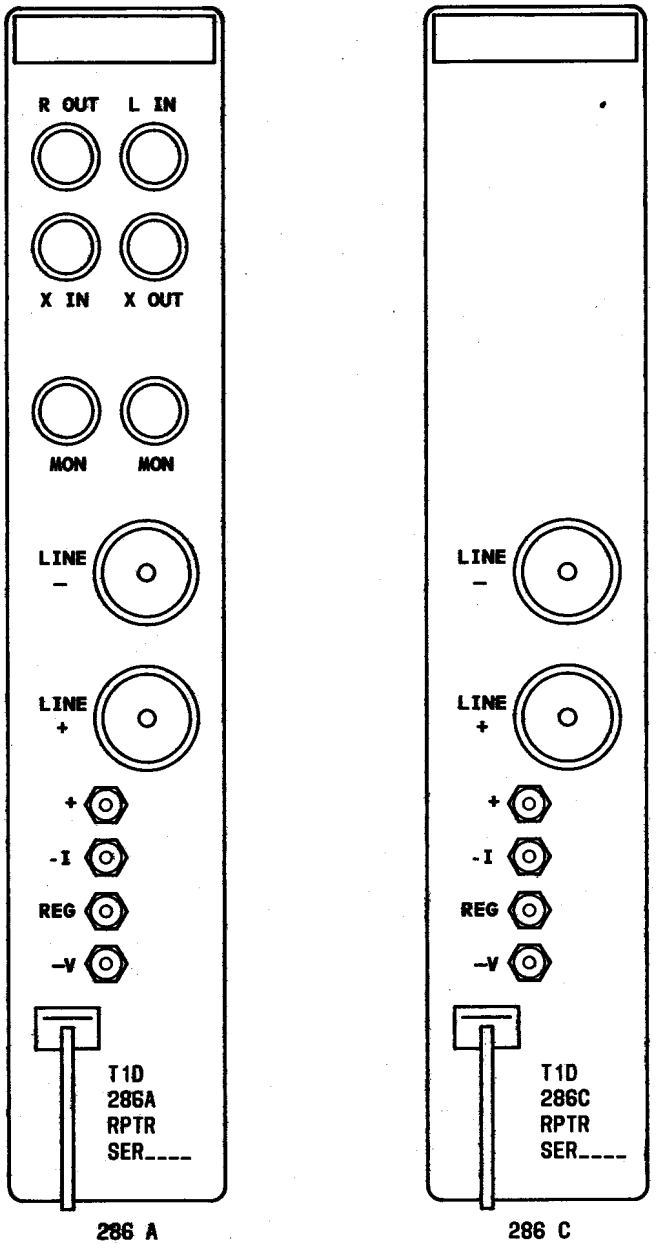


Fig. 6—286-Type Office Repeaters

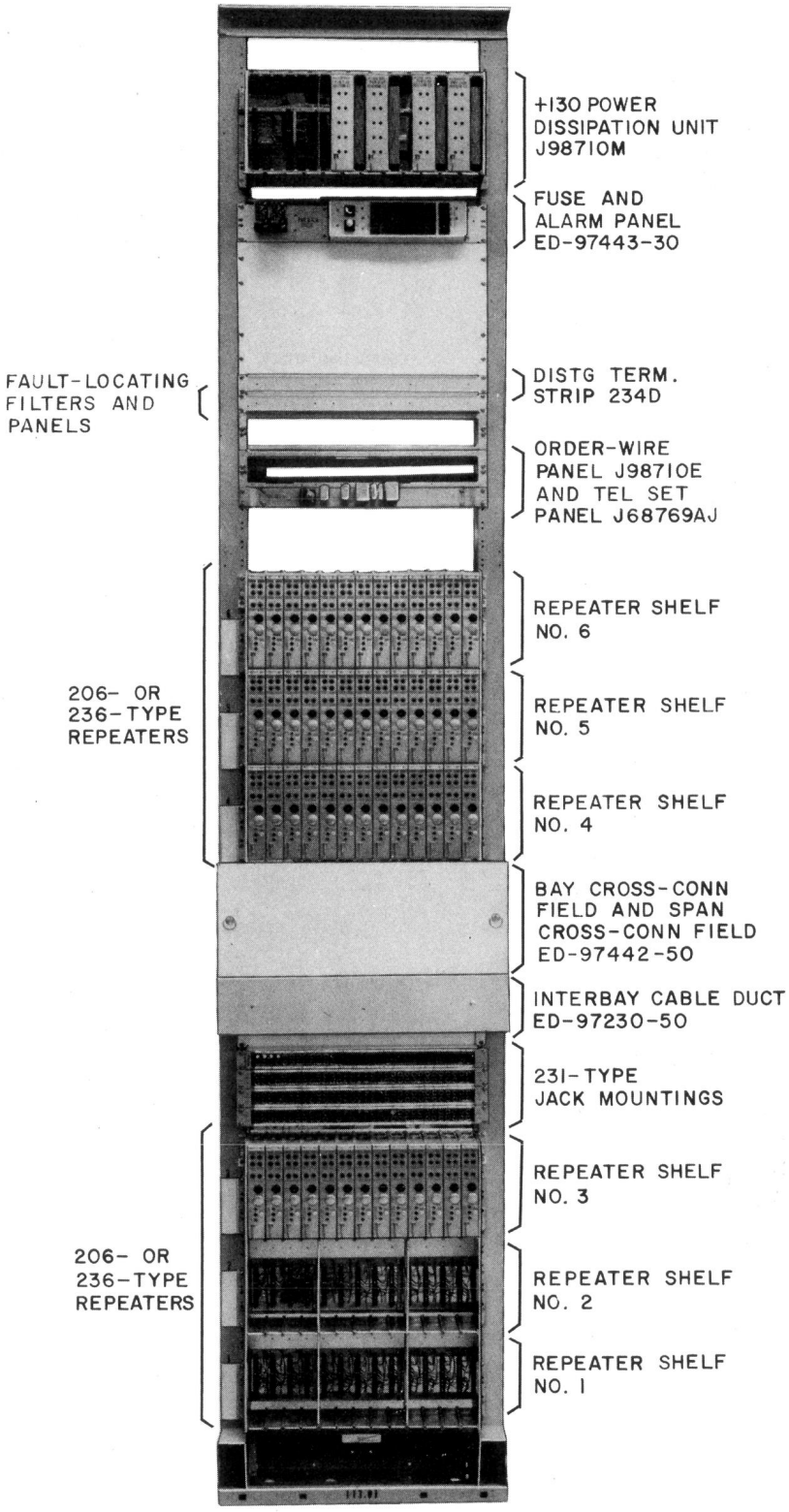


Fig. 7—Typical 206 Office Repeater Bay (206 ORB)

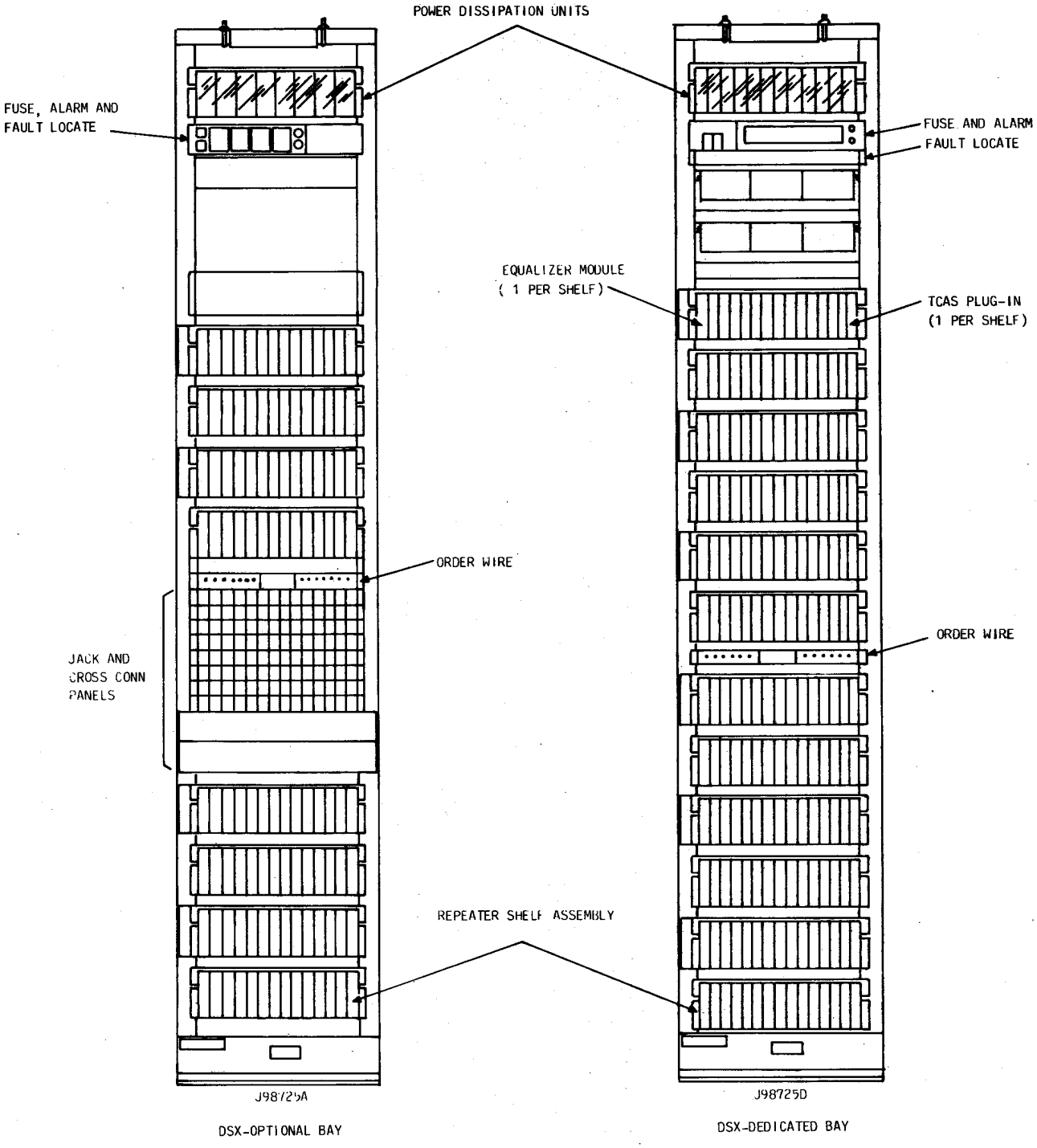
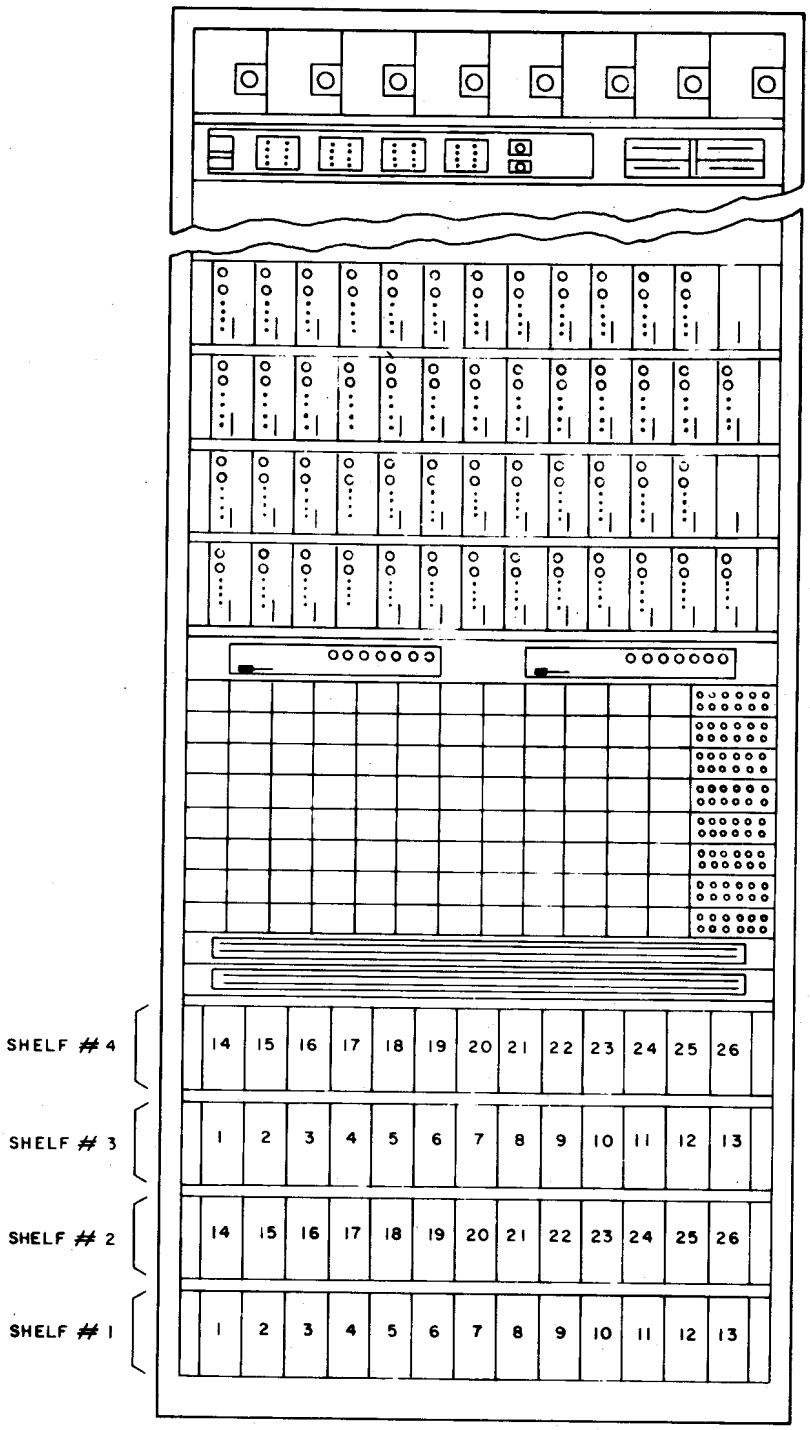


Fig. 8—J98725( ) Office Repeater Bay—11 Feet 6 Inches



NOTES:

25 - MAINTENANCE REPEATER
26 - BRIDGING REPEATER

Fig. 9—Office Repeater Arrangement

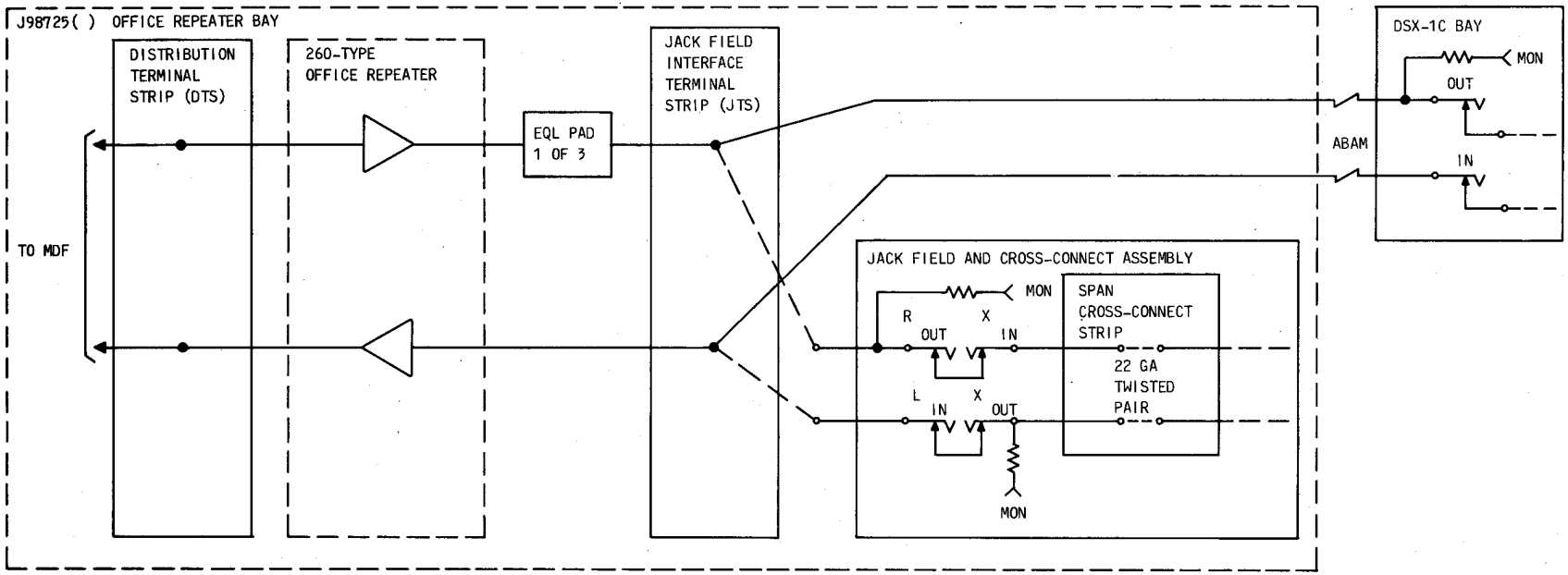


Fig. 10—T1D Cross-Connect Arrangement

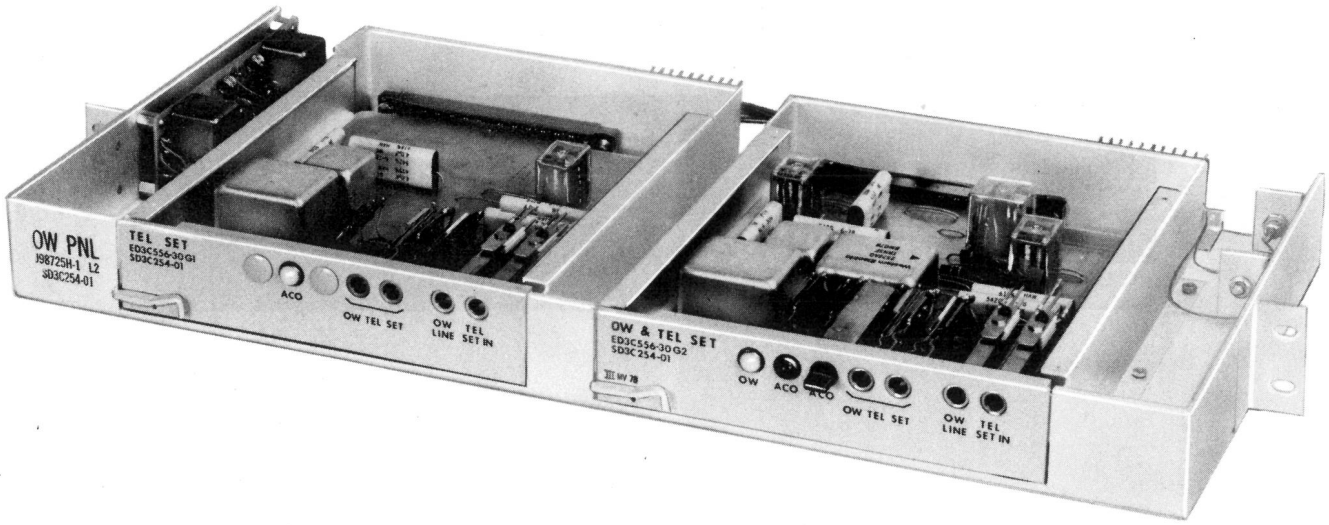


Fig. 11—Order-Wire and Tel Set Panel

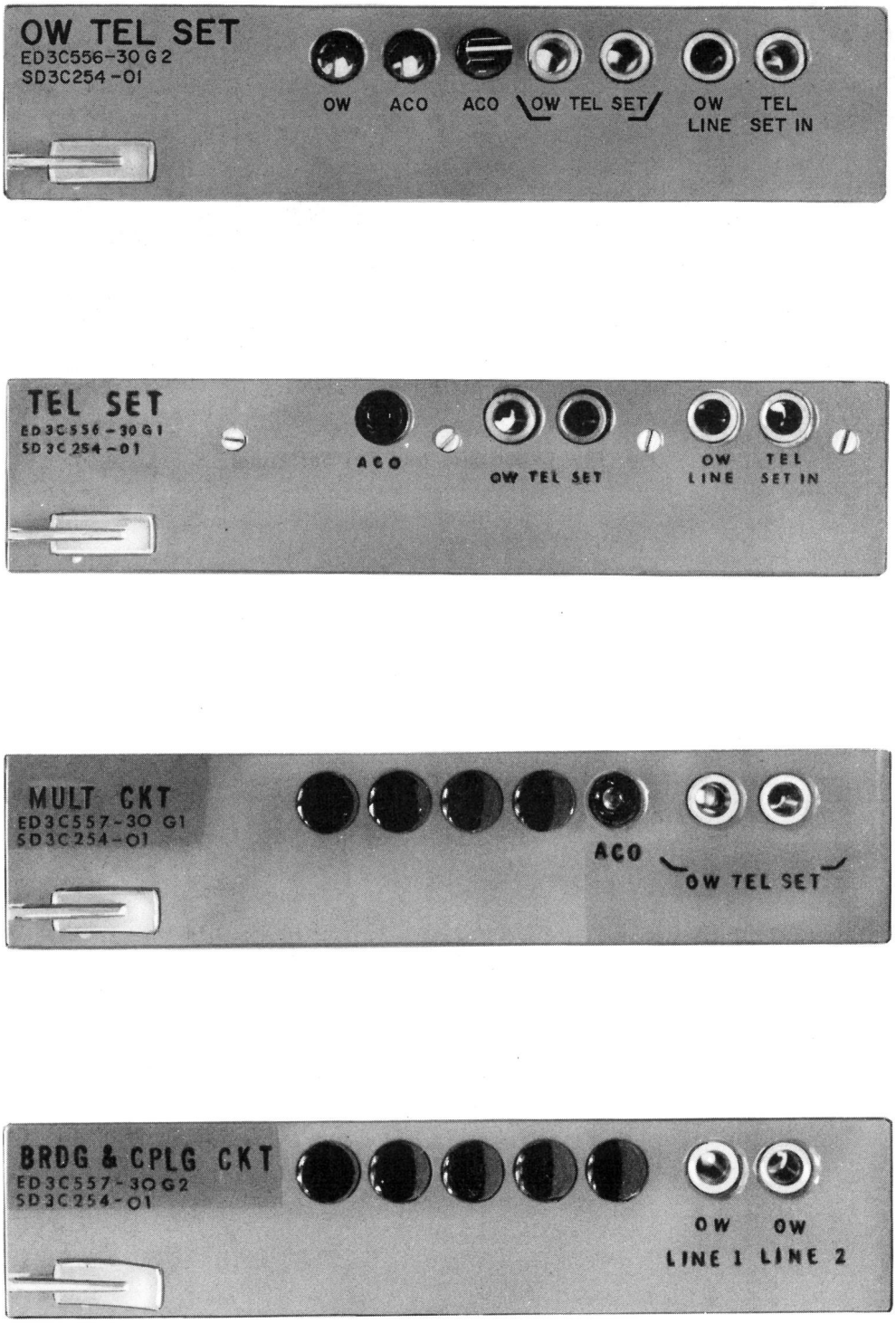


Fig. 12—Order-Wire and Tel Set Plug-In Units

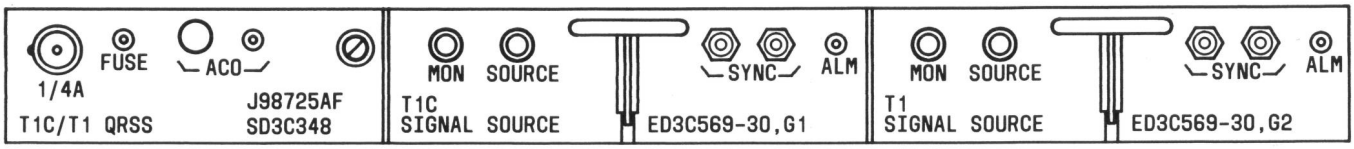


Fig. 13—J98725AF Quasi-Random Signal Source

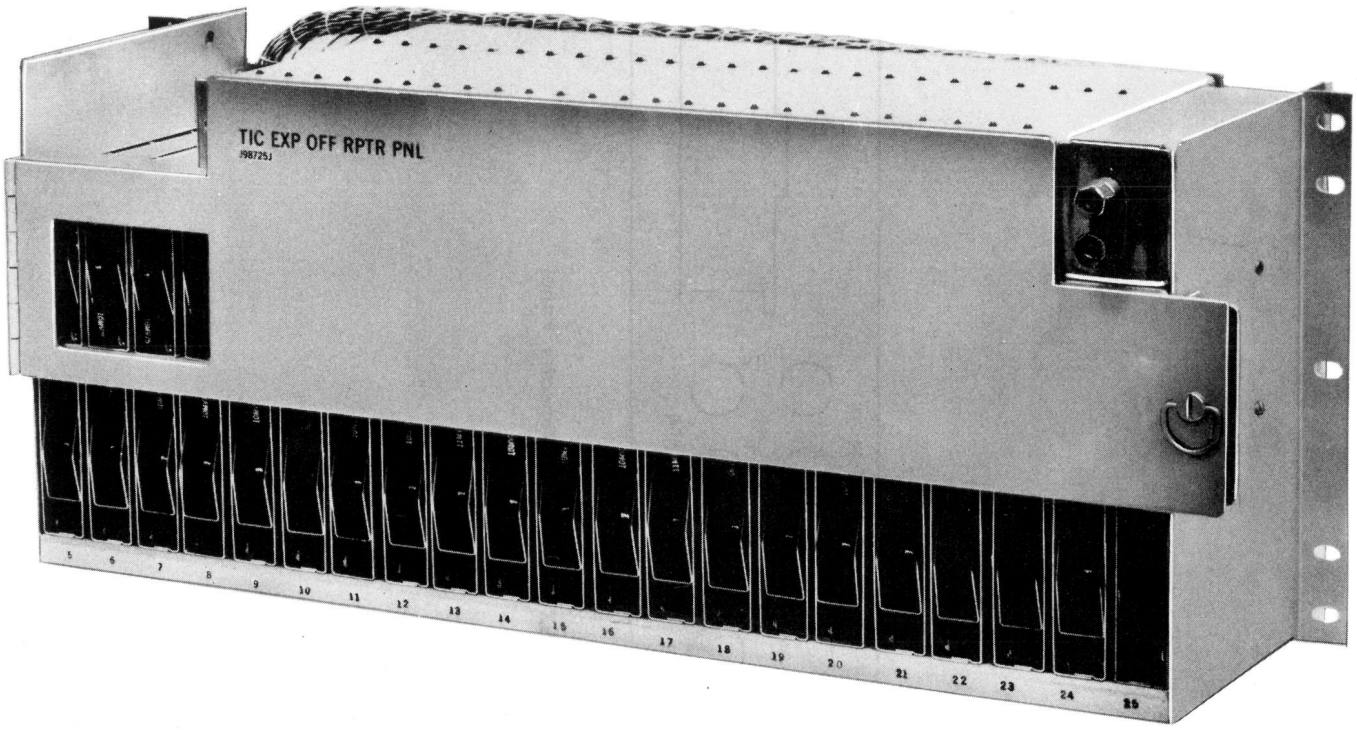


Fig. 14—J98725J Express Office Repeater Panel (EORP)

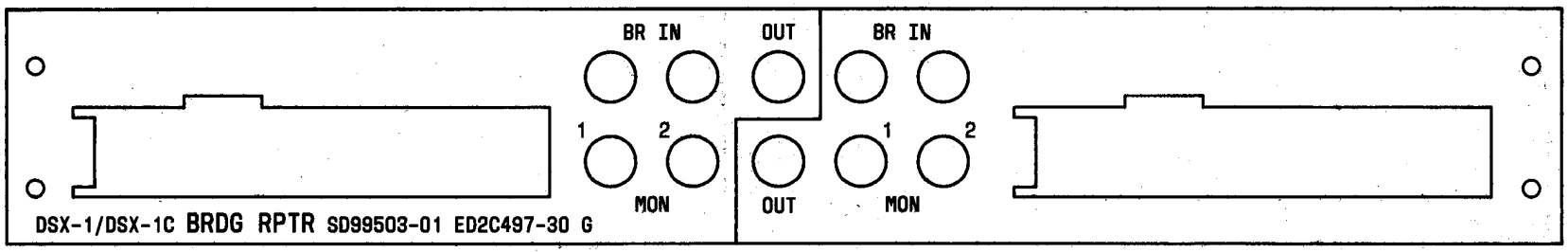


Fig. 15—DSX-1/DSX-1C Bridging Repeater Panel

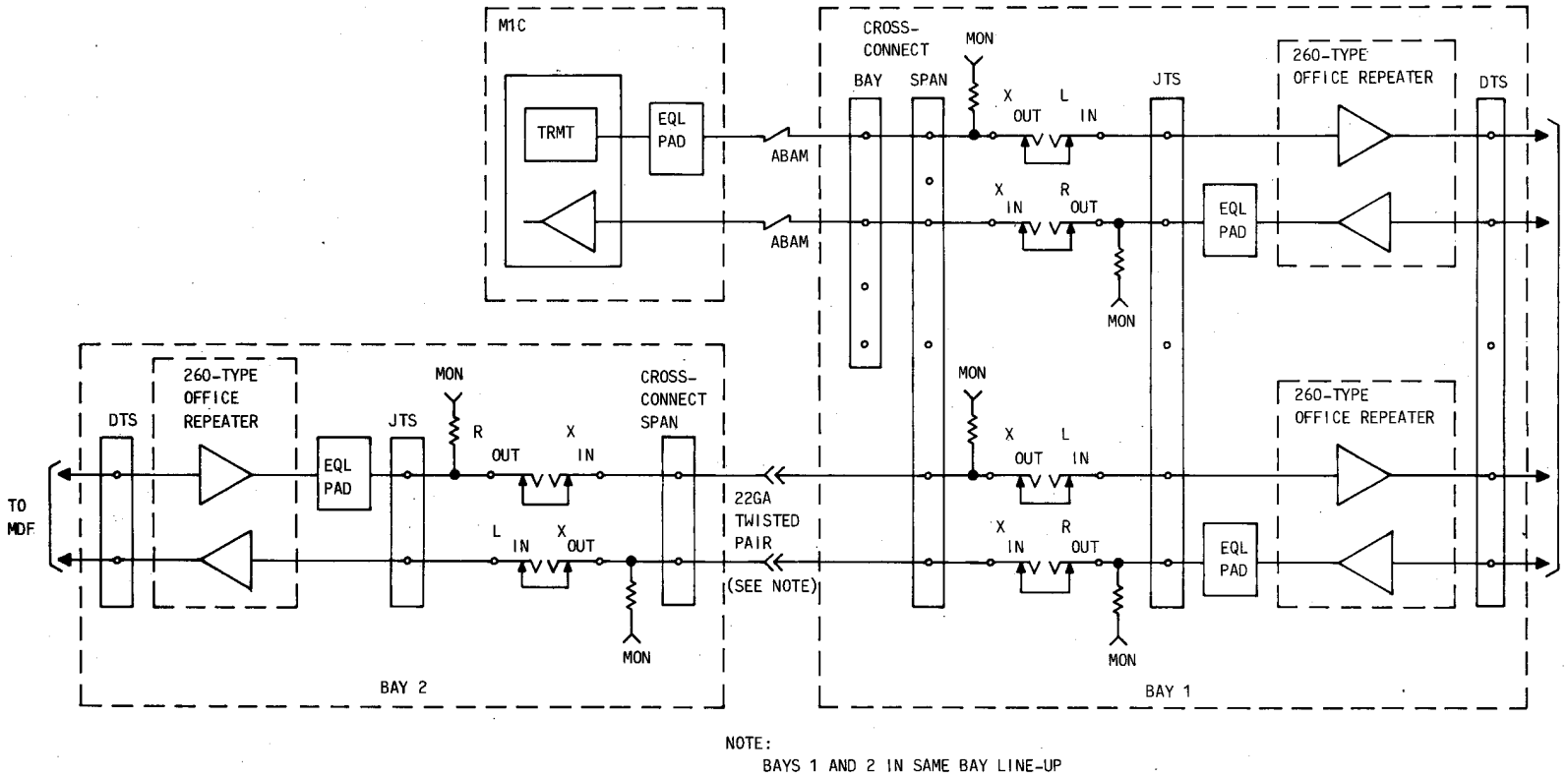


Fig. 16—T1D Cross-Connection Without DSX

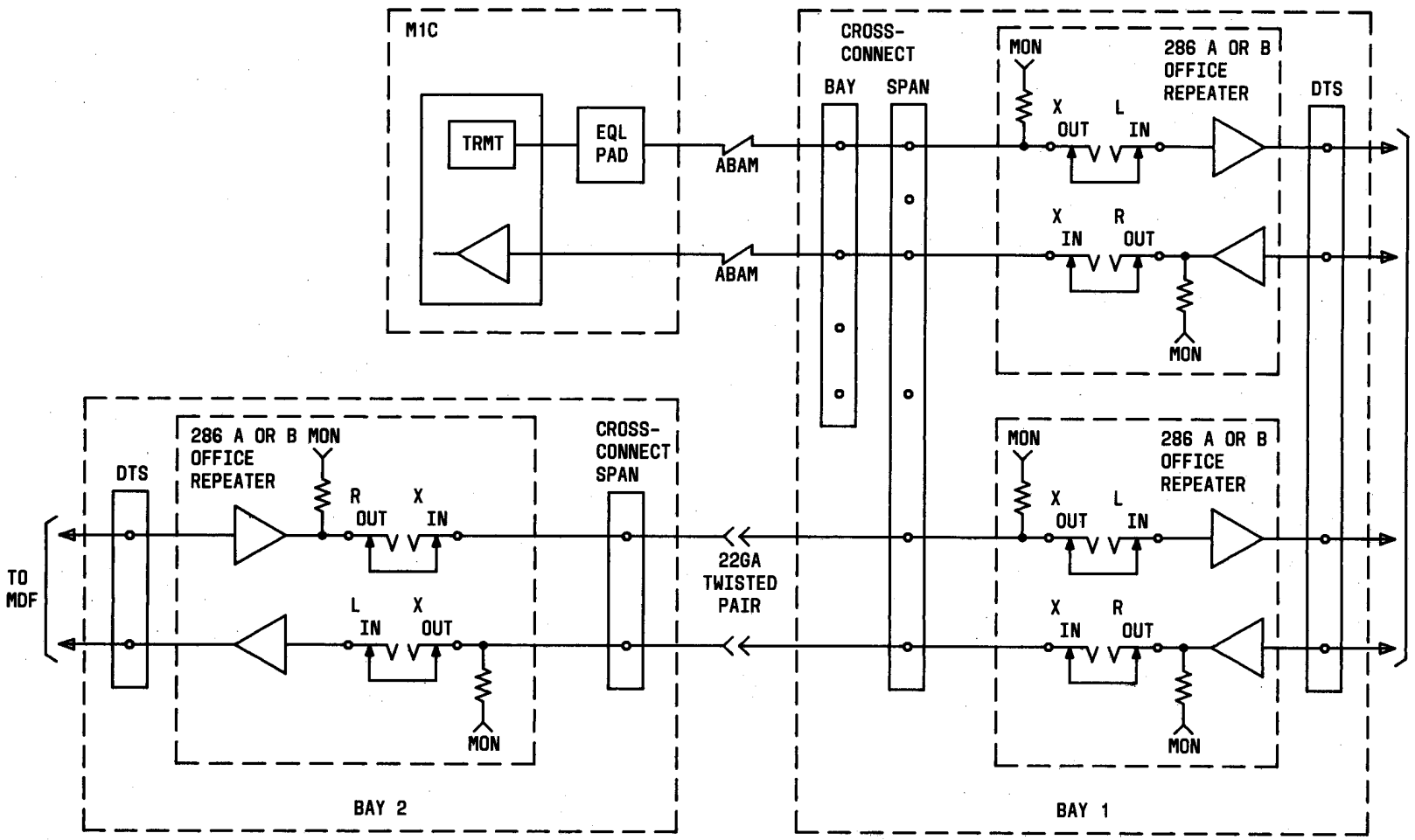
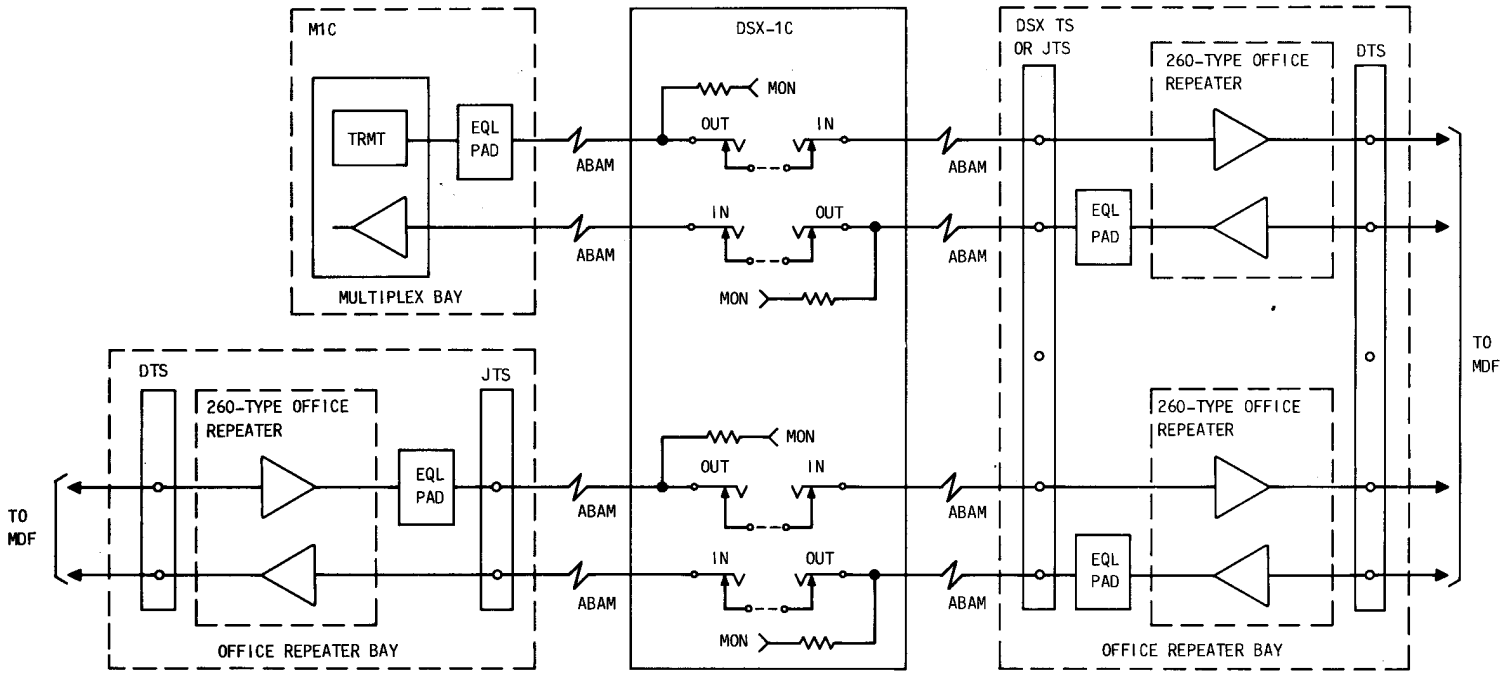


Fig. 17—◆T1 Line Retrofit to T1D, Cross-Connection Without DSX◆



JTS = JACK FIELD INTERFACE TERMINAL STRIP (USED IN DSX-OPTIONAL ORB)
DTS = DISTRIBUTION TERMINAL STRIP
DSX TS = DIGITAL CROSS CONNECT TERMINAL STRIP (USED IN DSX-DEDICATED ORB)

Fig. 18—T1D Cross-Connection With DSX

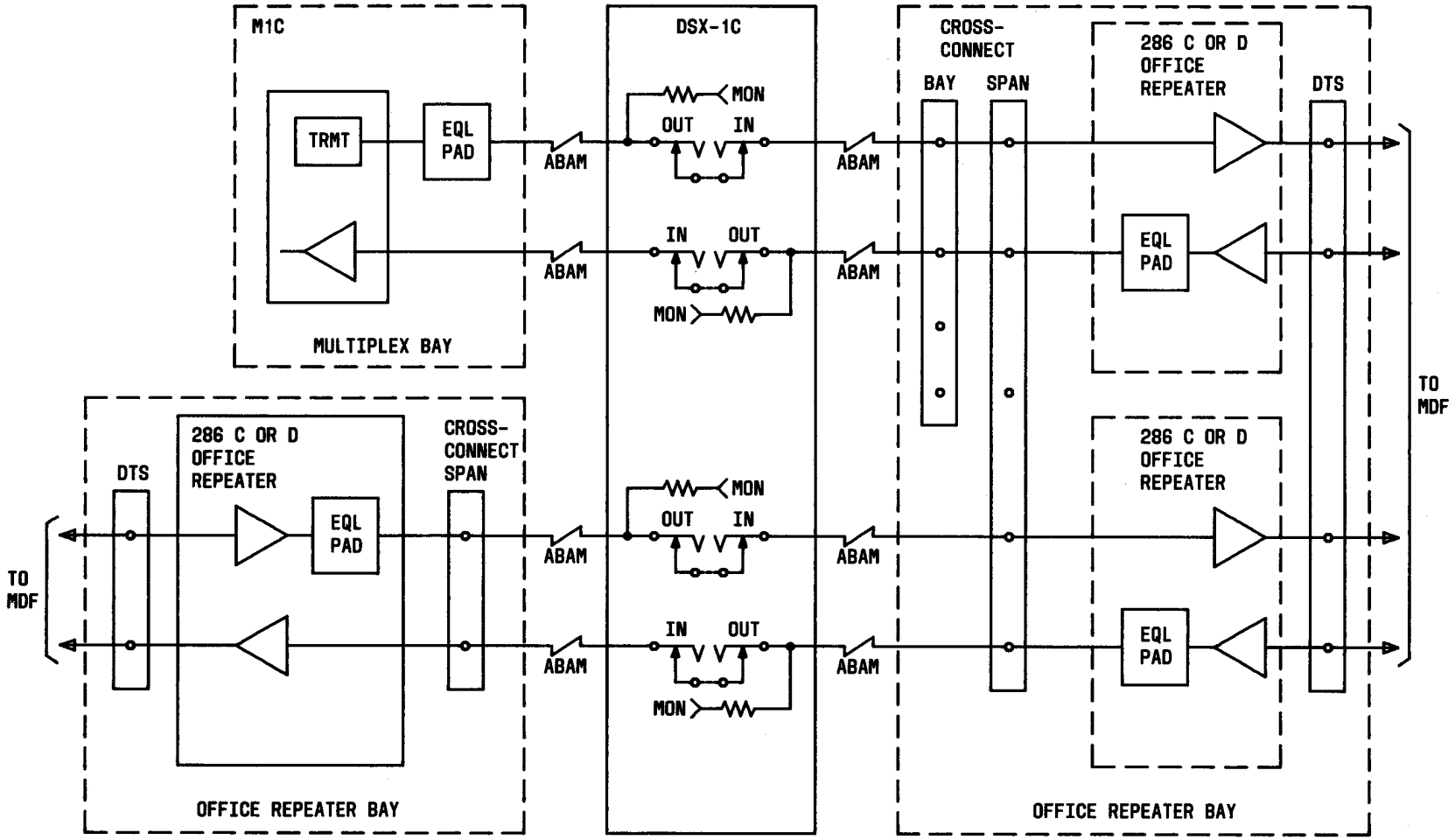


Fig. 19—◊T1 Line Retrofit to T1D, Cross-Connection With DSX◊

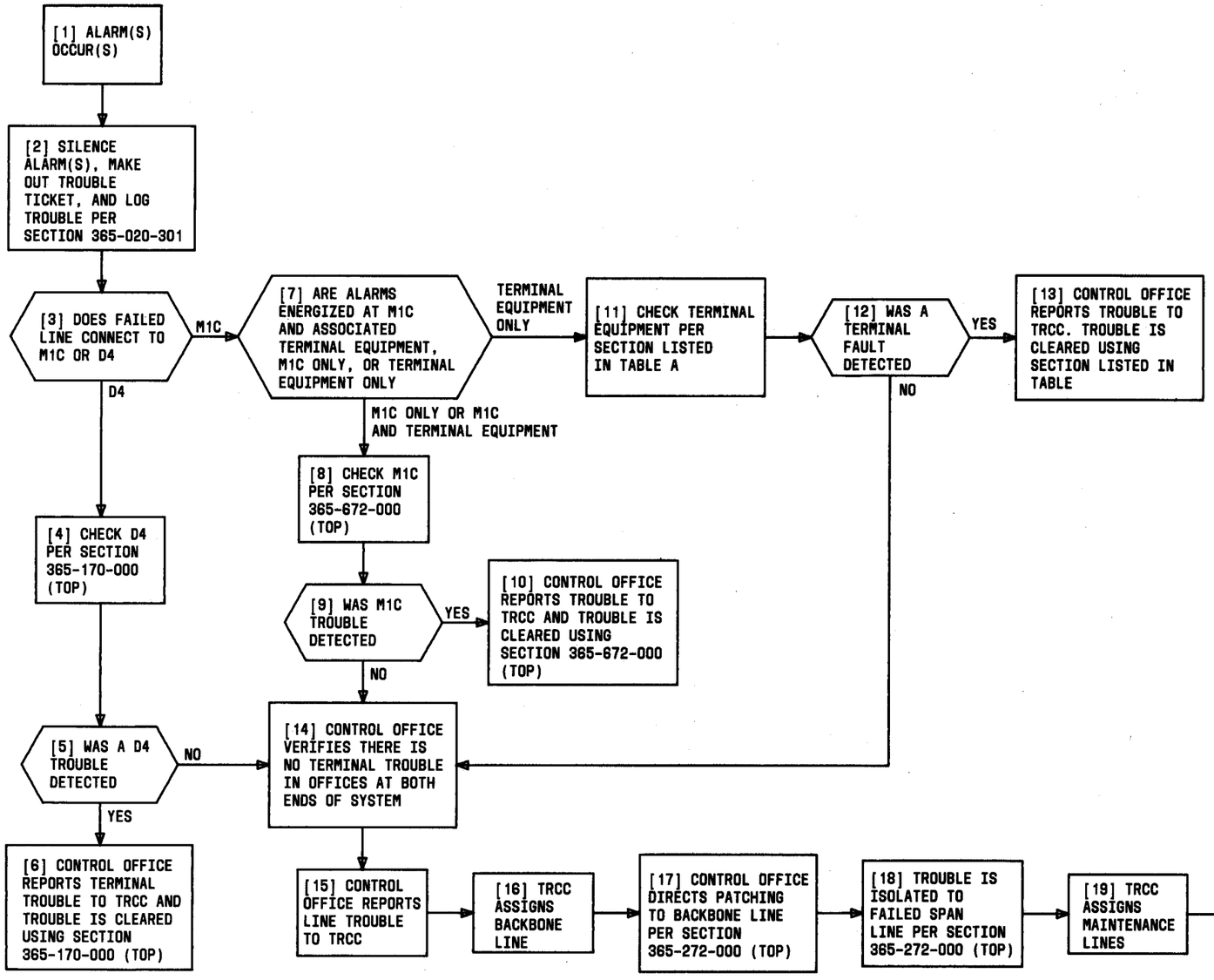


TABLE	
TERMINAL EQUIPMENT	APPLICABLE SECTION
D1A,B,C	365-110-500
D1D	365-116-505
D2	365-410-500
D3	365-150-505
D4 MODE 3	365-170-000
M12	365-600-503
M12A,B	365-600-506
M13	365-671-521
TW1B 1,2	365-118-502
T1WB 3	365-120-502
TW1B 4	314-915-501
TW1B 5	314-915-510
T1WM 1	365-119-502
T1WM 4	365-121-500
T1DM	314-983-300

Fig. 20—T1D Trouble Isolation Flow Chart

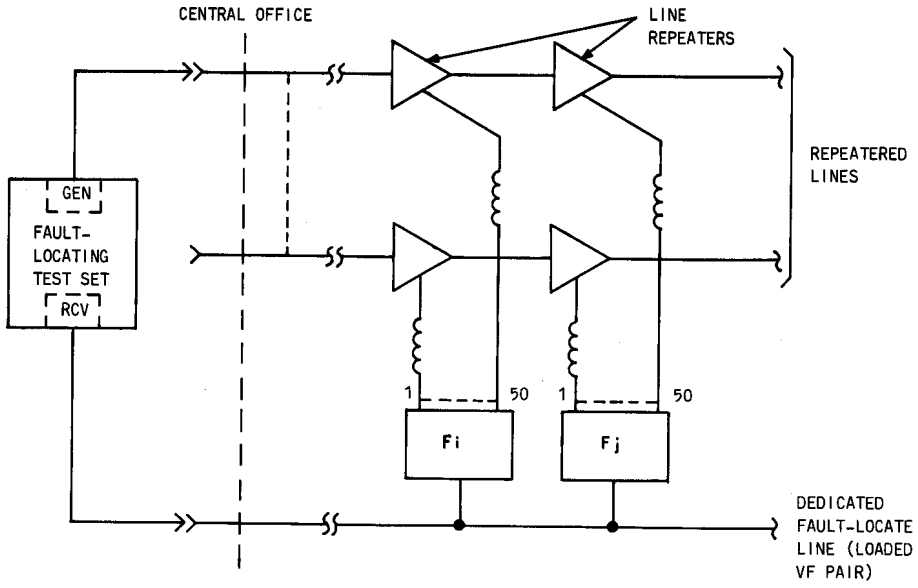


Fig. 21—Fault-Locating System

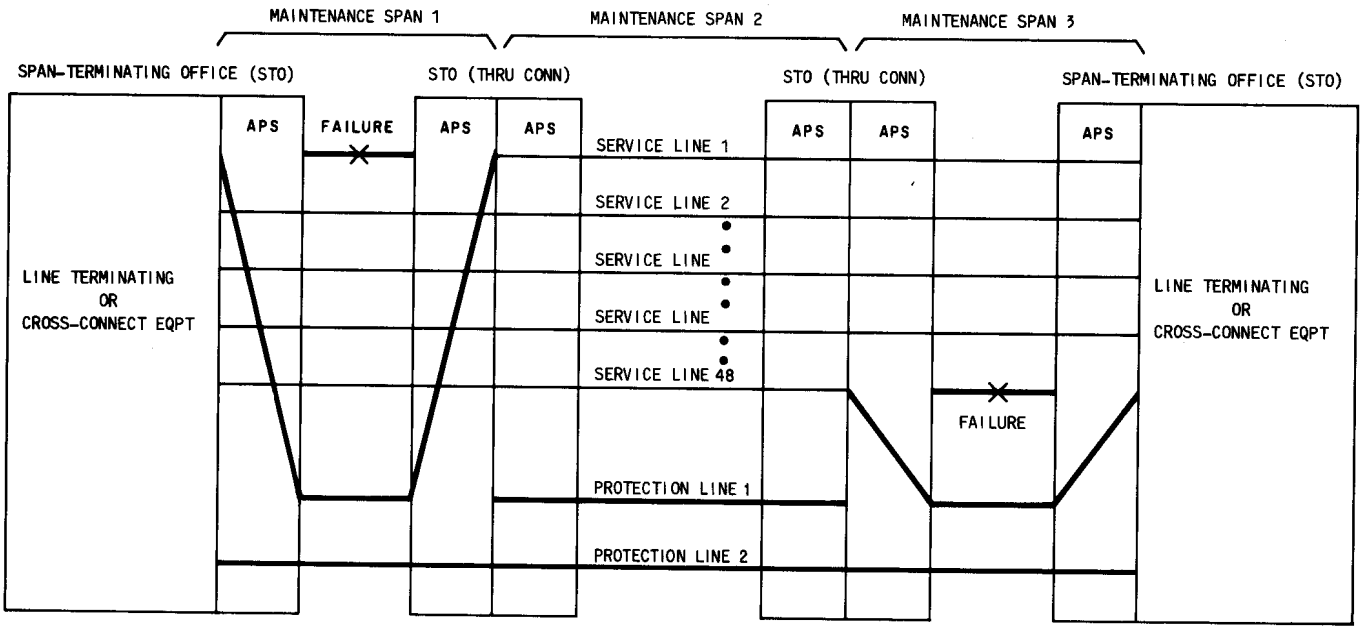


Fig. 22—Sectionalized Use of Protection Span Line