DSX-1, DSX-1C, AND DSX-2
NEW INSTALLATION
DIGITAL TRANSMISSION SYSTEMS
CARRIER ENGINEERING

CONTENTS PAGE

Figures

CONTENTS PAGE

Tables

1. GENERAL

1.01 This section provides general information for engineering DSX-1, DSX-1C, and DSX-2 patch and cross-connect bay installations. Specific wiring connections for current applications are shown in SD-99503-01, Issue 16D. The J98731 equipment design requirements are listed in Section 801-500-150. The term DSX, as used in this section, means the DSX-1, DSX-1C, and DSX-2 cross-connect bays. The user of this section should have a thorough knowledge of the DSX general description found in Section 365-301-101.

1.02 This section is being reissued to:

- Delete equalizer tables. (Equalizers plug into transmission equipment. Each engineering section for transmission equipment lists the rules and equalizers for its equipment.)
- Remove descriptive information that can be found in Section 365-301-101.
- Update cabling information.
- Replace equation for determining number of quasi random signal sources needed with an explanation.
- Replace 2EM (blue) cap with 2AH (white) cap.

Change arrows are used to denote significant changes.

1.03 This section provides information on cabling and floor plans that will aid in engineering DSX installations. Also special considerations for selected equipment are included.

2. ENGINEERING RULES

CABLING

2.01 The basic rules for all DSX installations are:

(a) All cables between the connecting equipment and the DSX shall be either 22-gauge 606B through 611B cables or ABAM cables. (For some applications, the higher loss 750-type or BF-type cables may be used.)

(b) The shield of the 606B through 611B cables or the ABAM cable shall be grounded at one end only—the equipment end if possible.

(c) Input and output signals shall be in separate cables. The DSX-1 may have both directions of transmission in one cable, but separate cables are recommended.

(d) Office cables to or from DSX bays should not be run above bays or a lineup for electromechanical or crossbar switching equipment. It should not be run in parallel (in the same rack) with power, ground, or interbay cabling for electromechanical bay lineup or cable run. If these limits are not observed, a high level of induced impulse noise may develop which will cause errors on the T-Carrier line.

2.02 The wire required for connecting between jacks in a DSX-1 or DSX-1C lineup is Y1 cross-connect wire. Usually 3-pair Y1 cross-connect wire is used. However, special connections such as D4 channel banks to time assignment speech interpolation (TASI) equipment require 4-pair Y1 cross-connect wire.

> ***Note:*** Systems using T1D digital lines connect to DSX-1C cross-connect jacks and follow the same rules as systems using T1C lines.

2.03 It is recommended that all DSX-2 cross-connections be made with 3-pair shielded wire (W.L. GORE & ASSOC., RCN 1261) and that the shield be grounded at one end only. The maximum cross-connect length within the DSX-2 is 15 feet between jack sets.

2.04 Cable length between transmission equipment and the DSX depends on the digital signal (DS) rate and the output level of the transmission

equipment. Cable lengths to DSX-2 cross-connect panels may be up to 1050 feet. Maximum cable lengths to DSX-1 and DSX-1C cross-connect panels are listed in Tables A and B respectively. ▶Cable lengths between cross-aisle terminal strips (when used) must be included in calculations.◀

FLOOR PLAN

2.05 The DSX should be planned for its ultimate size prior to the installation of the first DSX bay. Section 760-100-084 covers detailed guidelines for planning various size offices. The office sizes in relation to the number of DSX bays are as follows:

(a) Very small office—No DSX bays [equivalent jacks mounted in office repeater bays (ORB)]

(b) Small office—1 to 5 DSX bays

(c) Intermediate office—6 to 23 DSX bays

(d) Large office—24 to 46 DSX bays

(e) Very large office—47 to 66 DSX bays.

These guidelines are based on 7-foot bays but can be modified for use with 9-foot or 11-foot 6-inch bays.

2.06 The 7-foot bays are 26 inches or 31 inches wide but the 9-foot and 11-foot 6-inch bays are 26-1/2 inches or 31-1/2 inches wide. In this section, all bays will be referred to as 26 inches or 31 inches wide. The 17-inch wide ED-2C544-30 jack panels are recommended for all new installations because the frameworks meet the 26-inch wide New Equipment Building System (NEBS) standards, and more jack positions are available per square foot of floor space when 26-inch wide bays are used. However, individual panel adapters are available for mounting the ED-2C544-30 jack panel in a 31-inch center bay where necessary.

2.07 Only one installation of each type of DSX bay is to be installed in an office and it is always located in the transmission area. Normally, each type of DSX bay is segregated from the other type. There are two exceptions to this rule. One is when the ultimate size of the DSX installation is so small that a single framework will suffice for two or more DSX installations. Then multiple DSXs may be installed in the same bay with the panels segregated so that the higher bit rate is on top. The other exception is

TABLE A

DSX-1 CONNECTING DISTANCES

	EQUIPMENT CONNECTED TO DSX-1	MAXIMUM CABLE CONNECTING DISTANCE TO DSX-1 (FEET) (NOTE)	CROSS-CONNECT DISTANCES BETWEEN EQUIPMENT AT DSX-1
A	±3V DS1 Terminal	85	85 feet to B through E
B	±3V T1 Office Repeater With Fixed Line Buildout at First Line Repeater	85	15 feet to B or C
			85 feet to A, D, or E
C	±3V T1 Office Repeater With Automatic Line Buildout at First Line Repeater	85	15 feet to B
			85 feet to A, C, D, or E
D	±6V T1 Office Repeater With Automatic Line Buildout at First Line Repeater	655	85 feet to A through E
E	±6V DS1 Terminal	655	85 feet to A through E

Note: 606B through 611B or ABAM cable.

TABLE B

DSX-1C CONNECTING DISTANCES

EQUIPMENT CONNECTED TO DSX-1C	MAXIMUM CABLE CONNECTING DISTANCE TO DSX-1C (FEET) (NOTE)	CROSS-CONNECT DISTANCES BETWEEN EQUIPMENT AT DSX-1C
±4V DS1C Terminal	400	85 feet
±4V T1C Office Repeater	400	
±6V T1C Office Repeater	655	
±6V Office Repeater		
T1C Office Repeater	655	
T1D—260A,B, 286C,D Repeaters	655	
T1D—260C,D Repeaters	400	

Note: 606B through 611B or ABAM cable.

when DSX-1 bays are planned for conversion to DSX-1C bays. These convertible bays are discussed in Part 3 of this section.

2.08 A T-Carrier Maintenance Center (TCMC) is recommended for larger offices. The TCMC will allow most maintenance in the office to be centrally administered. Details of the TCMC are given in Section 855-350-108.

2.09 Because the cross-connect limits of the DSX-1/DSX-1C and DSX-2 are different, there are different maximum lengths for a single lineup of each type of DSX assembly. The DSX-1/DSX-1C may have a maximum lineup length of 73 feet 10 inches. The DSX-2 may have a maximum lineup length of 10 feet 4 inches. These DSX lengths are based on the use of 7-foot bays mounted on 26-inch centers. All discussions in this section will be based on the same assumptions. For other bay heights and the 31-inch center bays, see Table C for DSX-1 or DSX-1C. DSX-2 is always limited to four bays. When ESS* switch 7-foot DSX bays are used, lineup length is limited to six frames. ▮Where more than six bays would be required, unequal flange bays should be used with a special overhead cable rack for holding extra cable.◀

* Trademark of Western Electric

DSX-1 OR DSX-1C LINEUP

2.10 Although the maximum length for a single DSX-1/DSX-1C lineup is 73 feet 10 inches, the maximum recommended length is only 50 feet. This limit is recommended because of local fire codes and the possibility of cable congestion in overhead cable racks in very long DSX-1/DSX-1C layouts. Whenever the length of the DXS-1/DSX-1C lineup is more than the recommended 50-foot limit, a multiple lineup of DSX-1/DSX-1C bays may be necessary. This multiple lineup arrangement will also provide access to more jack circuits. The basic guidelines (for 26-inch center bays) for determining when to use a single or multiple lineup of DSX-1/DSX-1C bay are:

(a) Up to 23 bays—single lineup

(b) 24 to 46 bays—double lineup

(c) 47 to 66 bays—triple lineup.

TABLE C

DSX-1 OR DSX-1C BAY LINEUP MAXIMUMS

MAXIMUM	BAY HEIGHT	NUMBER OF LINEUPS (NOTE)		
		1	2	3
LINEUP LENGTH*	7′ 0″	73′ 10″	50′ 5″	47′ 11″
	9′ 0″	71′ 10″	47′ 2″	44′ 9″
	11′ 6″	71′ 10″	42′ 3″	39′ 9″
NUMBER OF 31-INCH CENTER BAYS 11′ 6″	7′ 0″	28	38	54
	9′ 0″	27	36	51
	27	32	32	45
NUMBER OF 26-INCH CENTER BAYS	7′ 0″	34	46	66
	9′ 0″	33	42	60
	11′ 6″	33	38	54

Note: These numbers are based on a 5′ 6″ maintenance aisle and a 2′ 6″ wiring aisle.

* Maximum recommended lineup length is 50 feet.

More lineups are possible but not recommended due to cable congestion in the overhead racks. Additional lineups of DSX-1/DSX-1C bays shorten all lineup lengths of the DSX-1/DSX-1C.

2.11 The DSX-1/DSX-1C will have an interbay patch panel in every fourth bay whenever the number of DSX-1/DSX-1C bays exceeds four. The interbay patch panel allows patching for the three bays on either side of the fourth bay. When the lineup is between five and seven bays long, the patch panel should be split (wired upon itself) so that each end of the lineup can use it. A single lineup will have a straight connection between every fourth bay. A double lineup will have the panels laced between the two rows of bays. A triple lineup uses a combination of in-line and cross-aisle lines connected to separate panels.

2.12 In the DSX-1 and DSX-1C, cross-aisle terminal assemblies should be installed in every bay when there is a multiple lineup configuration. They are mounted behind the fuse and alarm panels at the top of the bays. These terminal assemblies make cross-connecting between lineups easier. There are two terminal blocks on each assembly. The terminal blocks are connected by 609B cable to another terminal block in the corresponding bay in another lineup. More than two bays on a given terminal assembly are prohibited. For a double lineup, both terminal blocks are connected to the other lineup. For a triple lineup, each block in the assembly is connected to a different lineup. ▶Each terminal block can accommodate 25 cross-connections.◀

DSX-2 LINEUP

2.13 The DSX-2 is limited to a maximum lineup length of four bays with the cross-connections run by the most direct route to the extreme limits of the lineup. A single lineup is always used for DSX-2.

INTRAOFFICE REPEATER SYSTEM

2.14 The rapid growth of digital facilities in some buildings has exhausted floor space within cabling range of the DSX location. Where this circumstance exists and no alternative is available, a second DSX can be placed within cabling range of the new equipment. The new equipment should be equalized to the second DSX and extended to the primary DSX by ***active tie lines.*** This method (although somewhat more costly) maintains the standard 3-volt cross-connect point, provides full assignment flexibility, and permits testing and restoration activity without constraint.

2.15 When equipment such as a satellite earth station is more than 655 feet from the DSX installation, the remote terminal equipment is equalized to a (J98725A, B or C) repeater bay (internal jacks are provided in the repeater bay) rather than a separate DSX at the remote terminals. These two methods are detailed in SD-99503-01. This arrangement ***does not*** provide a second DSX with full restoration and testing capability. Looping is possible at the remote location for acceptance testing, but restoration and testing can be done only at the primary DSX where the spare lines and bridging repeaters appear. Under no circumstances should a second DSX be placed without active lines between it and the primary DSX.

3. EQUIPMENT CONSIDERATIONS

PANEL SELECTION AND MANAGEMENT

3.01 Regular DSX panels are 2 inches high with 12 jack sets, 3 inches high with 16 jack sets, and 4 inches high with 25 jack sets. Whenever possible, the number of jack sets on a panel or group of panels should equal the number of 2-way transmission paths at the connected transmission equipment. See Tables D and E. Generally, office repeater bays (ORB) should terminate on 4-inch jack panels, D-type channel banks on 2-inch jack panels, and multiplexers on 3-inch jack panels. Whenever 2-inch jack panels are used, they should always be mounted in pairs so that there is enough room on the side of the bay for the 91K designation strips. The bay normally contains up to 14 4-inch jack panels, but the 9-foot and 11-foot 6-inch bays may contain up to 18 4-inch jack panels.

3.02 Individual jack panels are normally associated with only one equipment type; ie, D3 channel banks on a separate panel from other D-type channel banks, M1C multiplexers separate from other multiplexers, etc. There are unique equipment types, such as Digital Data System equipment, where there may not be enough of a specific equipment type to fill a complete panel. Then various equipment types can be combined on the same panel. These equipment types should be terminated on 2-inch panels. If only a few of these circuits exist in an office and there are unused jack sets available on an existing panel, then these circuits may be terminated on the unused jack sets.

3.03 Panel grouping is also important in order to accommodate the various equipments in an orderly manner. Congestion in the DSX bay can be minimized if, during the initial assignment of the DSX panels, an attempt is made to place panel groups which have high amounts of intergroup cross-connections close to each other in the DSX bays. Cross-connections within a bay are appropriate. Dedicating an entire bay to one type of equipment could lead to serious congestion problems. As the office grows, there should be a continuing effort to assign circuits in such a way as to minimize the length of cross-connections. This effort would be facilitated if the DSX position of each system was incorporated into the office layout records.

3.04 The following guidelines on panel grouping should prove helpful:

(a) Panels associated with office repeaters should be grouped so that an entire apparatus case(s) terminates in one group of panels. This could be from two to six 4-inch panels grouped together, depending upon the specific ORB. It is recommended that there be dedication between the apparatus cases, ORB shelves, and DSX panels. If ORB shelf-to-apparatus case dedication does not exist, DSX panels will be dedicated to the apparatus case(s). If office repeater panels (unidirectional repeaters) are associated with the same apparatus case, the respective DSX panels should be adjacent.

(b) Panel groups for the ORBs and channel banks may be intermixed on a DSX bay. The ratio of ORB panels to channel bank panels should be determined by the ratio of through systems to terminating systems in the office.

(c) Special panel groupings should be made for equipment having specialized maintenance

TABLE D

PANELS FOR 31-INCH WIDE BAYS (ED-1C544-30)

PANEL HEIGHT	GROUP NUMBER	USED WITH			COMMENTS
		DSX-1	DSX-1C	DSX-2	
2 Inches	1	yes			Manufacture discontinued (MD)
	2	yes	yes		12 jack sets
	7			yes*	MD
	8			yes*	12 jack sets
	15			yes*	Communications panel — accepts various jacks G16-27, 30-34, 37-46, 48, 52, and 53
	36	yes	yes		12 auxiliary maintenance line jack sets
	47	yes	yes		10 auxiliary maintenance line (ML) jack sets plus 2 BRDG FOR NET CLK SYNC
	51	yes			D4 — TASI-E, 12 jack sets
3 Inches	5	yes	yes		MD
	6	yes	yes		16 jack sets
	11			yes	MD
	12			yes	16 jack sets
4 Inches	3	yes			MD
	4	yes	yes		25 jack sets
	9			yes	MD
	10			yes	25 jack sets
	13	yes			MD
	14	yes			MD
	28	yes	yes		24 jack sets plus ML in position 1
	29	yes	yes		24 jack sets plus ML in position 25
	35	yes			Interbay patch 25 jack sets
	54	yes	yes		23 auxiliary maintenance line jack sets plus 2 BRDG FOR NET CLK SYNC

* Since fault locating is not done from the DSX-2, order wire jacks are not needed at the DSX-2.

routines, such as DDS equipment, or the M12 and M13 multiplexers at the DS1 digital rate or MX3 at the DS1, DS1C, and DS2 digital rate.

3.05 Identification of the equipment connected to the DSX jack sets on the panels is accomplished by use of designation strips at the bottom of the panel, front and rear. Different color designation cards are available for each type DSX. To identify carrier routes, 91K designation strips with E-6457 record cards are mounted on the sides of the bay next to the jack panels. Figures 1 through 19 show typical jack panel labeling.

3.06 When T1D spans appear at a DSX-1C, there should be no mixing of T1C spans and T1D spans on the same panel. Although the input and output signals of the office side of the T1D repeater are DS1C signal rates, special maintenance procedures require that these lines be uniquely identified. The 2AY (white) tracer lamp caps on all office repeater panels in the bay should be changed to either 2BF (white)◀ with the letter C on them for T1C or ▶2AH (white)◀ caps with the letter D on them for T1D. ▶The 2EM (blue) caps are no longer recommended because they are not bright enough.◀ A notation should be made on the E-6457 record card to indicate whether a span is T1C or T1D.

TABLE E

PANELS FOR 26-INCH WIDE BAYS (ED-2C544-30)

PANEL HEIGHT	GROUP NUMBER	USED WITH			COMMENTS
		DSX-1	DSX-1C	DSX-2	
2 Inches	3	yes	yes		12 jack sets
	6			yes	12 jack sets
	12	yes	yes	yes	Communication panel with minimum equipment — accepts group 13
	14	yes	yes	yes	Maintenance panel with minimum equipment — accepts group 15
	17	yes	yes	yes	Miscellaneous jack panel — accepts groups 18-35, 39, 40, 42 and 43
	37	yes	yes		10 jack sets — auxiliary maintenance line jacks
	38	yes	yes		8 auxiliary maintenance line jacks plus 2 BRDG FOR NET CLK SYNC
3 Inches	2	yes	yes		16 jack sets
	5			yes	16 jack sets
	9	yes	yes		16 jack sets — auxiliary maintenance line
	10	yes	yes		14 auxiliary maintenance line jacks plus 2 BRDG FOR NET CLK SYNC
4 Inches	1	yes	yes		25 jack sets
	4			yes	25 jack sets
	7	yes	yes		24 jack sets plus one jack set in position 1 for maintenance line
	8	yes	yes		24 jack sets plus one jack set in position 25 for maintenance line
	11	yes	yes		20 jack sets for interbay patching
	36	yes			25 jack sets for D4 channel bank to TASI-E
	41	yes	yes		20 jack sets for interbay patching

QUASI RANDOM SIGNAL SOURCE (QRSS)

3.07 ▶To determine the number of QRSS panels needed for a DSX lineup, four items are considered.

- Number of QRSS jacks needed. These should be at least two QRSS jacks per bay, and one QRSS output for each QRSS jack.

- Number of unassigned lines in the lineup. Each line that is equipped but not in service should be driven by a QRSS output or a test set. One QRSS output should be available for each unassigned line.

- Number of maintenance or restoration lines in the lineup. One QRSS output can drive ten maintenance or restoration lines.

- Number of QRSS outputs per panel. The J98710R and J98725AF QRSS panels have 50 outputs each while the J98725AK QRSS has 25 outputs.◀

3.08 One QRSS signal output can drive up to ten maintenance and/or restoration lines when the QRSS cross-connect panel (ED-2C503-31, G2) is used. One QRSS cross-connect panel can be used to drive up to 80 maintenance and/or restoration lines from only eight QRSS signal outputs. The QRSS outputs have certain restrictions associated with them.

Every third output (3, 6, 9, 12, 15, 18, 21, and 24) must be terminated with a 100-ohm resistor on the interface board at the rear of the QRSS or on a QRSS jack. Also, any time an output is used on the terminal strip on the rear of the QRSS, the associated resistor on the QRSS interface board must be removed from the circuit. (See Section 103-494-105.)

T-CARRIER ADMINISTRATION SYSTEM (TCAS)

3.09 When the TCAS maintenance line status indicator (MLSI) is available, the MLSI cross-connect panel (ED-2C503-31, G4 or G6) is used. An MLSI cross-connect panel is needed in every other bay when the TCAS bridging resistors are mounted on the MLSI cross-connect panel. This is because the MLSI cross-connect length is limited to 12 feet between the panel-mounted bridging resistors and the DSX jack set. When TCAS bridging resistors are mounted at the DSX bay maintenance line OUT jack, only one MLSI cross-connect panel is needed per DSX lineup. The MLSI cross-connect length is then limited to 180 feet (T1) or 50 feet (T1C) between the MLSI cross-connect panel and the DSX-mounted bridging resistors. Details on MLSI engineering are given in Section 865-201-110, Transmission Maintenance Systems—TCAS Remote Office Engineering.

3.10 A writing shelf (ED-2C562-30) can be mounted in every fourth bay at a height of approximately 3 feet. This shelf has been designed for DSX bays and is smaller than the standard writing shelf. The standard writing shelf will obstruct access to the jacks on the panel below it and will interfere with wire-wrapping the cross-connections.

DSX CONVERTIBLE BAYS

3.11 Although it is not recommended that DS1 and DS1C digital rates be mixed within the same bay or lineup of bays, an exception occurs when DS1 rate equipment is scheduled for conversion to DS1C digital rate.

3.12 Conversion from T1 to T1C facilities at the ORB is only allowed in 4-shelf, 50-line groups. The 50-line group corresponds to two DSX panels; thus entire panels for ORBs will be converted from one rate to the other. ▶However, T1 to T1D conversions may be done one shelf at a time.◀ When planning D4 channel bank conversions, it is recommended that the D4 channel banks have their A digroup connected to one DSX-1 panel and their B digroup connected to another DSX-1 panel directly below the first. When the conversion occurs, jacks on the first panel will become DSX-1C and jacks on the second panel will become available for reassignment.

3.13 During the conversion period, DS1 and DS1C digital rates will appear on the same panel. To reduce confusion during this time, care must be taken to insure that the jacks are properly labeled as to the digital rate at the jack. During conversion, it is recommended that the tracer lamp 2AY (white) cap be replaced by a 2BF (white) cap which has a letter C on it for TC1 applications, or by ▶2AH (white)◀ cap which has a letter D on it for T1D applications. After a panel is converted, the designation strips under the jacks should be changed from white for DSX-1 applications to orange for DSX-1C designations.

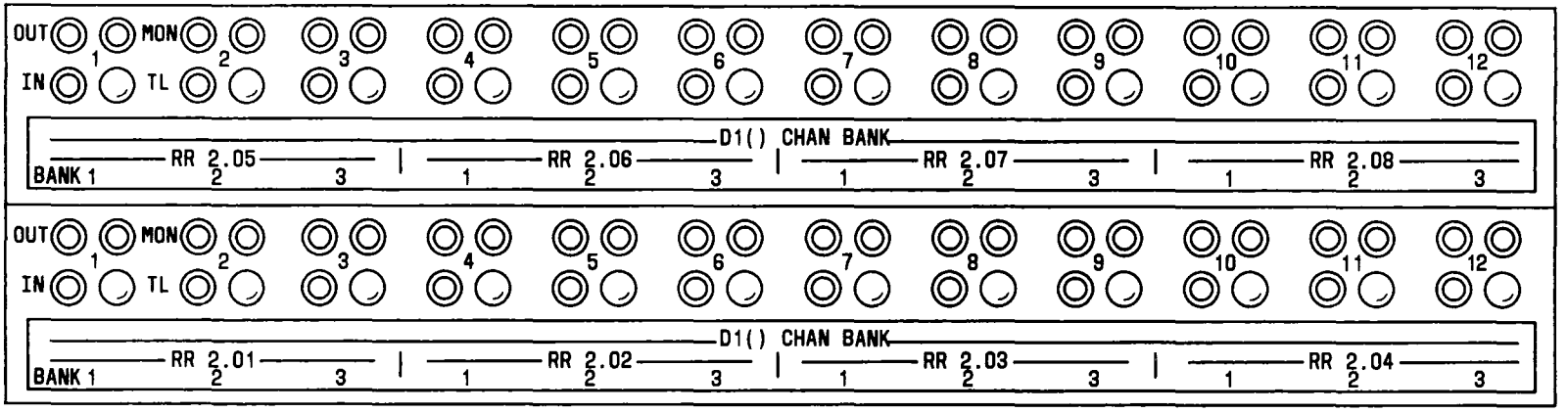


Fig. 1—D1( ) Channel Bank—DSX-1 Appearance

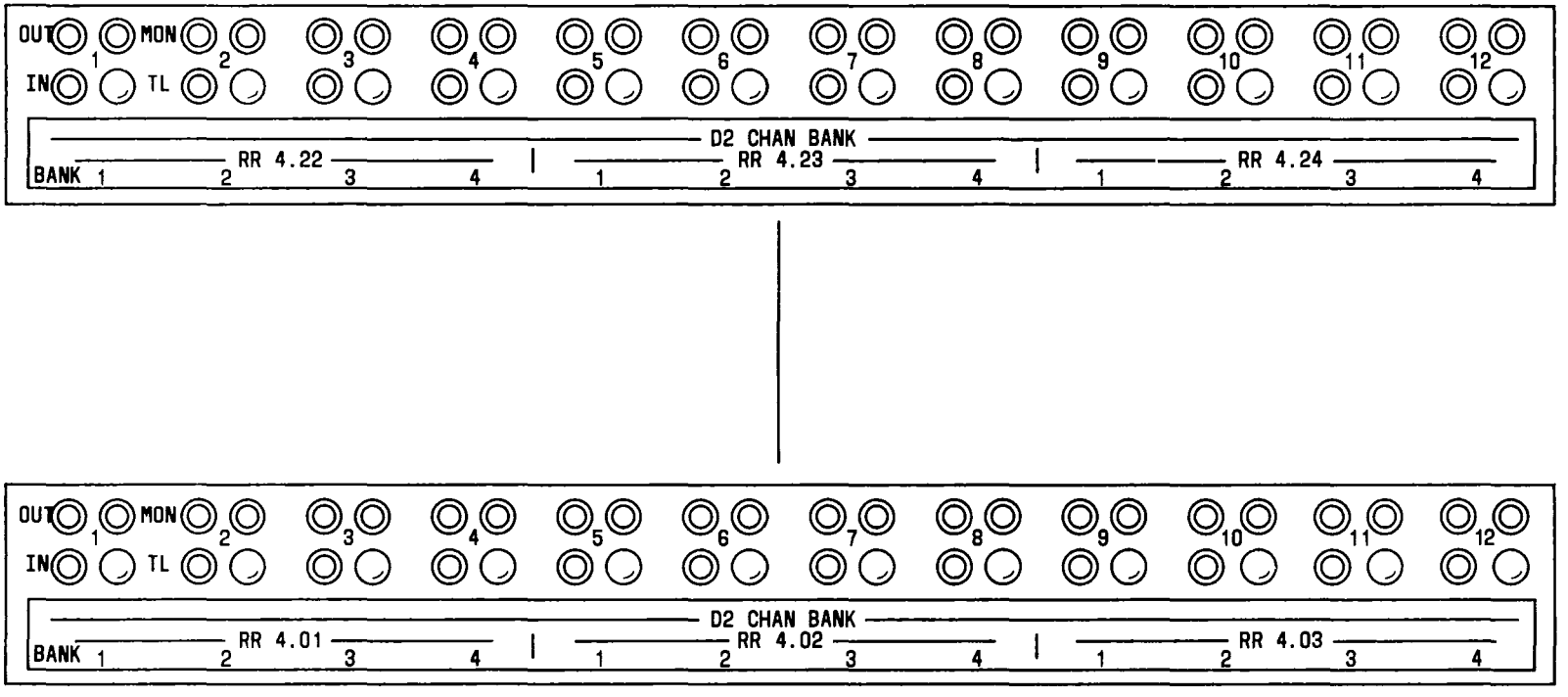


Fig. 2—D2 Channel Bank—DSX-1 Appearance

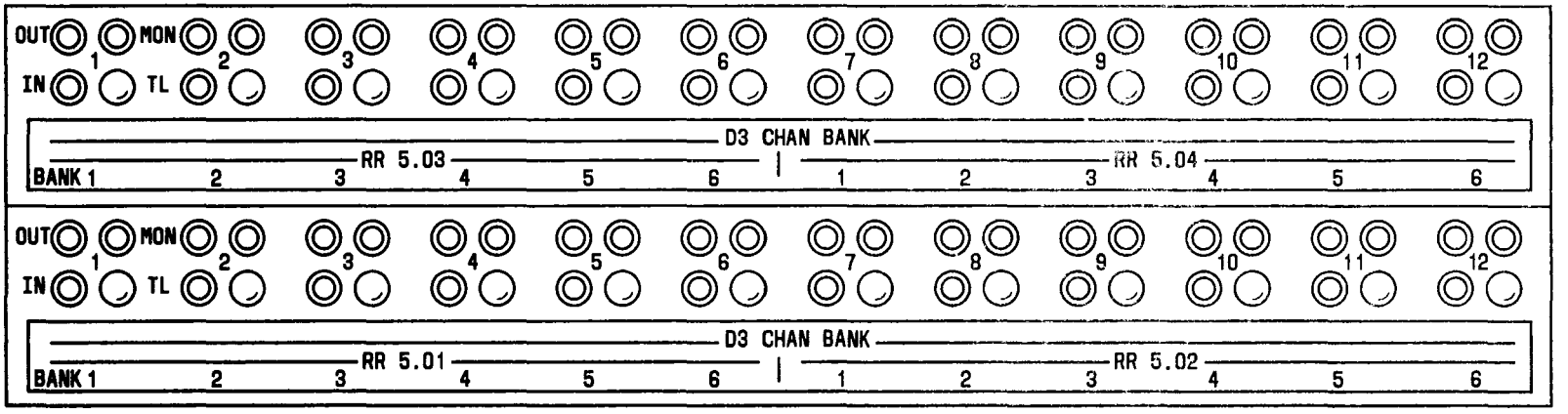


Fig. 3—D3 Channel Bank—DSX-1 Appearances

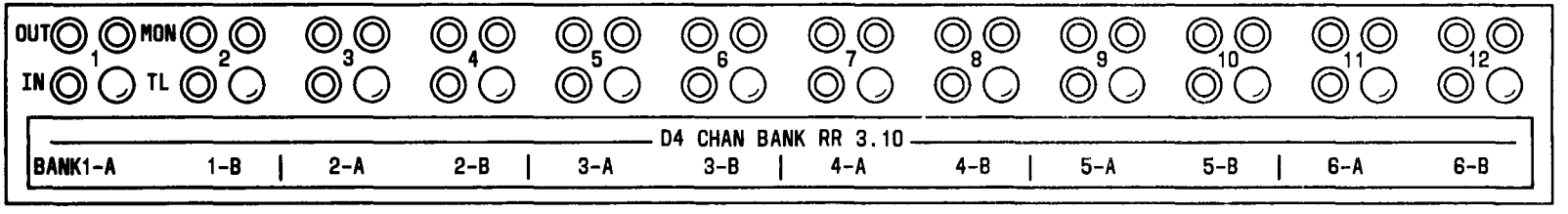


Fig. 4—D4 Channel Bank—DSX-1 Appearance

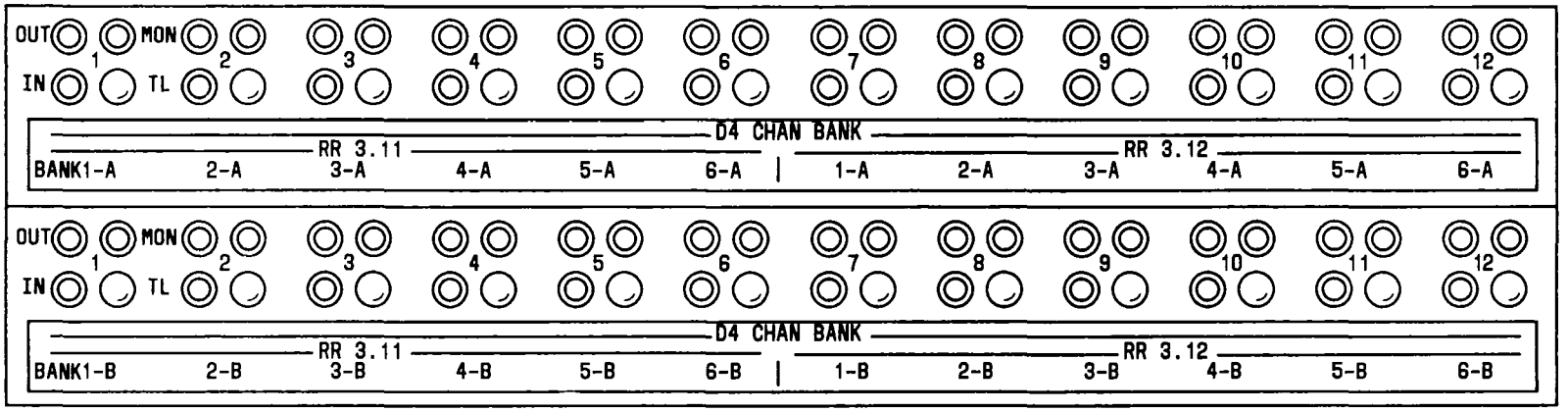


Fig. 5—D4 Channel Bank—DSX-1 Convertible Bay Appearance

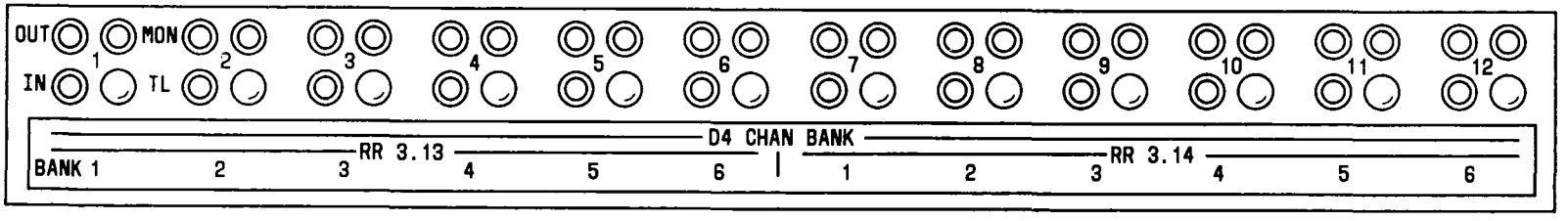


Fig. 6—D4 Channel Bank—DSX-1C Appearance

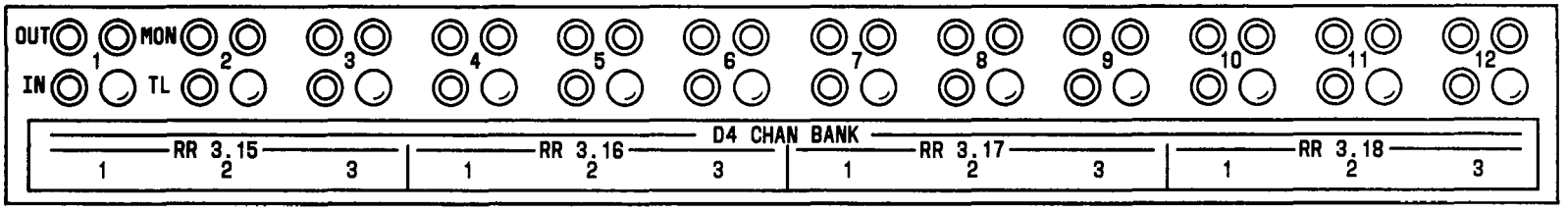


Fig. 7—D4 Channel Bank--DSX-2 Appearance

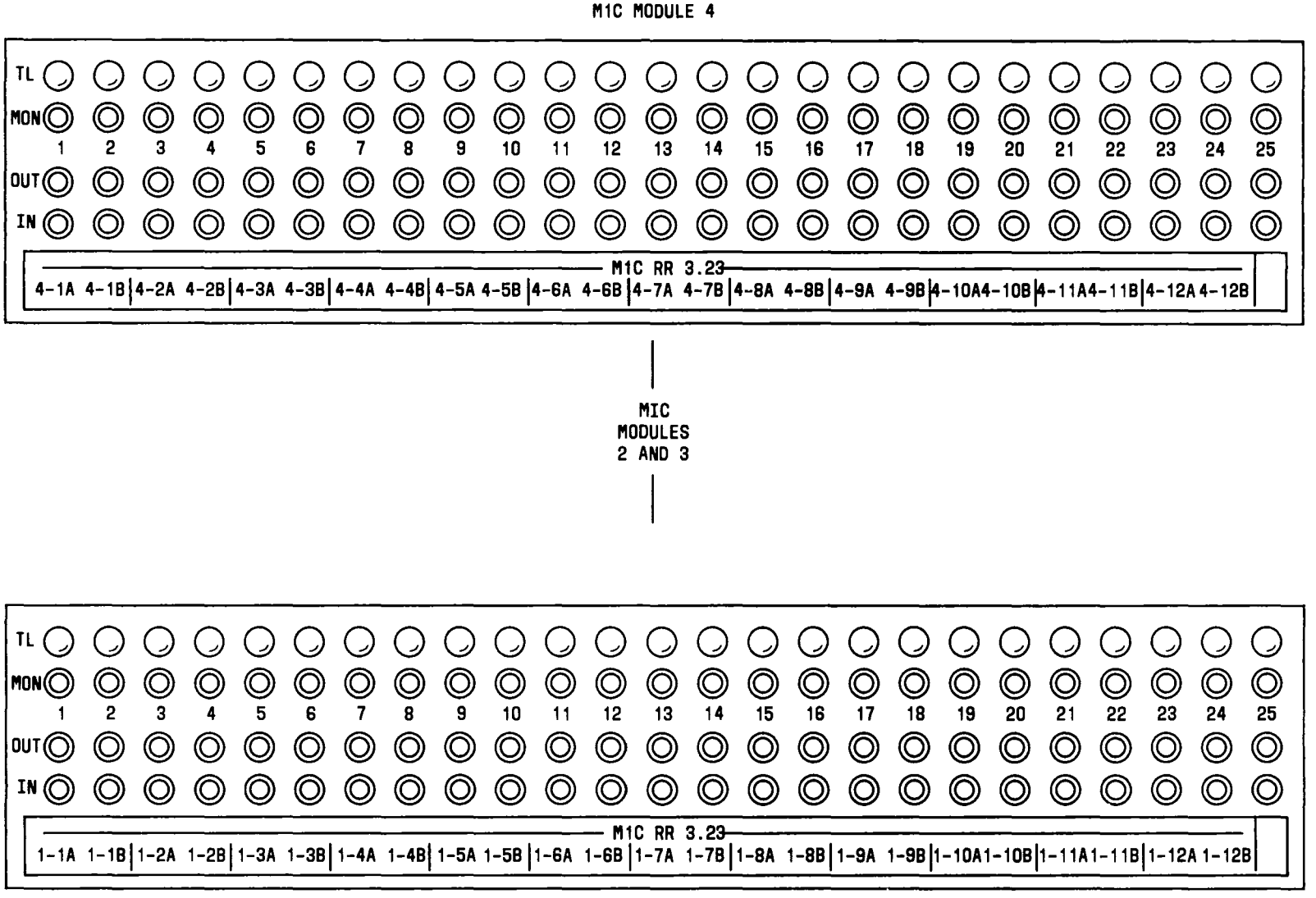


Fig. 8—M1C Multiplexer—DSX-1 Appearance

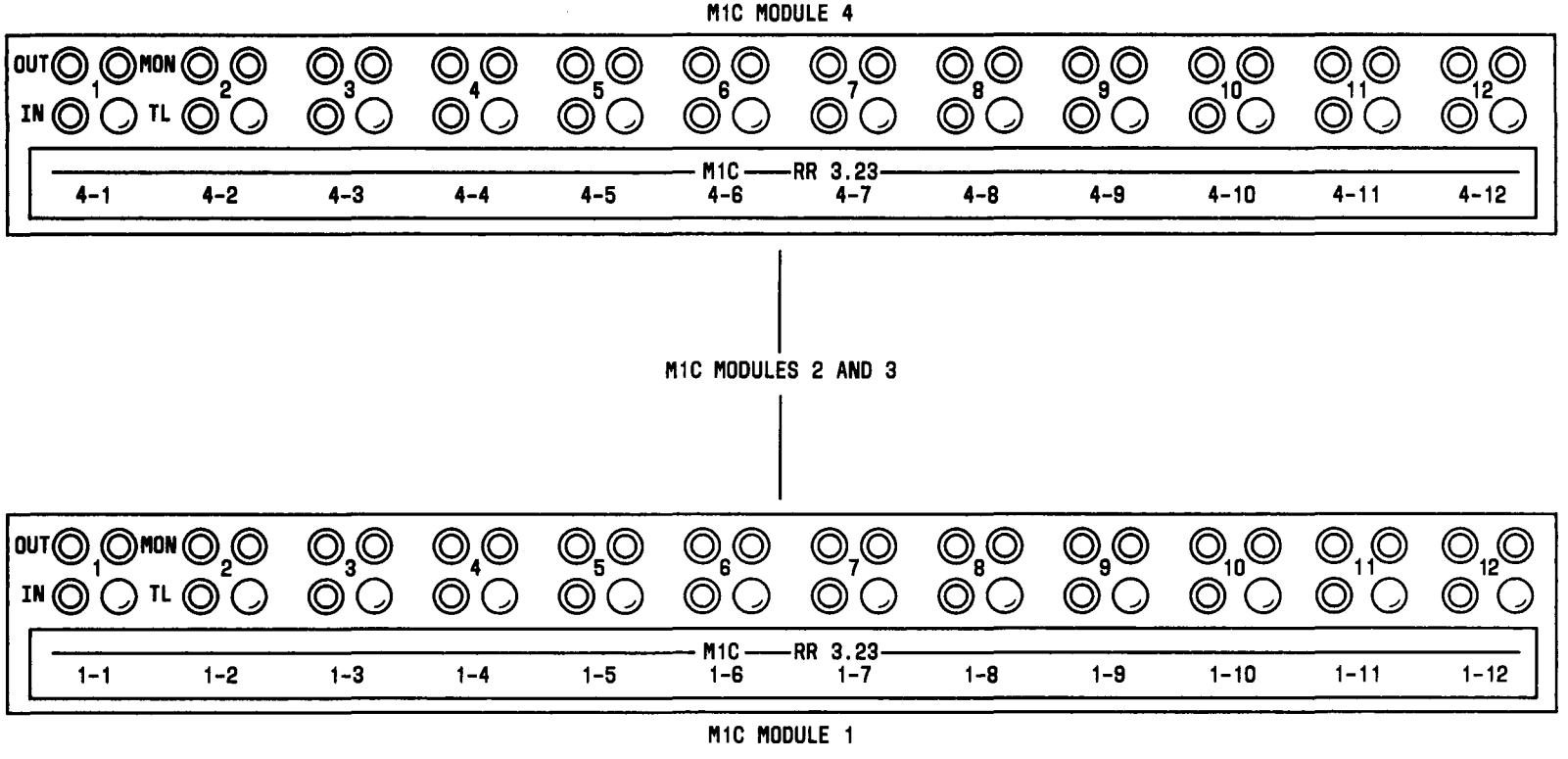
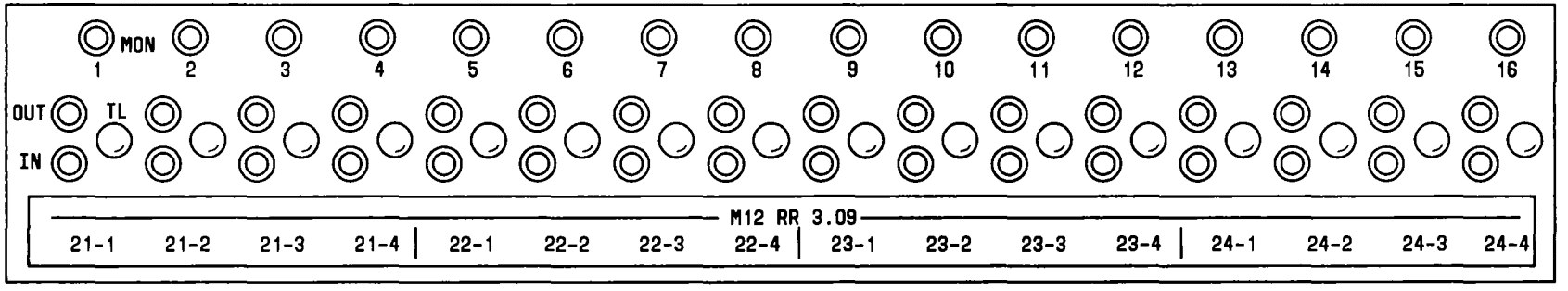


Fig. 9—M1C Multiplexer—DSX-1C Appearance



M12 MULDEM
5- ( ) THRU 20- ( )

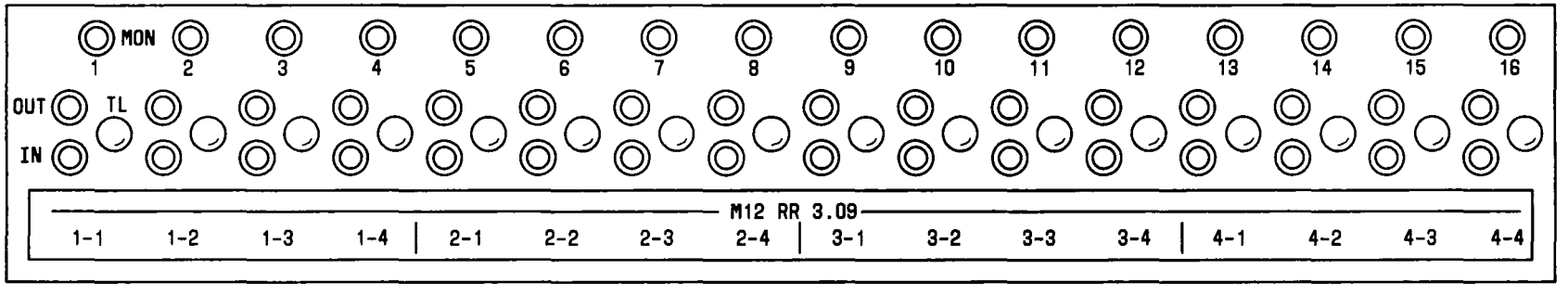


Fig. 10—M12 Multiplexer—DSX-1 Appearance

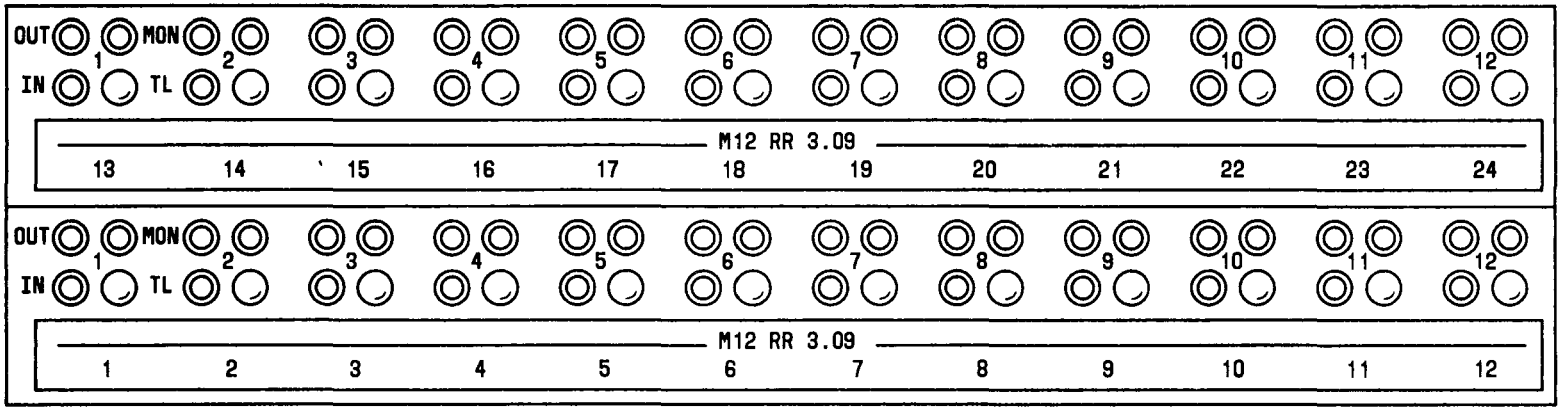


Fig. 11—M12 Multiplexer—DSX-2 Appearance

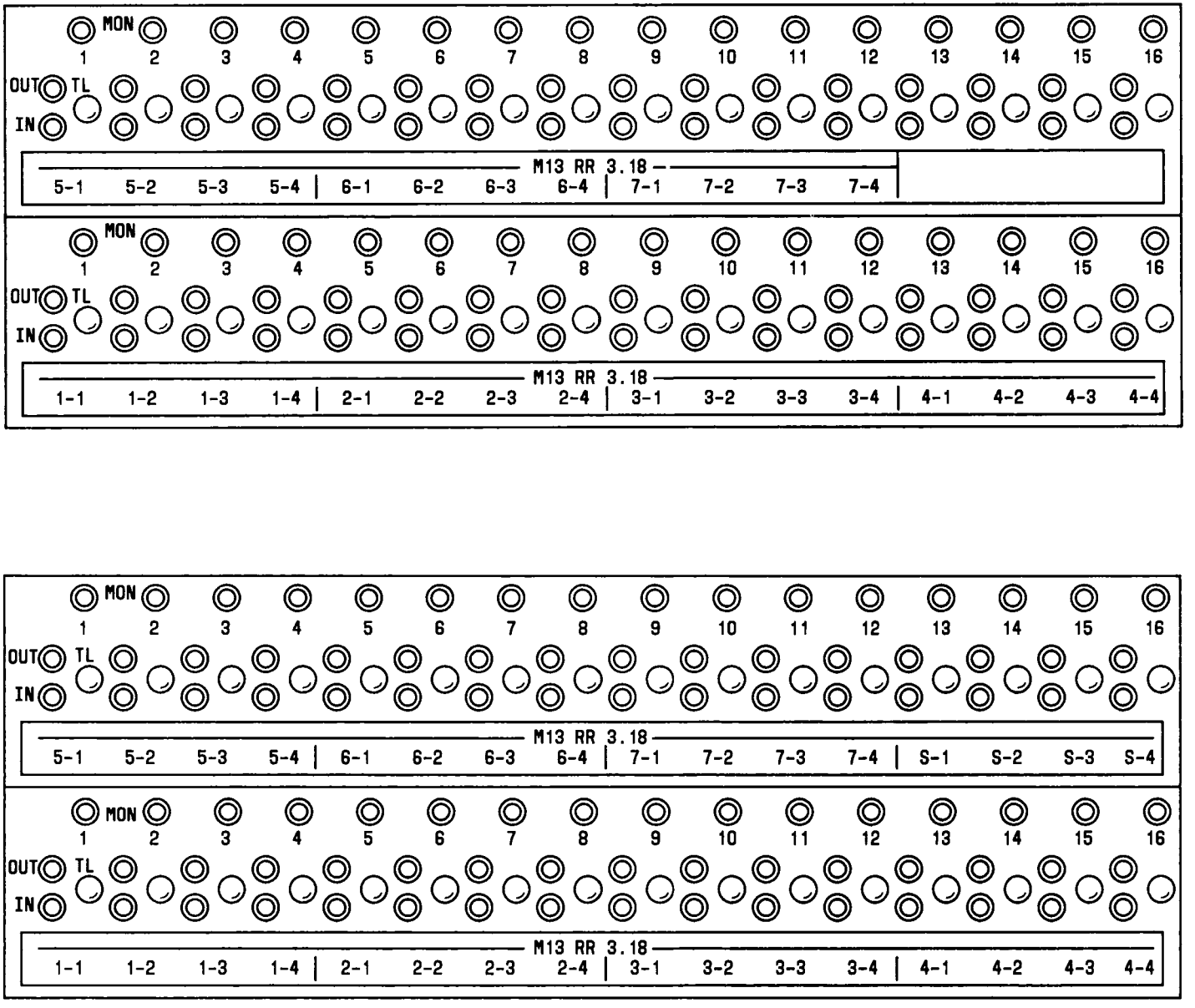


Fig. 12—M13 Multiplexer—DSX-1 Appearance

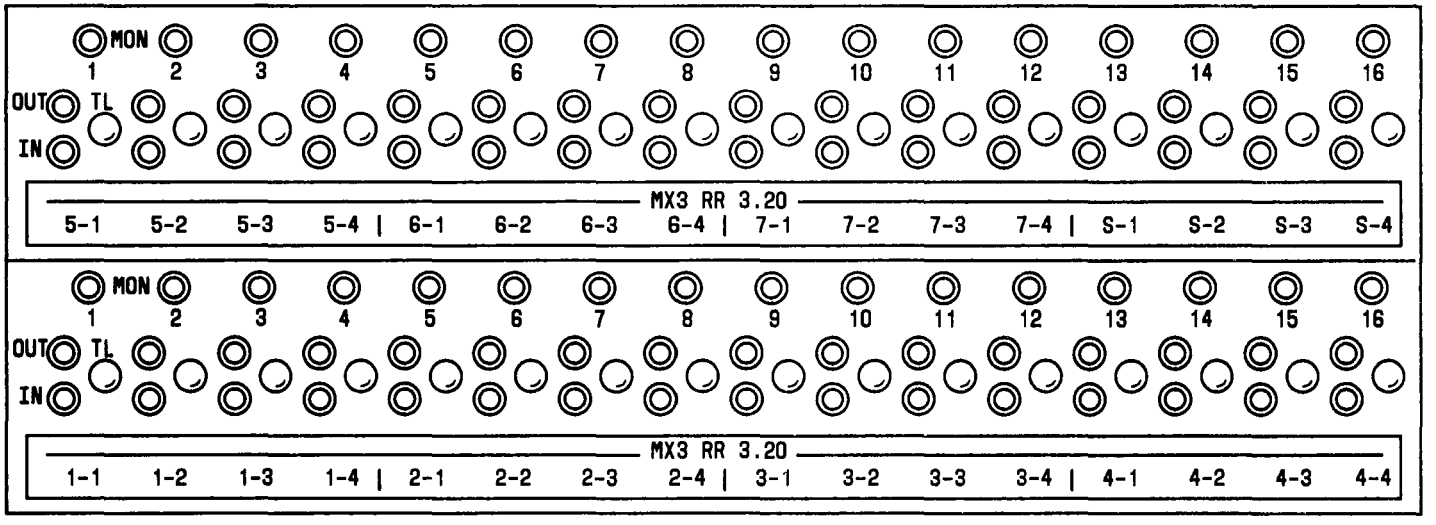


Fig. 13—MX3 Multiplexer—DSX-1 Appearance

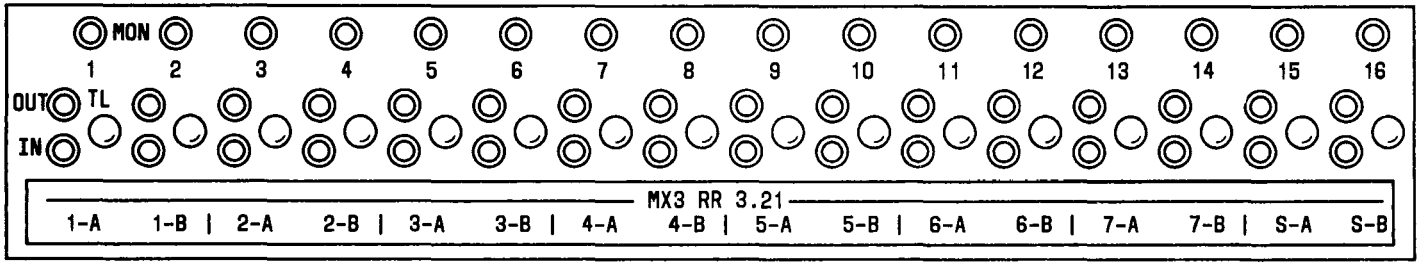


Fig. 14—MX3 Multiplexer—DSX-1C Appearance

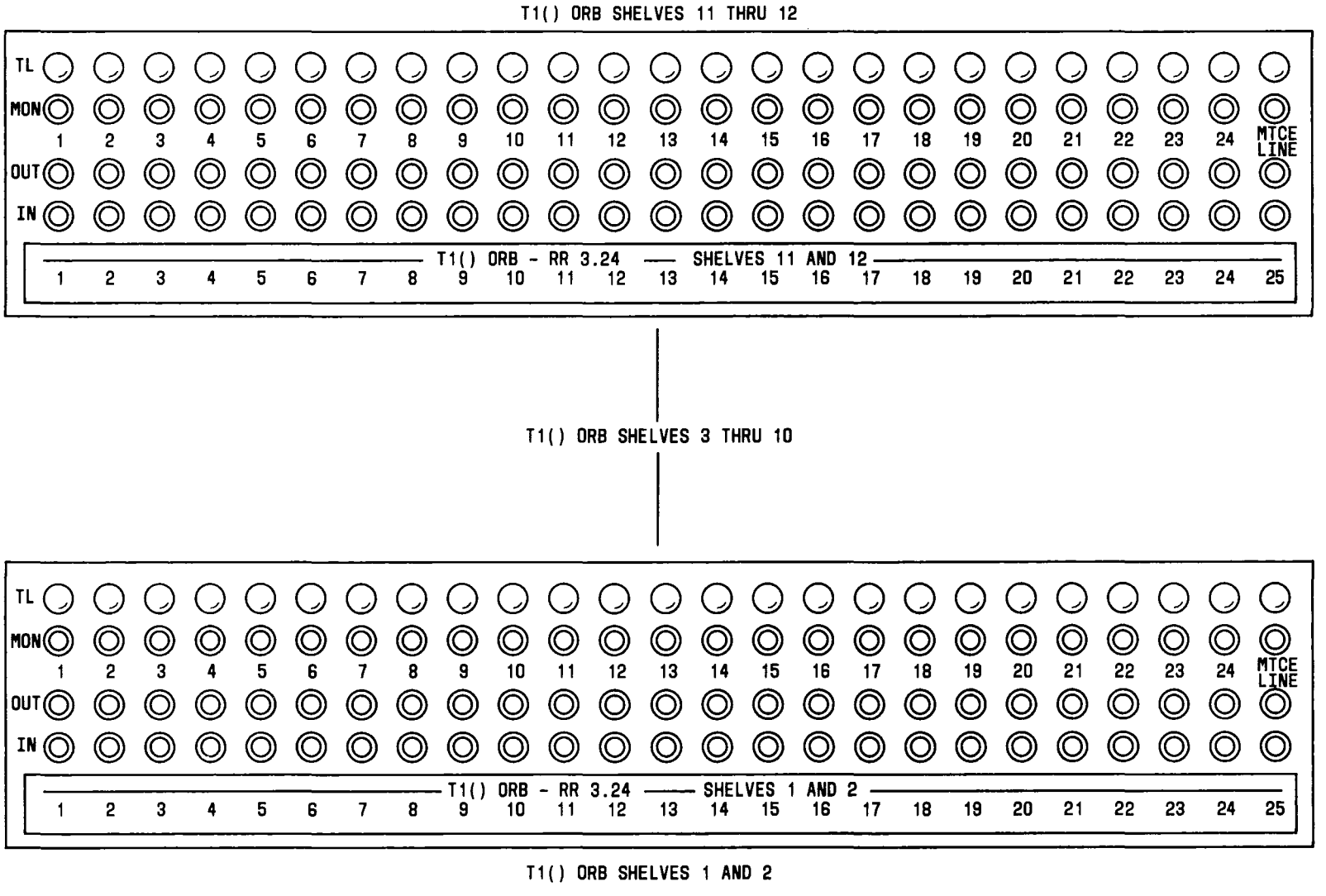


Fig. 15—T1( ) Office Repeater Bay—DSX-1 or DSX-1C Appearance

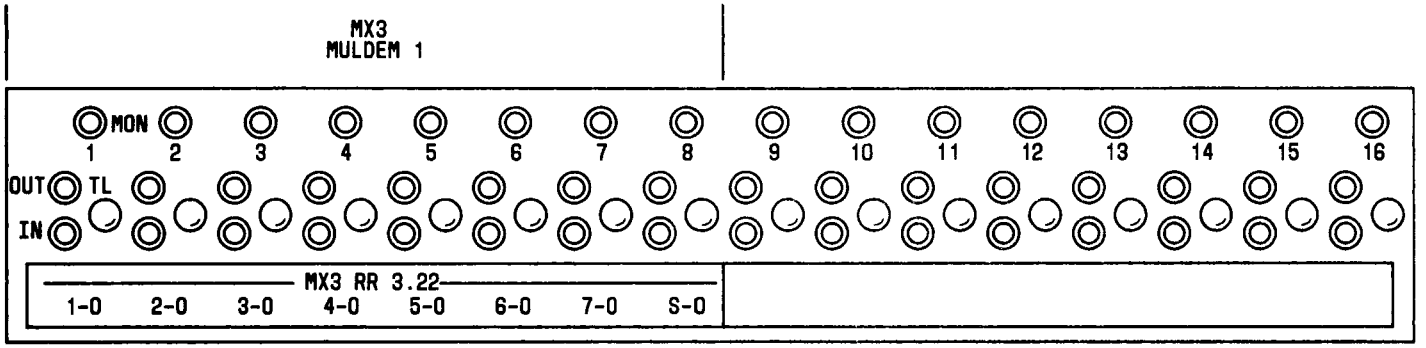


Fig. 16—MX3 Multiplexer—DSX-2 Appearance

TPA655391

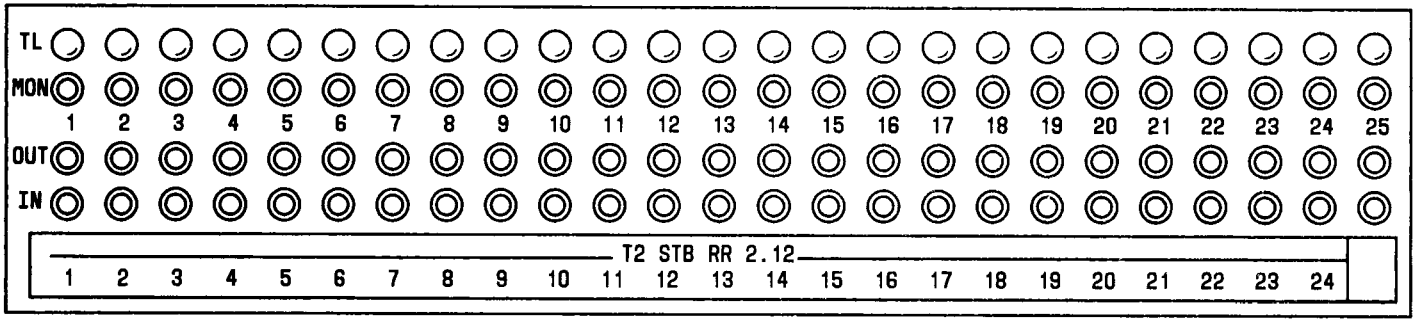


Fig. 17—T2 Span Terminating Bay—DSX-2 Appearance

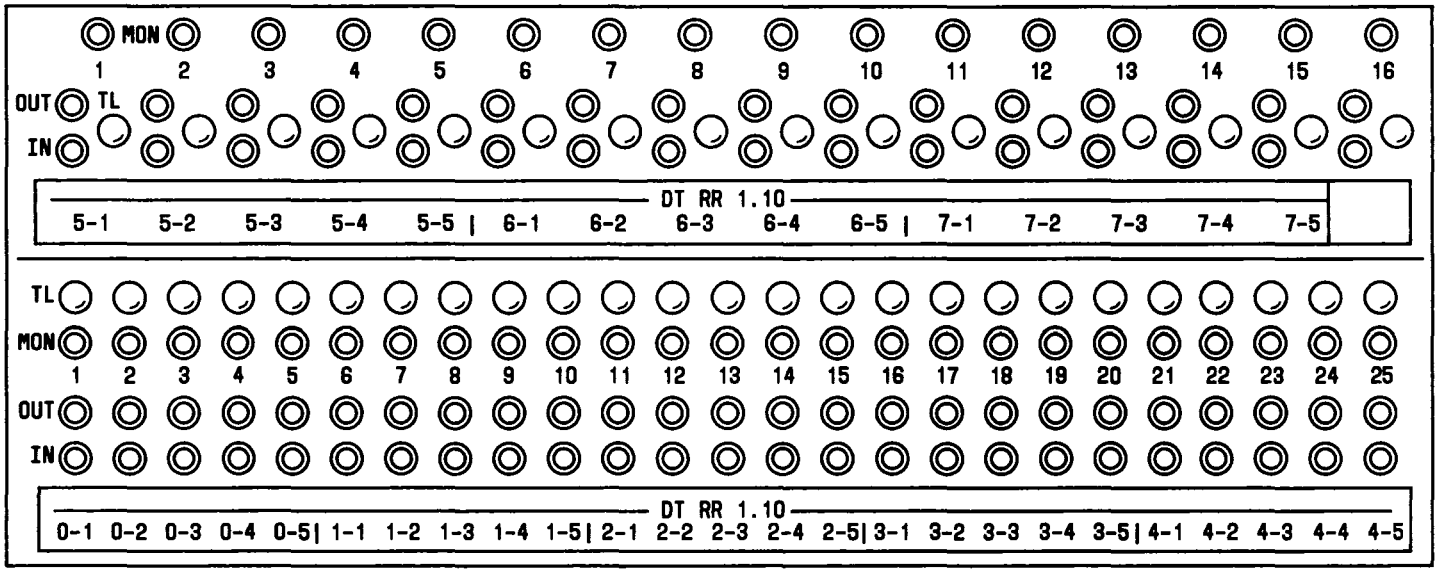
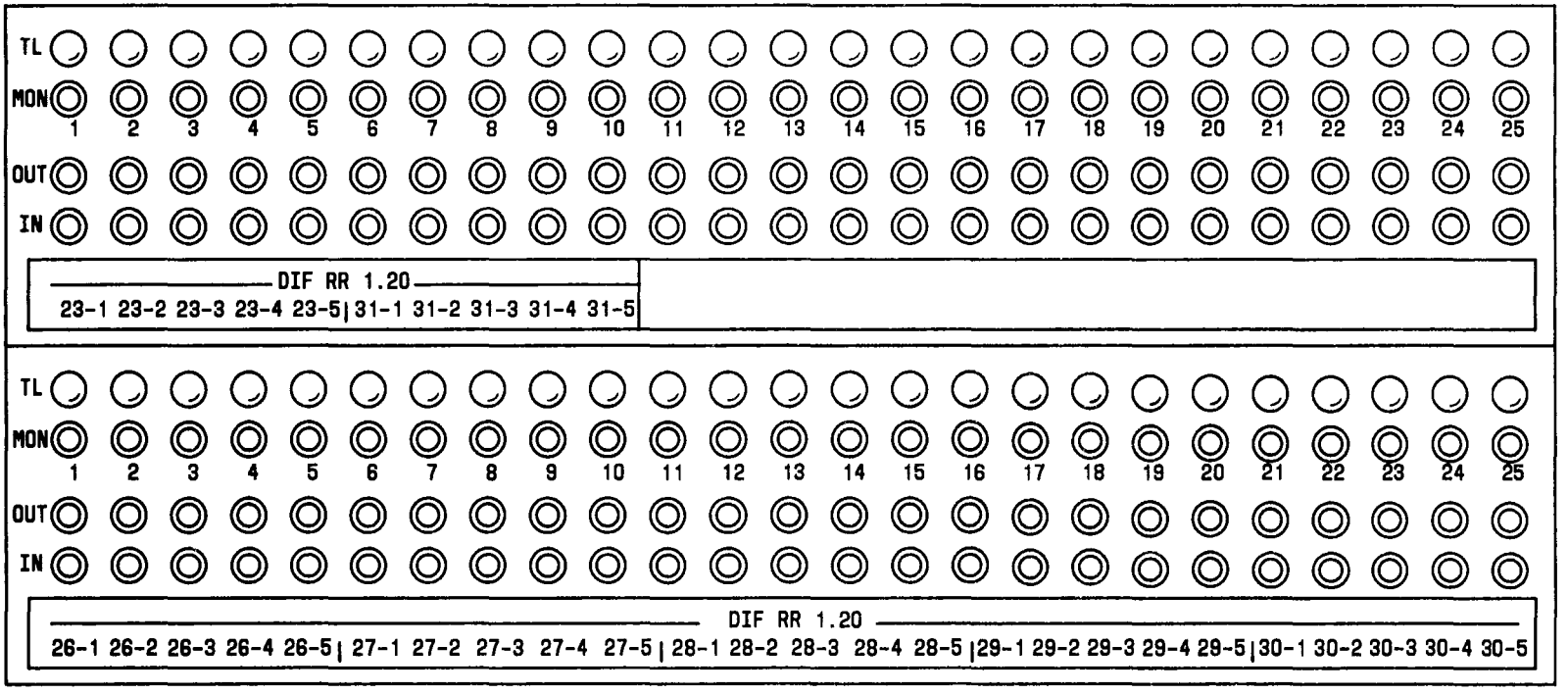


Fig. 18—No. 4 ESS Digroup Terminal—DSX-1 Appearance



5-( ) THRU
22-( ), 24-( )
25-( )

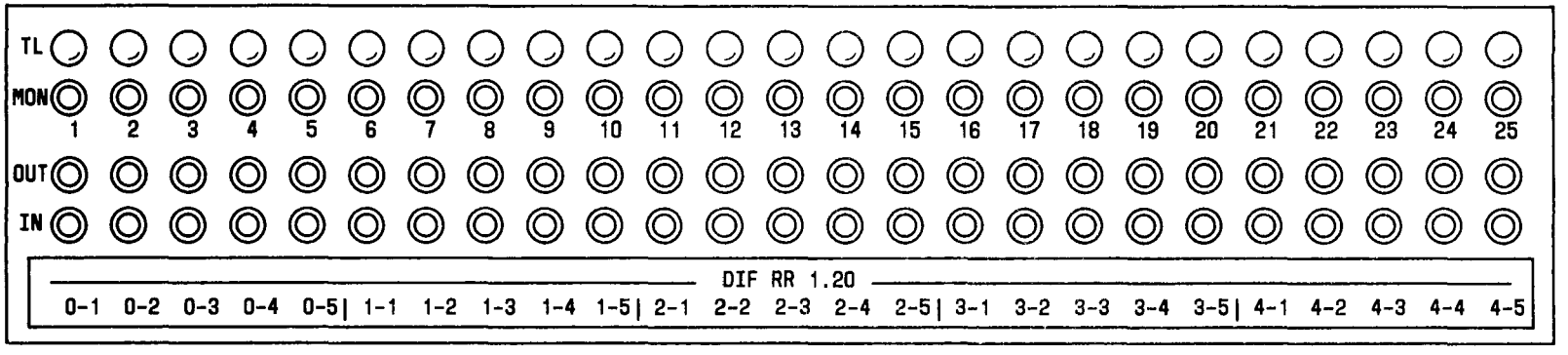


Fig. 19—Digital Interface Frame—DSX-1 Appearance