SECTION 365-250-100
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T1C DIGITAL LINE
GENERAL DESCRIPTION
DIGITAL TRANSMISSION SYSTEMS

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section describes the T1C Digital Transmission Line and its associated equipment. The T1C line is used in conjunction with the D4 channel bank or M1C multiplexer which converts DS1 signal sources such as D-type channel banks, T1 lines, and M12 or M13 multiplexers to DS1C signal levels. Figure 1 shows the basic T1C/M1C or T1C/D4 facility in block diagram.

1.02 The reasons for reissuing this section are listed below. Since this reissue is a general revision, no revision arrows have been used to denote significant changes.

(a) To provide coverage for T1C low-powered bidirectional line repeaters with bidirectional operation

(b) To state that T1C range has been extended to a maximum of 250 regenerated sections

(c) To provide coverage of the automatic protection switch (APS)

(d) To provide coverage of the active fault-locate filters.

(e) To introduce intercity and outstate trunk (ICOT) cable.

2. GENERAL DESCRIPTION OF T1C DIGITAL LINE

2.01 The T1C digital line uses two exchange grade cable pairs, one for each direction of transmission of 48 pulse code modulation (PCM) voice or data channels. The M1C multiplexer (see Section 365-604-100) provides the interface between DS1 and DS1C signals as shown in Fig. 1. The M1C combines two DS1 signals at 1.544 Mb/s, adds appropriate framing information, and performs required pulse coding for the resulting 3.152-Mb/s DS1C signal. The D4 channel bank in modes 1 and 2 (see Section 365-170-100) generates the 3.152 Mb/s DS1C signal from 48 separate input channels. This DS1C signal is applied via a DSX-1C, or equivalent, cross-connect panel to an office repeater bay (ORB). The ORB and the digital line equipment provide a facility for transmitting and receiving the bipolar 3.152-Mb/s signals of the M1C or D4 channel bank. At each end of the digital line, an ORB in conjunction with an M1C equipped with the proper interface card or D4 channel bank (mode 1 or 2) 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 M1C multiplexer uses time division multiplexing to combine the two asynchronous DS1 signals for transmission over the T1C line. Synchronization is accomplished by bit stuffing, which, combined with the required framing and control bits, results in a T1C line rate of 3.152 Mb/s. A single-cell scrambler is included in the M1C to maintain control of the pulse density on the line. Framing monitors in the M1C operate a local alarm (LA) when framing is lost for more than 200 ms. When this occurs, the framing pattern in the opposite direction of transmission is automatically modified to bring up a remote alarm (RA) (at the distant terminal) to facilitate maintenance and restoration.

2.03 The T1C 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. Complete repeater spacing information is provided in Section 855-351-110. 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, pulp, metropolitan area trunk (MAT), intercity and outstate trunk (ICOT) 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 has a regenerator for the low level incoming line signal and passive networks for the high level outgoing line signal. Office repeaters and the 219 and 249 line repeaters are provided with secondary lightning protection.

2.04 T1C, T1D, and T1 are compatible in the same cable sheath but not in the same unit (binder group). See Section 855-351-110 for T1C engineering rules. Special voice frequency (VF) filters are required when service pairs (order wire, fault-locating, etc) are used in the same unit with a T1C line. The order-wire and fault-locating pairs carry only low-frequency information and are normally assigned to units carrying VF service.

2.05 T1C is engineered in blocks of 50 unidirectional or 25 bidirectional lines in either a one-cable, a two-cable, or a screened-cable mode with a maximum range of 250 regenerative sections. The maximum range depends on the design criterion of the T1C facility which is covered in Section 855-351-110.

2.06 Up to 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 479- or 800-type apparatus case. For unidirectional operation, two apparatus cases per line repeater location are required for both one- and two-cable operation and only one direction of transmission is permitted per case. For bidirectional operation, one apparatus case per line repeater location is required for either one- or two-cable operation. These cases are usually located in manholes or at pole-mounted repeater locations. Section 640-527-107 describes the 479-type apparatus case and Section 640-525-307 describes the 800-type apparatus case. Each case provides two stubs which are spliced into the main cable. The 800-type case can also have a quad-screened stub for splicing into the main cable. One stub is for low-level incoming signals, the other for high-level regenerated signals. Either two stubs or a quad-screened stub is necessary to ensure adequate crosstalk isolation between input and output signal levels which can differ as much as 54 dB (worst case pair loss for maximum section length) at the T1C reference frequency of 1.576 MHz. The T1C 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. The EORP description is provided in Section 365-250-105. Engineering information for the EORP is provided in Section 855-351-110.

3. MODES OF OPERATION

3.01 The T1C line can be constructed for any of the following four modes of cable-repeater operation:

(a) One cable using bidirectional operation (Fig. 2)

(b) One cable using unidirectional operation (Fig. 3)

(c) Two cables using unidirectional operation (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. The engineering rules required to select a cable type are provided in Section 855-351-110.

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 T1C 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. The use of bidirectional line repeaters determines the powering scheme (as covered in Part 13) and also requires only one maintenance line of bidirectional line repeaters for span patching.

3.03 Bidirectional operation for T1C is accomplished by reversing the repeater's input and output of side 2 at the splice case and not on the repeater's printed circuit board; therefore, the input and output pins of the repeater are the same for unidirectional and bidirectional codes. Different codes are required to accommodate power looping.

B. One Cable Using Unidirectional Operation

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 T1C 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 line repeaters determines the powering scheme (as covered in Part 13) and requires two maintenance lines in each direction to restore the two T1C digital lines associated with each repeater. If growth occurs, the apparatus cases can be spliced to two cables carrying the separate directions of transmission to obtain maximum cable pair usage (paragraph 3.05).

C. Two Cables Using Unidirectional Operation

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 T1C 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 T1C 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 (as covered in Part 13) and also requires two maintenance lines in each direction to restore the two T1C 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, (MAT and ICOT), is an uneven 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 have 16 pairs reserved for service pairs, whereas NSLA or DM cable is still 600-pair with no reserved service pairs. More information on screened cable can be located in Section 855-351-110. Even though it is not recommended, a fault-locate or order-wire pair may share the same binder group with T1C pairs if the special crosstalk suppression filters are used on each of these pairs.

3.07 Each cable unit of T1C 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 for air core cable and this can be an interstitial pair if a filter is used. Filtering for the order-wire and fault-locate pairs can be provided in the splice case or apparatus case. For air core cable, the filter for the pressure alarm pair must be located in the splice case if no interstitial pair is available.

3.08 On a route with large voice-frequency demand and a slower carrier growth rate, a one-cable installation provides greater flexibility. On a route with rapid growth and large cross section, a two-cable installation provides more capacity and has more NEXT margin. In ducted metropolitan areas where demand for carrier circuits greatly exceeds the need for voice frequency, or where such shared operation for maintenance and operation is prohibited, use of large screened cables is recommended.

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 T1C 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. T1C spans are engineered in minimum blocks of 50 one-way lines for unidirectional operation or 25 two-way lines for bidirectional operation to match the capacity of the apparatus case. The office repeater bay provides arrangements for powering span lines. For basic engineering rules of the T1C line, refer to Section 855-351-110.

4.02 The T1C line connects to IN jacks on the DSX-1C or L 1N jacks on the ORB at the transmit end of the line. The receive end of the T1C line connects to OUT jacks on the DSX-1C or R OUT jacks on the ORB jack panel. Equalizers provide standard level signals to the DSX-1C or ORB jack panel. Thus, span lines can be cross-connected to each other, to an M1C muldem, or to a D4 channel bank in an office.

5. T1C OFFICE REPEATER BAY

A. General

5.01 T1C spans terminate at central offices in office repeaters mounted in shop-wired office repeater bays (ORBs). Six J98725 ORB letter codes (A through E and F) are used by the T1C line (see Table B). There are two types of ORBs: the DSX-optional ORB which can be used with the DSX-1C or ORB jack panel and the DSX-dedicated bay which is always used with the DSX-1C (see Fig. 6). There are three sizes of DSX-optional, or dedicated, T1C/T1 ORBs (11-foot 6-inch, 9-foot, and 7-foot).

5.02 Table B lists the subassemblies contained in each type of ORB. Both the 11-foot 6-inch DSX-optional T1C/T1 ORB and the 9-foot T1C/T1 DSX-dedicated ORB contain eight repeater shelves. The 9-foot and 7-foot DSX-optional T1C/T1 ORBs contain four repeater shelves. The 11-foot 6-inch T1C/T1 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 to 13, left to right. The even numbered repeater shelf slots are numbered 14 to 26, left to right. Repeater slot 25 is dedicated to the maintenance line. Repeater slot 26 is reserved for the bridging repeater. (See Fig. 7)

5.03 Other circuits included in the ORB are plug-in equalizers, power dissipation circuits, fuse and alarm circuits, fault locating circuits, and order wire circuits. Jack panels and span and bay cross-connect panels are provided in the DSX optional T1C/T1 ORB when no DSX-1C is available. For additional information about the DSX optional T1C/T1 ORB, refer to CD-3C252-01 and SD-3C252-01. For additional information about the T1C/T1 DSX-dedicated ORB, refer to CD-3C371-01 and SD-3C371-01.

B. Office Repeaters

5.04 Table C lists the office repeaters used with T1C. There are three types of office repeaters: regulating, looping, and bridging. The 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. A detailed description of the repeaters is provided in Section 365-250-101.

C. Equalizers

5.05 On the DSX-optional T1C/T1 ORB, a connector assembly for a discrete component plug-in equalizer is associated with each office repeater. In the T1C/T1 DSX-dedicated ORB, 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 DSX-optional ORB, the output of the equalizer is connected back to a connector on the associated repeater as an outgoing tie point. Table D lists the equalizers used in DSX-optional

T1C/T1 ORBs and T1C/T1 DSX-dedicated ORBs. The equalizers provide pulse equalization over the interoffice cable lengths listed in Table D. The equalizers provide 0.8-dB steps to maintain the signal level difference between -0.4 dB and +0.4 dB caused by equalization. All 220 series office repeaters provide 4-volt output pulses and must be used with ED-3C555-30 (T1C/T1 DSX-optional ORB) or ED-3C744-30 (DSX-dedicated ORB) equalizers in order to provide proper signal levels. All 250 series office repeaters provide 6-volt output levels and must be used with ED-3C655-30 (DSX-optional ORB) or ED-3C767-30 (DSX-dedicated ORB) equalizers.

5.06 When no DSX-1C bay is provided and the ultimate growth is not expected to exceed four 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.

D. Jack and Cross-Connect Panels

5.07 T1C patching and cross-connect functions are provided by the jack and cross-connect panels (Fig. 8) which are mounted on a single shelf assembly in the DSX-optional T1C/T1 ORB 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 growth capacity in the central office exceeds four office repeater bays, a centrally located DSX-1C cross-connect bay should be installed initially. Figure 9 shows typical T1C cross-connect arrangements.

5.08 In the 11-foot 6-inch DSX-optional T1C/T1 ORB, the jack panel contains jacks for eight shelves of office repeaters plus miscellaneous jacks. In the 9- and 7-foot bay arrangement, jacks are provided for four shelves of office repeaters, plus miscellaneous jacks. The jacks for each repeater provide a normalled-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 contiguous bays are made via the span cross-connect field. Cross-connections to noncontiguous bays, M1C multiplexer bays, or D4 channel banks are made via the bay cross-connect field.

5.09 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 normalled 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 or D4 receiver). In-service signal monitoring for regenerated signals appears at the MON jacks associated with the R OUT—X IN jacks.

5.10 Transmitted signals (from M1C or D4 bank) are connected from the span cross-connect to the X OUT jacks which are normalled-through 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.

5.11 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 spare repeater). The BRDG OUT jack and the X IN jacks are normalled. 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.

E. Jack Field Interface Terminal Strip and DSX Cross-Connect Terminal Strip

5.12 The jack field interface terminal strip, used in the DSX-optional T1C/T1 ORB, and the DSX cross-connect terminal strip, used in the T1C/T1 DSX-dedicated ORB, 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 DSX-optional T1C/T1 ORB, the jack field is contained in the jack and cross-connect panel in the ORB or the jack panel in the DSX-1C. In the case of the T1C/T1 DSX-dedicated ORB, the jack field is always in 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 passive 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 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 its corresponding repeater connector position terminals. Also, on an optional basis, connections are provided for the T Carrier Administration System (TCAS).

F. Fuse and Alarm Panel

5.13 In the DSX-optional T1C/T1 ORB, the fuse and alarm circuits are contained in the fuse, alarm and fault-locate filter panel (see Fig. 10). In the T1C/T1 DSX-dedicated ORB, the fuse and alarm circuits are contained in the fuse and alarm panel (see Fig. 6). In both cases, the fuse and alarm circuits perform identical functions.

5.14 The fuse and alarm circuits (Fig. 10) 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 unit fuse failure causes another pair of relay contacts to operate and light the white (minor alarm) lamp. The fuse and alarm circuits in the DSX-optional T1C/T1 ORB 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 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 DSX-dedicated ORB is used, the fuse and alarm panel on the DSX-dedicated ORB contains only one miscellaneous -48 volt power fuse for the order wire circuit.

5.15 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 as +130V and 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.

5.16 T1C alarm circuitry makes connection to the central office audible and visual alarms. Connections to the E2 remote alarms are available on an optional basis.

G. Fault-Locate Filters

5.17 Fault-locating filters are installed in the apparatus cases to implement the T1C FL system. An active or passive FL system may be established for the T1C system. A mixture of passive and active filters on the same FL line is not permitted, but a mixture of lines using either all active or all passive filters can be terminated on the maintenance panel. The following codes of FL filters are used for T1C:

(1) 1114-type single-input active filter

(2) 1115-type dual-input active filter

(3) 1068-type passive filter.

5.18 The 1114-type filter is usually used with the unidirectional mode of repeater operation. It may be used in T1C configurations that implement either the single-end or both-ends FL systems. It is powered from the FL pair and allows double use of the A-M frequencies on each FL pair through choice of power polarity. Since the 1114-type filter has one amplifier, the proper placement of tip-ring reversal in the fault-locating line pair causes the 1114-type filter to be activated or nonactivated.

5.19 The 1115-type active filter is used only with the bidirectional mode of repeater operation. It is used in T1C configurations that implement the single-end testing FL systems. It requires one FL pair and is powered from the FL pair. One powering polarity activates only one of the amplifier filters and reversing the polarity activates only the other amplifier filter.

5.20 The 1068-type passive filter may be used with the T1C system to establish a passive FL system similar to that used on the T1 digital carrier system. Because of the differences in output levels, 1068-type filters should not be used on the same FL line with either of the active FL filters (1114- or 1115-type). The 1068-type filters with the single-letter (frequency) code are used for unidirectional operation and filters with the double-letter (frequency) code are used for unidirectional or bidirectional operation. The 1068-type filters with the double-letter code are a direct replacement for the single letter code.

5.21 On the DSX-optional T1C/T1 ORB, the fault-locate filters are part of the fuse, alarm and fault-locate filter panel (Fig. 10). On the T1C/T1 DSX-dedicated ORB, the fault-locate filters are mounted on a separate panel (Fig. 6). In the DSX-optional T1C/T1 ORB, the fault-locate filter assembly contains receptacles for four plug-in filters and four microswitches which short circuit the associated filter receptacle when no filter is installed. The T1C/T1 DSX-dedicated ORB fault-locate panel contains receptacles to accommodate a maximum of six fault-locate filters with six associated shorting switches. In initial installations, one filter is installed for every four repeater shelves. In the 9-foot and 7-foot DSX-optional T1C/T1 ORB, only receptacle J12 is used. In the 11-foot 6-inch DSX-optional ORB, receptacles J12 (shelves 1 through 4) and J16 (shelves 5 through 8) are equipped with filters. In the 9-foot T1C/T1 DSX-dedicated ORB, receptacles J2 (shelves 1 through 4) and J4 (shelves 5 through 8) are used. In the 11-foot 6-inch DSX-dedicated ORB, receptacles J2 (shelves 1 through 4), J4 (shelves 5 through 8), and J6 (shelves 9 through 12) are used.

H. Power Dissipation Units

5.22 High 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 (see Fig. 11) is dedicated to a particular shelf of repeaters. Table B lists the number of power dissipation plug-in units used by each ORB code. These units are not required when powering low powered (60 mA) lines or when powering the 120 mA lines with -48 volts and ground. When 60 mA repeaters are used, either 292A adapters are installed in place of the power dissipation units or hard wire option P is installed.

I. Order Wire

5.23 The order wire includes the order-wire panel (Fig. 12) and voice equipment between repeater locations and the central office. Jacks are provided on the order-wire panel plug-in units at the controlling office for communications between the office and repeater locations. Order-wire jacks also make appearances at the DSX-1C cross-connect bay when provided.

5.24 The order-wire panel provides connectors to accommodate two order-wire plug-in units. There are four order-wire plug-in units which can be used (Fig. 13). 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.

Section 365-325-100, CD-3C254-01, and SD-3C254-01 provide detailed descriptions of the order-wire circuits.

J. T Carrier Administration System (TCAS)

5.25 TCAS interface equipment for the T1C 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. Information about the TCAS interface equipment is located in Sections 365-330-110 and 865-201-110.

6. T1C/T1 QUASI-RANDOM SIGNAL SOURCE

6.01 The T1C/T1 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 inches high by 23 inches wide panel and includes brackets for mounting in either a 1-3/4 or 2-inch rack space. The QRSS is normally mounted in the DSX-1C. If no DSX-1C 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 (ED-3C569-30, G1) plug-ins may be used to provide up to 25 outputs each (Fig. 14).

6.03 Refer to CD-3C348-01, SD-3C348-01, and Section 103-494-105 for a detailed circuit description of the QRSS.

7. T1C EXPRESS OFFICE REPEATER PANEL

7.01 The T1C express office repeater panel (EORP) 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 T1C carrier span, accommodates 25 line repeaters. The EORP is described in detail in Section 365-250-105. (See Fig. 15.)

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

8.01 The bridging repeater panel (Fig. 16) accommodates 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. Section 365-250-102 describes the bridging repeater panel in detail.

9. AUTOMATIC PROTECTION SWITCH (APS)

9.01 The APS is a maintenance span-by-maintenance span-type switch. If T1C 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. For further information on the APS, refer to paragraph 14.13 and Section 365-200-106.

10. OFFICE CABLING

10.01 T1C interbay cabling arrangements provide the following:

(a) Compatibility for arrangements with or without DSX-1C 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 Figure 17 shows a typical cabling and cross-connect arrangement when a DSX-1C is ***not*** provided. Figure 18 shows a typical interbay cabling arrangement when a DSX-1C is used for centralized patching, cross-connection, monitoring, and fault location. The DSX-1C provides maximum flexibility for ORB-to-ORB, D4-to-ORB, and M1C-to-ORB separations of up to 800 feet when 220-type repeaters are used, and 1310 feet when 250-type repeaters are used. The maximum distance to the DSX-1C from an ORB, M1C, or D4 is 400 feet for 120-mA applications and 655 feet for 60-mA applications. See Fig. 19. An additional 50 feet of cabling may be used for cross-connection on DSX-1C. When a DSX-1C is used, no jack appearances except order-wire jacks are permitted on the office repeater bay. The DSX-1C is engineered as a common level (3-volt) point for all T1C signals.

10.03 Figure 20 shows a typical intraoffice cabling arrangement. The office repeater bays are connected back-to-back using a DSX-1C patch and cross-connect.

10.04 The associated wiring and equipment include the entrance cabling, intraoffice cabling, main distributing frame, office repeater bays, and either a DSX-1C 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 T1C span lines. T1C installations can use 19-, 22-, and 24-gauge copper, pulp-insulated, unitized cable; PIC 19-, 22-, and 24-gauge copper cables (filled and air core); 17- and 20-gauge aluminum cables; MAT 25-gauge copper cables; and ICOT 24-gauge copper cables for outside plant. See Section 855-351-110.

10.05 Only one direction of T1C transmission is allowed in a single tip cable. In addition, carrier dedicated tip cable must be used for incoming T1C signals. No voice-frequency pairs are permitted in the same tip cable with T1C. This greatly diminishes the effect of central office switching noise. T1, T1C, and T1D can share tip cabling if both are transmitted in the same direction. The office cabling between the office repeaters and the main distributing frame (MDF) must be 22-gauge ABAM or, preferably, 606B through 611B code cable. Therefore, it is preferable that the tip cable between the MDF and the entrance cable also be 22 gauge. However, the main cable and entrance cable on some end sections can be of different gauge and type than the connecting tip cable. In such cases, other gauges and types of tip cable are acceptable. Another exception is allowed where a short section of fuse cable is required for protection at the transition between aerial and underground plant. Fuse cable is usually a few feet of cable which is two sizes smaller in gauge than the main cable (ie, 22-gauge main cable, 24-gauge fuse cable). Gauge changes should be kept to a minimum.

10.06 Office cabling is 22-gauge ABAM cable, 606B through 611B cable, or equivalent, and only one direction of T1C transmission can be carried in a single sheath. The maximum cable lengths are shown in Fig. 19.

10.07 To prevent loss of performance in longer cable lengths, compensation is made by a series of pads, which are used in conjunction with the office repeaters. By following the length restrictions and using the appropriate pads, signals appearing at the cross-connect are at standard level point. Individual 606B or ABAM 6 cable runs are used to connect the DSX-1C B IN jack to the bridging repeater and to connect the bridging repeater output to the DSX-1C BR MON jack. Cabling from the ORB to the MDF must be 22-gauge ABAM cable, 606B through 611B cable, or equivalent.

10.08 Because of the office switching noise, the length limitation (underground) for an office end section is 3350 feet for 24-gauge pulp cable. This length is measured from the office repeater bay out to the first line repeater. In effect, the line repeater sees the 3350-foot section plus the DSX to ORB wiring. Tip cable from the MDF to the cable vault is dedicated to carrier systems with high-level and low-level signals assigned to separate sheaths. A connector coded 303B-2-50 with two 50-pair stubs and mounted on the MDF facilitates this arrangement. This connector is used for odd multiples of 50 T1C systems to conserve space on the MDF when the 100-pair, single-stub connector cannot be used. Connections to the office repeater bay are made with ABAM or 606B through 611B cable runs which terminate in protectors on the vertical side of the MDF.

11. SIGNAL TRANSMISSION

11.01 The office repeater bay equipment and the line equipment transmit and receive 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 T1C 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 (T1C/T1 DSX-optional ORB) or DSX INT TS (T1C/T1 DSX-dedicated ORB) for distribution to the DSX-1C, the jack and cross-connect panels, or to another ORB. Finally, the T1C incoming signal is applied to the M1C or D4 for demultiplexing.

11.03 Outgoing (transmitted) signal flow is from the M1C multiplexer or another ORB to the DSX-1C or the ORB jack and cross-connect panels. From the DSX-1C (or the jack and cross-connect panels) the transmitted signal is applied through the passive 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 T1C OFFICE REPEATER BAY

12.01 The line repeaters (Table A and Fig. 21) designed for use in the T1C digital line are powered from the central office. The office repeaters (Fig. 21) are housed in the ORB. The regulating office repeater contains a line-current regulator which supplies 120-mA or 60-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.

12.03 For unidirectional operation (Fig. 22), office repeaters are paired to form power mates. Repeaters 1 through 13 on shelf 1 are power mates of corresponding repeaters 1 through 13 on shelf 3. Likewise, repeaters 14 through 24 on shelf 2 are power mates of repeaters 14 through 24 on shelf 4. This relationship of repeater power mates continues with shelves 5 through 8 on 8-shelf bays and shelves 9 through 12 on 12-shelf bays. This arrangement minimizes the number of circuits lost when a fuse failure occurs.

12.04 For bidirectional operation (Fig. 23), only one office repeater at each office is required to power one T1C line.

12.05 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 and tel set, test jacks, signal sources, etc). The white lamp also indicates a repeater fuse failure; while the red lamp, when lighted, indicates a repeater shelf failure. Alarm relays K1 and K2 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 alarm relay K1 operates, the MINOR alarms are activated and the white lamp lights. K2 operates the MAJOR alarms and lights the red lamp.

12.06 The office repeaters supply power to the line repeaters in the apparatus cases. 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. Rules for powering the T1C line are provided in Section 855-351-110. 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 T1C DIGITAL LINES

13.01 T1C repeaters are powered by transmitting dc power over the cable pair simplex. See Fig. 22 and 23. Line current is fed through one zener diode in 60-mA repeaters or two zener diodes in 120-mA repeaters 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, -130, 178 (-48V and +130V), and 260 (+130V and -130V). The office repeater should be powered in tandem 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 tandem would increase the required battery voltages, then the office repeater should be powered independently using the -48 volt battery through a voltage dropping resistor. In general, the voltage levels selected should be the minimum levels which will meet the line powering requirements.

14. MAINTENANCE

14.01 The T1C maintenance plan consists of trouble isolation and trouble locating. A trouble isolation chart is shown in Fig. 24. 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 T1C 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 available for T1C. The maintenance procedures are contained in Section 365-271-000 (TOP) for fault-locating the T1C digital line.

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. 25) 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 a group of 12 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 A T1C cable unit requires an associated fault-locating cable pair for each set of repeater locations in tandem along a span. These repeater locations correspond to the fault-location system limit of 12 filters for repeater interrogation and fault detection per cable pair.

14.05 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. Very long spans may require the fault-locating pair to be repeatered.

14.06 The active filters improve signal-to-noise (S/N) performance of the FL lines, and permit separation of fault identification in opposite directions of bidirectional repeaters. The latter is made possible by the use of the 1115-type filters, split fault output repeaters and apparatus cases with split wiring. 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.*** The polarity sensitive 1115-type dual-amplifier filters enable the return of FL signals from one or the other direction of digital transmission within the repeater. When this arrangement is combined with a loop-back capability in the APS (paragraph 14.13), single-end fault location of both directions of transmission can be accomplished within a maintenance span for the bidirectional mode of operation. The 1114-type single-amplifier filters are used in combination with the loop-back capability of the APS to provide single-end fault location for the unidirectional mode of operation. 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. The single-end FL techniques using the 1114-type and 1115-type filters can be extended by using additional FL lines. Also, it is general practice to use the 1114-type filter to serve the office repeaters in the terminating offices in both the bidirectional and unidirectional modes of operation.

14.07 The unique advantage of the FL system described in paragraph 14.06 is the provision of single-end testing capability. This capability provides for isolating faults in both directions of digital transmission from measurements made at one end of the maintenance span and utilizes a far-end loopback of the digital line. Both-ends testing means that only one direction of transmission, the outgoing direction, can be tested from a given office, thus the need to test a span from both ends. If unidirectional repeater 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 T1C can be accomplished by using the 1114-type active filters or the 1068-type passive filters. The fault-locate jacks provide test equipment access to the output of any selected FL line. 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.

14.08 Fault location must be done in the direction of transmission of the repeatered line. To locate a defective repeater or cable section, the fault-locating test set is connected to the digital line under test and the associated fault-locating pair. The test set generates test signal sequences with controlled bipolar violations at desired audio frequencies supplied to the repeatered line. By varying the bipolar violation density and by choosing to inject only positive, negative, or both types of bipolar violations, degraded regenerator operation can be checked and marginal repeaters can be detected or isolated. The test set is successively set to each of the interrogation frequencies, A through M, corresponding to the first set of repeater locations along the span line under test. By measuring the level of the returned signal tone on the fault-locating pair, repeaters at any of the locations can be evaluated for proper operation. If the proper, acceptable tone level is received from each location, the level is recorded for future reference. On the other hand, if the tone level is not acceptable, repeater replacement or other maintenance is required. The test set may now be connected to the fault-locating pair associated with the next group of repeater locations (if any) on the same span line and the tests repeated. This procedure is repeated for additional span lines to be tested.

C. Order-Wire Pair

14.09 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-1C 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-1C 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.

14.10 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. 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. 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 with T1C, a suppression filter is installed to prevent interference with voice communications on digital transmission from interaction crosstalk.

D. Maintenance Lines

14.11 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 line repeaters are used, one maintenance line providing both directions of transmission for one facility will be necessary. For unidirectional line repeaters, 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.

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

E. Automatic Protection Switch (APS)

14.13 The APS automatically switches when a service line is in trouble. This is done without affecting service. Two failures are illustrated in Fig. 26, and each failure causes independent transfer to the protection line. The APS automatically resets the service from the protection line to the service line when the operation of the service line is restored. This automatic switching is done by the APS monitoring and sensing equipment. Further information is located in Section 365-250-120.

15. TEST EQUIPMENT

15.01 The following test equipment is required for T1C/T1 maintenance:

J98725AA T1C/T1 Pair Loss Test Set—Used to determine dc integrity and pair loss between repeater location. See Section 103-494-104.

J98725AE T1C Line Repeater Test Set—Used to check the repeater operability before installation. See Section 103-494-103.

J98725AC T1C/T1 Office Bipolar Violation Detector—Used to detect bipolar violations and bipolar violation seconds (error rate) in the office. See Section 103-494-100.

J98725AB T1C/T1 Manhole Bipolar Violation Detector—Used in manholes to detect bipolar violations. See Section 103-494-101.

J98725AD T1C/T1 Fault Locate Test Set—Generates preset violation patterns which give rise to low-frequency tones at the repeater outputs. Used to determine the location of failed repeaters. See Section 103-494-106.

J98725AF T1C/T1 Quasi-Random Signal Source (QRSS)—Provides a signal suitable for transmission over T1C facilities. Used to drive unassigned lines after power turnup and to stress spans suspected of marginal operation. See Section 103-494-105.

J98725AJ Fault Line Powering Module—Provides -48 volts for powering the FLTS and 40 volts or 118 volts for the FL line. It is used for powering active FL filters on the FL line. See Section 103-494-109.

KS-22331 DS1/1C/2 Error Rate Test Set Transmitter—Used for inserting DS1C bipolar violations on the service lines. See Section 103-494-120.

KS-22332 DS1/1C/2 Error Rate Test Set Receiver—Used for measuring DS1C bipolar violations on the service lines. See Section 103-493-120.

TABLE A

T1C LINE REPEATERS

REPEATER CODE	LINE POWER TYPE	POWER OPTION	CABLE TYPE (NOTE 1)	MAXIMUM LOSS RANGE (db) (NOTE 2)	APPARATUS CASE (NOTE 3)	OPERATION TYPE
218A		Through	Pulp (short code)	5.7 to 38.7		
218B		Through	Pulp (long code)	20.0 to 54.0	479-type	
218C		Looped	Pulp (short code)	5.7 to 38.7	or 818A1C	
218D	120 mA	Looped	Pulp (long code)	20.0 to 54.0	or 818C1C	Unidirectional
218E		Through	DEPIC & PIC	5.7 to 54.0	Unprotected	
218F		Looped	DEPIC & PIC	5.7 to 54.0		
218G		(Note 4)	MAT & ICOT	10.0 to 54.0		
218AA		(Note 4)	Pulp	9.0 to 54.0	479-type or	
218AB	120 mA	(Note 4)	DEPIC & PIC	9.0 to 54.0	818A1C, C1C, or A2C	Unidirectional
218AC		(Note 4)	MAT & ICOT	9.0 to 54.0	Unprotected	
219A		Through	Pulp (short code)	5.7 to 38.7		
219B		Through	Pulp (long code)	20.0 to 54.0	479-type or	
219C		Looped	Pulp (short code)	5.7 to 38.7	819A1C, B1C,	
219D	120 mA	Looped	Pulp (long code)	20.0 to 54.0	or C1C	Unidirectional
219E		Through	DEPIC & PIC	5.7 to 54.0	Protected	
219F		Looped	DEPIC & PIC	5.7 to 54.0		
219G		(Note 4)	MAT & ICOT	10.0 to 54.0		
219AA		(Note 4)	Pulp	9.0 to 54.0	479-type or 819A1C,	
219AB	120 mA	(Note 4)	DEPIC & PIC	9.0 to 54.0	B1C, C1C, A2C, or B2C	Unidirectional
219AC		(Note 4)	MAT & ICOT	9.0 to 54.0	Protected	
248A		(Note 4)	Pulp	9.0 to 54.0	479-type or 818A1C,	
248B	60 mA	(Note 4)	DEPIC & PIC	9.0 to 54.0	C1C, or A2C	Unidirectional
248C		(Note 4)	MAT & ICOT	9.0 to 54.0	Unprotected	
248BA		(Note 4)	Pulp	9.0 to 54.0		
248BB	60 mA	(Note 4)	DEPIC & PIC	9.0 to 54.0	818A2C	Bidirectional
248BC		(Note 4)	MAT & ICOT	9.0 to 54.0	Unprotected	
249A		(Note 4)	Pulp	9.0 to 54.0	479-type or 819A1C,	
249B	60 mA	(Note 4)	DEPIC & PIC	9.0 to 54.0	B1C, C1C, A2C, or B2C	Unidirectional
249C		(Note 4)	MAT & ICOT	9.0 to 54.0	Protected	
249BA		(Note 4)	Pulp	9.0 to 54.0		
249BB	60 mA	(Note 4)	DEPIC & PIC	9.0 to 54.0	819A2C or B2C	Bidirectional
249BC		(Note 4)	MAT & ICOT	9.0 to 54.0	Protected	

Notes:

1. Refer to Section 855-351-110 for maximum and minimum cable lengths.
2. The loss range indicates the range of cable loss over which the line repeaters will operate. This loss is the cable loss as measured at 1.576 MHz.
3. Apparatus cases with single fault-locate wiring are 818A1C and C1C and 819A1C, B1C, and C1C. Apparatus cases with dual fault-locate wiring are 818A2C and 819A2C and B2C.
4. Option plugs on repeaters are used to select through or looped power configuration.

TABLE B

ORB SUBUNIT SUMMARY

UNITS/MODULES	T1C/T1 DSX OPTIONAL ORB			T1C/T1 DSX DEDICATED ORB		
	J98725A	J98725B	J98725C	J98725D	J98725E	J98725F
	11′ 6″ BAY	9′ BAY	7′ BAY	11′ 6″ BAY	9′ BAY	7′ BAY
Office Repeaters	96	48	48	144	96	72
Maintenance Repeaters	4	2	2	6	4	3
Bridging Repeaters	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	Not Used	Not Used	Not Used
Fuse, Alarm, & Fault Locate	1	1	1	Not Used	Not Used	Not Used
Fuse & Alarm Panel	Not Used	Not Used	Not Used	1	1	1
Fault Locate Panel	Not Used	Not Used	Not Used	1	1	1
Power Dissipation Units	8	4	4	12	8	6
Order Wire Panel	1	1	1	1	1	1
TCAS Plug-In	Not Used	Not Used	Not Used	12	8	6

* Used at bridging repeater position.
** 13 equalizers per card.

TABLE C

T1C OFFICE REPEATERS

REPEATER CODE	TYPE	NOMINAL LOOP CURRENT	APPLICABLE SD-/CD-	CABLE LOSS RANGE (dB) (NOTE 1)
220A	Current Regulating	120 mA	3C253-01	4.0 to 37.0
220B	Current Looping	120 mA	3C253-01	4.0 to 37.0
220C	Bridging	—	3C253-01	—
220AA	Current Regulating	120 mA	3C407-01	4.0 to 37.0
220AB	Current Looping	120 mA	3C407-01	4.0 to 37.0
250A	Current Regulating	60 mA	3C378-01	4.0 to 37.0
250B	Current Looping	60 mA	3C378-01	4.0 to 37.0
250C	Bridging	—	3C378-01	—

Note 1: The cable loss range indicates the range of cable loss over which office repeaters will operate. The cable loss is measured at 1.576 MHz. This range covers cable lengths from 500 to 4000 feet.

TABLE D

T1C/T1 ORB-MOUNTED EQUALIZERS (NOTE 1)

EQUALIZER			OFFICE RPTR CODES	ORB CODES J98725	DSX-1C REQD	OFFICE CABLE LENGTH (FEET)
ED-CODE	GROUP	QTY REQD				
3C555-30 (Note 2)	1 2 3	1 Per RPTR	220-Type	A, B, & C	No	0 - 133 133 - 267 267 - 400
3C655-30 (Note 2)	1 2 3 4 5	1 Per RPTR	250-Type	A, B, & C	No	0 - 133 133 - 267 267 - 400 400 - 533 533 - 655
3C744-30 (Note 2)	1 2 3	1 Per RPTR Shelf	220A and B	D, E, & F	Yes	0 - 133 133 - 267 267 - 400
3C555-30	1	1 Per RPTR	220C	D, E, & F	Yes	—
3C767-30 (Note 3)	1 2 3 4 5	1 Per RPTR Shelf	250A and B	D, E, & F	Yes	0 - 133 133 - 267 267 - 400 400 - 533 533 - 655
3C655-30	1	1 Per RPTR	250C	D, E, & F	Yes	—

Notes:

1. At cable length transition point, use equalizer for the shorter length (do not over equalize).
2. Position 26 (Bridging repeater) is equipped with Group 1 equalizer for all cable lengths.
3. Thirteen equalizers per card.

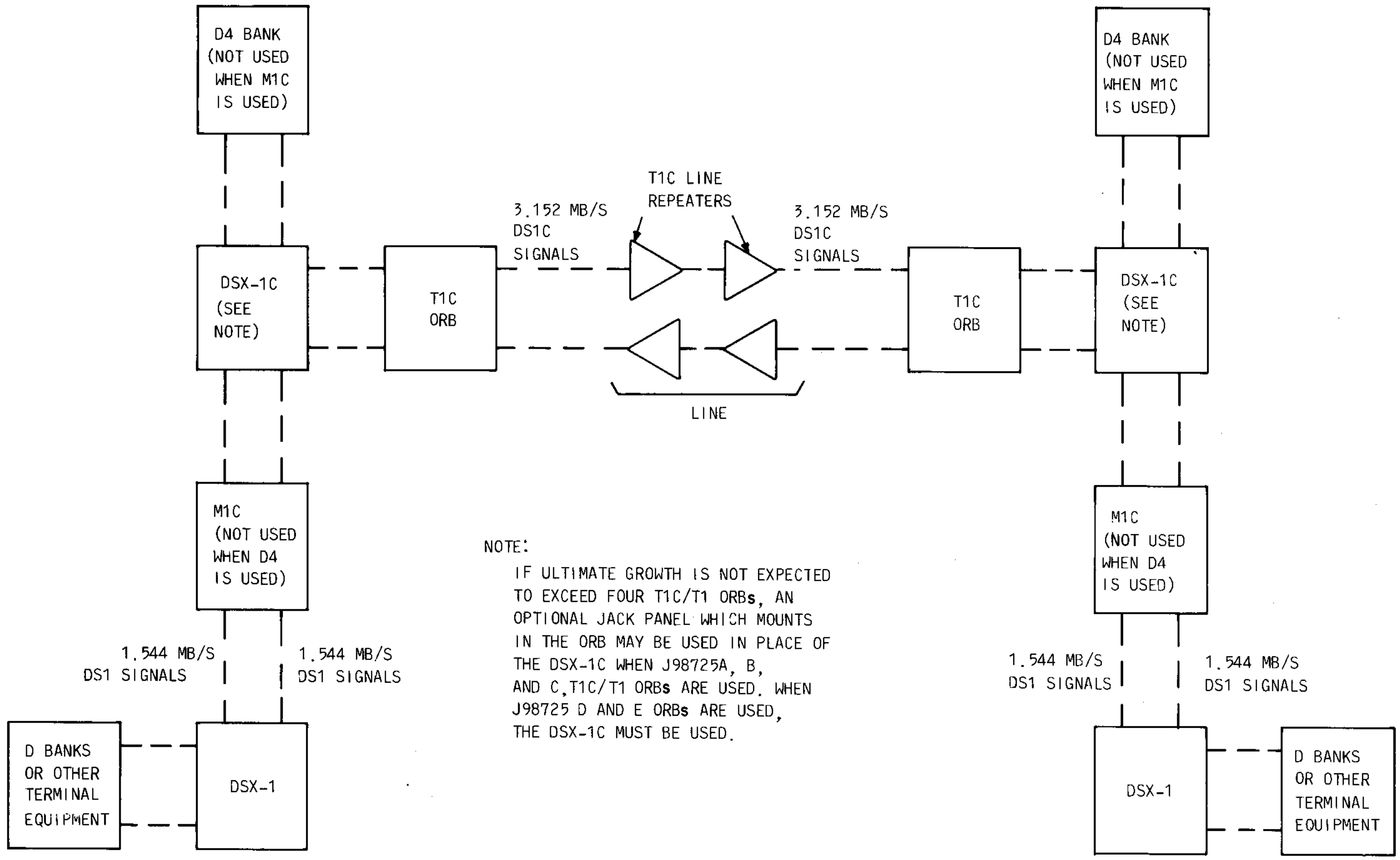


Fig. 1—T1C/M1C or T1C/D4 Facility Block Diagram

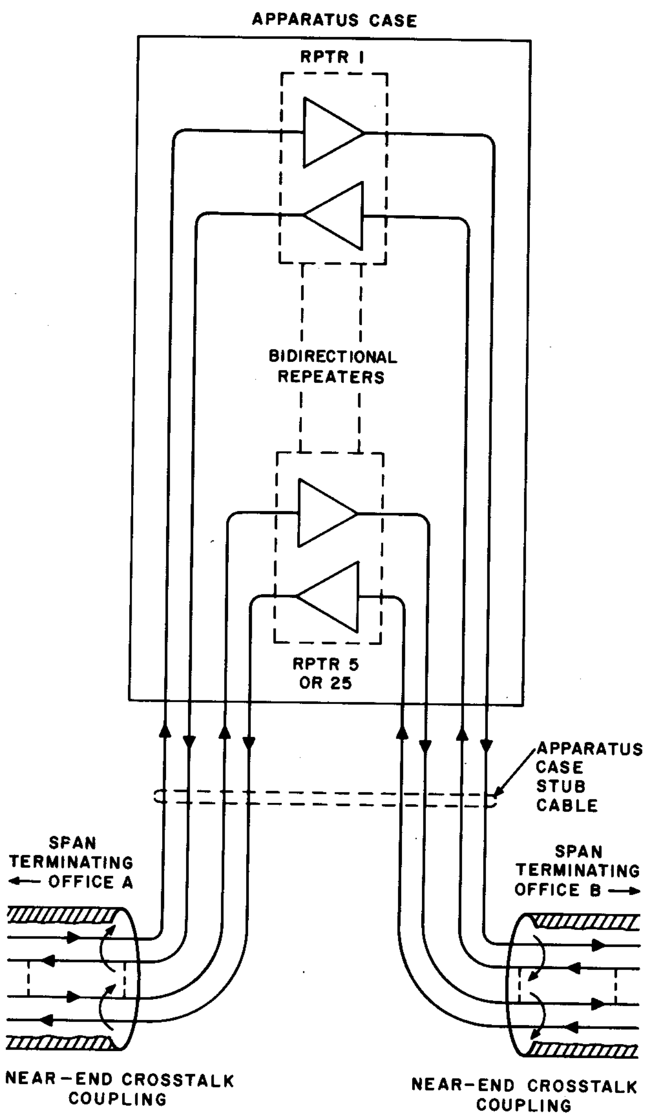


Fig. 2—One Cable Using Bidirectional Operation

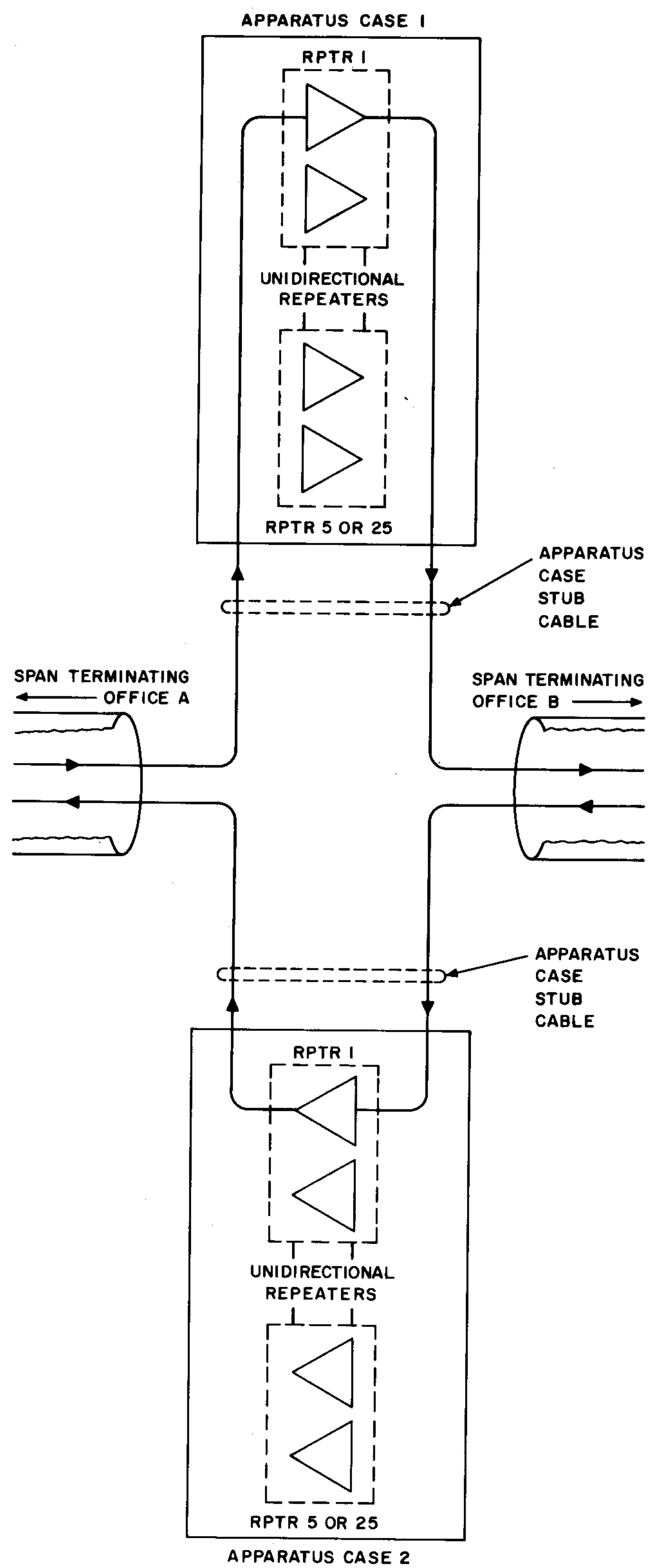


Fig. 3—One Cable Using Unidirectional Operation

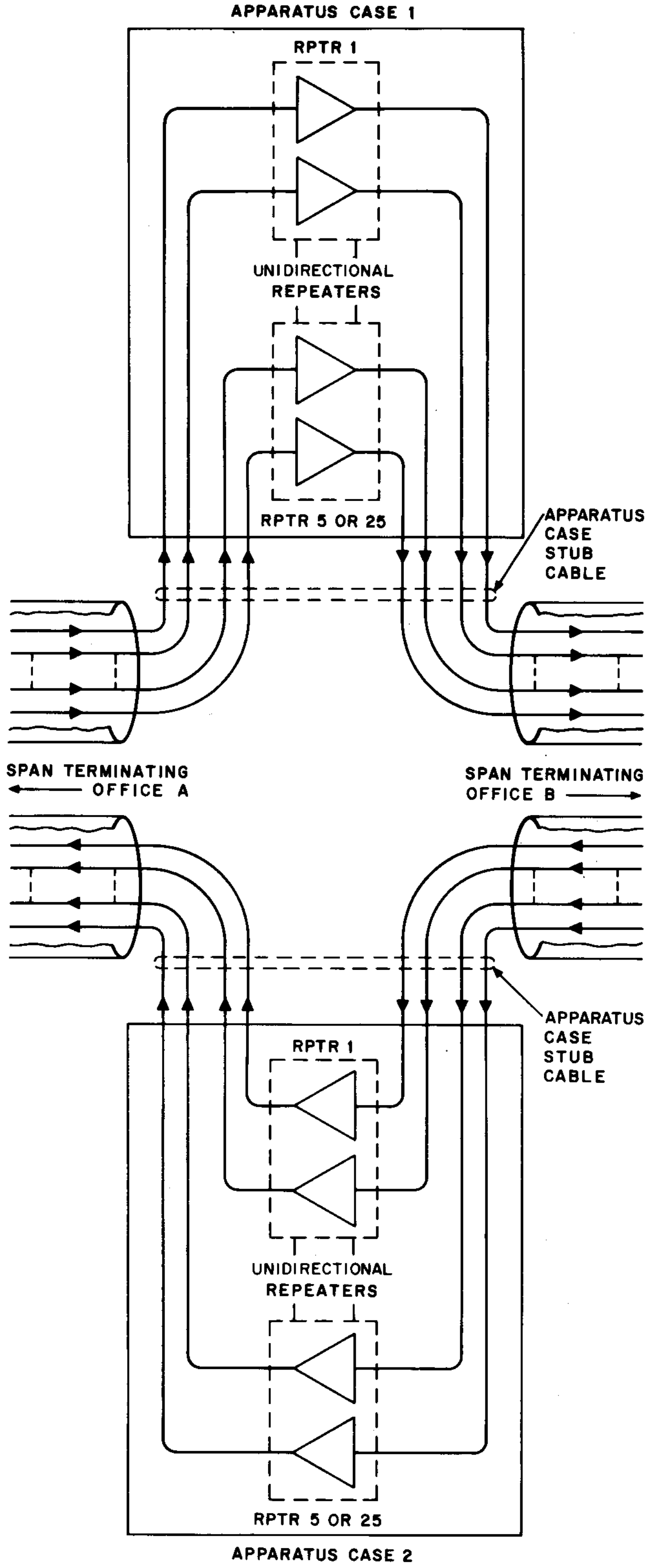


Fig. 4—Two Cables Using Unidirectional Operation

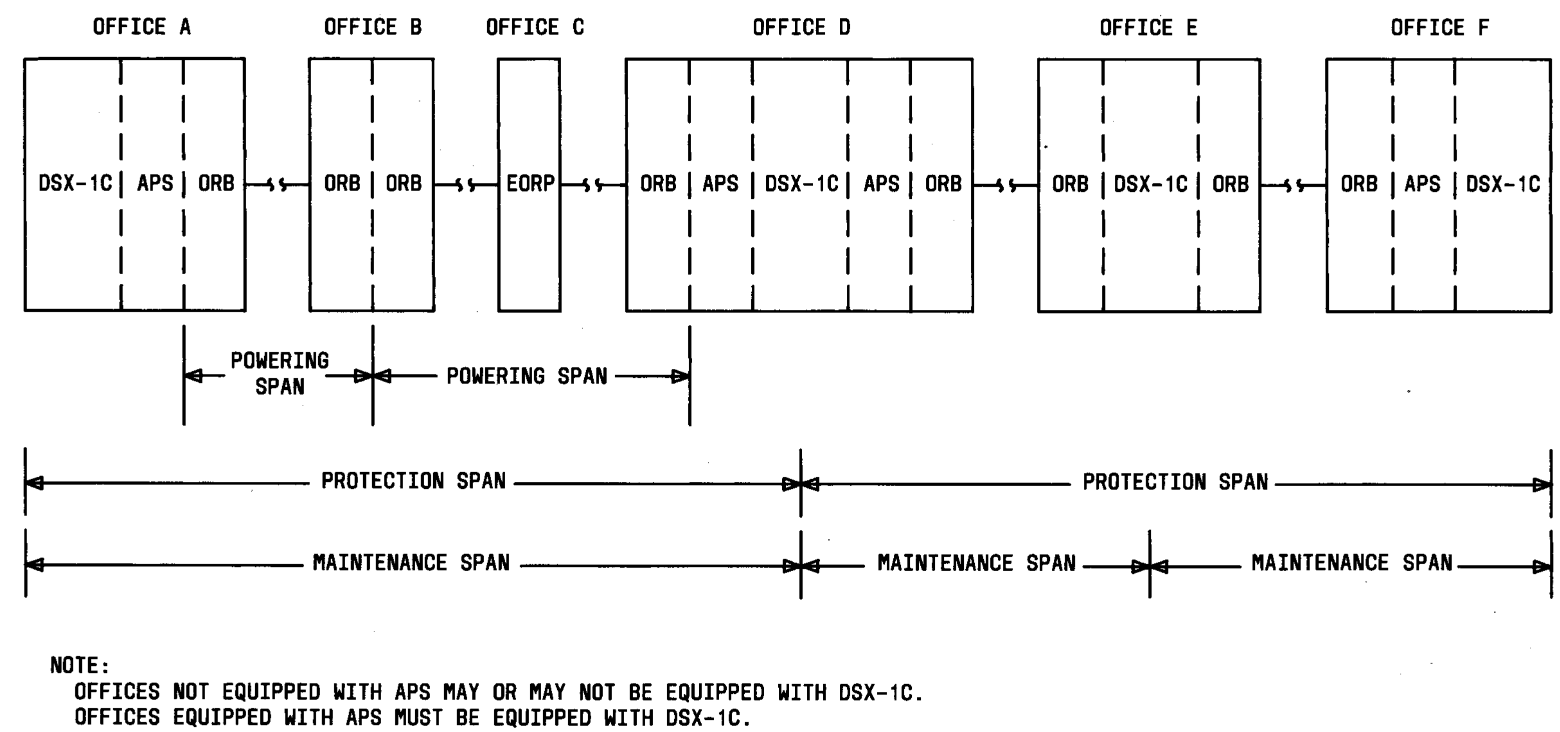


Fig. 5—Span Concept

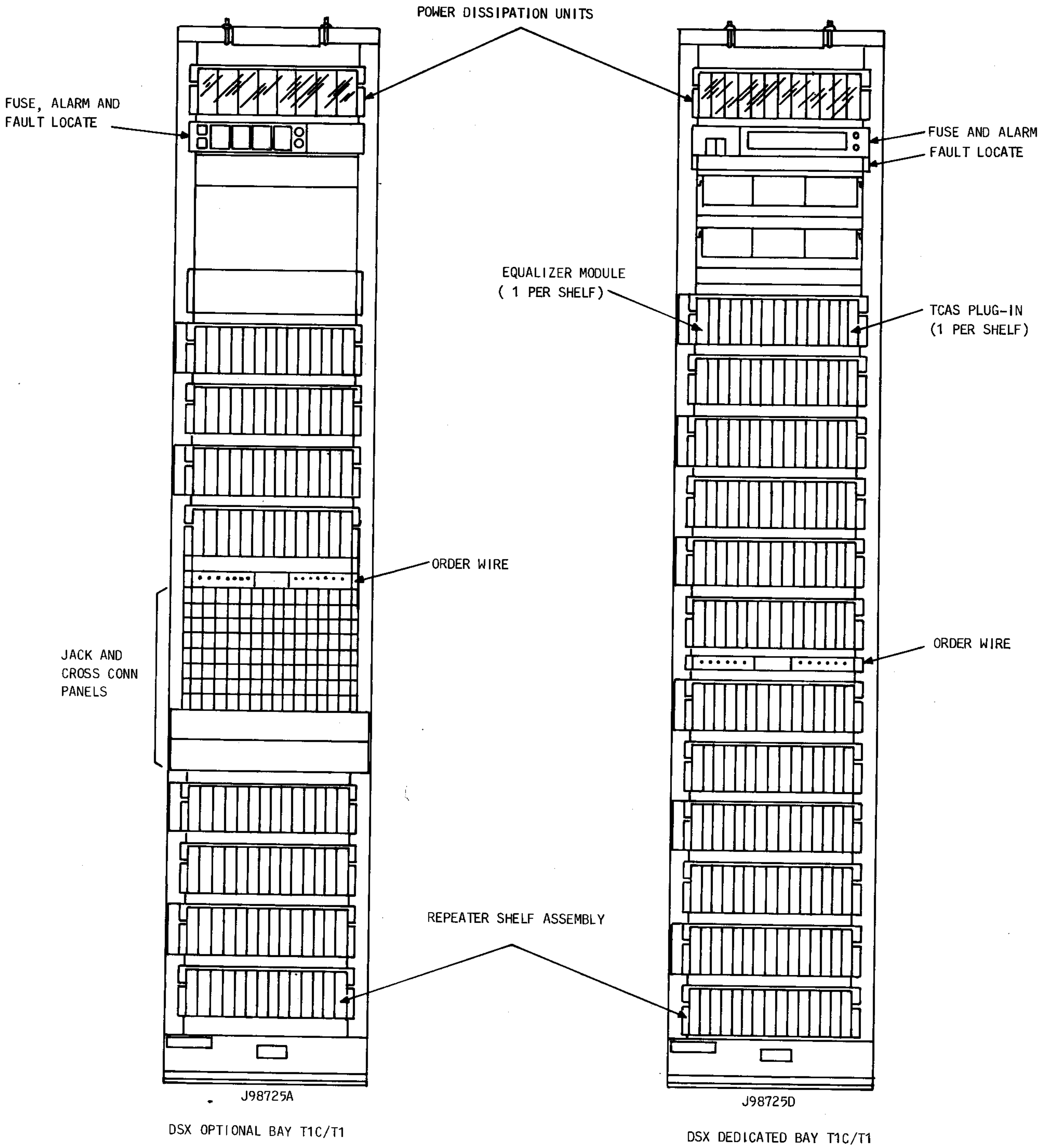
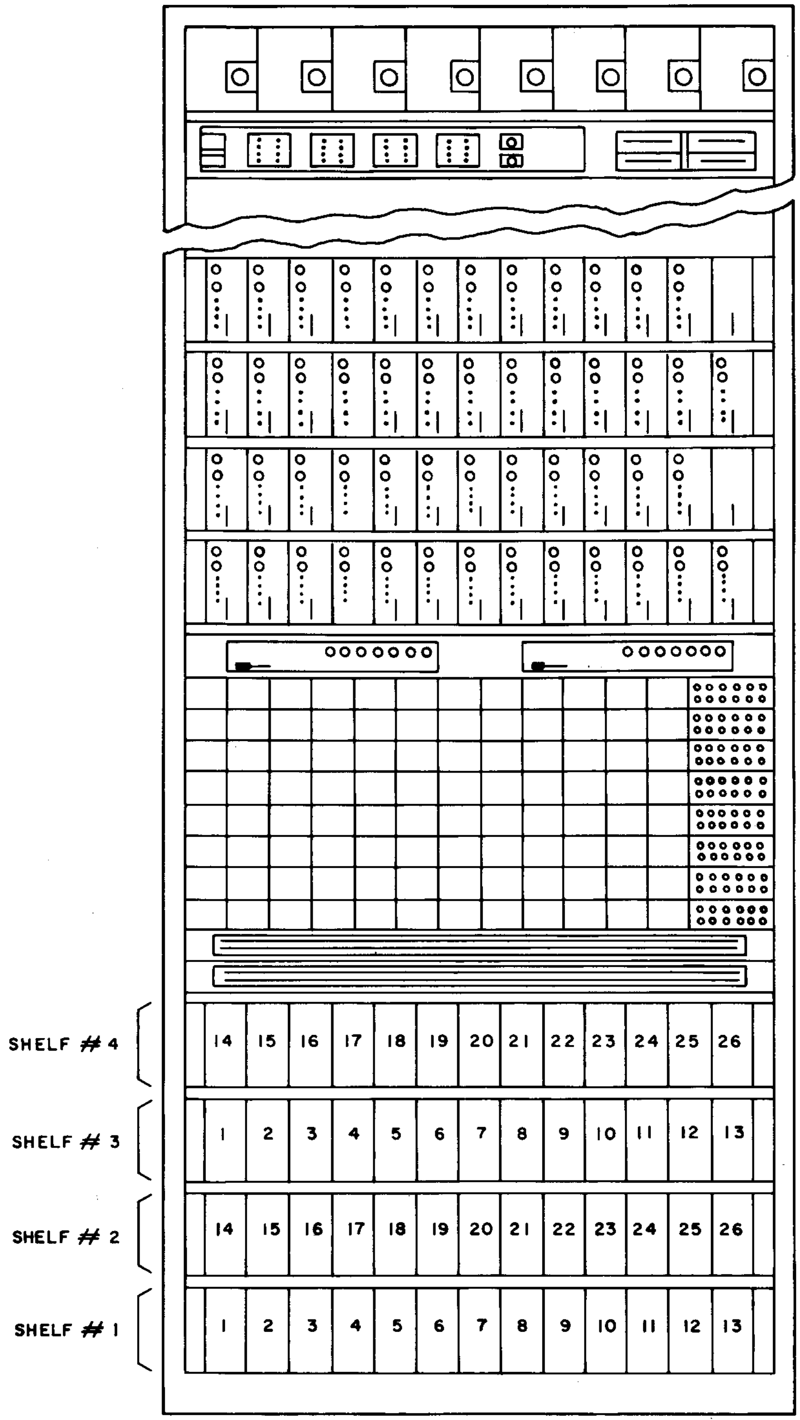


Fig. 6—Office Repeater Bay, 11-Feet 6-Inches



NOTES:
CORRESPONDING REPEATERS ON ODD SHELVES ARE POWER MATES.
CORRESPONDING REPEATERS ON EVEN SHELVES ARE POWER MATES.
25 - MAINTENANCE REPEATER
26 - BRIDGING REPEATER

Fig. 7—Office Repeater Arrangement

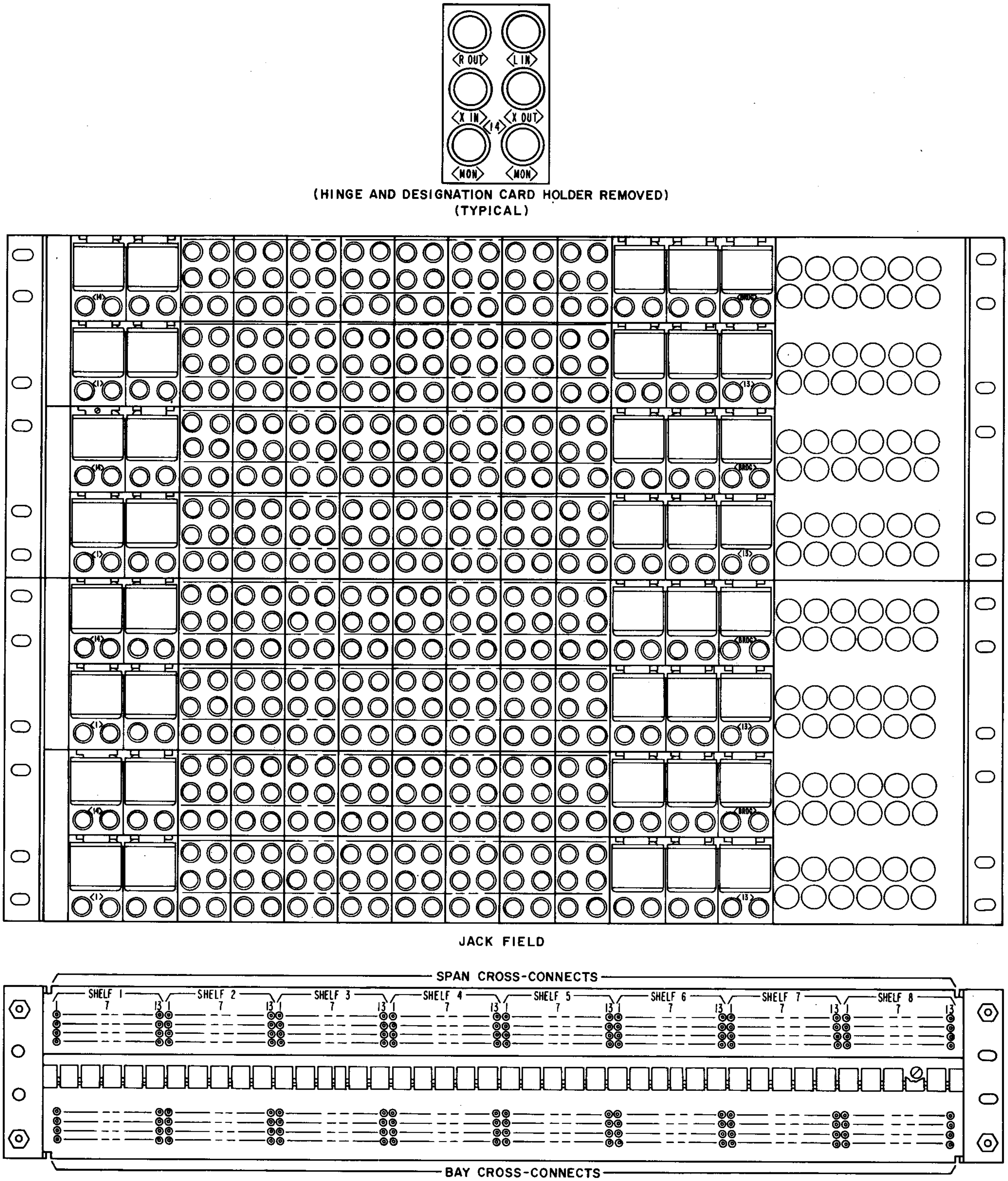


Fig. 8—Jack Field and Span and Bay Cross-Connect Panels

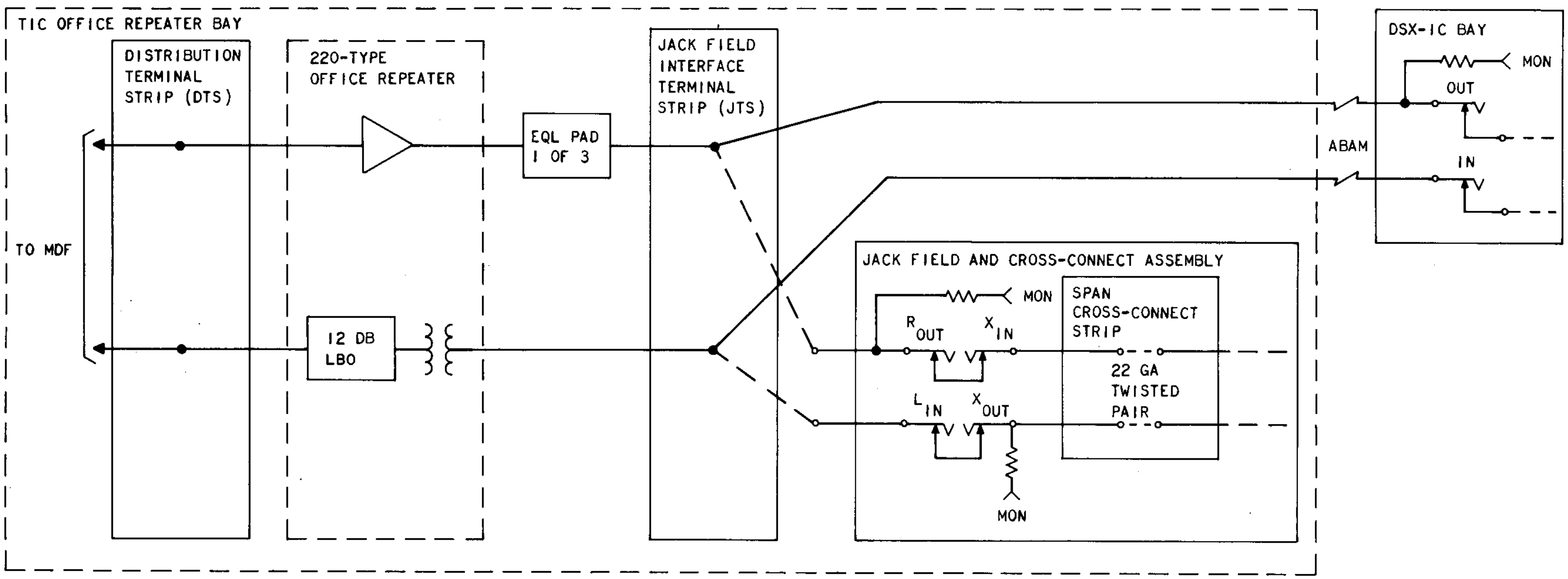


Fig. 9—T1C Cross-Connect Arrangements

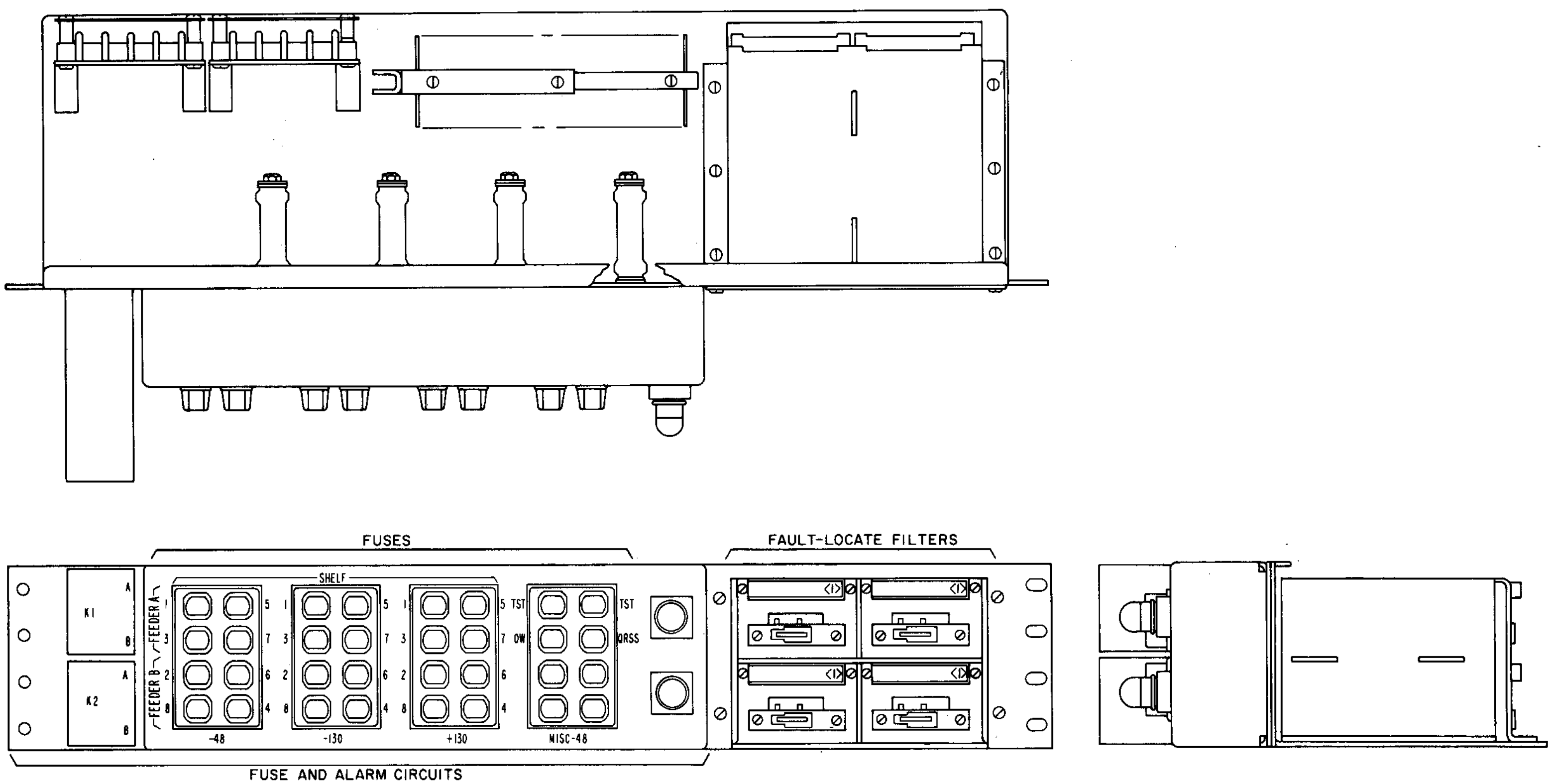


Fig. 10—Fuse, Alarm, and Fault-Locate Filter Panel

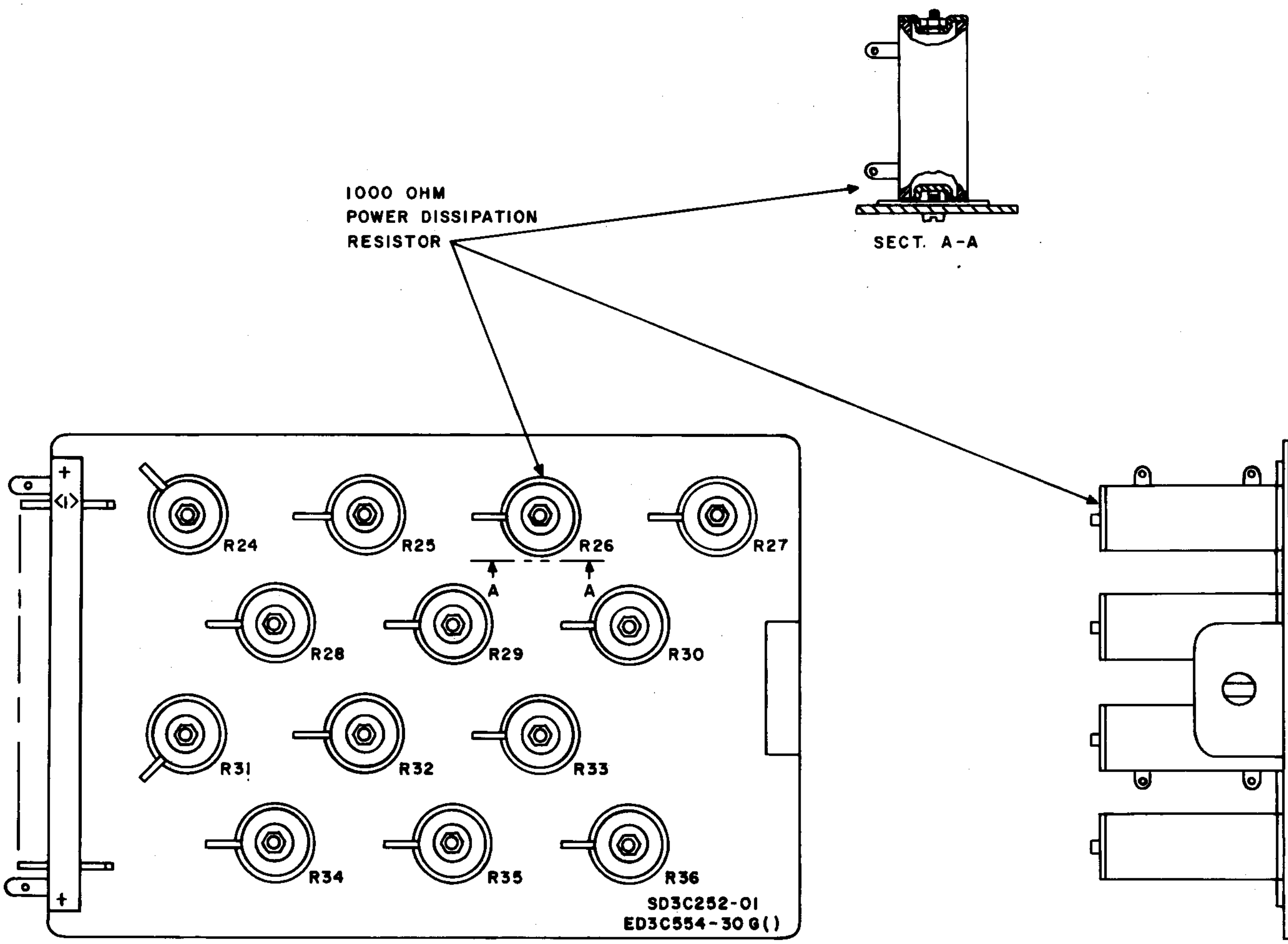


Fig. 11—Power Dissipation Plug-In Unit

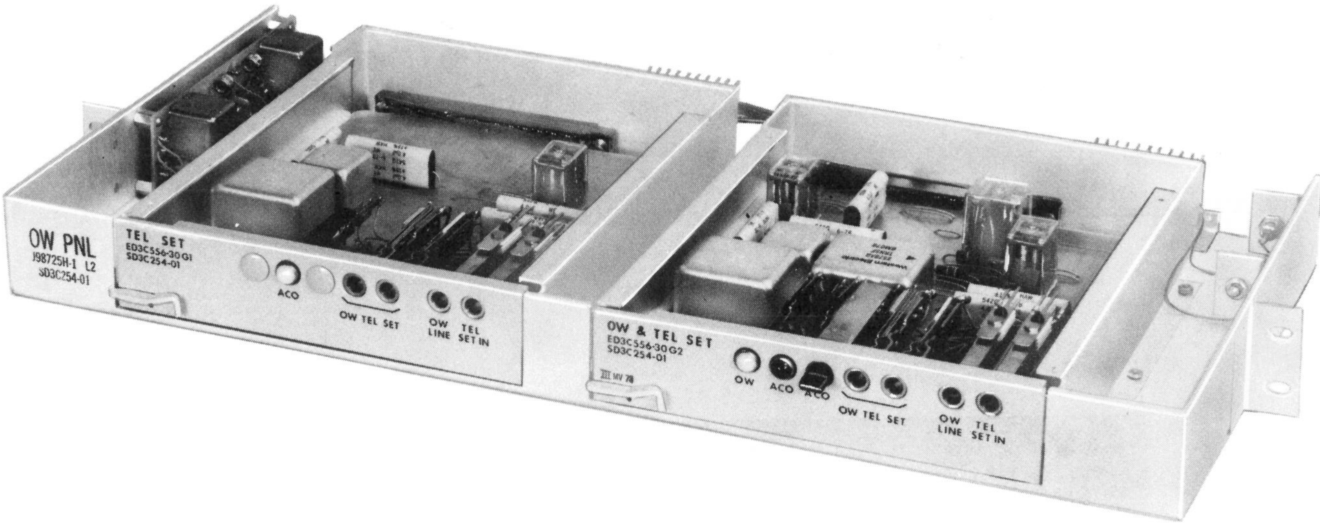


Fig. 12—J98725H Order--Wire and Tel Set Panel

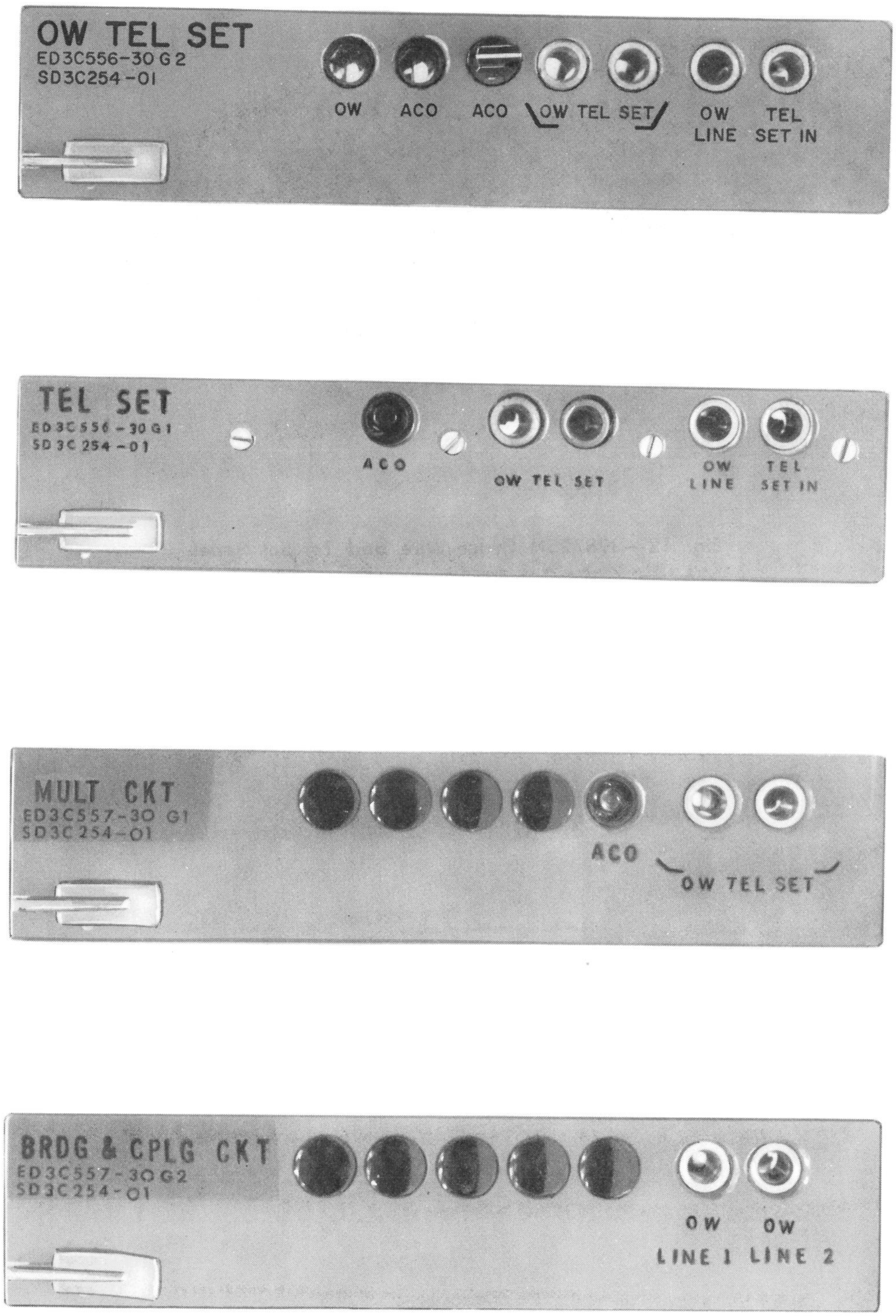


Fig. 13—Order-Wire and Tel Set Plug-In Units

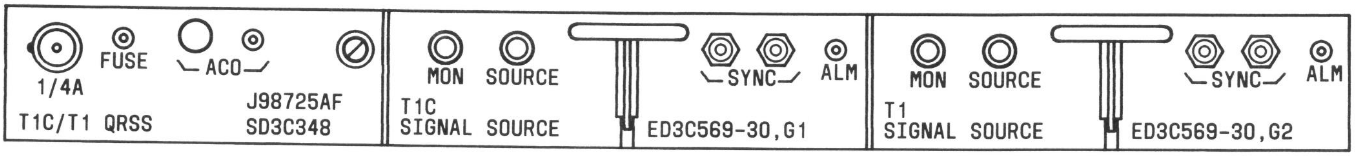


Fig. 14—J98725AF T1C/T1 Quasi-Random Signal Source

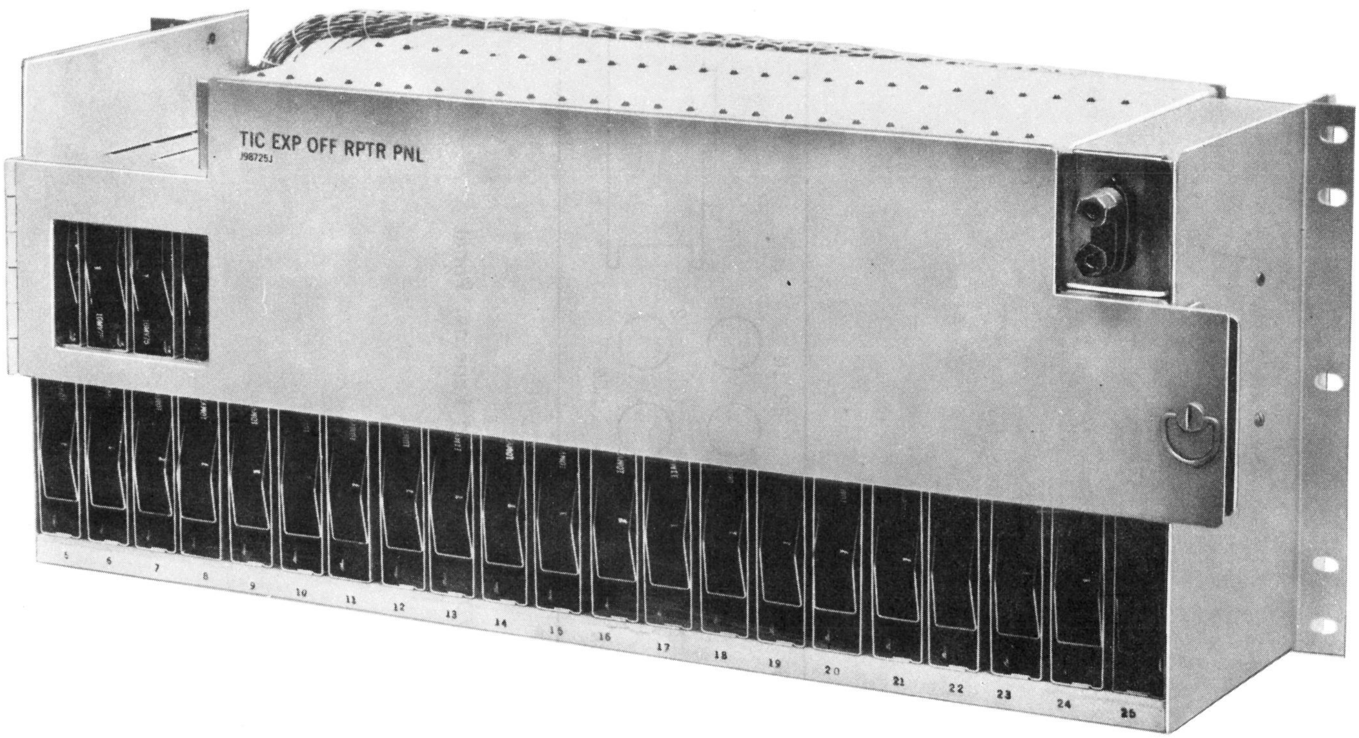


Fig. 15—T1C Express Office Repeater Panel (EORP)

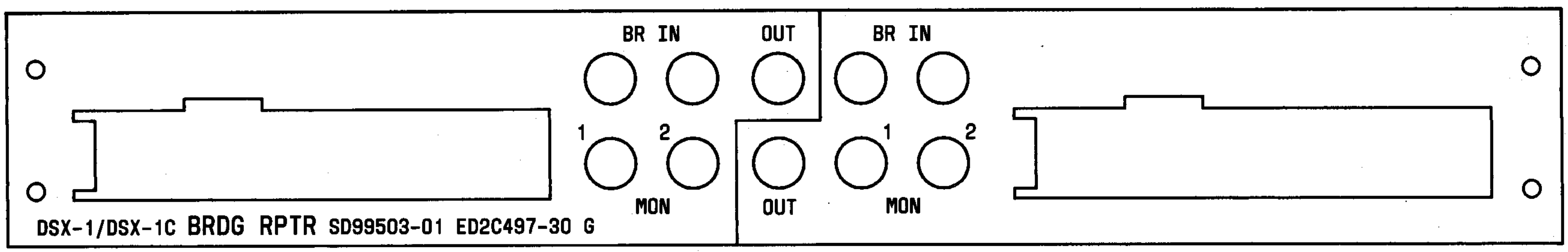
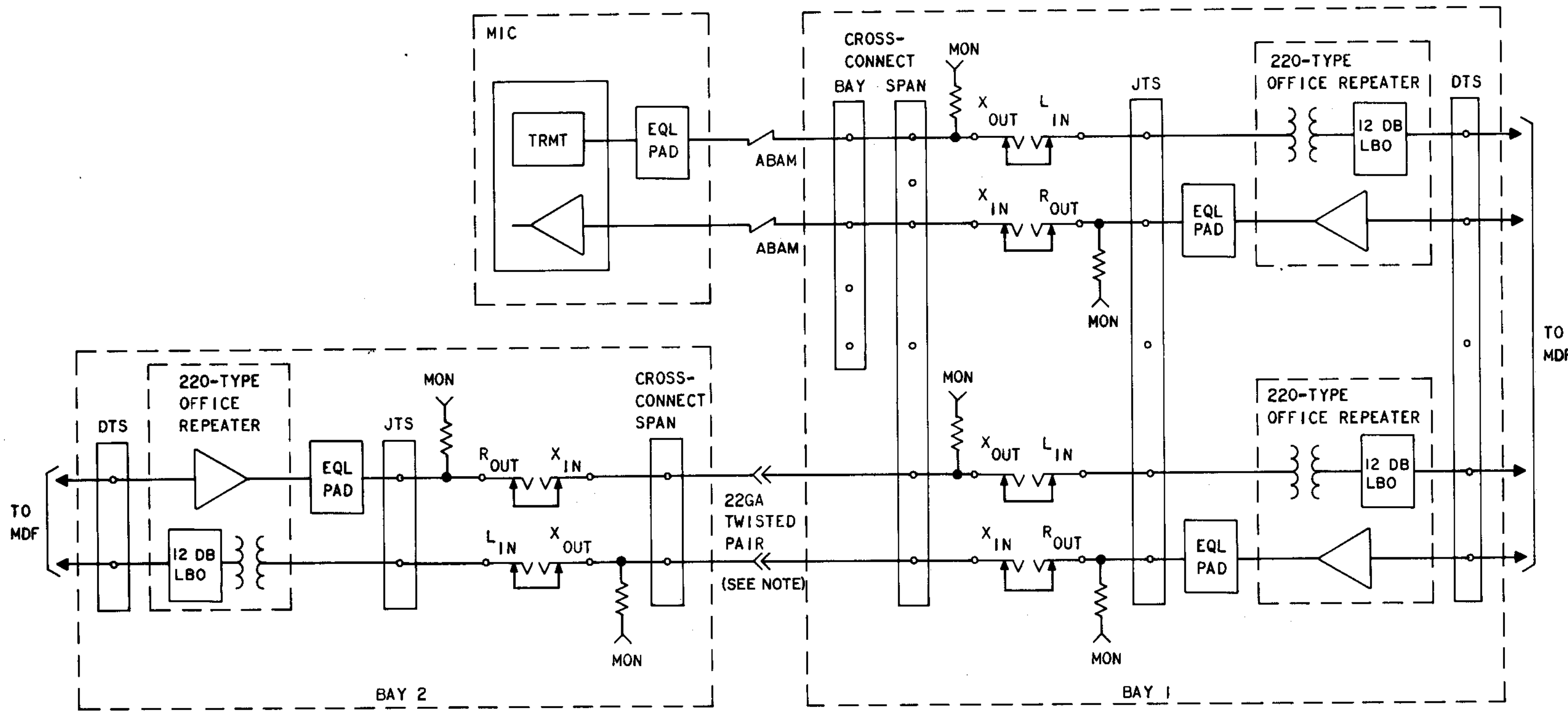
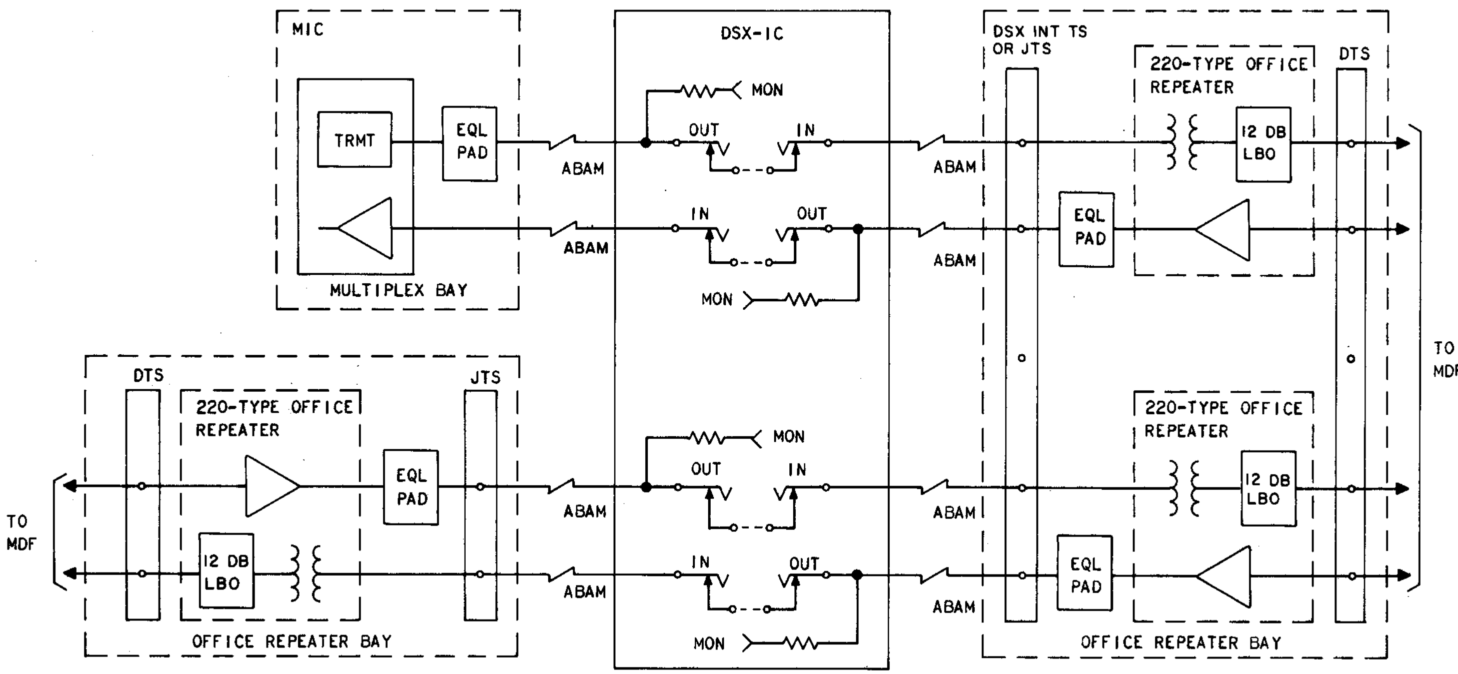


Fig. 16—DSX-1/DSX-1C Bridging Repeater Panel



NOTE:
BAYS 1 AND 2 IN SAME BAY LINE-UP

Fig. 17—T1C Cross Connection With No DSX-1C



JTS = JACK FIELD INTERFACE TERMINAL STRIP (USED IN T1C/T1 DSX OPTIONAL ORB)
DTS = DISTRIBUTION TERMINAL STRIP
DSX INT TS = DSX CROSS CONNECT TERMINAL STRIP (USED IN T1C/T1 DSX DEDICATED ORB)

Fig. 18—T1C Cross Connection With DSX-1C

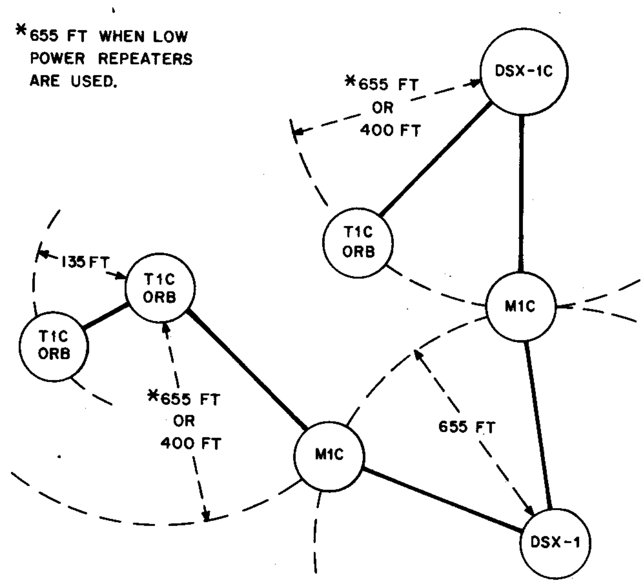


Fig. 19—T1C Maximum Interbay Cable Length for ABAM and 606B through 611B Cable

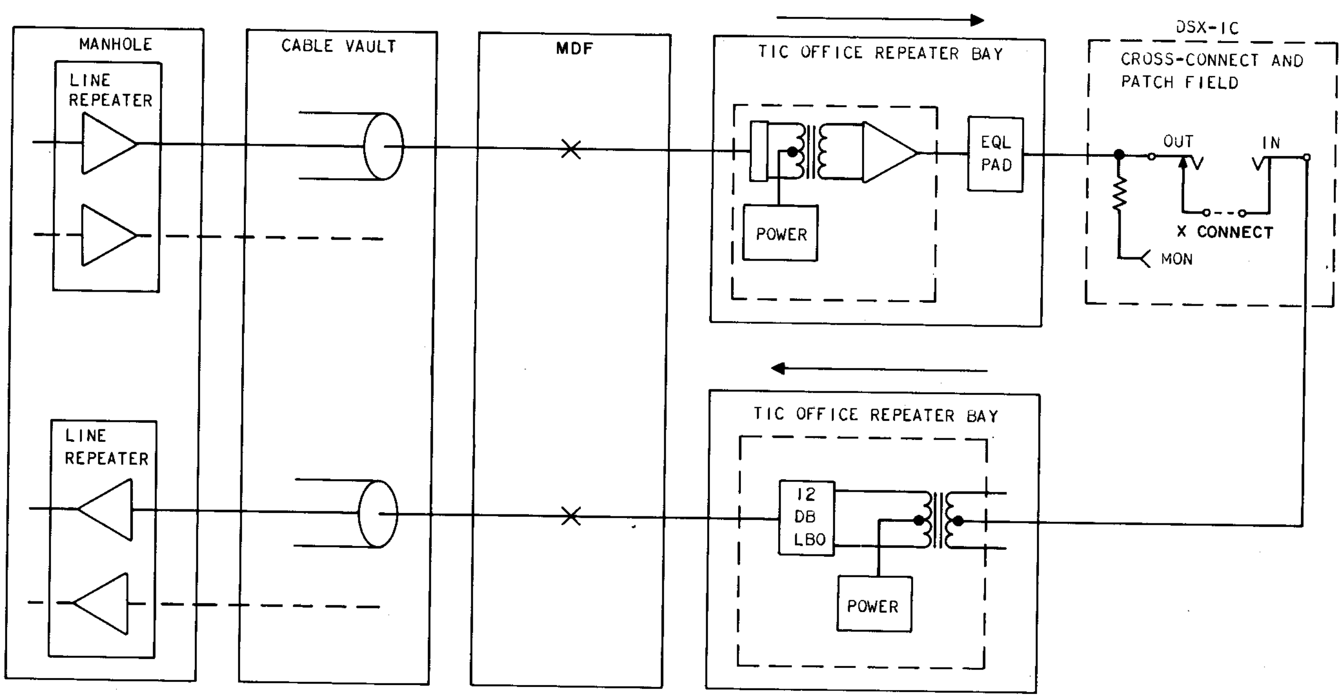


Fig. 20—Intraoffice Cabling

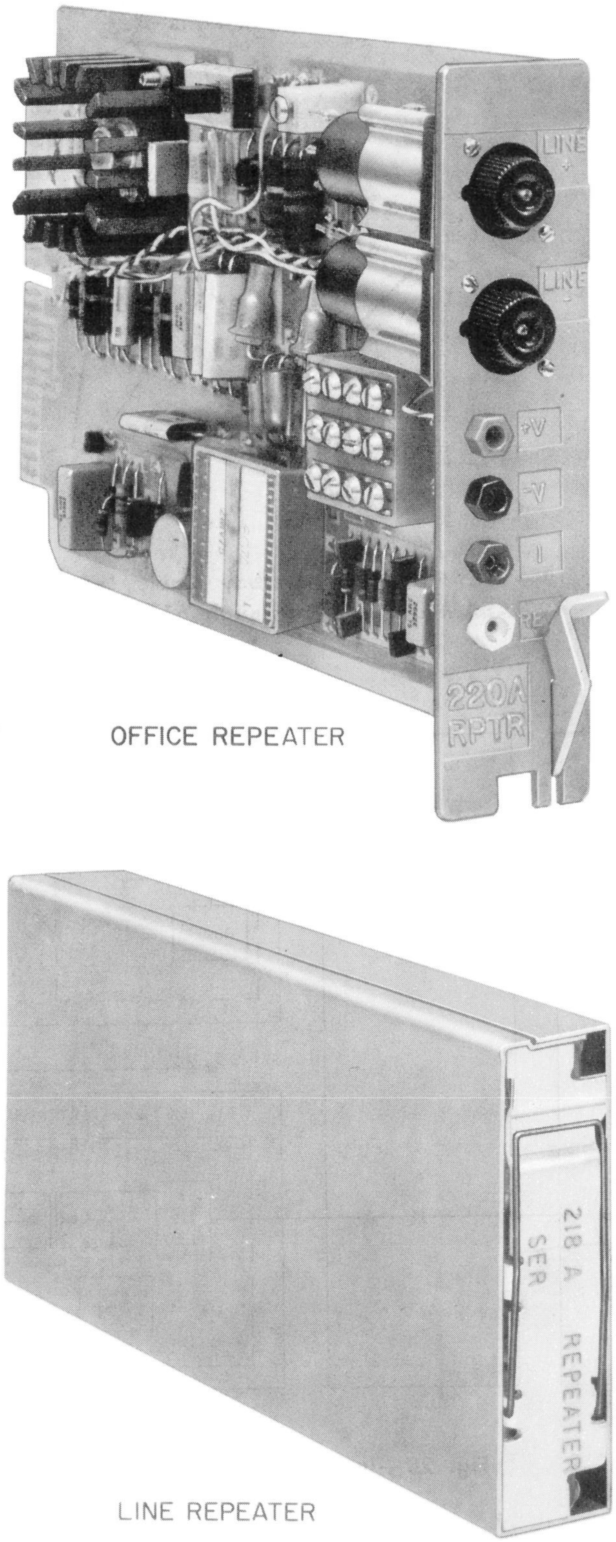


Fig. 21—Typical T1C Repeaters

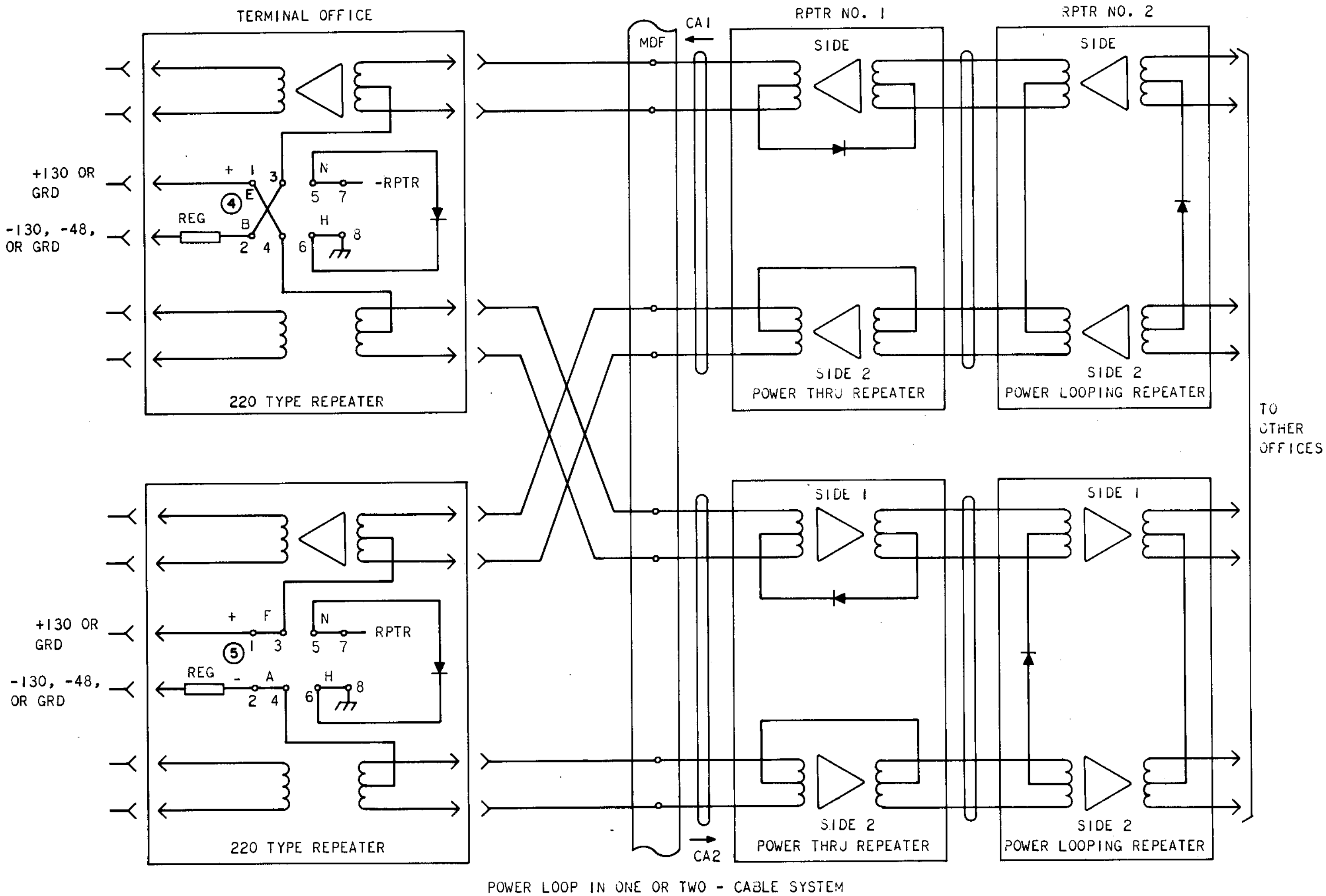
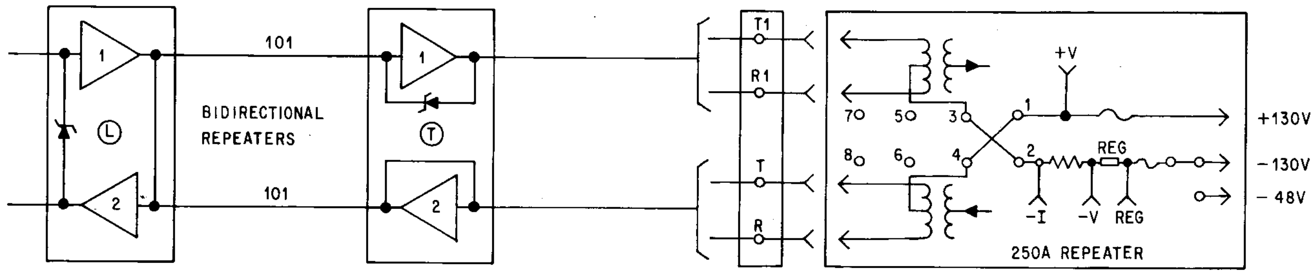


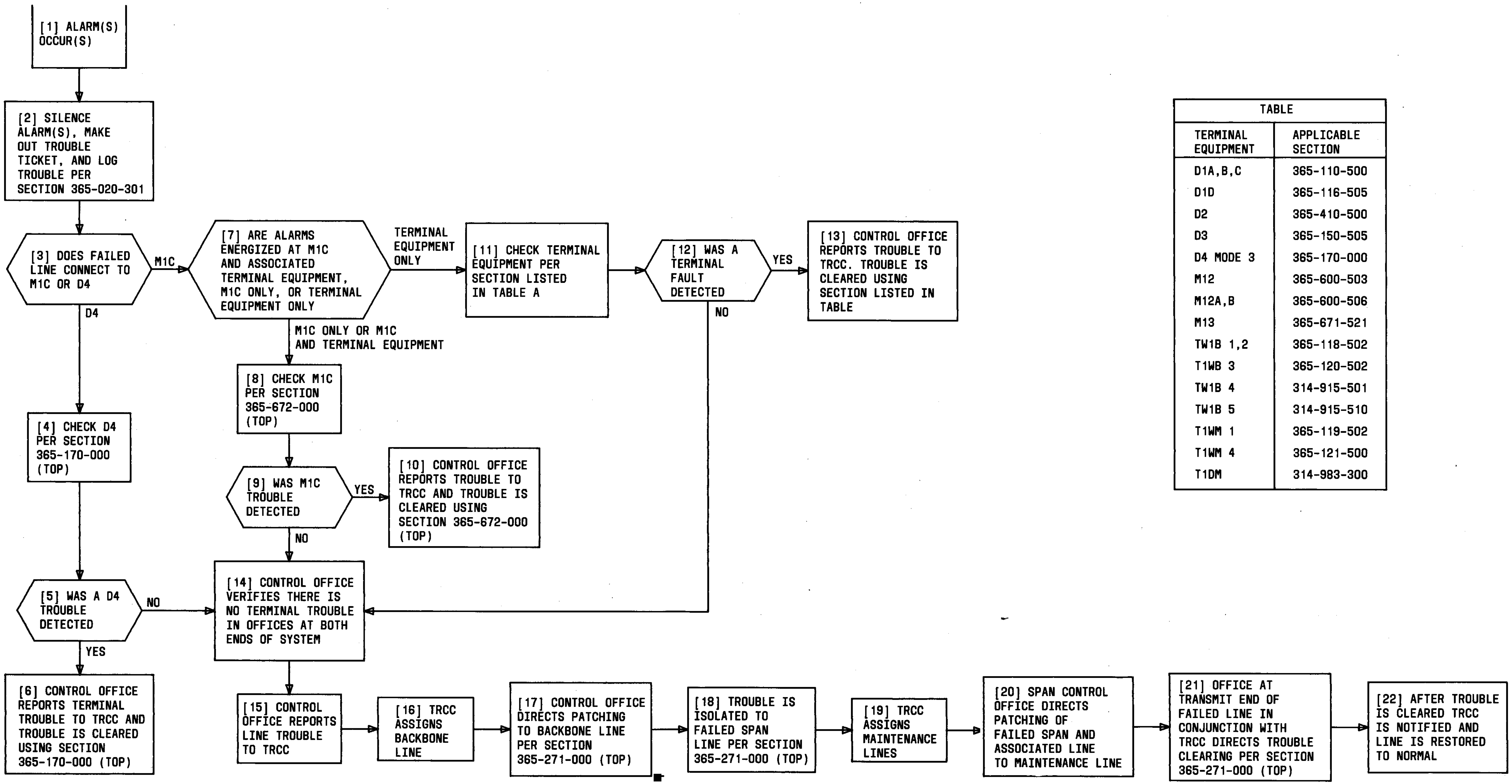
Fig. 22—Power Options Over Unidirectional One- or Two-Cable Systems



Ⓛ INDICATES POWER IS LOOPED BY PROVIDING THE CORRECT CODE OF REPEATERS OR THE CORRECT OPTIONS SELECTED.

Ⓣ INDICATES POWER IS FED THROUGH BY PROVIDING THE CORRECT CODE OF REPEATERS OR THE CORRECT OPTIONS SELECTED.

Fig. 23—Powering Scheme for Bidirectional Line Repeaters



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. 24—T1C Trouble Isolation Flow Chart

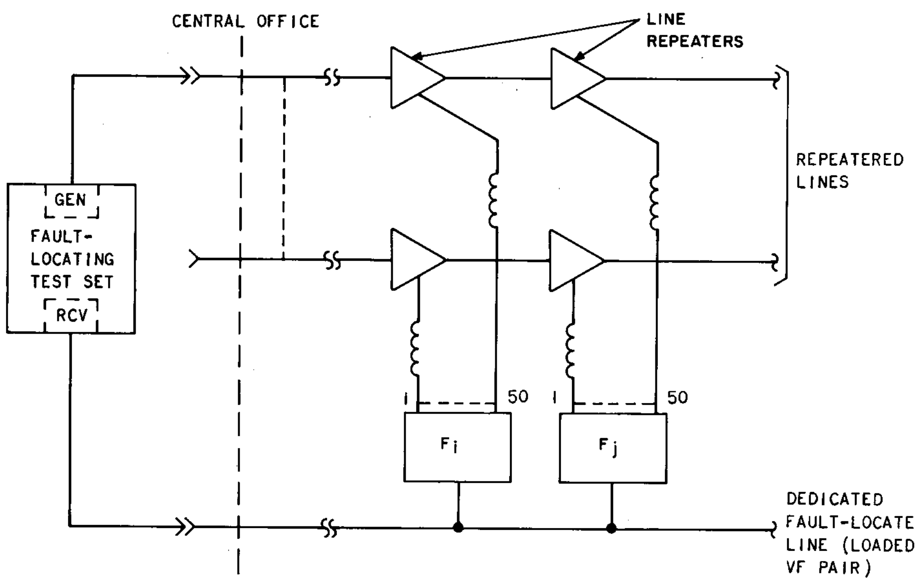


Fig. 25—T1C Fault-Locating System

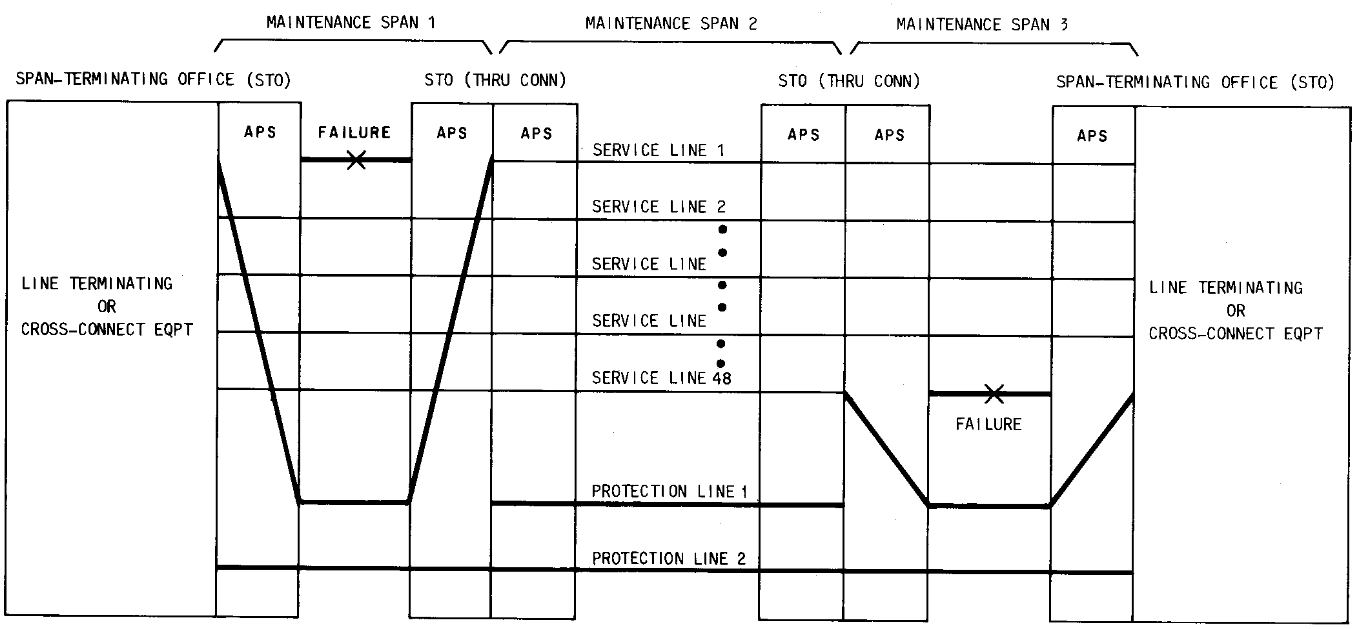


Fig. 26—Sectionalized Use of Protection Span Line