

## DIGITAL TRANSMISSION FACILITIES

### M13 DIGITAL MULTIPLEX

### SYSTEM APPLICATION AND EQUIPMENT DESIGN REQUIREMENTS

### COMMON SYSTEMS

#### 1. GENERAL

#### DESCRIPTION

##### SCOPE

##### A. General

**1.01** This specification, together with the supplementary information listed herein, covers the equipment design requirements for the manufacture and installation of the M13 digital multiplex equipment.

**1.04** The M13 digital multiplex is a terminal that combines 28 digital signals at the first level (DS1) in the digital hierarchy into a single digital signal at the third level (DS3). Inputs to the multiplex can be from any system generating a 1.544 megabit per second DS1 signal (eg, the D-type channel banks, the T1 repeatered line, the T1WB4 data bank, the T1DM data multiplexer, or the digroup terminal associated with No. 4 ESS). The data rates of the 28 inputs need not be in synchronism. The signals can be driven over a considerable range of office cable from the generating system to the multiplex.

**1.02** Detailed reasons for reissue will be found at the end of the specification.

##### CAPACITY

**1.03** The M13 digital multiplex has two multiplexer-demultiplexer (muldem) units per frame and the capacity per muldem unit is shown in Table A.

**1.05** In the multiplexer, the inputs are first synchronized and then multiplexed together on a time-division basis. The resulting DS3 signal at 44.736 megabits per second can provide an input to the next higher multiplex, the M34, whose output is used by various high-bit-rate transmission systems; or the DS3 signal can be applied directly to the input of DS3 transmission facilities, eg, 3ARDS. The various components of the digital transmission hierarchy are summarized in Fig. 1. The M13 multiplex bypasses the DS2 level, resulting in considerable cost savings in the multiplex equipment for applications using the DS1 level as the primary input to the higher level transmission systems.

**TABLE A**  
**CAPACITY PER MULDEM UNIT**

| M13 INPUTS  | NO.<br>PER DS1 | NO. PER<br>M13 MULDEM |
|---|----------------|-----------------------|
| DS1 digital signals   | —              | 28                    |
| Voice channels (digitally encoded)                          | 24             | 672                   |
| DDS 56 kb/s wideband data channels (using T1DM multiplexer) | 23             | 644                   |

**1.06** In addition to the multiplexing function, the M13 provides for demultiplexing of a DS3 signal into 28 DS1 signals, thus providing 2-way service. Operations in the demultiplexing path are the reverse of those in the multiplexing path. The 28 DS1 outputs of the demultiplexer emerge asynchronous, preserving the characteristics of the DS1 inputs at the originating end. Fig. 2 is a block diagram of the

#### Notes

1. Above capacities are 2-way.
2. M13 allows any mixture of the above sources in DS1-sized blocks.

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M13 multiplexing and demultiplexing circuitry. The operations are carried out in a 2-step process, with low-speed portions similar to the M12 multiplex.

**1.07** The physical unit containing the multiplexer and demultiplexer circuitry is a muldem. Fig. 3 shows an M13 muldem.

#### B. Monitor and Protection

**1.08** In a fully equipped bay, there is one-for-one protection for the high-speed circuits and one-for-fourteen protection for the low-speed circuits. The high-speed circuits are protected by a fully duplicated standby located in each muldem. The low-speed circuits are protected by one low-speed standby, located in the monitor and protection switch unit, which covers all the low-speed circuits in a bay.

**1.09** Two versions of the M13 digital multiplex, differentiated by list structure, may be ordered:

- (a) SD-1C165-01, option Z, is a multiplex without full monitoring and with manual protection switching. Option Z can be converted to option Y at any time without interruption of traffic (see 1.13).
- (b) SD-1C165-01, option Y, contains a time-shared performance monitor and automatic protection switching.

**1.10** Associated with each muldem in option Z is the monitor and protection switching assembly. This assembly contains the circuit packs for office trunk interface and for alarm and control circuitry, as well as standby equipment that can be manually switched into service in case of a muldem failure. Fig. 4 shows the monitor and protection switching assembly with the circuit packs required for option Z. The interface cards provide line build-out circuits for adjustment to differing lengths of office trunks, and the cards contain relays that permit switching of service to the standby condition. The alarm and control circuit packs shown in Fig. 5 provide:

- (a) Indication of an out-of-frame condition on the demultiplexer.
- (b) Information on the location of this condition in the demultiplexer path.

- (c) An alarm on clock failure in the multiplexer.
- (d) Power supply failure indication.

These alarms may be connected to the office alarm system or may be remoted by the E2 status and control system; no other alarms are provided. Switching of the standby equipment into service is accomplished by pushbuttons energizing the relays on the interface cards.

**1.11** Fig. 6 and 7 show the monitor and automatic protection switching circuit packs for option Y. Option Y contains the same interface circuit packs as option Z. Some circuit packs associated with the alarm and control function, however, are replaced by a performance monitor that is time-shared over all the DS1 signals in the bay. Monitoring is done by periodically scanning DS1 lines (incoming and outgoing) and comparing them bit by bit with the corresponding DS3 signal. If the error rate in the multiplexing or demultiplexing process goes above a predetermined amount, signals are generated to energize the relays on the interface circuit packs and switch standby equipment into the portion of the circuitry that is at fault. The failed circuitry is then diagnosed by the monitor, and the code of the probable source of trouble is indicated by the digital readout on the 104A display unit in the J98724AE automatic protection and status panel assembly. The code numbers displayed are defined on the 128B apparatus blank.

**1.12** In addition to the digital readout that indicates failure diagnosis, the 104A display unit (Fig. 8) also provides failure location indicators, alarm indicators, pushbutton switches, and a switch for automatic or manual mode. When the display unit is in the manual mode, the pushbutton switches may be operated to control the protection switching equipment manually (ie, either substitute the standby circuits for operating circuits or return the equipment to standby after the failed equipment has been replaced) and to perform additional troubleshooting procedures.

**1.13** The circuit packs for option Y are mounted in the J98724AC unit, which is always furnished as part of the frame, and in the J98724AE unit, which is furnished only when option Y is required. The J98724AE,L1 unit is manufactured with eight cables permanently wired to it. These cables have a paddleboard-type connector on the free end to permit rapid and simple interconnection with the other units in the frame for field conversion from option Z to option Y. For field conversion, a blank panel or order

wire panel (J98724A,L2 or L3) must be removed from the frame to provide mounting area required for the J98724AE,L1 unit. The J98724AE,L2 unit has no paddleboard connectors and is provided when the unit is to be wired in an M13 frame at the factory.

### C. Office Interface and Patching Facilities

**1.14** The interface between the M13 digital multiplex and other equipment in the digital hierarchy is through the DSX-1 cross-connect (ED-1C544-30) at the DS1 rate and the DSX-3 cross-connect [ED-2C340-( )] at the DS3 rate. These cross-connects allow a centralized point for circuit work for all the equipment in an office having a common data rate. Cabling at the DS1 rate is via ABAM-16 cable, and at the DS3 rate by 728 coaxial cable. The recommended arrangement of DS1 lines on the DSX-1 cross-connect panel is shown in Fig. 9.

**1.15** The maximum allowable ABAM cable length from the M13 to the DSX-1 cross-connect is 655 feet, and the maximum allowable 728 cable length from the M13 to the DSX-3 cross-connect is 450 feet.

**1.16** All DS1 signals entering and leaving the M13 frame are accessible, through bridges, for testing at the faceplates of the KP12 DS1 bridge and switch circuit packs (one KP12 per low-speed muldem). The signals are also accessible at the DSX-1. (For each M13 frame, four additional DS1 lines are also connected to the DSX-1 and may have future use in providing additional capacity over a standby DS3 facility.)

**1.17** The DS3 signals likewise appear on jacks on the faceplate of the KP10 DS3 switch circuit pack (one KP10 per M13 muldem). The output signal at these jacks is tapped off the output of the M13 multiplex through a hybrid so that a dual feed, over a spare line to the DSX-3, can be established without disturbing the main signal. For the same reason, patching of the input signal to this circuit pack is accomplished with a normal through jack, assuring minimum loss of signal to the demultiplexer during the patching interval. By this arrangement, rolling of traffic to and from the M13 muldem can be accomplished at the DS3 level without loss of service (although a short "hit" will occur). The patching facilities can also be used for rapid restoration of service in the event of a failure in the office cable.

**1.18** Provision has been made to terminate the spare line needed for rolling and office cable restoration at the M13 frame. The line, if equipped, terminates on a KP28 DS3 spare trunk access circuit pack. The line can then be accessed through jacks on the KP28 faceplate. When the spare line is not being used, test signals from the standby high speed muldem are sent down the line, looped at the DSX-3, and returned to ensure that the spare line is always ready for operation. The ratio of spare lines to service lines and the location in a lineup of the line terminations (KP28) have been designed to be somewhat flexible (see Fig. 10 for examples). For installations with the M34 digital multiplex, the first six M13 muldems installed must terminate a spare line because rolling at the M34 requires that the six DS3 inputs to that multiplex be rolled together. Larger initial installations, or growth beyond the first six M13 muldems, can share spare lines within the practical limits of patch cord length. It is not recommended that more than three bay widths separate a patching point from the nearest KP28. The examples in Fig. 10 show these limits. For installations where connection to M34 is not involved (such as with 3ARDS systems), spare lines can be immediately shared as required within the practical limits of patch cord length.

**1.19** The limitations of patch cord length can be circumvented by installing a tandem trunk between two separated bays in a lineup. Circuitry on the KP28 circuit pack allows such an arrangement. Selector blocks on the circuit pack can be set to the master mode for the KP28 within the tandem link, and the remote mode for the KP28 at the end of the tandem link. KP28s not terminating a tandem trunk are to be set in the stand-alone mode. Fig. 10 shows how the tandem trunk can be used and the appropriate mode for each example. A lamp on KP28 shows when its associated spare line is in use to prevent inadvertent patching into the line. By using the tandem trunk feature, the number of spare cables needed in an office may be kept to a minimum. Local practice, however, may dictate more spare cables than shown in Fig. 10.

### D. Plug-In Units

**1.20** The M13 plug-in units are shown in Table B. However, since it is not expected that they will be maintained in the field except for direct replacement, detailed plug-in information is not included in this specification.

**E. Bay Arrangements**

**1.21** All M13 bays are mounted on 26-inch wide, 12-inch deep uniframe-type framework meeting the specifications of the New Equipment-Building System (NEBS), Section 800-610-164.

**1.22** The J98724A M13 digital multiplex frame is shown in Fig. 11. (An installation of three frames, equipped for option Z, is shown in Fig. 12.) The lower part of the bay contains two M13 muldem, each with a capacity of 28 DS1 signals, 2-way, and housed in a J98724AA M13 muldem assembly.

**1.23** The J98724AC monitor and protection switch assembly is mounted above the two M13 muldems. The lower shelf of this assembly contains the interface electronics for the 56 two-way DS1 circuits. Fourteen KP12 DS1 bridge and switch circuit packs provide the interface function; they are partitioned so that one circuit pack interfaces all DS1 inputs and outputs for one low-speed muldem. Microribbon-type connectors are mounted on the center rear of this overall assembly to terminate all DS1 ABAM-16 office cable. The M13 end of the ABAM-16 cable is furnished with connectors at the factory. The upper shelf contains the standby low-speed muldem and the monitor circuitry. In option Z there are circuit packs for low-speed muldem and DS3 signal status, manual pushbutton switch control of standby low-speed and high-speed circuitry, and major and minor alarm indicators (Fig. 5). For option Y, many of these locations are equipped with different circuit packs for the time-shared performance monitor (Fig. 6). Jack access for testing DS1 input and output signals is also provided for both option Z and option Y on circuit packs KP16 and KP22, respectively. Located in the area between the shelves is the local order-wire facility (local frame line circuit), which consists of jacks for a head telephone set.

**1.24** The space above the monitor and protection switch is equipped with one of these:

- (a) ED-2C346-( ) blank panel.
- (b) ED-2C345-( ) digital network order wire (DNOW) assembly for option Z.
- (c) J98724AE, automatic protection and status panel for option Y.

Fig. 13 shows ED-2C345-( ). Fig. 7 shows J98724AE. The DNOW facility interconnects with

the SS3 order wire circuit and consists of jacks for a head telephone set and a pushbutton dial and indicator for signaling and supervision. The DNOW facility for option Y is implemented on the KP34 circuit pack, which is mounted in the J98724AE unit.

**1.25** The next higher space is equipped with the J98724AB dc-to-dc converter assembly, which provides low-voltage power for most of the electronics in the frame (Fig. 14). The input voltage to the M13 multiplex frame is supplied by two -48 volt office battery feeders, each with its own ground. Power supply outputs are multiplied such that the failure of any one power unit plug-in will not cause a loss of power. Power supplies are +5.2, -5.6, and -12 volts. All outputs are fused within the J98724AB assembly.

**1.26** At the top of the bay is the J98724AD fuse and alarm panel assembly (Fig. 15) which contains:

- (a) Fuses for the -48 volt office battery inputs.
- (b) Terminal blocks for alarm and miscellaneous leads interfacing with the office.
- (c) Frame major alarm lamp.
- (d) Coaxial cable jacks for termination of service and spare DS3 coaxial cable going to the DSX-3 cross-connect.

**F. Test Set**

**1.27** A portable test set (KS-20775 L1 error rate test set) is required for making accurate error measurements during installation and maintenance testing of the M13. Either list 1 or list 2 may be used. The test set (Fig. 16) is designed to count the number of logical errors or the number of bipolar violations occurring on a DS1 (bipolar, 1.544 Mb/s) transmission facility during a selected time interval. The measurement of error rates on digital transmission systems is necessary to comply with overall system objectives. The error rate test set is composed of two major parts: the transmitting section and the receiving section. The transmitting section generates a 1,048,575-bit quasi-random test pattern identical to that provided by the J98710R T1 quasi-random signal source. This output pattern appears on four jacks that may be used to drive as many as four T1 lines or four inputs of the multiplex. The output pulse shape meets all the DSX-1 compatibility requirements (see 5.04 and 5.05).

**1.28** For option Y and option Z there are three plug-in test cards and a shorting plug that are used during installation to test T-Carrier Administration System interconnections, power supply plug-ins, and inhibit alarms when alarm circuit pack KP15 or KP27 is not plugged in. The test cards (806A tool, 806B tool, and 806C tool) and the shorting plug (476A plug) are part of the WE installation test equipment kit. The test cards are used in the KP27 and KP31 circuit pack positions in the frame for option Y and in the KP13 and KP15 circuit pack positions for option Z (see 5.08).

### G. Equalization

**1.29** To obtain a standard level digital signal at the DSX-1 cross-connect, it is necessary to equalize the cable loss between the M13 multiplex frame and the cross-connecting point. A 967A, -B, or -C equalizer is used and the specific code varies with cable length (see 5.01). The equalizer is installed on the KP12 (DS1 bridge and switch) circuit pack associated with a specific low-speed muldem.

### H. Temperature Range and Power Dissipation

**1.30** The J98724 equipment is designed to operate satisfactorily in ambient temperatures ranging from +40 to +100°F (+4 to +38°C) as required by Section 800-610-164. Power dissipation for a fully equipped M13 multiplex frame is approximately 500 watts. The conventional cooling system will normally be sufficient to provide adequate cooling. Where many frames are involved, or where other high dissipation equipment is located with the frames, additional air supply may be needed or the KS-21344 dropped diffuser or J85512 Modular Cooling System may be used. See Section 800-610-164 for further details.

### FLOOR PLAN ARRANGEMENTS

**1.31** The M13 multiplex frame is designed for location on the standard 2-foot 6-inch maintenance aisle, with a standard 2-foot wiring aisle. Direction of growth may be either to the left or right. See floor plan data sheet FPD 801-525-154-1 and New Equipment-Building System standard Section 800-610-164. Valuable information for central office engineering and installation of this equipment is in ED-2C447-01. Detailed office planning information is contained in Section 760-100-085, Digital Transmission Office Planning, and Section 760-100-032, NEBS in existing buildings.

## 2. SUPPLEMENTARY INFORMATION

- 795-209-001—Common Language—Transmission Equipment Identification—Digital Carrier and Data Systems—Catalog of Basic Codes
- 795-209-166—Common Language Encoder—M13 Digital Multiplex Frame (DMBB)
- 795-209-176—Common Language Encoder—M13 Digital Multiplex Circuit Pack (DMGB)
- 801-000-000—Numerical Index—Common Systems
- 800-600-000—Checking List—General Equipment Requirements
- 365-011-300—Digital Transmission Systems—Service Maintenance Plan for T4M Digital Line and Interconnect M13 (Option Z) and M34A Multiplexes
- 365-303-101—DSX-3 and DSX-4 Cross-Connects—General Description
- 365-320-100—T1 Carrier System Order-Wire Facility Description
- 365-550-100—T4M Digital Line—General Description
- 365-601-100—M13 Multiplex—General Description
- 365-601-101—M13 Muldem Description
- 365-601-102—M13 Multiplex Monitor Alarm and Restoration Circuits Description
- 365-671-501—Digital Transmission Networks Containing High Capacity DS3 and DS4 Systems—Maintenance Operations—TOP
- 365-671-521—M13 (Option Y) Digital Multiplex—TOP
- 760-100-032—New Equipment-Building System (NEBS) in Existing Buildings
- 760-100-085—Digital Transmission Office Planning
- 800-610-164—New Equipment-Building System (NEBS)—General Equipment Requirements
- 801-026-155—General Purpose 4-Wire Order Circuit—Equipment Design Requirements
- 801-525-181—Performance Requirements for M13 Digital Multiplex—General Equipments—Common Systems
- J85515—802-015-160—Central Office Lighting Using KS-21559 Fixtures—Equipment Design Requirements
- J90606—801-006-158—Equipment Design Requirements—Cableway System for Electronic Offices Using 7-Foot 0-Inch Frameworks
- J97039—801-015-152—Universal Framework (Uniframe) and Associated Parts—Equipment Design Requirements
- J98716—801-525-151—M12 Digital Multiplex

J98721—801-523-152—T4M Digital Line  
 J98723—801-525-153—M34 Digital Multiplex  
 X-74300—New Equipment-Building System (NEBS)  
 — Building Engineering Standards — Pt 1,  
 Building and Equipment Layout  
 Floor Plan Data—(7-Foot 0-Inch Bay) — FPD 801-  
 525-154-1  
 KS-20775 L1—Error Rate Test Set  
 KS-21344—Air Diffusers

### 3. DRAWINGS

WE drawings listed should be ordered by referring to the prefix and base number and requesting the current dash (—) number.

#### Circuits

SD-1C165-01—M13 Digital Multiplex Circuit  
 SD-1C245-01—General Purpose Order Wire Circuit  
 SD-1G288-01—SS3 Order Wire Circuit  
 SD-82046-01—DC Distribution Circuit for Digital  
 Transmission System  
 SD-82257-01—70J, 71J, 71M Power Unit Circuit  
 SD-96188-01—Audible and Visual Office Alarm Cir-  
 cuit  
 SD-96379-01—Local Frame Line Circuit  
 SD-99503-01—Digital Facilities Interconnection Cir-  
 cuit (DS1 and DS2)  
 SD-99607-01—T-Carrier Administration Application  
 Schematic  
 SD-99610-01—Application and Interconnection Cir-  
 cuit  
 SD-96621-01—DSX-3 and DSX-4 Cross-Connection  
 Circuit

#### Equipment

ED-1A184-73—Lineup Cable Rack Covers  
 ED-1A198-( )—End Guards for Uniframe Frame-  
 work  
 ED-1C544-30—DSX-1 Cross-Connect  
 ED-2C340-( )—DSX-3 Cross-Connect  
 ED-2C345-( )—Common Systems—Digital Transmis-  
 sion Facilities — M13 Digital Multi-  
 plex — Digital Network Order Wire  
 Panel  
 ED-2C346-( )—Common Systems—Digital Transmis-  
 sion Facilities — M13 Digital Multi-  
 plex — Blank Panel  
 ED-2C441-01—Grounding Methods for High-Speed  
 Digital Transmission Equipment

ED-2C447-01—Common Systems—Installation Guide  
 for High-Speed Digital Transmission  
 Equipment  
 ED-97735-( )—Single 7-Foot 0-Inch Uniframe  
 Framework  
 ED-97738-30—Lineup Cable Racks—Assembly and  
 Stocklist  
 ED-97739-10—Method of Installing ED-97738-30  
 Lineup Cable Racks and Covers  
 ED-97740-10—Method of Installing ED-97741-70  
 Cross Aisle Troughs  
 ED-97741-70—Cross Aisle Trough Assembly and  
 Stocklist  
 ED-97773-10—Method of Running Switchboard Ca-  
 bles in J90606 Cable Distribution Sys-  
 tem  
 ED-97774-( )—Stile Strips for Uniframe Framework  
 ED-97776-( )—Bay Designation Label Holder  
 ED-97784-( )—Method of Grounding Uniframe  
 Framework  
 ED-97785-( )—Method of Installing Uniframe Frame-  
 works, Adaptor Plates, Stile Strips,  
 and the Frame Designation Label  
 Holder  
 ED-97787-( )—Floor Supported via Cabling System  
 ED-97795-( )—Base Cover and Appliance Outlet Dis-  
 tribution  
 J98724A-( )—M13 Digital Multiplex Frame (DMBB)  
 J98724G-( )—M13 Digital Multiplex Plug-In Circuit  
 Packs (DMGB)  
 J98724H-( )—M13 Digital Multiplex Spare Plug-In  
 Circuit Packs (DMGB)  
 J98724AA-( )—M13 Muldem Assembly  
 J98724AB-( )—M13 DC-to-DC Converter Assembly  
 J98724AC-( )—M13 Monitor and Protection Switch  
 Assembly  
 J98724AD-( )—Fuse and Alarm Panel Assembly  
 J98724AE-( )—Automatic Protection and Status  
 Panel Assembly

#### Cabling

ED-1A159-10—Common Systems—Method of Ter-  
 minating Power and Ground Feeders  
 ED-2C234-12—Method of Cabling Drawing for Appli-  
 cation of Formed Cables for M13 Multi-  
 plex  
 ED-92524-10—Formed Connectorized Cable Assem-  
 blies for M13 Multiplex  
 ED-92524-10,18,21—Method of Terminating Shielded  
 Wire and Coaxial or Twin Con-  
 ductor Shielded Office Cable

**4. EQUIPMENT****J98724A—AT&TCo Standard—M13 Digital Multiplex Frame (DMBB) (See Notes A, B, C, D, E)**

**List 1**—Framework, assembly, wiring, and equipment required for shop-wired M13 per SD-1C165-01, option Z, Fig. 10, 11, and 12. A single 7-foot uniframe bay is arranged to accommodate two complete M13 muldem circuits, manual protection switching circuits, alarm circuits, and associated power supplies for multiplexing up to 56 DS1 (1.5 Mb/s) bit streams, in groups of as many as 28, into two DS3 (44.7 Mb/s) bit streams. Bay is wired for -48 volt office battery. (See Notes D and E.)

**List 2**—ED-2C346-( ) blank panel for option with manual protection switching (option Z). (See Note C.)

**List 3**—ED-2C345-( ) digital network order wire assembly for option with manual protection switching (option Z), per SD-1C165-01, Fig. 13. (See Note C.)

**List 4**—J98724AE,L1 automatic protection and status panel assembly required in addition to list 1 to provide processing of monitor data, automatic control of protection switching, and status and control panel per SD-1C165-01, option Y, when this equipment is to be added to an M13 frame previously installed in the field. (See Notes D and E.)

**List 5**—J98724AE,L2 automatic protection and status panel assembly required in addition to list 1 to provide processing of monitor data, automatic control of protection switching, and status and control panel per SD-1C165-01, option Y, when this equipment is to be wired in an M13 frame at the factory. (See Notes D and E.)

**Notes**

- A. All plug-in units and test equipment shall be furnished separately. (See J98724G, J98724H, 5.04, and 5.05.) Summary of plug-in units is shown in Table B.
- B. 967-type equalizers are ordered separately and are field mounted. See 5.01.
- C. Either one list 2 or one list 3 must be ordered for option Z. List 2 or list 3 is not required for option Y.

D. List 1 includes two J98724AA,L1, one J98724AB,L1; one J98724AC,L1; and one J98724AD,L1, but does not include J98724AE,L1 or L2 (M13 automatic protection and status panel assembly). List 1 is wired for SD-1C165-01, option Z. For option Y, list 4 or list 5 must be ordered in addition to list 1.

E. A bay equipped for manual option Z can be converted at any time to automatic option Y by the addition of J98724A,L4 and J98724G,L5 for plug-in units (see 1.13, 5.09, and Table B).

**J98724B—Reserved**

**J98724C—Reserved**

**J98724D—Reserved**

**J98724E—Reserved**

**J98724F—Reserved**

**J98724G—AT&TCo Standard—Plug-in Circuit Packs (DMGB) (See Notes A, B, C, D, and E)**

**List 1**—Plug-in circuit packs common to one M13 digital multiplex frame.

**List 2**—Plug-in circuit packs required in addition to list 1 to equip the high-speed portion of one M13 muldem. Order one for each M13 muldem that is fully or partially equipped with J98724G,L3. Order a maximum of two per M13 frame.

**List 3**—Plug-in circuit packs to equip one low-speed muldem. Order one for each whole or partial group of four DS1 signals to be equipped, as many as seven per list 2 ordered.

**List 4**—Plug-in circuit packs to provide alarm and switch control for the option with manual protection switching (option Z). Order one per frame if option Z is required. (See Note B.)

**List 5**—Plug-in circuit packs and display unit to provide full monitoring, automatic control of protection switching, and status and control panel. Order one per frame if option Y is required (J98724A,L4 or L5 must be ordered in addition to J98724G,L5). (See Note B.)

**List 6**—Plug-in circuit pack required to terminate a spare DS3 trunk on the frame, as required by office arrangement considerations (Section

365-601-100). Order as many as two per frame. (See Note C and Fig. 10.)

**List 7**—Plug-in circuit pack required to provide a dummy termination if list 6 is not equipped. Order as many as two per frame. (See Note C and Fig. 10.)

**List 8**—Plug-in circuit pack to provide for the digital network order wire. Order one per frame only if required and if J98724A,L4 or L5 is ordered.

**List 9**—Apparatus blanks to fill spare positions when list 8 is not equipped. Order one per frame if required and if J98724A,L4 or L5 is ordered.

#### Notes

A. For fully equipped J98724A, order one list 1, two list 2, fourteen list 3, one of either list 4 or list 5, plus lists 6, 7, 8, and 9 as required.

B. Order one of either list 4 or list 5. List 5 may only be ordered if J98724A,L4 or L5 is also ordered.

C. Total number of lists 6 and 7 must be equal to the number of J98724G,L2 that are ordered (eg, the number of M13 muldems to be equipped). See Fig. 10 for typical applications.

D. Apparatus blanks are provided with the lists for all positions unfilled in a fully equipped frame. Unfilled circuit pack positions for partially equipped installations may be filled if desired by ordering additional 128A apparatus blanks as required. The faceplate of the apparatus blank is 0.77 inch wide, the basic single faceplate width.

E. Plug-in unit complement for each list is shown in Table B.

#### **J98724H—AT&TCo Standard—Spare Plug-in Circuit Packs (DMGB) (See Note A)**

**List 1**—Spare plug-in units recommended per office for each M13 J98724A frame.

**List 2**—Spare plug-in units recommended per office in addition to list 1 for the first M13 frame and every third frame thereafter.

**List 3**—Spare plug-in units recommended per office in addition to list 1 and list 2 for the first M13 frame equipped for option Z and every nine frames so equipped thereafter.

**List 4**—Spare plug-in and display unit recommended per office in addition to list 1 and list

2 for the first M13 frame equipped for option Y and every nine frames so equipped thereafter.

**List 6**—Spare plug-in units recommended per office, in addition to list 1 and list 2, for the first M13 frame and every nine frames so equipped thereafter.

#### Notes

A. This will provide approximately 10 percent spare plug-in units per office after several frames have been ordered.

#### **J98724AA—AT&TCo Standard—M13 Muldem Assembly**

**List 1**—Shelf unit, assembly, wiring, and equipment for one M13 muldem circuit per SD-1C165-01, Fig. 1 and 2.

#### **J98724AB—AT&TCo Standard—M13 DC-to-DC Converter Assembly**

**List 1**—Shelf unit, assembly, wiring, and equipment for dc-to-dc converter circuitry per SD-1C165-01, Fig. 10.

#### **J98724AC—AT&TCo Standard—M13 Monitor and Protection Switch Assembly (See Notes A and B)**

**List 1**—Shelf unit, assembly, wiring, and equipment for monitoring, protection switching, alarm, switch control, and spare low-speed muldem circuitry per SD-1C165-01, Fig. 1, 3 through 9, and 11.

#### Notes

A. Jacks T and R for the local telephone facility, on this unit, are plugged with apparatus blanks at the factory. These shall be removed by the installer if the jacks on a given frame are used for the frame line circuit, SD-96379-01, or other telephone facility circuit.

B. The locking bar and designation strips on J98724AC shall have lettering hand-stamped by the installer as follows:

- (1) A, B, or C as a suffix to the KP12 designation to denote code of 967-type equalizer located on the KP12 circuit pack (see 5.01).

(2) A or B as a suffix to the KP10 designation and to the KP28 designation when KP28 is equipped, to denote position of selector plugs on these circuit packs. These plugs provide LBO options, depending on the length of 728 cable from the M13 frame to the DSX-3 cross-connect (see 5.02).

(3) S, R, or M above the KP28 designation, when KP28 is equipped, to indicate one of the following modes of operation: stand-alone, remote, or master.

**J98724AD—AT&TCo Standard—Fuse and Alarm Panel Assembly**

**List 1**—Panel, assembly, wiring, and equipment for fuse and office lead interface circuitry per SD-1C165-01, Fig. 12.

**J98724AE—AT&TCo Standard—Automatic Protection and Status Panel Assembly**

To provide full monitoring, processing of monitor data, automatic control of protection switching, and status and control panel. (See Notes A, B, and C.)

**List 1**—Shelf unit, assembly, wiring, and equipment per SD-1C165-01, option Y, Fig. 14, 15, and 16, provided when this equipment is to be added to an M13 frame previously installed in the field.

**List 2**—Shelf unit, assembly, wiring, and equipment per SD-1C165-01, option Y, Fig. 14, 15, 16, provided when this equipment is to be wired in an M13 frame at the factory.

**Notes**

- A. List 1 includes interface cabling and paddleboard connectors to connect the shelf to the rest of the M13 frame. No wiring is required at time of installation. (See 1.13.)
- B. J98724G,L5 provides plug-in units for this assembly.
- C. An optional plug-in for the digital network order wire may be ordered per J98724G,L8. This plug-in may be equipped in J98724AE,L1 or L2 only.

**5. GENERAL NOTES AND INDEXES**

**5.01** The following equalizers are required for equalization of ABAM-16 cables between the

M13 multiplex frame and the DSX-1 cross-connect. Order one for each KP12 (DS1 bridge and switch) circuit pack ordered per J98724G,L1 and L3, and order appropriate codes for spares for each KP12 circuit pack ordered per J98724H,L1.

| CABLE LENGTH (FEET) | EQUALIZER |
|---------------------|-----------|
| 0 to 150            | 967A      |
| 150+ to 450         | 967B      |
| 450+ to 655         | 967C      |

Note that four identical equalizer circuits are located on one 967-type unit and therefore the cable length for all four inputs to a low-speed muldem must be within the range of a single equalizer code. (This will normally be the case for all 56 DS1 inputs and outputs from DSX-1 to M13.)

**5.02** The transmit and receive 728-type coaxial cables associated with an M13 muldem shall be of the same nominal length so that the arrow on both LBO selector plugs on KP10 will be set to either A or B. The same restriction applies to KP28.

| CABLE LENGTH (FEET) | ARROW SETTING                 |
|---------------------|-------------------------------|
| 0 to 210            | S1.0 & S1.1<br>to B (LBO IN)  |
| 210 to 450          | S1.0 & S1.1<br>to A (LBO OUT) |

**5.03** One 52PR head telephone set or equivalent may be ordered as required by the telephone company. The 52PR is equipped with a transmitter on-off switch. This equipment is shipped separately.

**5.04** The KS-20775 L1 or L2 error rate test set is required for use during installation and maintenance testing of the M13. Order one list 1, because of its lower cost, if list 1 or list 2 is not already available in an office.

**5.05** A test cord, 841477235, is required for connection of DS1 input and output signals on the KP12 circuit pack to the KS-20775 error rate test set. Order five cords for each test set to be used with the M13 frames in an office.

**5.06** The uniframe-type bay used for M13 is designed to be used with ED-97738-01 cable racks, also a part of the New Equipment-Building System (NEBS), Section 800-610-164. Such cable

racks provide a mounting surface for the bay designation (equipment title, SD number, and J number). If the ED-97738-01 cable rack is *not* used, as for example in offices where older racks already exist in the area of the M13 equipment, the ED-97774-03 stile strip must be separately ordered to provide this mounting surface and to "finish off" the top of the M13 frame. See ED-2C447-01 for further information.

**5.07** For special circuit, equipment, and information notes for the M13 frame, see SD-1C165-01, D sheets.

**5.08** For option Y and option Z, the telephone company may order for each office one 806A tool, one 806B tool, one 806C tool, and four 476A plugs if it desires to have the test capability of these items following installation. See 1.28 for functional description of these items.

**5.09** When J98724A,L4 is added to a J98724A,L1 frame that is already installed in the field (conversion to option Y), the upper locking bar, 841139793, located on the J98724AC unit must be discarded and be replaced by the 841845472 locking bar, which is furnished as part of J98724A,L4.

**5.10** Codes J98724J through Y are unassigned.

## 6. REASONS FOR REISSUE

1. To make various minor changes and additions to Section 1.
2. To add BSPs to Section 2.
3. To change reference to floor plan data sheet from Section 7.1, sheet 193 to FPD 801-525-154-1.
4. To add Common Language Equipment (CLE) codes.
5. To add J98724A,L5; J98724H,L6; and J98724AE,L2.
6. To correct minor errors in Table B and Addendum 1 of Issue 1.
7. To add cable length and arrow setting information to 5.02.
8. To update, correct, or expand Fig. 1, 2, 9, 10, and 11.

**TABLE B**  
**SUMMARY OF PLUG-IN UNITS**

| CODE              | 128A<br>BLANKS | TITLE  | DESIGNATION            | QUANTITY FURNISHED |    |    |    |    |    |         |    |    |    |    |    |    |    |   |   |
|-------------------|----------------|--|------------------------|--------------------|----|----|----|----|----|---------|----|----|----|----|----|----|----|---|---|
|                   |                |  |                        | J98724G            |    |    |    |    |    | J98724H |    |    |    |    |    |    |    |   |   |
|                   |                |  |                        | L1                 | L2 | L3 | L4 | L5 | L6 | L7      | L8 | L9 | L1 | L2 | L3 | L4 | L6 |   |   |
| KP1 Ckt Pack      | 1              | Synchronizer-Desynchronizer                            | SYNDES                 | 4                  |    | 4  | 1  |    |    |         |    |    |    |    | 6  |    |    |   |   |
| KP2 Ckt Pack      | 1              | LS Multiplexer-Demultiplexer                           | LS MUX DMUX            | 1                  |    | 1  |    |    |    |         |    |    |    |    | 2  |    |    |   |   |
| KP3 Ckt Pack      | 1              | HS Multiplexer   | HS MUX                 |                    | 2  |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| KP4 Ckt Pack      | 1              | HS Multiplexer Control                                 | HS MUX CONT            |                    | 2  |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| KP5 Ckt Pack      | 1              | HS Demultiplexer                                       | HS DMUX                |                    | 2  |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| KP6 Ckt Pack      | 1              | HS Demultiplexer Control                               | HS DMUX CONT           |                    | 2  |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| KP7 Ckt Pack      | 1              | HS Demultiplexer Receiver                              | HS DMUX RCVR           |                    | 2  |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| KP8 Ckt Pack      | 2              | 6 Megabit Transmit Switch                              | 6 MB TRMT SW           |                    | 1  |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| KP9 Ckt Pack      | 2              | 6 Megabit Receive Switch                               | 6 MB RCV SW            |                    | 3  |    |    |    |    |         |    |    |    |    |    | 2  |    |   |   |
| KP10 Ckt Pack     | 2              | DS3 Switch   | DS3 SW                 |                    | 1  |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| KP11 Ckt Pack     | —              | DS3 Bridge   | DS3 BRDG               |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP12 Ckt Pack     | 2              | DS1 Bridge and Switch                                  | DS1 BRDG & SW          | 1                  |    | 1  |    |    |    |         |    |    |    | 2  |    |    |    |   |   |
| KP13 Ckt Pack     | —              | Operate Status   | OPR STATUS             |                    |    |    | 1  |    |    |         |    |    |    |    |    |    | 1  |   |   |
| KP14 Ckt Pack     | —              | Standby Control  | STBY CONT              |                    |    |    | 1  |    |    |         |    |    |    |    |    |    | 1  |   |   |
| KP15 Ckt Pack     | —              | Alarm  | ALARM                  |                    |    |    | 1  |    |    |         |    |    |    |    |    |    | 1  |   |   |
| KP16 Ckt Pack     | —              | Signal Generator                                       | SIG GEN                |                    |    |    | 1  |    |    |         |    |    |    |    |    |    | 1  |   |   |
| KP17 Ckt Pack     | —              | DS1 Interface  | DS1 INFAC              |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP18 Ckt Pack     | —              | DS3 Interface  | DS3 INFAC              |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP19 Ckt Pack     | —              | Monitor Demultiplexer Control                          | MON DMUX CONT          |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP20 Ckt Pack     | —              | Monitor LS Demultiplexer                               | MON LS DMUX            |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP21 Ckt Pack     | —              | Monitor Comparator                                     | MON COMPRTR            |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP22 Ckt Pack     | —              | Monitor Signal Generator                               | MON SIG GEN            |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP23 Ckt Pack     | —              | Monitor Processor                                      | MON PROC               |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP24 Ckt Pack     | —              | Monitor Memory   | MON MEM                |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP25 Ckt Pack     | —              | Monitor Interface                                      | MON INFAC              |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP26 Ckt Pack     | —              | Protection Switch Interface                            | PROT SW INFAC          |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP27 Ckt Pack     | —              | Monitor Alarm  | MON ALARM              |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP28 Ckt Pack     | —              | DS3 Spare Trunk Access                                 | DS3 STA                |                    |    |    |    |    | 1  |         |    |    |    |    |    |    |    |   | 1 |
| KP29 Ckt Pack     | —              | DS3 Standby Loop                                       | DS3 STBY LOOP          |                    |    |    |    |    |    | 1       |    |    |    |    |    |    |    |   | 1 |
| KP30 Ckt Pack     | 1              | DS3 Interconnect                                       | DS3 INTCON             |                    |    |    | 1  |    |    |         |    |    |    |    |    |    | 1  |   |   |
| KP31 Ckt Pack     | —              | E Telemetry Interface                                  | E TLM INFAC            |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP32 Ckt Pack     | —              | Display Interface                                      | DISP INFAC             |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP33 Ckt Pack     | —              | Monitor HS Demultiplexer                               | MON HS DMUX            |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |
| KP34 Ckt Pack     | —              | Digital Network Order Wire                             | DNOW                   |                    |    |    |    |    |    |         | 1  |    |    |    |    |    |    |   |   |
| 70J Power Unit    | —              | 70J Power Unit   |                        | 6                  |    |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| 71J Power Unit    | —              | 71J Power Unit   |                        | 4                  |    |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| 71M Power Unit    | —              | 71M Power Unit   |                        | 2                  |    |    |    |    |    |         |    |    |    |    |    | 1  |    |   |   |
| 128A App Blank    | —              | Apparatus Blank  | APP BLK                | 6                  |    |    | 4  | 2  |    |         |    |    | 5  |    |    |    |    |   |   |
| 128B App Blank    | —              | Apparatus Blank—Diagnostic Codes for 104A Display Unit | DIAGNOSTIC CODE        |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    |   |   |
| 128C App Blank    | —              | Apparatus Blank—Route Designation Card                 | ROUTE DESIGNATION CARD | 1                  |    |    |    |    |    |         |    |    |    |    |    |    |    |   |   |
| 104A Display Unit | —              | Display Unit   | 104A                   |                    |    |    |    | 1  |    |         |    |    |    |    |    |    |    | 1 |   |

\* Denotes the quantity of 128A apparatus blanks required to fill space of unequipped circuit pack (see J98724G, Note D).

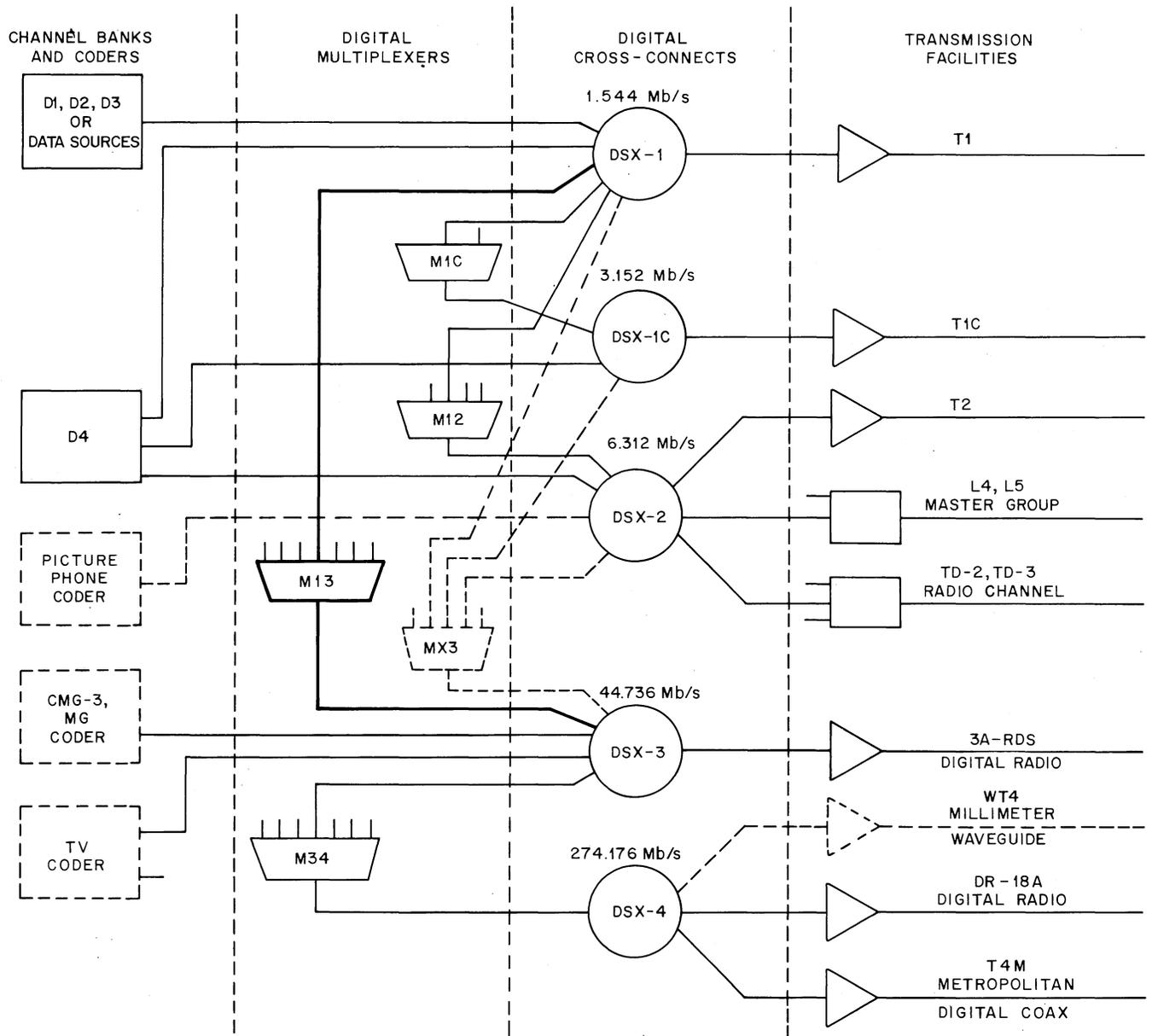


Fig. 1 — Position of the M13 in the Digital Transmission Hierarchy

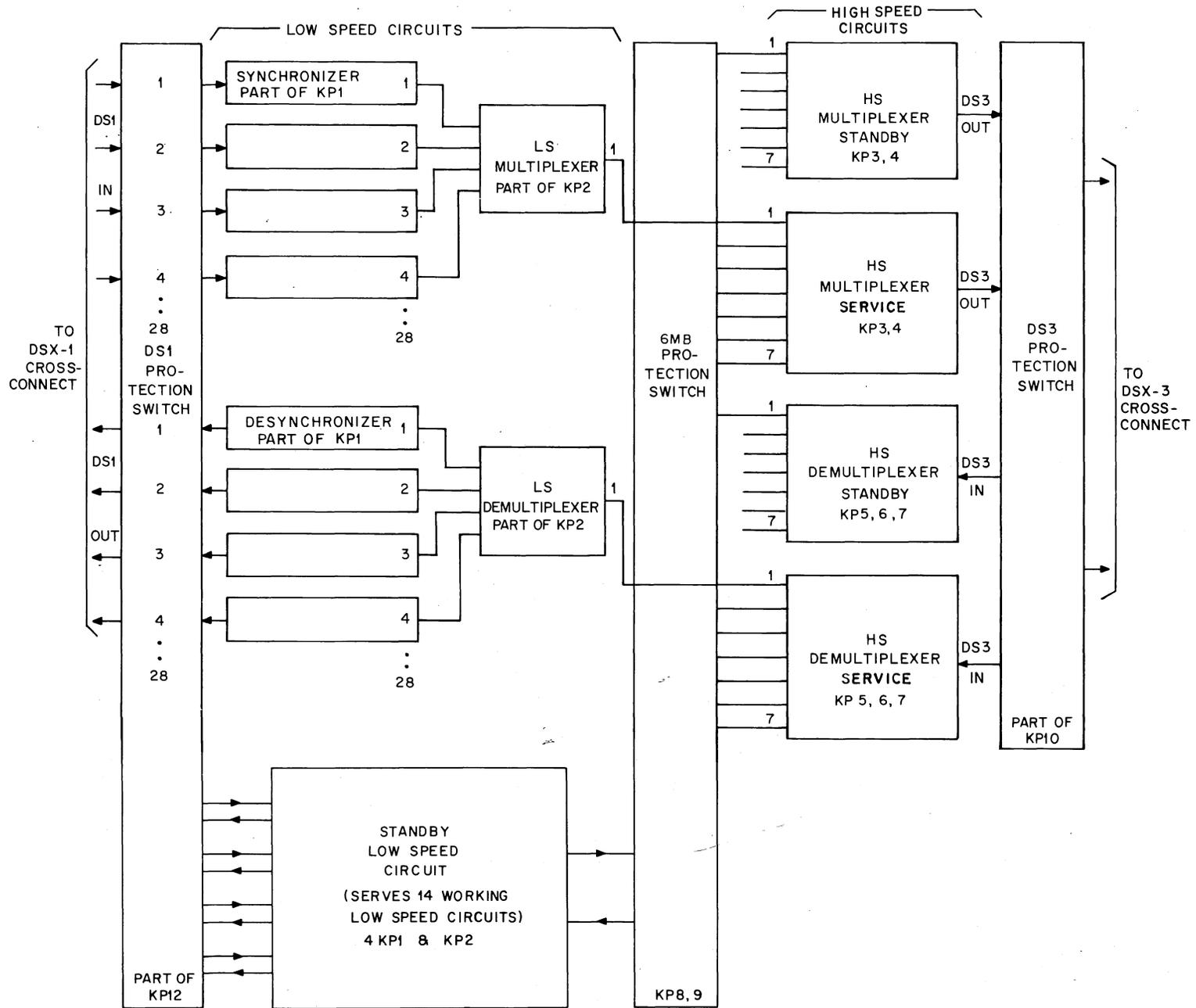


Fig. 2—M13 Multiplex, Simplified Block Diagram

01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28

SHELF POS. NO.  
FOR KS-21271  
CONNECTOR

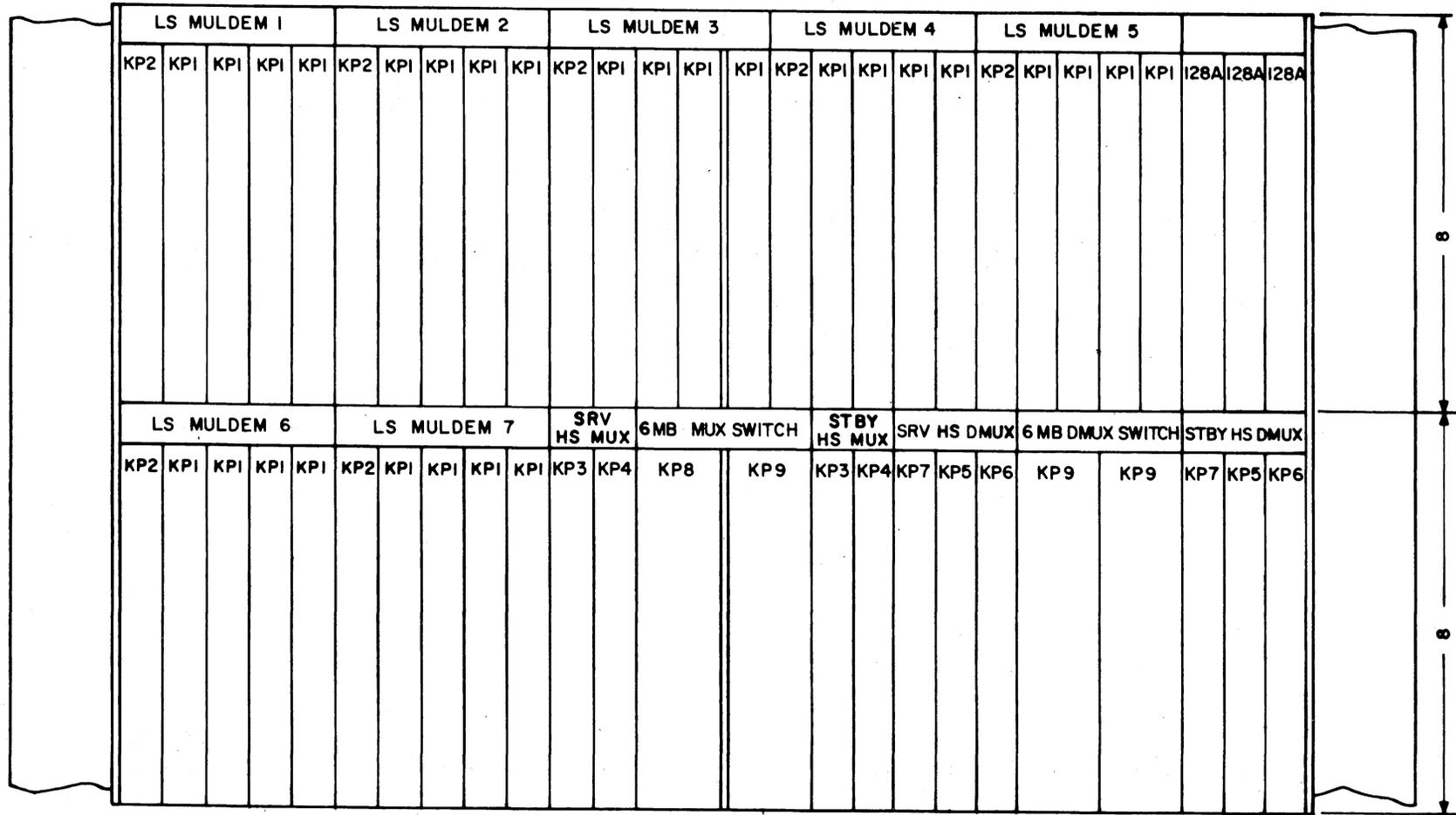


Fig. 3—M13 Muldem Assembly (J98724AA), Circuit Pack Arrangement

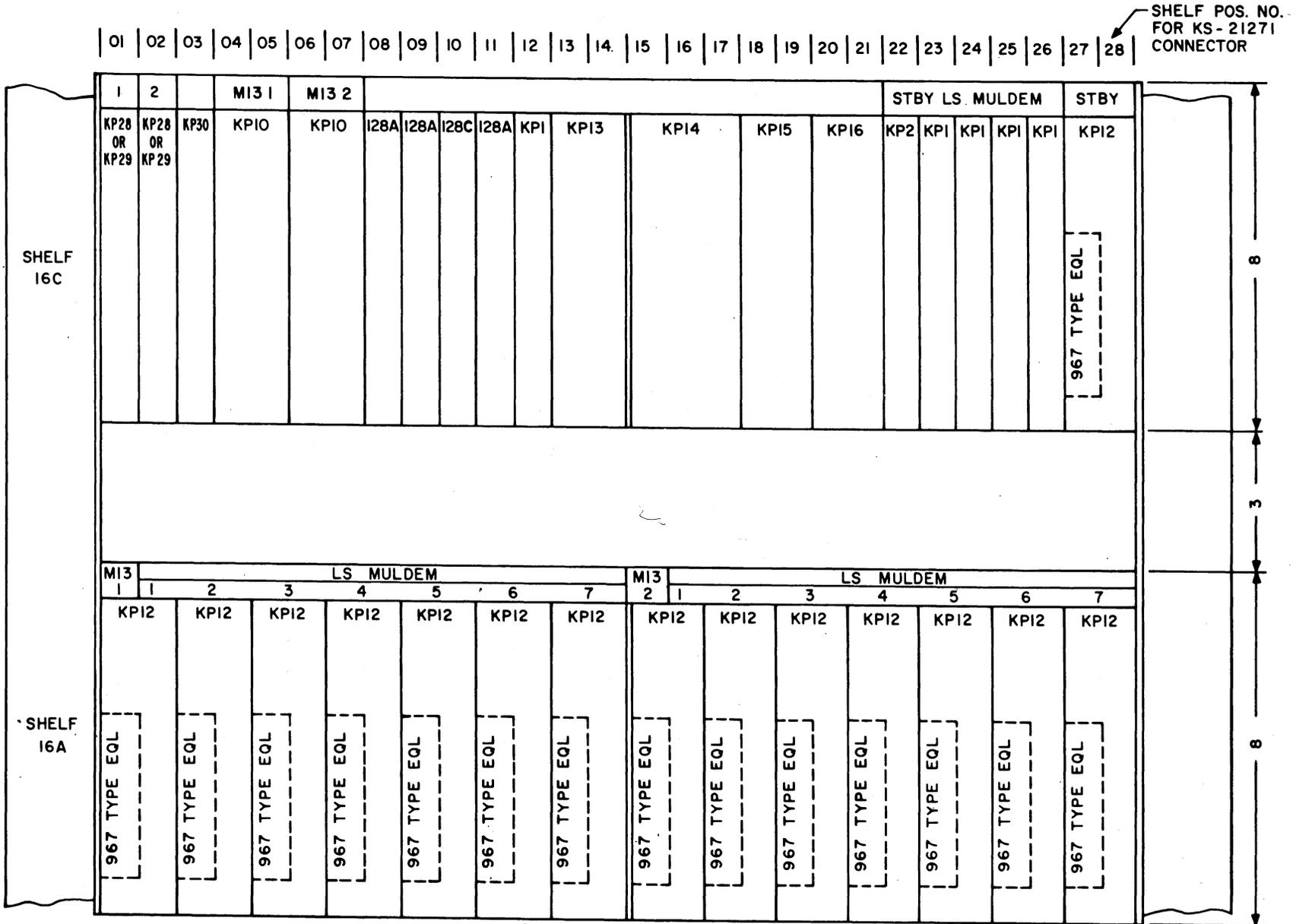


Fig. 4—Monitor and Protection Switch Assembly (J98724AC), With Shelf 16C Showing Circuit Packs for Option Z

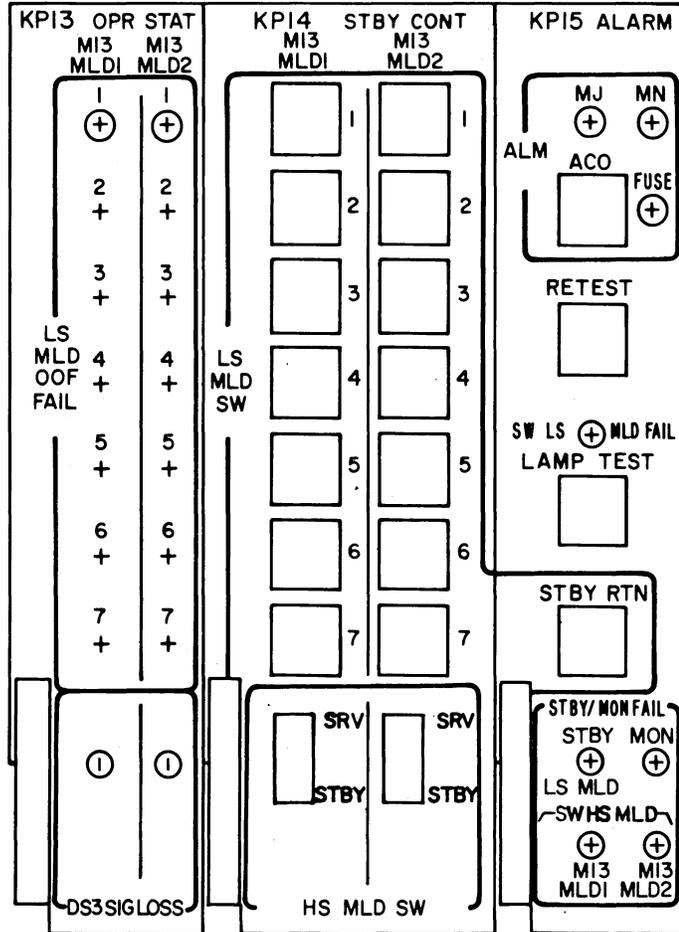


Fig. 5—Status and Control Functions on J98724AC, Option Z

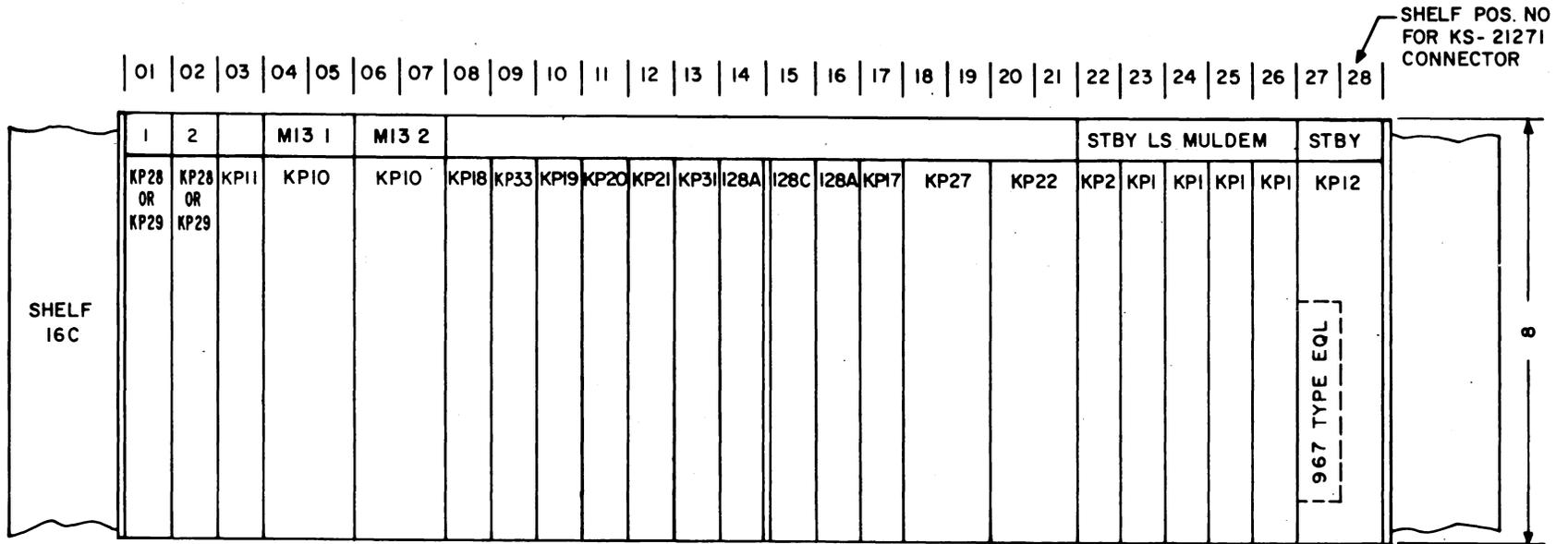


Fig. 6—Part of Monitor and Protection Switch Assembly (J98724AC), Shelf 16C Showing Circuit Packs for Option Y

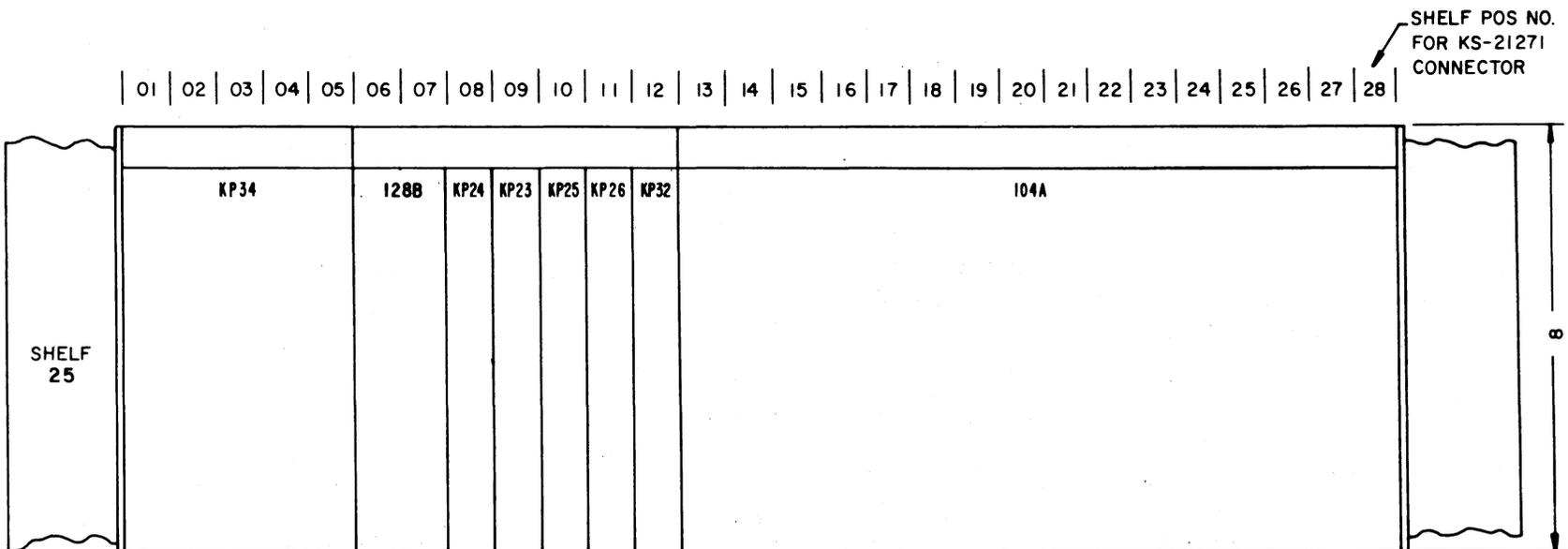


Fig. 7—Automatic Protection and Status Panel Assembly (J98724AE)

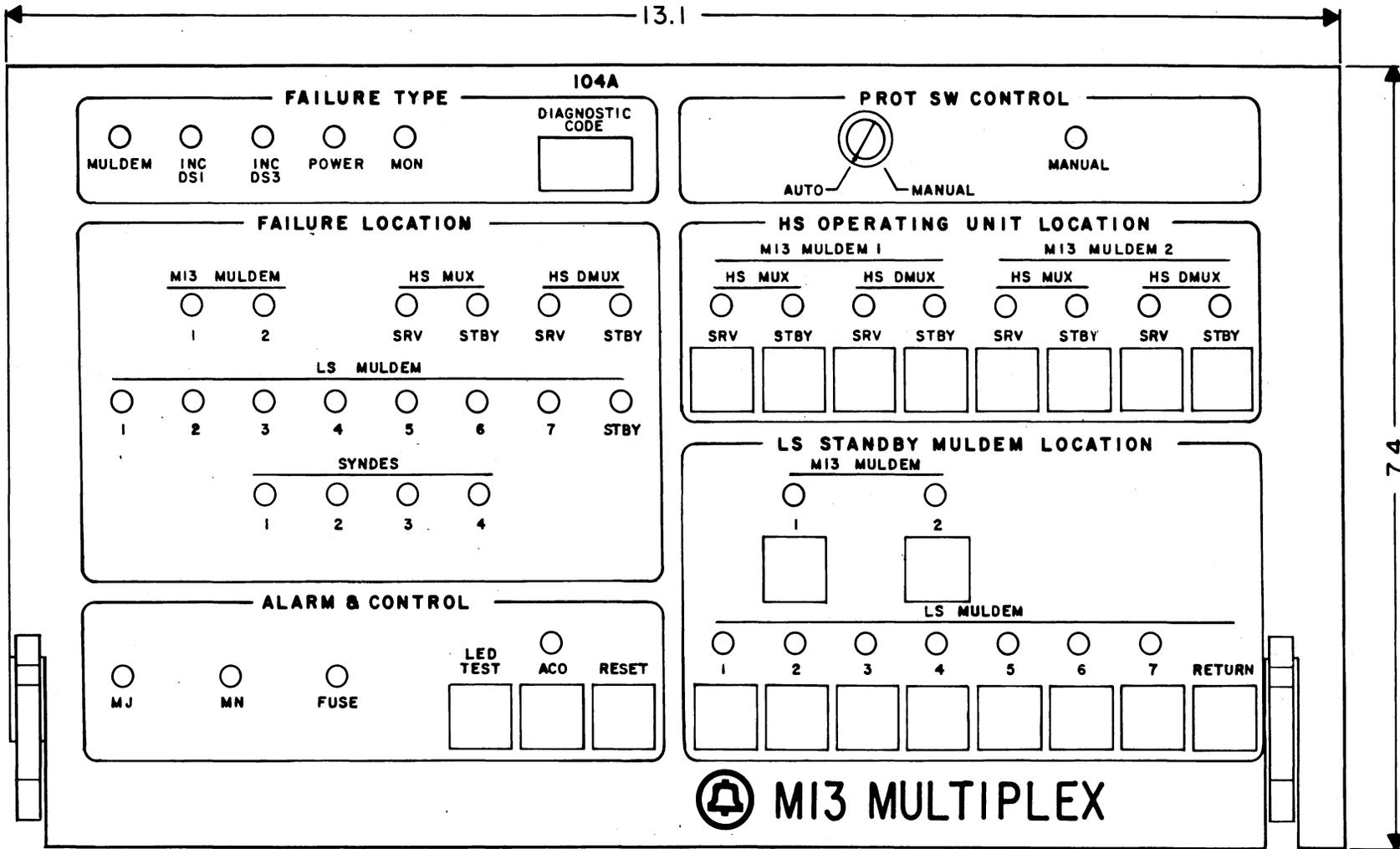


Fig. 8— 104A Display Unit

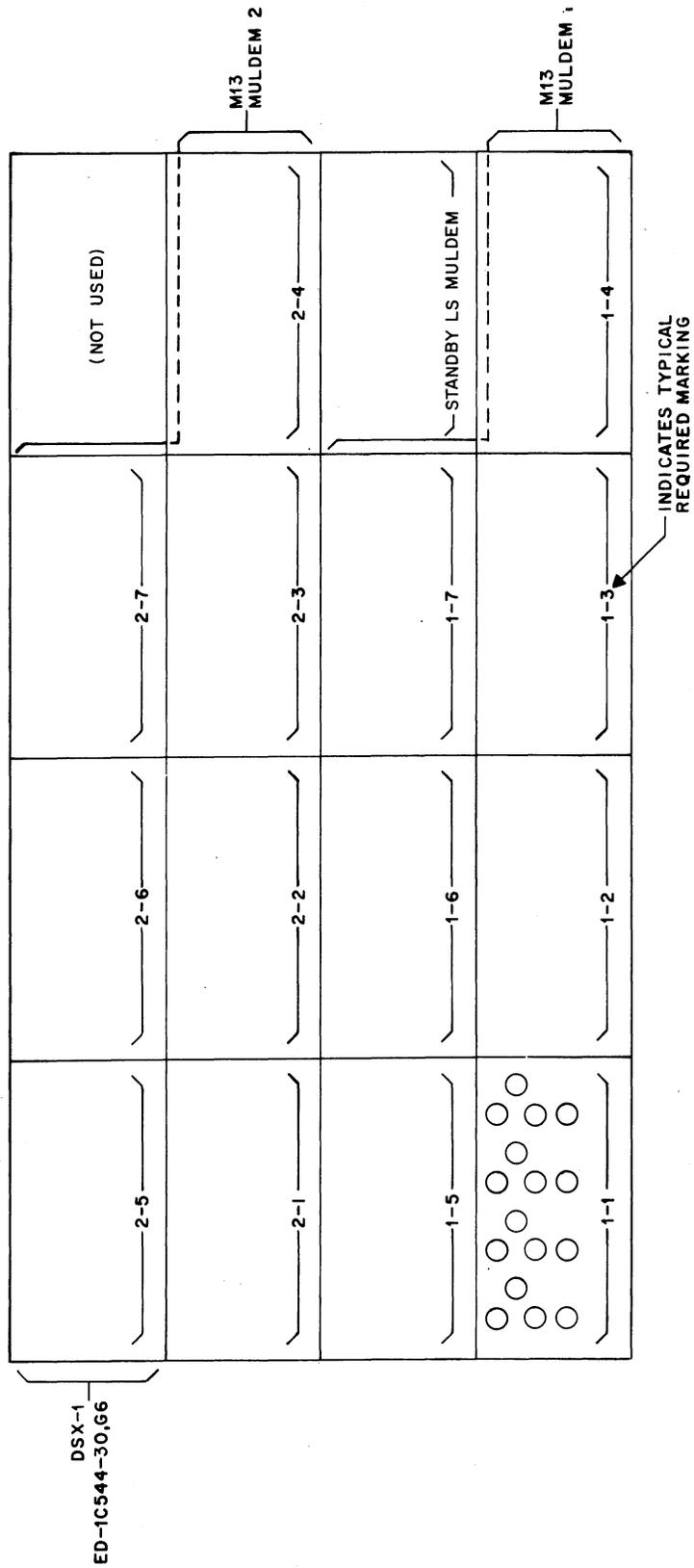
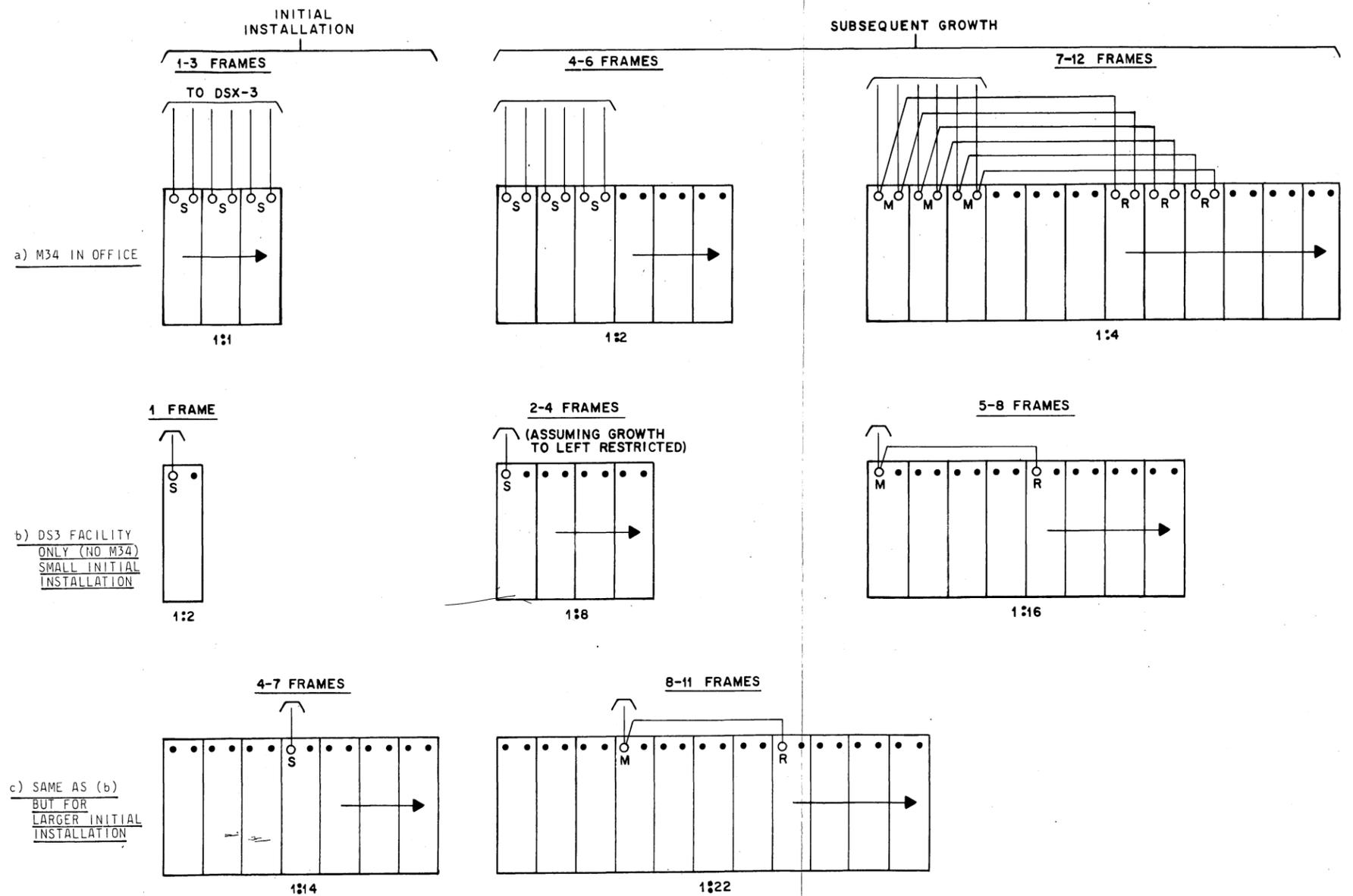


Fig. 9—Arrangement of DS1 Lines at DSX-1 Panels



NOTES:

1. BAY OUTPUTS MARKED WITH A CIRCLE REQUIRE A KP28(J98724G,L6)  
BAY OUTPUTS MARKED WITH A DOT REQUIRE A KP29(J98724G,L7)
2. MODES ARE SHOWN AS 'S'(STAND-ALONE),M(MASTER)AND R(REMOTE).
3. SPARE: SERVICE LINE RATIO IS SHOWN UNDER EACH CASE.
4. ARROW INDICATES ASSUMED DIRECTION OF GROWTH AS WELL AS AMOUNT OF GROWTH FOR EACH CASE.
5. ABOVE EXAMPLES ASSUME BOTH M13 MULDEMS ARE TO BE EQUIPPED IN EACH FRAME.

Fig. 10—Use of KP28 (DS3 Spare Trunk Access) and KP29 (DS3 Standby Loop) in Typical Applications

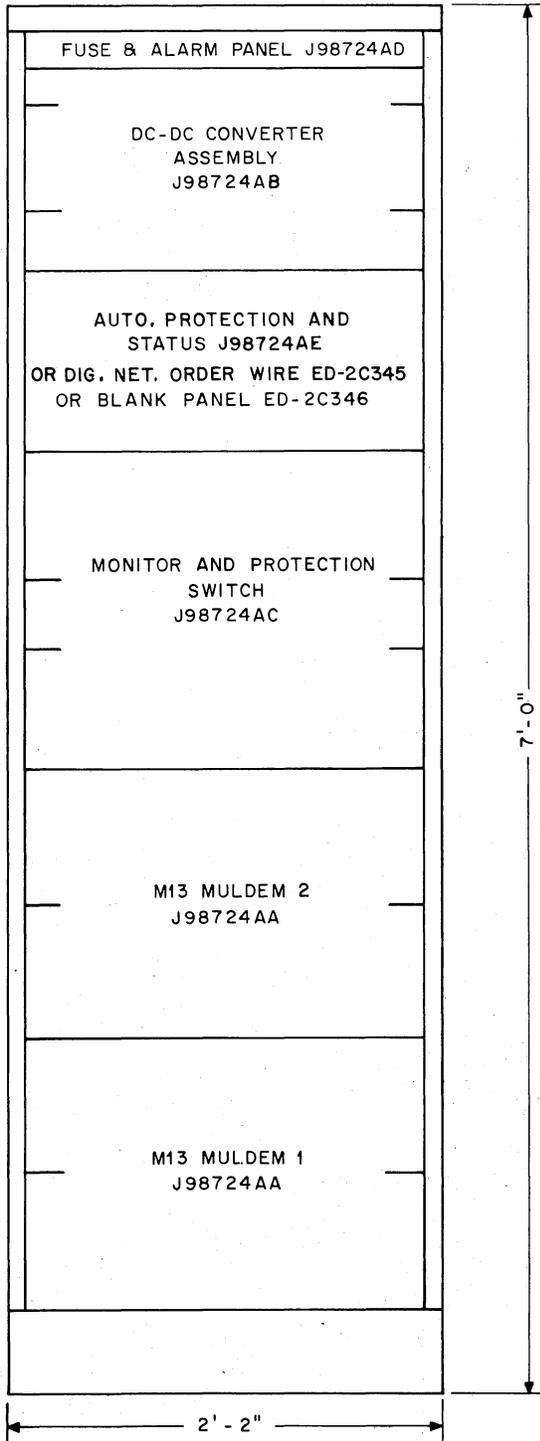


Fig. 11—M13 Multiplex on 7-Foot 0-Inch Uniframe Bay

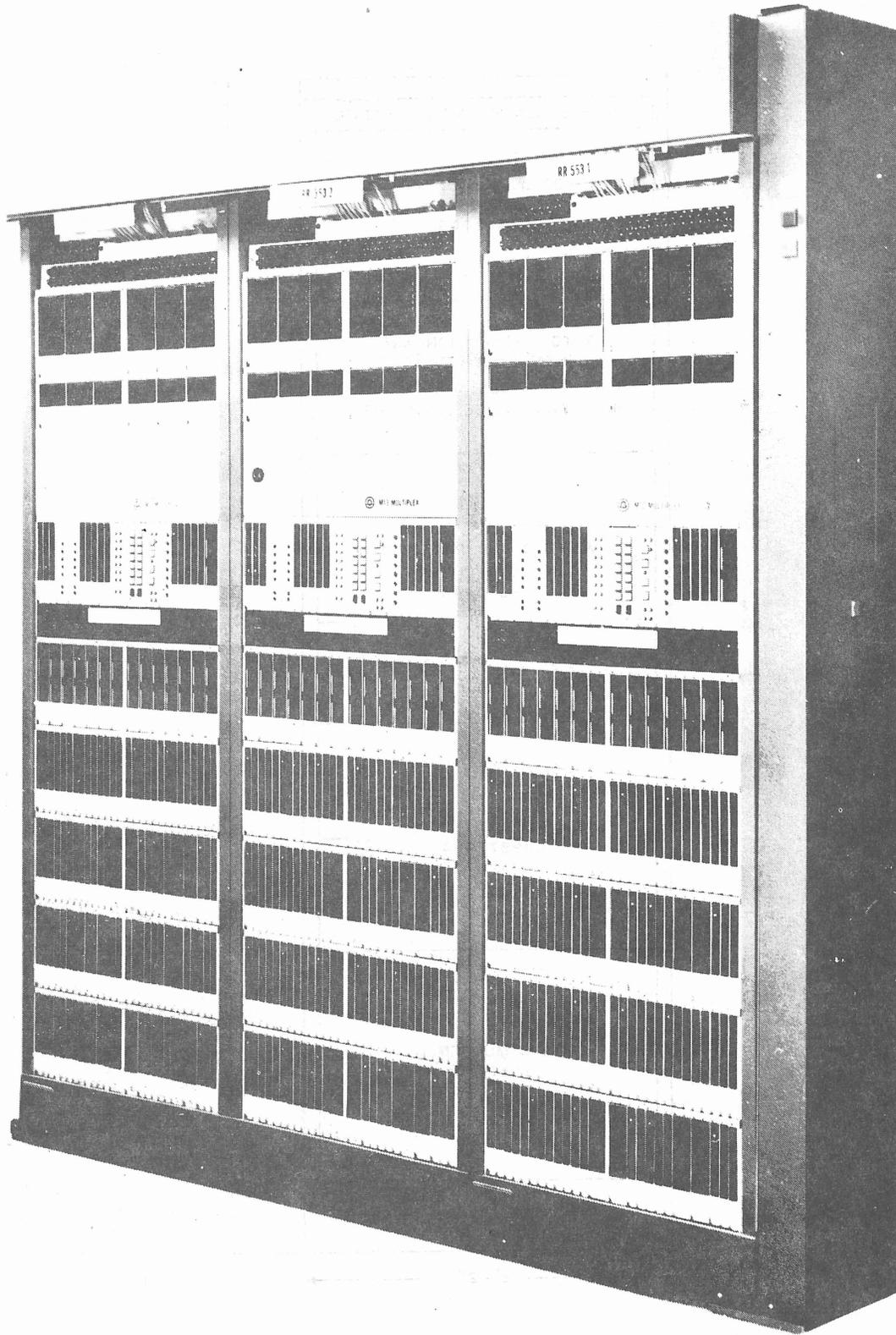


Fig. 12—Typical Installation of Three M13 Frames, Option Z

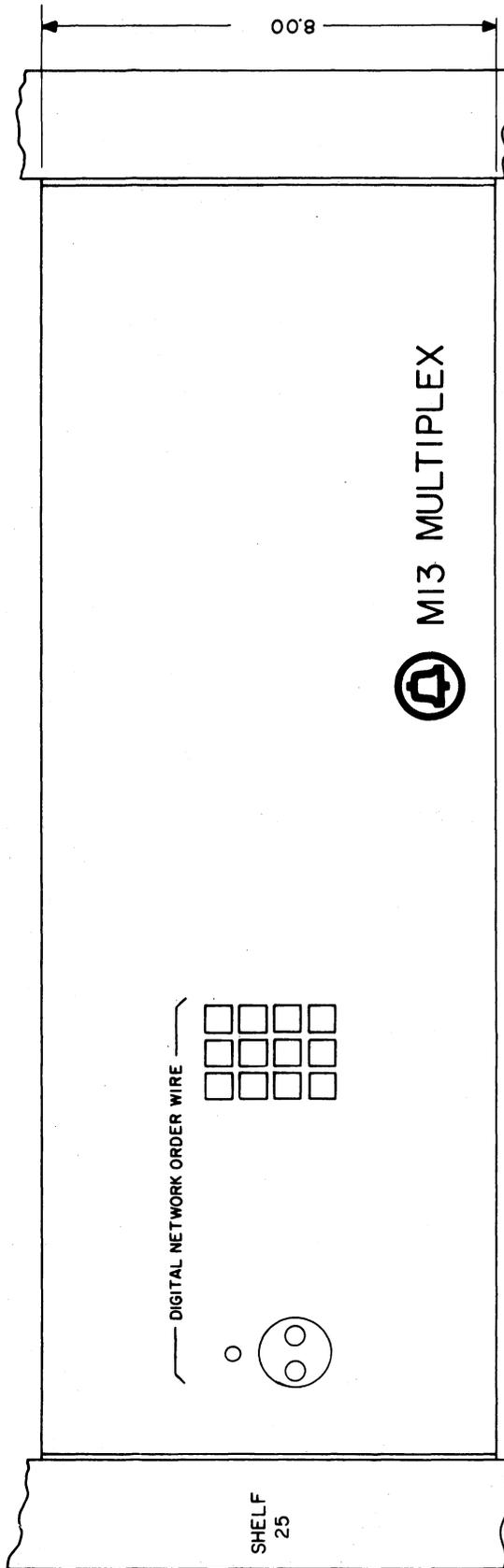


Fig. 13—Digital Network Order Wire for Option Z [ED-2C345-( )]

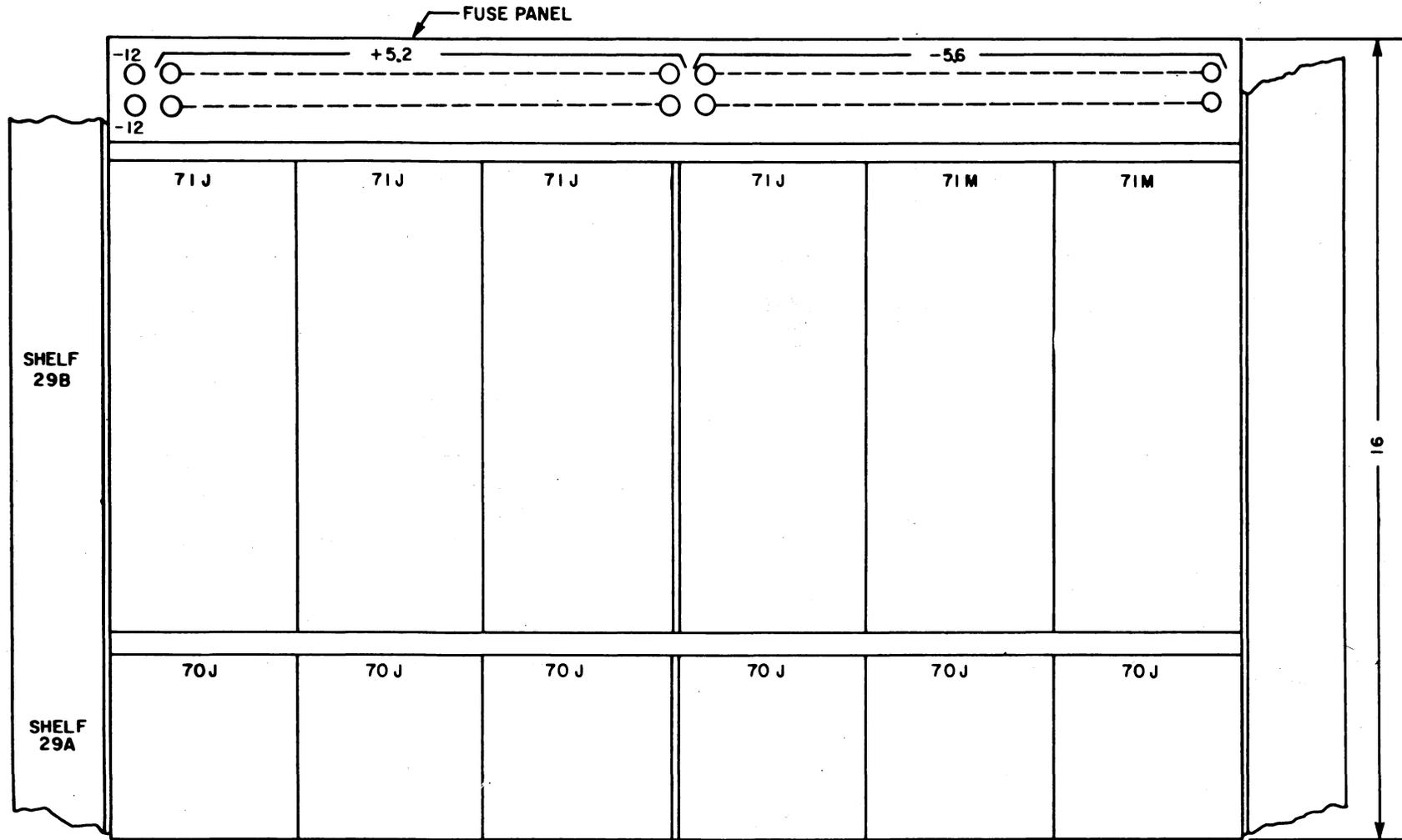


Fig. 14—M13 DC-to-DC Converter Assembly (J98724AB)

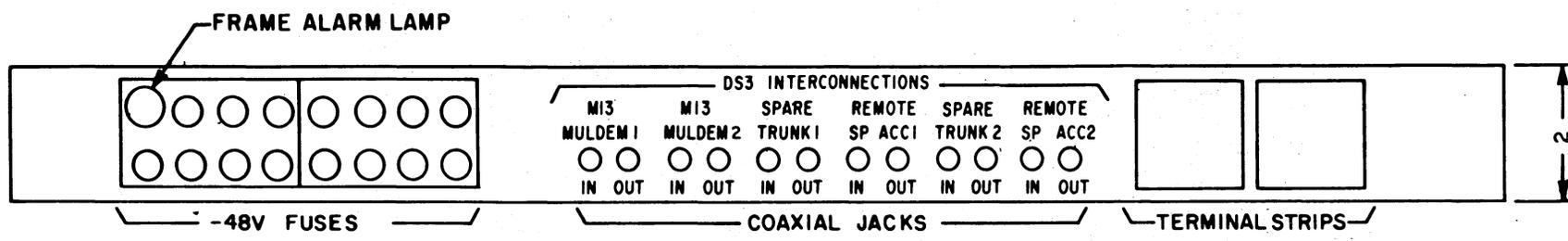


Fig. 15—Fuse and Alarm Panel Assembly (J98724AD)

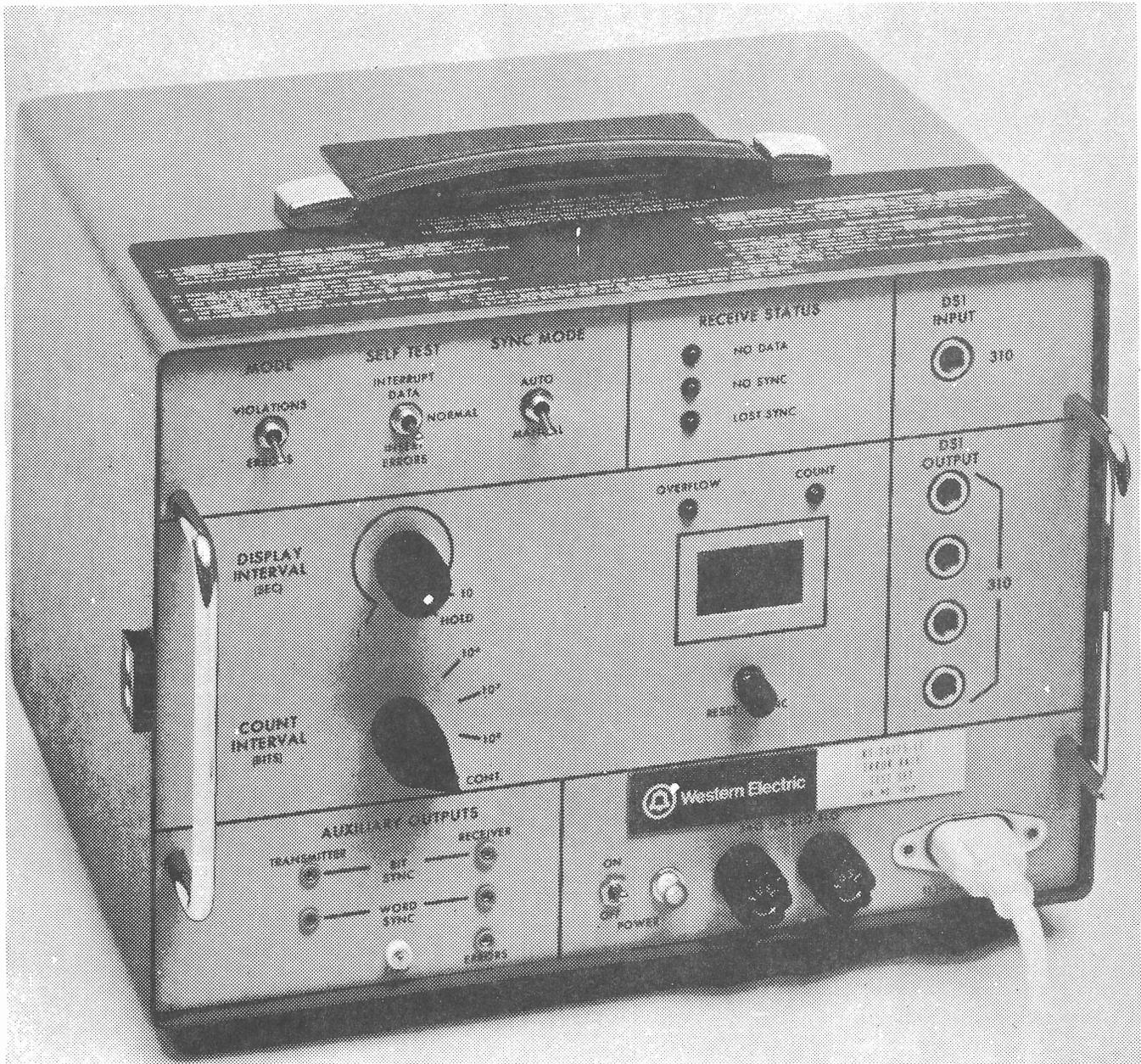


Fig. 16—Error Rate Test Set (KS-20775 L1)

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