DIGITAL TRANSMISSION FACILITIES
T4M DIGITAL LINE
SYSTEM APPLICATION & EQUIPMENT DESIGN REQUIREMENTS
COMMON SYSTEMS

1. GENERAL

SCOPE

1.01 This specification, together with the supplementary information listed herein, covers the equipment design requirements for the T4M digital line and associated field applied test sets. Information is also included to cover summary considerations relative to overall system application in various plant and service conditions. Engineering considerations, and transmission and outside plant layout rules are covered in Sections 855-353-100 and 855-353-101, respectively. Descriptive information is covered in Section 365-550-100. (Abbreviations are listed in 5.03.)

1.02 This specification is reissued to:

(a) Add ED-2C234-( ), ED-2C235-( ), ED-2C236-( ), ED-2C240-( ), ED-2C241-( ), and ED-2C530-( ).

(b) Add list 4 to J98721A and J98721B.

(c) Add descriptive information and to update the text.

(d) Add common language coding information.

(e) Add tables and guides for plug-in and apparatus blank administration.

CAPACITY

1.03 The T4M digital line is a coaxial cable digital transmission facility for DS4* signals. Powering span length is limited to 47 and 111 miles for single-ended and double-ended powering, respectively, with maximum regenerator spacing. A 500-mile long system can be obtained by placing spans in tandem. Two-way transmission is provided over a pair of coaxial units to provide a 2-way DS4 channel. Each channel has the capacity for 168 DS1s, which is equivalent to 4032 voice-frequency (VF) circuits, 42 DS2s, or 6 DS3s. Various combinations of the above, along with combinations of wideband data channels, can also be carried on a T4M DS4 channel.

DESCRIPTION

Overall Line

1.04 The T4M digital line is defined as a separate entity commencing and terminating with and including the span terminating frame but independent of various terminal equipment that might deliver signals to the line for transmission. The transmission medium consists of disc insulated air dielectric 3/8-inch diameter 75-ohm coaxial tubes. The span terminating frame can accommodate up to 22 such tubes, ie, 11 2-way channels. These tubes can be placed into a single cable along with their attendant wire pairs needed for maintenance purposes or, under certain conditions, into a maximum of four different cables that follow diverse routing. In either case the tubes can be in a composite cable with up to 12 coaxial tubes and a larger number of wire pairs that can be used to serve VF or T1 transmission requirements.

1.05 The T4M digital line contains:

(a) Maintenance offices (MOs) that mark the ends of spans. These spans are coincident with:

(1) Protection switching spans.

(2) Powering spans.

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* Digital signal, fourth level (274.176 Mb/s) in the digital hierarchy.

(3) Fault locating spans.

(b) Auxiliary stations (ASs) that mark the ends of fault locating subspans.

(c) Add/drop offices (ADOs) that mark the ends of transmission and protection subspans.

(d) Repeater stations (RSs) that mark the ends of regenerator sections.*

1.06 ***Maintenance Office:*** At MOs, transmission lines are administered for terminal connection or for through connection if the office is part of a tandem array of T4M digital lines, and for maintenance purposes. The particular functions implemented at these offices include:

(a) Office-to-line and line-to-office signal regeneration.

(b) Line performance monitoring.

(c) System alarming.

(d) Fault locating and restoration access.

(e) Optional protection switching.

(f) Optional system alarming including appropriate closures for interface with a remote status reporting system such as E-type or equivalent telemetry.

(g) MO-to-MO and MO-to-RS optional order wire (OW) circuits.

(h) Wire pair voltage surge protection.

(i) Combining and separating line power from DS4 signals.

(j) Line powering if MO is a power feed point.

(k) Line power loop-around if MO is not a power feed point.

Not part of this specification, but supplementary to it and required for T4M, are the additional maintenance office located equipments consisting of: the J87412A line feed converter, if the office is the powering point of a single-ended powering span; the J86899A power supply and the J86899B power supply spare and test load, if the office is the powering point of a double-ended powering span; the J68919AW,L2 power separation filter panels and J68919E,L1 and L3 or J68919L,L1 and L3 power separation filter cabinet, and the 32A1 protector cabinet equipped with 127A1A-52 protector blocks and 200A terminal strips. (See SD-99610-01 and 5.05.)

1.07 ***Auxiliary Station:*** When a fault locating span exceeds 29 regenerator sections (about 31 miles), an AS is required to provide audio amplification and powering for equipment associated with the maintenance functions provided over wire pairs that may include fault locating, order wire, gas pressure monitoring, and E-type or equivalent telemetry. Coaxial lines need not enter an AS. Subsequent issues of this specification will cover an AS in additional detail.

1.08 ***Add/Drop Office:*** Subsequent issues of this specification will cover an ADO.

1.09 ***Repeater Station:*** Repeater stations are usually located within manholes, but a MO or ADO is also considered a repeater station. For the T4M system, each direction of transmission is functionally and essentially physically separate from the other direction of transmission. As such, there is no T4M repeater. Instead, regenerators are used for each direction of transmission. Four regenerators are accommodated in a single apparatus case such that each case provides regeneration for two 2-way lines. The regenerator apparatus case provides for automatically maintaining line powering currents when regenerators are removed. In addition, jacks are provided for accessing a working regenerator to monitor line violations. Also located within a manhole repeater station is a maintenance apparatus case that provides wire pair termination and facilities for fault locating apparatus, wire pair loading, wire pair voltage surge protection, and the optional features of order wire (OW) access and gas pressure monitoring.

Line Powering

1.10 Powering of T4M line regenerators is provided by a constant current supply via the coaxial center conductor. This current is supplied by line feed converters (LFCs) located in MOs. Powering span length is limited to 47 miles for single-ended powering and 111 miles for double-ended powering. In the former case, one MO contains a LFC for each T4M 2-way line and the other MO serves as a power looping office. For the longer line, both MOs contain

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*A regenerator section extends from the output of one regenerator to the output of the next regenerator.

a LFC for each T4M 2-way line. The constant current output of the LFC is applied to the line at the power separation filter (PSF) where it is added to the information signal. Two PSFs are required for each 2-way line at each MO and are located in the PSF cabinet. A pair of PSFs share a single shelf. Office regenerators are not powered from the LFCs. They receive power from supplies located in the span terminating frame (STF).

Protection Switching

1.11 Protection switching can be provided on an optional basis to make available one 2-way line to automatically protect up to ten 2-way working lines. The ten lines need not be contained in the same cable or be in the same route. System rules allow for up to four different cable routes to be terminated on the same STF. Protection, however, is only provided on a MO-to-MO basis. The switching circuit is equipped on a plug-in basis into a prewired shelf in the STF. Protection switching functions on a one-way basis such that protection is available for one-way lines in each direction (from different 2-way lines). A switch can be initiated by either automatic means upon detection of a failure or by manual means. In addition, all lines, including the protection line, can be accessed (via patches) for manual restoration. Failures of two or more lines in the same direction cannot be fully protected by automatic means. Protection switching is automatically initiated by command from the receiving end violation monitor and remover (VMR) whose output is processed by the protection switching circuit (PSC). Switch command information is then injected onto the reverse direction protection line via the protection data multiplexer (PDM). This establishes switch request communication among the transmit and receive MOs, and ADOs. One VMR is required for each receive line in the STF. A special VMR is required for the protection line to remove the switch control information added by the transmit end PDM. Selecting the protection switching option provides for the PSC, a PDM, and the per line coaxial switches. The protection VMR is always provided for line 1, whether or not the protection switching option is selected.

Maintenance Facilities

1.12 Maintaining a T4M facility depends on OW and fault locating (FL) facilities derived from loaded 19- or 22-AWG 0.083 μF per mile, or 19-AWG 0.062 μF per mile wire pairs contained within the coaxial cable along with the additional facilities provided by the gas pressure system, optional alarm telemetry, and the T4M family of test sets. Provision is made in the maintenance apparatus case to handle up to five wire pairs to provide combinations of 2- and 4-wire OW circuits. Two wire pairs are available for each fault locating subspan, one to handle each direction of transmission. For a maintenance span of maximum length containing four fault locating subspans, five wire pairs are required. The monitoring of gas pressure can be implemented with either contactors or transducers. Two wire pairs are provided in the maintenance apparatus case for this function, as well as two wire pairs that are provided for the remoting of alarms. Coax-18 and coax-22 provide sufficient auxiliary 19-AWG wire pairs to provide all of these functions, although, on an optional basis, all of them need not be implemented. On composite and other cables used for a T4M facility, the available 22-AWG wire pairs may be used to provide the maintenance functions. When diverse routing of the coaxials is employed, fewer pairs per route may be implemented on an optional basis. Additional details covering diverse routing will be presented in Sections 365-550-100 and 855-353-101, which cover its description and layout procedures, respectively. In general, T4M test sets do not require the use of wire pair facilities. The exception is the fault locating test set (FLTS).

Order Wire

1.13 ***T4M Order Wire:*** As mentioned above, various OW circuit options can be implemented on the available VF loaded wire pairs. It is expected that one or more of the following would be employed as T4M associated OW circuits: a 4-wire order circuit for MO-to-MO communication, a 4-wire order circuit for MO-to-RS, RS-to-RS, or RS-to-MO communication, and a 2-wire order circuit for RS-to-RS and RS-to-MO communications. Provisions are made for access to these lines at the STF and LFC in MOs and at both the ADO and AS, where in addition, direct distance dialing (DDD) access can be provided. Optional OW access can be made available in the repeater station at the manhole collar for a 4-wire system. A 2-wire terminal is provided on the 472H1 apparatus case that is connected to the 2-wire facility in the coaxial cable. Details are available on SD-99610-01.

1.14 ***Digital Network Order Wire:*** In addition to the T4M associated OW circuits, a digital network order wire (DNOW) is available to provide communications between and within MOs among those equipments comprising the digital hierarchy. This

facility assists in the isolation of trouble conditions to a particular equipment and access may be provided at the T4M STF, the M13 and M34 multiplexes, and the DSX1, DSX3, and DSX4 cross connects. Access to DNOW is not provided at RSs outside of the MOs, and therefore, DNOW is not to be considered as a substitute for the T4M associated OW circuits described in 1.13. DNOW requires a 4-wire circuit preferably on a facility outside of the T4M coaxial cable, on a diverse route. DNOW documentation is covered by SD-1G288-01.

1.15 ***Fault Locating:*** The T4M fault locating system is similar in function to the audio tone technique used in both the T1 and T2 digital lines. To locate a faulted regenerator, the output of a STF mounted FLTS is patched into the head end (MO transmit) of the failed line. As each RS is queried, an output is produced from each regenerator in that line. This output is first processed in the manhole maintenance package (MMP) located in the regenerator apparatus case and then the maintenance unit (MU) located in the maintenance apparatus case. The MU combines the fault locating outputs of all the regenerators in the RS carrying transmission in the same direction, filters the audio tone in order to identify the RS, and places the resultant signal on a wire pair for transmission back to the transmitting MO. If the RS is located in a FL subspan that is not adjacent to the transmitting MO, the return signal passes through one or more ASs for audio amplification and equalization. Since the MO is part of the first FL subspan, the STF mounted transmitting office regenerators are also serviced by this line via a STF mounted MU. Through a second patch, the FLTS interrogates the returned signals and it is determined, via a visual display, which regenerator in the given line has failed. Since each direction of transmission is handled separately, two sets of apparatus are required to process the FL tones. The maintenance apparatus case contains two MUs and the conditioning circuits for all FL wire pairs contained therein. The STF contains two MUs with space for the portable FLTS, up to four fault locating pilot detectors (FLPDs), a fault locating pilot generator (FLPG), build-out cards, load coil cards, fault locating power converters (FLPCs), jack access into each transmit line, and up to four jacks for access to each fault locating subspan return signal. The FLPD and FLPG constantly monitor the integrity of the fault locate line and provide alarms if a failure occurs in this line including power failure. When route diversity is employed, the STF requires additional circuit packs (CPs). On a miscellaneous mounted basis, the AS contains a VF amplifier for each FL line passing through that office, a FLPG, and a FLPC.

1.16 ***Gas Pressure System:*** As previously noted and depending upon operating company choice, two wire pairs are available for gas pressure monitoring on each route and these may be assigned for pressure contactors or transducers as determined by choice of central office (CO) monitoring facilities. Provision is made for mounting pressure sensing devices within the manhole RS maintenance apparatus case. External or independently housed contactors may be used as an alternative. Relatively simple CO alarms permit detection of contactor closures on a single wire pair and identification of a cable route involved. The more elaborate transducer arrangement uses two wire pairs, one for telemetry and one for control.

1.17 ***Restoration:*** Provisions have been made for the implementation of standard line restoration techniques in the outside plant. Specially coded tools are available for this purpose. (See Sections 644-200-041 and 644-200-044.)

Test Equipment

1.18 Test equipment designed specifically for use with the T4M digital line consists of five portable units of which three are intended primarily for CO use and two for general line application. The former three are the FLTS, the regenerator test set (RTS), and the portable signal generator (PSG). The latter two are the T4M transmission test set (TTS) and the portable violation monitoring test set (PVM).

1.19 ***21E Fault Locating Test Set:*** The 21E FLTS is the principal test set for corrective maintenance on T4M digital lines. Its use on T4M digital lines is on an out-of-service basis. This unit contains a signal source to drive the failed line, an audio receiver that processes the returned signals from the FL wire pair, and a display and control section. The set is powered from office battery via a STF mounted converter and is independent from the FL line constant current power supply, ie, the FLPC that is also mounted in the STF.

1.20 ***21F Regenerator Test Set:*** The 21F RTS is used in conjunction with the 21J PSG (see 1.23) and 21H PVM (see 1.22) for checking T4M digital line and office regenerators. Such tests are performed upon receipt of regenerators from WE and prior to the installation of regenerators into the line.

The RTS is ac powered, portable, suitable for bench type application, and can be used in COs or distributing warehouses.

1.21 ***21G Transmission Test Set:*** The 21G TTS is intended for use in RSs to determine the suitability of a coaxial line for T4M transmission. Test cords are provided with suitable fittings to permit its use directly on air dielectric coaxial lines, on the 66-type terminals located within manholes or on the PSF cabinet, in the regenerator apparatus case in place of the regenerator, or on the office cables at the STF terminal area. The TTS is used in pairs with one located in each of two adjacent RSs. One TTS is used as a transmitter and generates a test signal for transmission to the other TTS, which is used as a calibrated receiver to measure the quality of the transmission. Each TTS can serve as a transmitter or receiver or both when the TTS itself is being calibrated. When used as a receiver, a TTS requires a 3E regenerator. This portable unit is powered from rechargeable batteries.

1.22 ***21H Portable Violation Monitoring Test Set:*** The 21H PVM is an in-service test set used primarily to determine the error rate at the output of a line regenerator and is intended to assist in pinpointing cable or regenerator failures. A single test cord is supplied for a plug-in connection to the PVM port (VMJ1 through VMJ4) of the MMP in the regenerator apparatus case. This unit can also be used at the PVM jack access on the STF mounted office regenerator, VMRs, and PDM in MOs. Suitable attenuators are provided to allow the PVM to be used at other jack access points in the system. It is battery powered, permitting portable use of the unit in RSs.

1.23 ***21J Portable Signal Generator:*** The 21J PSG produces a 274.176 megabaud data stream at several levels suitable for testing T4M digital line and office regenerators, the J98721A and B STFs, and cross-office cabling. The data stream is organized into the standard DS4 frame format with a pseudo-random sequence in the information bit slots. In addition, four pulses per frame may be dedicated under front panel control to allow this signal to be distinguished from a normal DS4 signal. For regenerator testing, the clock frequency may also be varied from the front panel. The test set is portable and ac powered for CO or distributing warehouse use.

1.24 ***KS-21797 L1 Battery Charging Rectifier:*** This unit is intended for use in the MO or central maintenance location as convenient means for maintaining the KS-20431 L2 rechargeable batteries used in the 21H PVM and the 21G TTS. It is an ac powered unit, can be bench or bay mounted, and can charge up to eight batteries simultaneously. See Section 103-486-105.

Alarm System

1.25 Alarm provisions include indications on alarm sources and logical determination to distinguish the minor or major status of the alarm. Remoting of these alarms and status indications is possible via E-type or equivalent telemetry. The alarm circuitry is capable of registering its own alarms.

DETAILS OF EQUIPMENT

Span Terminating Frame (J98721A)

1.26 The J98721A span terminating frame, Fig. 1, employs the 7-foot 0-inch uniframe bay as its basic structural member and is 26 inches wide, 12 inches deep, and accommodates 25-inch wide by 2-inch high mounting plates. The frame terminates up to six 2-way T4M digital lines. When protection switching is equipped, line 1 is the protection line and lines two through six are service lines. In addition to the per line facilities, provision is made for protection switching control, alarms, fault locating, and other common functions. The frame is fully shop wired for all lists described in 4. but plug-ins are not included. Plug-in complements for the common functions are found in J98721K. Per line plug-ins are to be engineered and ordered separately by the customer as covered in 4. and 5. along with Sections 855-353-100 and 855-353-101, and SD-99613-01.

1.27 At the top of the frame is a terminal unit that receives all wire pairs and coaxial lines entering the bay with the exception of battery leads. This one mounting plate high unit makes all wire pairs and coaxials accessible at the front of the bay. Below the terminal unit is the fuse and filter panel that has the capacity for buffer fusing and filtering the incoming battery distribution leads, for fusing all leads that distribute the power within the frame, and for providing alarm contact closures to indicate blown fuses. This unit is one mounting plate high and is wired to handle the full capacity of the frame. Immediately below it is the alarm shelf that provides plug-in positions for alarm logic CPs, optional E-type alarm interface CPs, and FLPDs. The center panel on this shelf contains the frame alarm lamps, alarm cut-off

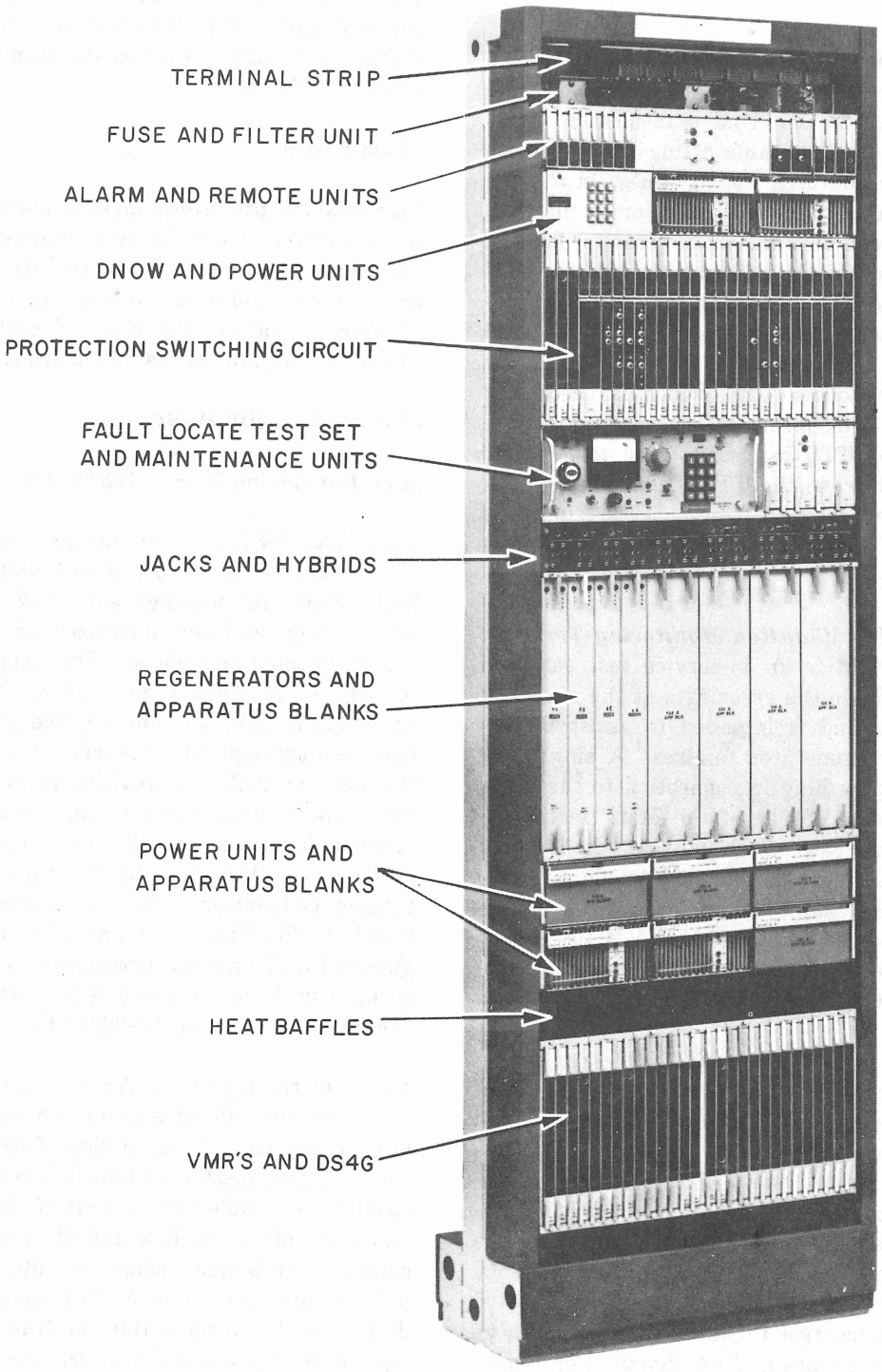

Fig. 1—J98721A Span Terminating Frame for up to Six 2-Way T4M Digital Lines on 7-Foot 0-Inch Uniframe Bay Framework

(ACO) switch, a line powering alarm lamp, and a lamp test switch. The alarm shelf is two mounting plates high. The next lower in the bay is the first of three power supply shelves. This two mounting plate high unit contains two power units and space on the left for the optional DNOW panel. The center unit powers the STF common equipment consisting of the PSC, PDM, FLTS, alarm circuits, and pilot detector circuits. The right power unit, which is a FLPC, supplies power to other FL circuits in the STF and manhole RSs.

1.28 The protection switching shelf assembly is a six mounting plate high unit that is sectionalized to provide for the following plug-ins: PDM circuit packs that inject switch commands into the protection line data stream and allows for MO-to-MO protection switching communications; PSC logic CPs; coaxial switch CPs; optional remoting CPs; and the 100A card storage unit. The shelf and bay are wired for the protection function independent of electing the protection switching option. Election of the option provides for the common plug-ins in order to equip the circuit. Growth accommodation for protection switching is implemented by adding additional per line plug-ins on this shelf. Not electing the option provides for the necessary plug-ins in order to bypass the circuit.

1.29 Below the protection switching shelf assembly is the maintenance shelf. This three mounting plate high unit contains facilities for receiving and providing power to the FLTS, the MUs, the load coils and buildouts for the maintenance wire pairs, and the FLPG circuit pack.

1.30 The jack and hybrid panel contains per line hybrids, per line coaxial access jacks, fault locating line jacks, and OW access jacks. This one and one half mounting plate high unit is fully wired and equipped to handle the full complement of the STF. No additional bay wiring is required to facilitate growth. Growth accommodations for this frame are accomplished by adding additional per line plug-ins within the STF. If the full complement of the incoming coaxial lines were not terminated on the STF terminal unit during initial installation, they must be terminated when the additional plug-ins are equipped.

1.31 Below the jack and hybrid panel are the shelf assemblies that handle most of the active per line plug-ins and the DS4 signal generator (DS4G). In sequence they are the regenerator shelf, two per line power supply shelves (see 1.32), and the VMR shelf assembly (see 1.33). The regenerator shelf is a nine mounting plate high unit that can accommodate up to 12 office regenerators, 6 transmitting regenerators (TRs), and 6 receiving regenerators (RRs). There is one code of TR and four codes of RRs (see 1.46).

1.32 The next two shelves are each two mounting plates high and provide a plug-in facility for powering the per line plug-ins. When equipped, each section of this 3-section shelf will provide power for the office circuits of one 2-way line that includes a TR, RR, and VMR. In addition, the power unit in position one of the lower shelf, provides power for the DS4G. Each power unit develops the required low voltage outputs of +8.5, -8.5, and -5.2 volts dc from the input battery voltage by dc-to-dc conversion techniques. Different power unit codes are available to accommodate -48 and +140 volt office battery sources.

1.33 The VMR shelf assembly, located at the bottom of the bay, is a six mounting plate high unit that can accommodate up to six VMRs and one DS4G. The latter provides a valid signal to drive an idle or protection line and provides a "blue" signal. A VMR consists of four circuit packs that are equipped on a per line basis. The DS4G similarly consists of four CPs that are required as common plug-ins. (See 1.44.)

1.34 Also located in the frame is a sheet metal heat baffle that assists in thermal management. This unit allows cooler air to enter the front of the frame and heated air to exhaust to the rear of the frame. It also serves to minimize the thermal interaction between the heat producing shelves and directs free convection currents.

1.35 Stile strips, base covers, and a frame designation label holder are required for the proper usage of this frame. These are to be ordered and engineered by the customer depending upon the framework location in the office and lineup, and the type of overhead cable racks to be used. See 5.08 and Section 801-015-152 for additional information.

1.36 Apparatus blanks are available for use in unequipped shelf positions of this frame. Their use does not preclude subsequent use of the unequipped positions as growth occurs but does protect the unused positions and does enhance the appearance of the frame. These plug-in units can be engineered and ordered by the customer as a function of

framework selected and number of channels equipped. See Table A for a description of the apparatus blanks and Table C for application information.

1.37 An 100A card storage unit is available to provide record and operation information convenience at the STF. This 3-inch by 8-inch plug-in unit mounts directly into the STF. Use of this unit and the record and information forms are found in Section 365-550-107.

Span Terminating Frame (J98721B)

1.38 The J98721B STF, Fig. 2, employs a dual uniframe bay assembly as its basic structural member. The frame is 7 feet 0 inch high, 52 inches wide, 12 inches deep, and accommodates 25-inch wide mounting plates constructed in 2-inch increments. This frame terminates up to eleven 2-way T4M digital lines. The bay on the left, which is similar to the J98721A, contains all common equipment and the per line equipment for the first six 2-way lines. The right hand bay provides the additional facility for the remaining five 2-way lines and contains a terminal unit, a fuse and filter panel, two per line power converter shelves, a VMR shelf equipped with a partial DS4G, an office regenerator shelf, a jack and hybrid panel, and a heat baffle. In addition, provisions are available for a second intraoffice trunk that can be used for manual restoration. The DS4G located in this bay consists only of distributing circuits. It is powered from the line seven power supply. The remaining space in the frame is restricted but can be employed for mounting miscellaneous T4M support equipment such as an OW and telephone set panel. Also, for route diversity, this space accommodates shelves for the additional MUs, pair conditioning circuits, FLPGs, and additional FLPCs. With the exceptions noted above, all other comments relating to the J98721A frame covered in 1.26 through 1.37 apply to the J98721B frame.

21E Fault Locating Test Set (J98721E)

1.39 The 21E FLTS, Fig. 3, is a portable unit that can be moved about when not in use and can be used with more than one STF. When in use, the test set is treated as a plug-in on the STF. The unit measures 5 inches high, 16 inches wide, and 10 inches deep. It is powered from office battery via a converter located in the STF. Two patches are required for its operation: a coaxial plug patch into the transmitting line access jack and a telephone plug patch into the fault locating line jack. Suitable patch cords are provided with the test set. The controls and readout of the unit are located on the front panel.

21F Regenerator Test Set (J98721F)

1.40 The 21F RTS, Fig. 4, is 18 inches wide, 10 inches high, and 12 inches deep and weighs approximately 55 pounds. The set is designed for bench-top operation within MOs or other central maintenance locations and is ac powered. The RTS must be used in conjunction with the 21J PSG, which provides the proper test signal, and a 21H PVM, which measures the error rate at the regenerator output. The 21J must be ordered separately if one is not already available at the location to use the 21F RTS. All codes of T4M digital line and office regenerators can be tested by these units. The RTS supplies power and test signals to the regenerator and measures the performance of the equalizer, timing, and decision circuits of the regenerator. The necessary patch cords and line and office regenerator interface units are provided with the 21F RTS.

21G Transmission Test Set (J98721G)

1.41 The 21G TTS, Fig. 5, is a portable unit designed for use in manhole environments. It weighs approximately 45 pounds and its overall size with cover and handle is 16 inches wide, 19 inches high, and 10 inches deep. The unit is powered from self-contained NiCad batteries that are designed to provide power for at least a normal work shift. The batteries are removed for charging. (See 1.45.) Appropriate plugs, adapters, and cables are provided and stored within a compartment located inside the cover of the unit. An appurtenant unit, the ED-2C219 regenerator enclosure and umbilical assembly, also provided with the TTS, must be fitted with a 3E regenerator prior to its use as a receiver. (See J98721G,L2.) Front panel controls are provided to select the mode of operation (ie, transmit, receive, or both), and equalization level to adjust for differing cable lengths. A visual output is provided to give the pass/fail test results.

21H Portable Violation Monitoring Test Set (J98721H)

1.42 The 21H PVM, Fig. 6, like the J98721G, is a unit designed for use in the manhole environment. It weighs approximately 30 pounds and with its cover is 16 inches wide, 7 inches high, and 16 inches deep. It is powered with the same code of rechargeable NiCad batteries used in the TTS. (See

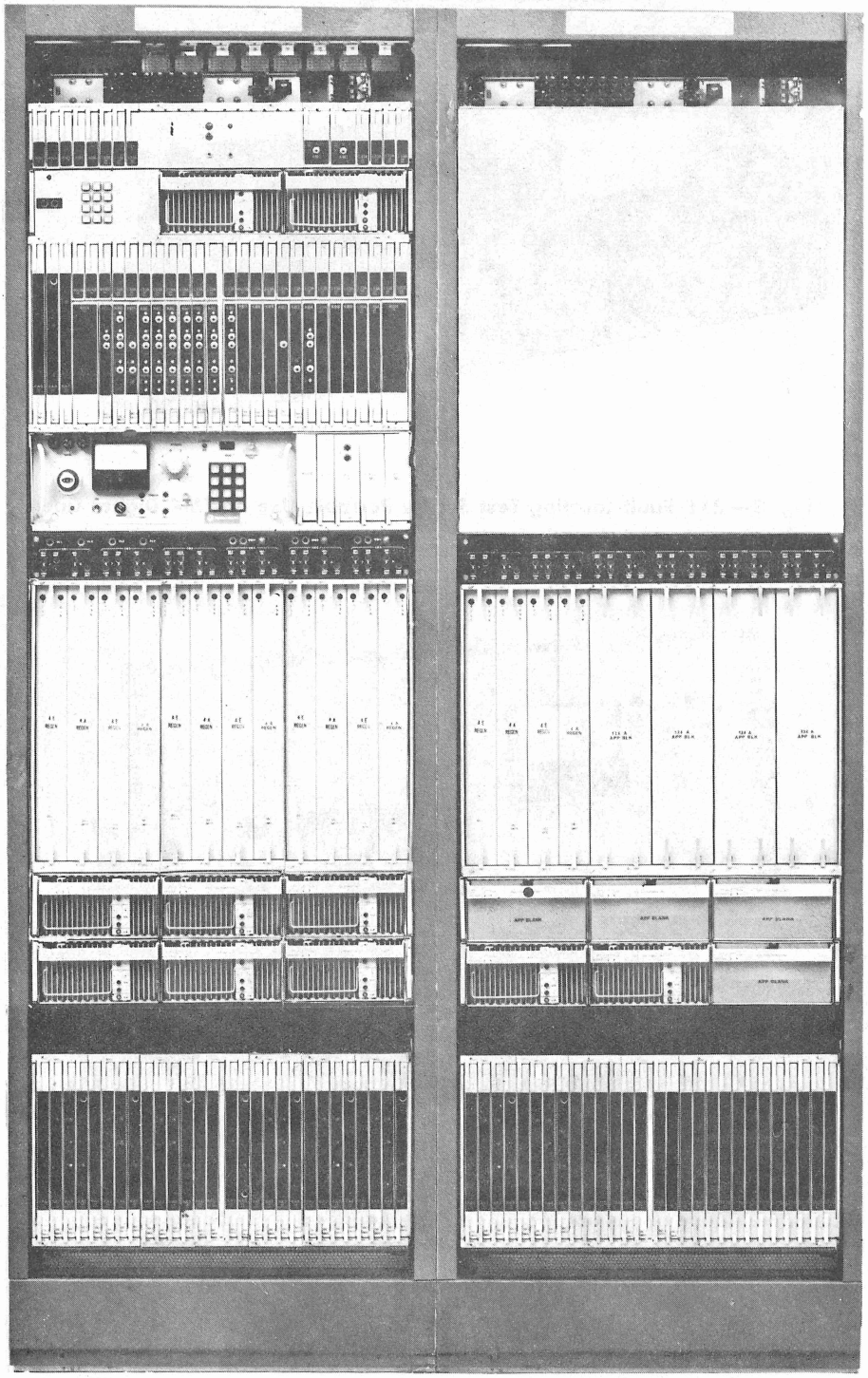

Fig. 2—J98721B Span Terminating Frame for up to Eleven 2-Way T4M Digital Lines on Dual 7-Foot 0-Inch Uniframe Bay Framework

Fig. 3—21E Fault Locating Test Set for Portable Use on TM4 Digital Lines

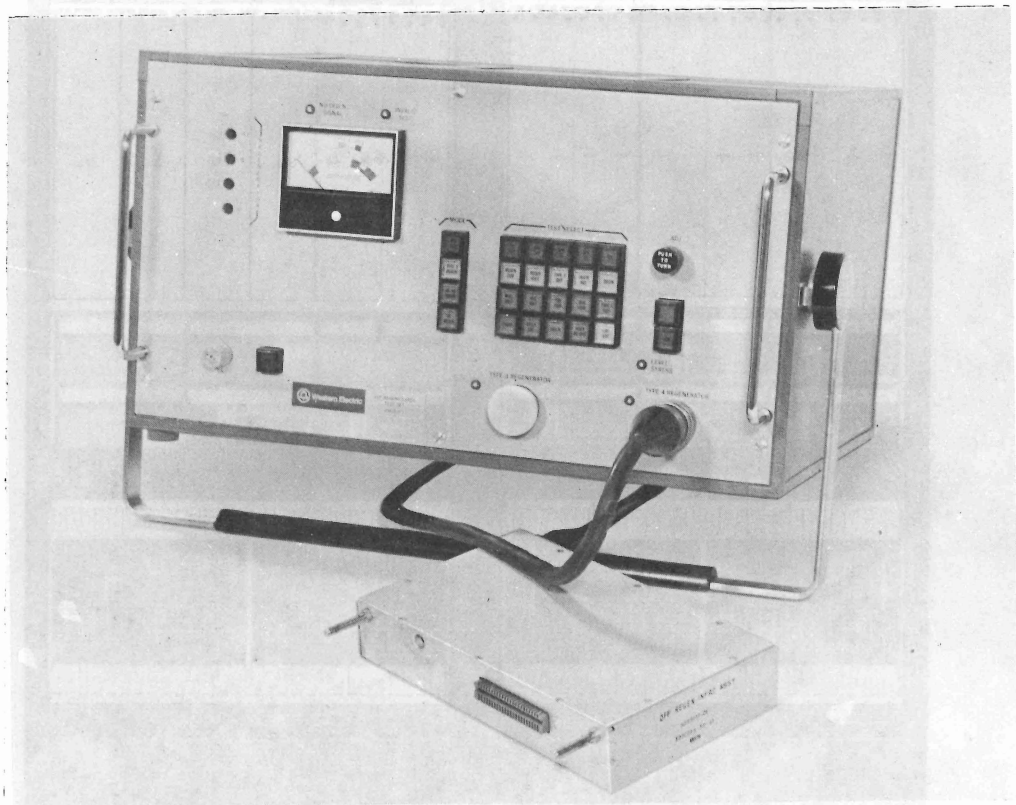

Fig. 4—21F Regenerator Test Set for T4M Regenerator Bench Tests

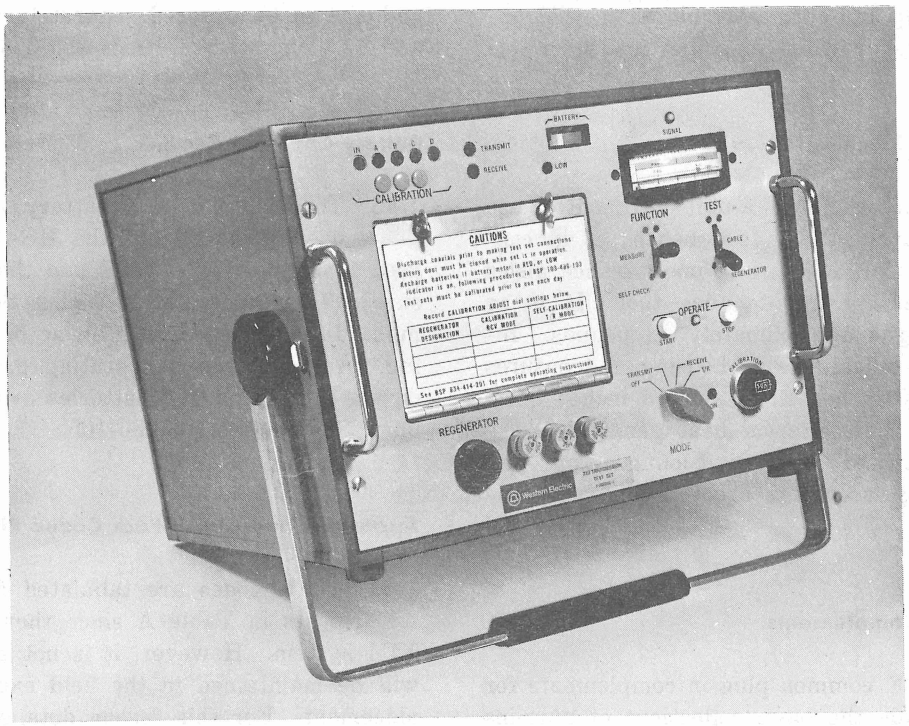

Fig. 5—21G Transmission Test Set for Portable Use on T4M Digital Lines

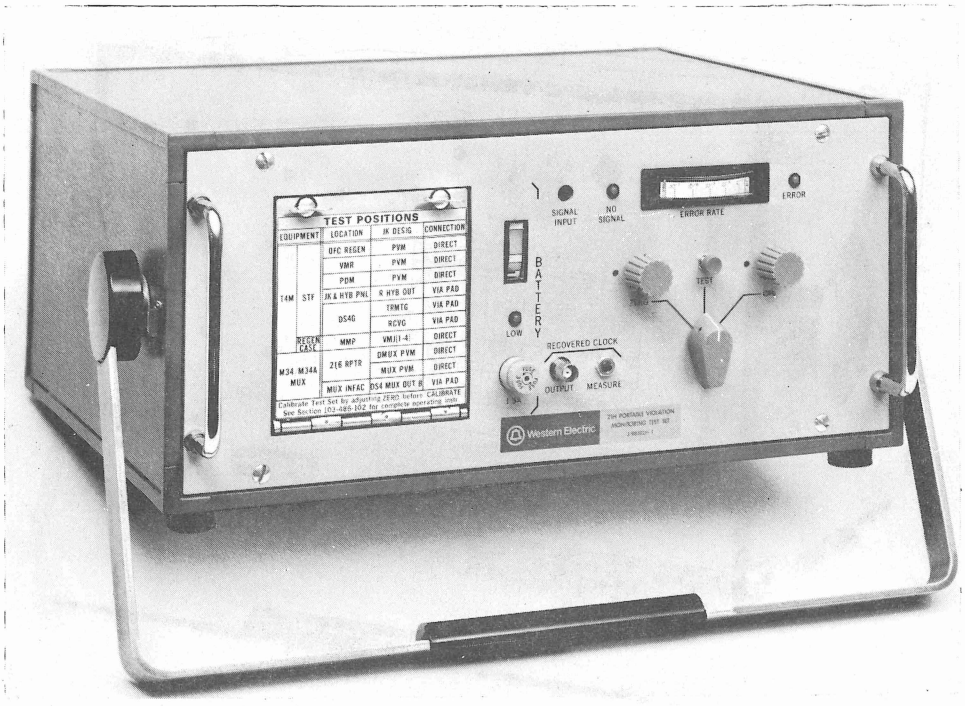

Fig. 6—21H Portable Violation Monitoring Test Set for Use on T4M Digital Lines

1.45.) A single plug and cord assembly along with appropriate pads are provided in order to utilize this test set.

21J Portable Signal Generator (J98721J)

1.43 The 21J PSG, Fig. 7, is a unit designed for use in maintenance offices as a bench set in conjunction with the 21F RTS or in maintenance aisles as an installation and maintenance tool. It is ac powered and weighs approximately 28 pounds. Including its fabricated aluminum housing, it measures 11 inches high, 16 inches wide, and 13 inches deep. Due to relatively high internal heat generation, the unit uses self-contained forced air cooling. Appropriate cord and plug assemblies are provided with the test set.

Common Plug-In Complements

1.44 The J98721K common plug-in complements for STFs provide the basic collections of plug-ins for STFs as a function of the various common options offered and selected by the customer when engineering the system. Per line plug-ins are not included and are to be ordered separately as indicated in **4.** and **5.**, along with Sections 855-353-100 and 855-353-101.

Battery Charging Rectifier

1.45 The KS-21797 L1 battery charging rectifier, used for servicing the KS-20431 L2 batteries used in both the 21G TTS and the 21H PVM, measures 17 inches wide, 15 inches deep, and 7 inches high. It is provided with an ac line cord for powering. An abbreviated operating procedure is located on the unit. Charged batteries can be stored in this unit. See Section 103-486-105.

Apparatus and Circuit Pack Coded Plug-ins

1.46 These codes are tabulated for reference purposes in Table A since they form part of the T4M system. However, it is not expected that they will be maintained in the field except for direct replacement. For this reason detailed circuit information is not always included in system documentation. See Table B for an application guide for T4M plug-ins and Table C for an application guide for T4M ap-

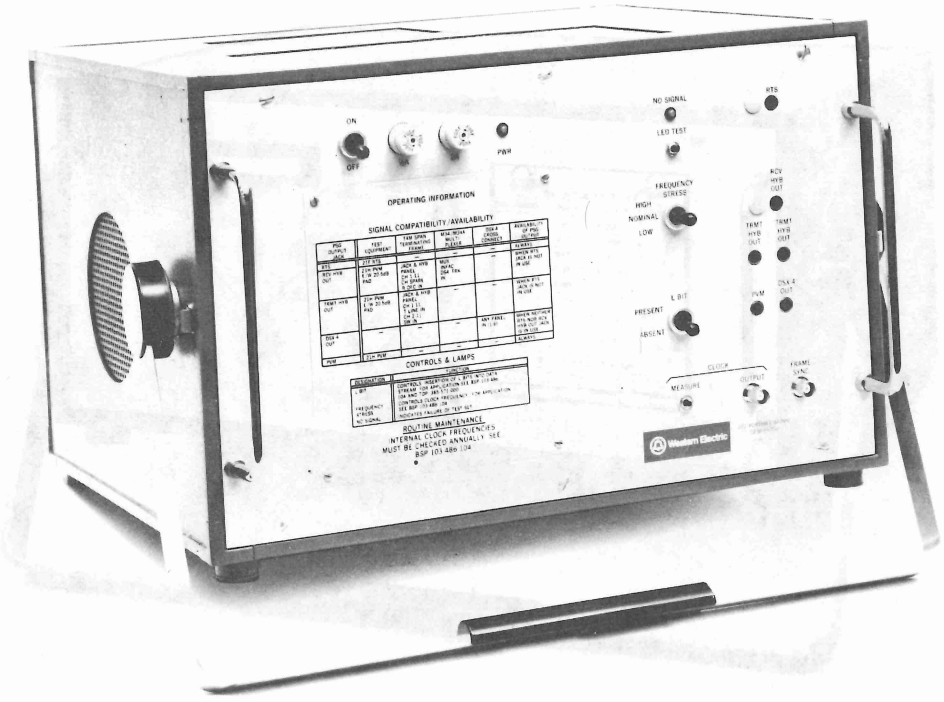

Fig. 7—21J Portable Signal Generator for T4M Installation and Maintenance Tests

paratus blanks. Additional application details are to be found in the engineering rules, Section 855-353-101.

FLOOR PLAN ARRANGEMENT

1.47 Transmission aspects for floor plan layouts of T4M frames in MOs and ADOs are covered in the engineering rules. Standard NEBS (see 5.09) spacing of STFs (ie, 2 feet 6 inches for the front aisle and 2 feet 0 inch for the rear aisle) is permissible providing proper precautions are taken in the design of the building air conditioning and distribution system to account for the high power dissipation. Reference should be made to Section 802-011-150, which covers the J85512 modular cooling system and the KS-21344 diffuser. The maximum dissipation in a fully equipped J98721A STF is approximately 600 watts. In a fully equipped J98721B STF, it is approximately 975 watts. Since the STF is a primary maintenance and administration point for the T4M digital line, a wider maintenance aisle is desirable whenever possible. In view of the relatively high heat generation and the maintenance considerations, it is recommended that the use of a 3-foot 6-inch maintenance aisle or locating the frames in a position along the floor bay perimeter be considered. In following this recommendation, no special precautions need be taken in the design of the building air conditioning and distribution system. (See FPD 801-523-152-1 and FPD 801-523-152-2.)

1.48 Schematic documentation for the T4M digital line and its associated test sets consists of the following:

CIRCUIT DRAWING	TITLE
SD-51110-01	Power Separation Filter Circuit
SD-99610-01	Application and Interconnection Circuits
SD-99611-01 (Mfr Disc.)	Power Separation Filter Circuit
SD-99612-01	Office and Maintenance Circuit Pack Schematic
SD-99613-01	Span Terminating Frame Circuit
SD-99615-01	21H Portable Violation Monitoring Test Set Circuit
SD-99616-01	21J Portable Signal Generator Circuit
SD-99617-01	21F Regenerator Test Set Circuit
SD-99618-01	21G Transmission Test Set Circuit
SD-99619-01	21E Fault Locating Test Set Circuit

2. SUPPLEMENTARY INFORMATION

Bell System Practices

801-000-000—Numerical Index—Common Systems
800-600-000—Checking List—General Equipment Requirements
800-610-164—NEBS General Equipment Requirements
801-523-183—Performance Requirements—Span Terminating Frame
801-525-181—Performance Requirements—M13 Digital Multiplex
801-525-182—Performance Requirements—M34A Digital Multiplex
852-307-100—V4 Telephone Repeaters—Engineering Message Circuits
852-307-102—Engineering—Loss and Gain Calculations
855-346-100—Engineering Considerations on the Joint Usage of L5 and T4M
855-353-100—T4M Digital Line Engineering Considerations
855-353-101—System Application—T4M Digital Line—Transmission and Outside Plant Design Guide
081-420-105—Coaxial Materials and Tools
103-486-100—21F Regenerator Test Set—Description, Operation, and Maintenance
103-486-101—21E Fault Locating Test Set—Description, Operation, and Maintenance
103-486-102—21H Portable Violation Monitoring Test Set—Description, Operation, and Maintenance
103-486-103—21G Transmission Test Set—Description and Maintenance
103-486-104—21J Portable Signal Generator—Description, Operation, and Maintenance
103-486-105—KS-21797 L1 Battery Charging Rectifier for KS-20431 L2 Batteries

103-487-100—DS3 Error Rate Test Set (KS-21366, KS-21424)—Description, Operation, and Maintenance
106-020-114—100-Type Communication Sets—Description and Use
106-020-135—AT-8465, L1A—4D Pressure Transducer
106-220-111—Megger Test Sets, High Voltage Types—Description
106-230-100—KS-14959 Test Set (Portable Wheatstone Bridge)—Description and Maintenance
161-202-100—120-, 130-, 140-Type Power Units—DC-DC Converters, PWC Summarizing Specification
167-694-100—DC Power Plants—680B Power Supply Circuit Spare and Test Load—Description
167-697-302—680B Power Plant—TOP Manual
201-646-101—General Purpose 4-Wire Order Circuit System
365-011-300—Service Maintenance Plan for T4M Digital Line and M13/M34A Multiplexes
365-303-101—DSX3 Patch and Cross Connect—General Description
365-304-101—DSX4 Patch and Cross Connect—General Description
365-320-100—T1 Carrier System Order Wire Facility—Description
365-550-100—T4M Digital Line—General Description
365-550-101—T4M Span Terminating Frame—Description
365-550-103—T4M Regenerator—Description
365-550-104—DC Power Plants—J87412 Power Supply—Description and Use
365-550-105—T4M Digital Line Manhole Maintenance Electronics—Description
365-550-106—T4M Digital Line Fault Locating System
365-550-107—100A Card Storage Unit for Use on T4M Digital Lines—Description and Use
365-550-300—Digital Transmission System—Service Maintenance Plan
365-571-000—T4M Digital Line—TOP Manual
365-603-100—M34A Multiplex—General Description
365-603-103—M34 Multiplex—General Description
365-671-000—M13/M34 Multiplexes—TOP Manual
620-140-501—Testing and Ventilating Manholes
622-506-100—Manholes, Precast Concrete—38Y Type—Description
622-506-200—Manholes, Precast Concrete—38Y Type—Installation
622-507-236—Manholes, Hardened Systems Case-In-Place Construction
626-759-151—Polyethylene Insulated Conductor Cable—19GA, 0.083 μF, Type BHB
626-759-170—PVC Insulated Terminating Cables—24 GA
628-200-210—Underground Placement of Coaxial Cable
631-710-210—Video and Coaxial Cable Terminals—Carrier System—Coaxial Terminals—Description and Mounting
631-710-220—Video and Coaxial Terminals—Carrier Systems—Non-Coaxial Terminals
632-035-120—Cable Type Standard (Serrated Seam) Coaxial Cables—Description
632-425-205—Splicing Multiple Tube Coaxial Cable—Serrated Seam
632-425-207—Procedures for Splicing Composite Cable
633-200-201—Lead Calcium Sleeves—Description and Installation
633-330-210—Plastic Joints—End Plate Kits for L4 and L5 Carrier and T4M Digital Line
634-320-010—Identification of Coaxials and General Precautions
634-320-502—Testing Fault Location Coaxial Cable Adaptors and Cords
634-320-506—Corona Noise Location Test Set—Use
634-320-550—Locating Faults in Coaxial Cable
634-414-201—21G Transmission Test Set—Use
634-414-210—TDR Test Set for T4M—Use
636-250-101—32A1 Protector Housing—Description and Installation
637-080-100—Toll Cable—Pressure Transducer Systems—Description and Operation
637-080-105—Toll Cable—Transducer System—B Transducer Controller—Description and Operation
637-080-200—Toll Cable—D Pressure Transducer and B Dummy Transducer—Description and Installation
637-211-100—P—Pressure Contactor
637-213-100—N—Pressure Contactor
637-222-100—Pressure Monitoring Devices—E Underground Pressure Transducer System (AT-8651, AT-8652, AT-8653)—Use, Description, and Installation
637-600-010—Cable Pressure Monitoring System
640-010-015—T4M Digital Line Cable Entrance
640-400-190—Joint Usage of L5 and T4M—Manhole Arrangements
640-540-101—T4M Outside Plant Construction and Testing—General Sequence

640-540-106—Description and Maintenance—471M1 Apparatus Case
640-540-107—Description and Maintenance—472H1 Apparatus Case
640-540-150—Installation and Replacement of T4M Manhole Plug-Ins
640-540-230—T4M Outside Plant Apparatus—Layout and Equipping of T4M Manhole
640-540-401—Preparation, Requirements, and Completion Tests—T4M Coaxial Tubes and Wire Pairs
644-200-040—Cable Maintenance—Toll Cable Restoration—General
644-200-041—Cable Maintenance — Hardware Description
644-200-042—Toll Cable Restoration Procedures—Coaxial Cables
644-200-043—90A Test Set Description and Operation
644-200-044—T4M Digital Line, Restoration Procedures
795-209-400—Common Language Encoder for T4M Span Terminating Frames
795-209-401—Common Language Encoder for T4M Power Separation Cabinet
795-209-415—Common Language Encoder for T4M Circuit Packs
795-209-416—Common Language Encoder for T4M Group Circuit Packs
795-209-417—Common Language Encoder for T4M Line Build-Out Circuit Packs
795-209-418—Common Language Encoder for T4M Fault Locating Filters
795-209-431—Common Language Encoder for T4M Noncoaxial Facility Protection
795-209-434—Common Language Encoder for T4M Power Separation Filters
795-209-435—Common Language Encoder for T4M Power Units
795-209-436—Common Language Encoder for T4M Apparatus Cases
795-209-437—Common Language Encoder for T4M Regenerators
795-209-440—Common Language Encoder for T4M Switch Units
795-209-485—Common Language Encoder for T4M Test Equipment
795-210-415—Common Language Encoder Converter For T4M Circuit Packs
795-210-416—Common Language Converter For T4M Group Circuit Pack
795-210-417—Common Language Converter For T4M Line Build-Out Circuit Packs
795-210-418—Common Language Converter For T4M Fault Locating Filters
795-210-431—Common Language Converter For T4M Noncoaxial Facility Protection
795-210-434—Common Language Converter For T4M Power Separation Filters
795-210-435—Common Language Converter For T4M Power Units
795-210-436—Common Language Converter For T4M Apparatus Cases
795-210-437—Common Language Converter For T4M Regenerators
795-210-440—Common Language Converter For T4M Switch Units
795-210-485—Common Language Converter For T4M Test Equipment
919-240-100—Underground Conduit—General

J Specifications

J1A054—801-801-155—Lineup Cable Racks and Cross Aisle Cable Troughs for 7-Foot Framework Electronic Switching Type
J1G032—811-019-153—SS3 Order Wire
J68769—804-627-156—Telephone Set Panel
J68919—804 631-151—Power Separation Filter
J85512—802-011-150—Modular Cooling System
J85515—802-015-160—CO Lighting, Fluorescent Type
J86899—802-867-151—680B Power Plant—Power Systems
J87304—802-233-150—-48 Vdc to -24 Vdc Converter for General Purpose Order Wire
J87412—802-304-156—Line Feed Converter for T4M Digital Line—Power Systems
J90606—801-006-158—Cableway System for No. 4 ESS and Transmission Equipment on 7-Foot Frames
J90609—801-006-161—Application of Dropped Air Diffuser
J97039—801-015-152—Universal Framework (Uniframe)
J98615—801-406-151—Mounting for 227-Type Amplifiers
J98710—801-523-150—T1 Carrier System — Order Wire Facility
J98723—801-525-153—M34 Digital Multiplex Equipment
J98724—801-525-154— M13 Digital Multiplex Equipment
J99340—801-026-155—General Purpose 4-Wire Order Circuit

Installation Engineering

Handbook 219, Section 814

Engineering Information

X-74300—Building Engineering Standards (see 5.09)
X-74500—Equipment Design Requirements (see 5.09)

Plant Training Course

PTC No. 291, T4M Digital Carrier

Manufacturing Testing Requirements Specifications

Manufacturing test specifications for products not contained in this list are covered in the appropriate circuit description or A-requirements drawings.

X-18032—Type 3 Regenerators
X-78838—21E Fault Locating Test Set
X-78839—21F Regenerator Test Set
X-78840—21G Transmission Test Set
X-78841—21H Portable Violation Monitoring Test Set
X-78858—J68919AW,L2 Power Separation Filter
X-78924—21J Portable Signal Generator

D Specifications

D-180755 Restoration Cover
D-180756 Restoration Cover Extender
D-180757 Jack Access Extender

KS Specifications

KS-20431 L2—Battery
KS-21344—Diffuser
KS-21797 L1—Battery Charging Rectifier

Floor Plan Data

FPD 801-523-152-1 (Formerly FPD Section 7.1, Sh 174)
FPD 801-523-152-2 (Formerly FPD Section 7.1, Sh 175)

Equipment Requirements

ED-2C185-01—System Application and Interconnecting Information, T-Carrier Administration System
ED-2C441-01—Grounding Methods for High Speed Digital Transmission Equipment
ED-2C447-01—Installation Guide for High Speed Digital Transmission Equipment

3. DRAWINGS

For additional drawings forming a part of this specification, see listings under **SUBDIVISIONS OF EQUIPMENT AND DETAILED INDEX.**

Circuits

SD-1C245-01—General Purpose Order Circuit
SD-1G228-01—SS-3 Order Wire Circuit
SD-1G265-01—SS-3 Selective Signaling System
SD-1P083-01—Digital Transmission Network, Order Wire Applique Schematic
SD-5G141-01—L4 Carrier Order Wire Circuit
SD-51110-01—Power Separation Filter Circuit
SD-56073-01—L or N Carrier Telephone Set Circuit
SD-82046-01—DC Distribution Circuits for Digital Systems
SD-82128-01—680B Power Supply Circuit
SD-82129-01—680B Power Supply Spare and Test Load Circuit
SD-82229-01—T4M Line Feed Converter Circuit
SD-96607-01—T Carrier Administration Application Schematic
SD-96621-01—Digital Facilities Interconnection Circuit (DS3 and DS4)
SD-97047-01—44V4-Type Repeater Circuits
SD-97085-01—T1 Carrier Order Wire Circuit
SD-99503-01—Digital Facilities Interconnection Circuit (DS1 and DS2)

Equipment

ED-1A198-( )—End Guards for J97039 Framework
ED-1A210-( )—Method of Installing End Guards.
ED-1A228-( )—Aisle Directory Designation Plates
ED-2C340-( )—DS3 and DS4 Cross Connect Bays (DSX3 and DSX4)
ED-97735-( )—Single Bay Uniframe Framework, 7' -0" High, 1' -0" Deep
ED-97736-( )—Double Bay Uniframe Framework, 7' -0" High, 1' -0" Deep
ED-97774-( )—Stile Strips for J97039 Framework
ED-97776-( )—Frame Designation Label Holder for J97039 Framework
ED-97784-( )—Method of Grounding Uniframe Framework
ED-97785-( )—Method of Installing Uniframe Framework, Adapter Plates, Stile Strips and the Frame Designation Holder

ED-97791-( )—Hardware for Junction and Attaching Uniframe Frame
ED-97795-( )—Base Cover and Appliance Outlet Distribution
J68919AW-( ),L2Power Separation Filters
J87412A-( )—T4M Line Feed Converter

4. EQUIPMENT

ED-2C219—AT&TCo Std Regenerator Enclosure and Umbilical Assembly

Group 1—Regenerator enclosure and umbilical assembly for use with the 21G transmission test set per SD-99618-01, App Fig. 3.

ED-2C220—AT&TCo Std—STF FL Shelf Assembly

ED-2C223—AT&TCo Std—FLTS Interconnect PWB Assembly

ED-2C224—AT&TCo Std—FLTS Terminal Board Assembly

ED-2C225—AT&TCo Std—Terminal Strip Panel Assembly

ED-2C226—AT&TCo Std—Fuse and Filter Panel Assembly

ED-2C227—AT&TCo Std—Alarm Shelf Assembly

ED-2C228—AT&TCo Std—STF Power Supply Shelf Assembly

ED-2C229—AT&TCo Std—PSC Shelf Assembly

ED-2C230—AT&TCo Std—STF Jack and Hybrid Shelf Assembly

ED-2C231—AT&TCo Std—STF Regenerator Shelf Assembly

ED-2C232—AT&TCo Std—Heat Baffle Assembly

ED-2C233—AT&TCo Std—STF VMR Shelf Assembly

ED-2C234—AT&TCo Std—Cabling for STF

ED-2C235—AT&TCo Std—DNOW Panel Assembly

Group 1—Assembly, wiring, and equipment for one DNOW panel for use on T4M STF per SD-99613-01, App Fig. 21.

ED-2C236—AT&TCo Std—Order Wire Jack Panel

Group 1—Assembly and equipment for one order wire jack panel for miscellaneous application. (Intended for use on T4M line feed converter bay.)

ED-2C237—AT&TCo Std—Test Set Enclosure and Cover Assemblies

ED-2C238—AT&TCo Std—Office Regenerator Interface Assembly

Group 1—Office regenerator interface assembly for use with the 21F regenerator test set per SD-99617-01, App Fig. 2.

ED-2C239-( )—Line Regenerator Interface Assembly

Group 1—Line regenerator interface assembly for use with the 21F regenerator test set per SD-99617-01, App Fig. 3.

ED-2C240—AT&TCo Std—VMR Protection Evaluation Circuit Pack (T4CP)

Group ( )—Assembly, wiring, and equipment for one VMR protection evaluation circuit pack PWB assembly. One of four circuit packs required to make a protection line VMR per SD-99612-01 (customer is to order latest group number available).

ED-2C241—AT&TCo Std—VMR Evaluation Circuit Pack (T4CP)

Group ( )—Assembly, wiring, and equipment for one VMR evaluation circuit pack PWB assembly. One of four circuit packs required to make a service line VMR per SD-99612-0L (customer is to order latest group number available).

ED-2C530—AT&TCo Std—Method of Cabling Plan

J98721A—AT&TCo Std—Span Terminating Frame for up to Six 2-Way T4M Lines on 7-Foot 0-Inch Uniframe Bay Framework (T4BT)

List 1—Framework, wiring, and common equipment for one span terminating frame with six 2-way circuits per SD-99613-01.

List 2—Wiring and equipment required in addition to list 1 for use when -48 volt battery is used for frame power per SD-99613-01, App Fig. 9, option W.

List 3—Wiring and equipment required in addition to list 1 for use where +140 volt battery is used for frame power per SD-99613-01, App Fig. 10, option X.

List 4—Assembly, wiring, and equipment required in addition to lists 1 and 2 or lists 1 and 3 when the J98721A frame is to be used with the digital network order wire, per SD-99613-01, App Fig. 21.

List 5—Reserved.

J98721B—AT&TCo Std—Span Terminating Frame for up to 11 2-Way T4M Lines on Dual 7-Foot 0-Inch Uniframe Bay Framework (T4BT)

List 1—Framework, wiring, and common equipment for one span terminating frame with eleven 2-way circuits per SD-99613-01.

List 2—Wiring and equipment required in addition to list 1 for use when -48 volt battery is used for frame power, per SD-99613-01, App Fig. 9, option W.

List 3—Wiring and equipment required in addition to list 1 for use when +140 volt battery is used for frame power, per SD-99613-01, App Fig. 10, option X.

List 4—Assembly, wiring, and equipment required in addition to lists 1 and 2 or lists 1 and 3 when the J98721B frame is to be used with the digital network order wire, per SD-99613-01, App Fig. 21.

List 5—Reserved.

J98721C—Reserved

J98721D—Reserved

J98721E—AT&TCo Std—21E Fault Locating Test Set for Portable Use on T4M Lines (T4TE)

List 1—Assembly, wiring, and equipment for one 21E fault locating test set per SD-99619-01.

J98721F—AT&TCo Std—21F Regenerator Test Set for T4M Regenerator Bench Tests (T4TE)

List 1—Assembly, wiring, and equipment for one 21F regenerator test set per SD-99617-01.

J98721G—AT&TCo Std—21G Transmission Test Set for Portable Use on T4M Lines (T4TE)

List 1—Assembly, wiring, and equipment for one 21G transmission test set per SD-99618-01.

List 2—Assembly, wiring, and equipment required for one 21G transmission test set equipped with a 3E regenerator per SD-99618-01. (See Note A.)

Note

A. A 3E regenerator is required when a 21G transmission test set is used as a receiver. (See 1.21.)

J98721H—AT&TCo Std—21H Portable Violation Monitoring Test Set for Portable Use on T4M Lines (T4TE)

List 1—Assembly, wiring, and equipment for one 21H portable violation monitoring test set per SD-99615-01.

J98721J—AT&TCo Std—21J Portable Signal Generator for Use on T4M Lines and Regenerator Bench Tests (T4TE)

List 1—Assembly, wiring, and equipment for one 21J portable signal generator per SD-99616-01.

J98721K—AT&TCo Std—Common Equipment Plug-In Complements for T4M Span Terminating Frames (See Note A) (T4GP)

List 1—Basic plug-in units required for one J98721A or B span terminating frame to equip it with line drive, fault locating, and alarm circuits

per SD-99613-01, App Fig. 7, 11, and 18: including one each KA10, KA11, KA30, KC1, KG1, KG24, KM1, KN1, KN2, KN3, KN4, and KN5 CPs; two each KG2 (see Note B); 100A card storage unit; and a 403B switch. (See Note C.)

List 2—Basic plug-in units required in addition to list 1 for one J98721A or B span terminating frame to equip it for protection switching per SD-99613-01, Fig. 5, option Z: including one each KA6, KA7, KA8, KB2, KB3, KB4, KB5, and KB6 CPs; two 402A switches; and one 404B switch.

List 3—Basic plug-in units required in addition to list 1 for one J98721A or B span terminating frame when it is not to be equipped for protection switching per SD-99613-01, Fig. 5, option Y: including two KA13; two KK1; and one KJ2 CP.

List 4—Basic plug-in unit required in addition to list 1 for one J98721A or B span terminating frame when it is to be equipped for E-type or equivalent remoting per SD-99613-01, Fig. 12, including one KN5 CP.

List 5—Reserved.

List 6—Reserved.

List 7—Basic plug-in unit required in addition to list 1 for one J98721B span terminating frame when it is to be equipped beyond six 2-way lines per SD-99613-01, Fig. 8, including one KA11 CP.

List 8—Basic plug-in units required in addition to list 1 for one J98721A or B span terminating frame for use with -48 volt battery per SD-99613-01, Fig. 16, option W and Fig. 18, option W; including one each 132A and 136B power units.

List 9—Basic plug-in units required in addition to list 1 for one J98721A or B span terminating frame for use with +140 volt battery per SD-99613-01, Fig. 16, option X and Fig. 18, option X; including one each 142A and 146B power units.

List 10—Basic plug-in unit required in addition to list 1 when lists 2 and 4 are selected to provide remoting circuits for common protection switching function per SD-99613-01, Fig. 14, including one KB8 CP.

List 11—Basic plug-in unit required in addition to list 1 for one J98721A or B span terminating frame when it is to be equipped for additional fault locating subspans per SD-99613-01, Fig. 20, including one KM1 CP. (See Note D.)

Notes

A. For per line plug-ins, see 5.01.

B. CP KG2 must be equipped prior to its installation with 1094-type filter selected according to Section 855-353-101.

C. In addition to the list 1 circuit packs, a build-out card must be selected from the KG3 through KG18 family of CPs for 19-AWG (0.083 μF/mile) wire pairs, from the KG25 through KG39 family of CPs for 22-AWG (0.083 μF/mile) wire pairs, or from the KG40 through KG55 family of CPs for 19-AWG (0.062μF/mile) wire pairs according to Section 855-353-101.

D. One list 11 is required for each fault locating subspan after the first, up to a maximum of three lists 11.

5. GENERAL NOTES AND INDEXES

5.01 Per line plug-ins shall be ordered separately per SD-99613-01. Table B is provided as an assist and gives an overview of all common and per line plug-ins.

5.02 In addition to the special test sets listed in 1.18, maintenance practices will occasionally call for the use of other test equipment that is normally found in COs and include such items as a digital voltmeter, a 3C noise meter, and wire pair fault locating sets.

5.03 Abbreviations used in this specification are consistent with the abbreviations used through the T4M system documentation and are as follows:

ACO—**A**larm **C**ut-**O**ff
ADO—**A**dd/**D**rop **O**ffice
AS—**A**uxiliary **S**tation
CO—**C**entral **O**ffice
CP—**C**ircuit **P**ack
DDD—**D**irect **D**istance **D**ialing (typically used to denote a circuit similar to subscriber circuit)
DNOW—**D**igital **N**etwork **O**rder **W**ire
DS4G—**DS4** **S**ignal **G**enerator
FL—**F**ault **L**ocating
FLPC—**F**ault **L**ocating **P**ower **C**onverter
FLPD—**F**ault **L**ocating **P**ilot **D**etector
FLPG—**F**ault **L**ocating **P**ilot **G**enerator
FLTS—**F**ault **L**ocating **T**est **S**et
LFC—**L**ine **F**eed **C**onverter

MMP—Manhole Maintenance Package
MO—Maintenance Office
MU—Maintenance Unit
NEBS—New Equipment Building Standards (see 5.09)
OW—Order Wire
PDM—Protection Data Multiplexer
PSC—Protection Switching Circuit
PSF—Power Separation Filter
PSG—Portable Signal Generator
PVM—Portable Violation Monitoring Test Set
RR—Receiving Regenerator
RS—Repeater Station (typically a manhole or CO containing T4M regenerators)
RTS—Regenerator Test Set
SS-3—Selective Signaling System for Order Wire Application
STF—Span Terminating Frame
TR—Transmitting Regenerator
TTS—Transmission Test Set
VF—Voice Frequency
VMR—Violation Monitor and Remover

Spare Parts

5.04 It is recommended that sparing levels for plug-ins be maintained at 10 percent or one unit, whichever is larger, at MOs or at other convenient maintenance centers so that maintenance procedures can be readily implemented. These recommendations are based on the anticipated performance of the equipment covered in this specification and their fulfillment of system objectives. As such, the above should not be misconstrued as representative of this type of equipment in general nor should this be used as a precedent for other equipments.

5.05 As referenced in 1.06, additional maintenance office equipment must be selected from the following. The specific options and quantities are covered in Section 855-353-101.

32A1—Protector Cabinet, Equipped With 127A1A-52 Protector Blocks and 200A Terminal Strips (T4PC)
J68919E,L1 and L3—Power Separation Filter Cabinet (9 feet-0 inch)
J68919L,L1 and L3—Power Separation Filter Cabinet (7-feet-0-inch)
J68919AW,L2—Power Separation Filter Panel
J86899A—Power Supply
J86899B—Power Supply Spare and Test Load
J87412A—Line Feed Converter
ED-52286-30,G3—PSF Shelf Assembly

5.06 The following items are to be ordered for the outside plant when equipping manhole repeater stations. The options, quantities, and intervals are covered in Section 640-540-230.

D Pressure Transducer

N Pressure Contactor

66A2-2( )—Coaxial Cable Terminal (of specified length)

66A2-4( )—Coaxial Cable Terminal (of specified length)

85A—Bracket

85C—Bracket

172A—Adapter (90° elbow)

244A—Adapter

100A1-4—25-Foot Pair Cable Terminal

100B1-4—Talk and Gas Pressure Terminal

471M1—Regenerator Apparatus Case

472H1—Maintenance Apparatus Case

480A—Dummy Apparatus Case

5.07 In addition to the plant items covered in 5.06, the following electronic items are to be ordered for use in equipped manhole repeater stations. Quantities of each are covered in the engineering rules.

3( )—Line Regenerators

KG2—Circuit Pack Equipped With a 1094-Type Filter

KH1—Circuit Pack (A&M Only)

KH2—Circuit Pack

KG3 through KG18—Circuit Packs (select proper code for use on 19-AWG 0.083 μF/mile wire)

KG25 through KG39—Circuit Pack (select proper code for use on 22-AWG 0.083 μF/mile wire)

KG40 through KG55—Circuit Pack (select proper code for use on 19-AWG 0.062 μF/mile wire).

437QA—Blocking Capacitors

5.08 For complete STF installations, stile strips are required and may be selected as follows: ED-97774-( ),GR1 for all single bay frames and includes both the left and right stile stripping; ED-97774-( ),GR2 for all double bay frames and includes left, right, and center stile strips; ED-97774-( ),GR7 for frames when not equipped with frame supported cable racks (one required for each single frame, two for each double frame) and includes top stile strips; ED-97776-( ) label holder used with J90606 or J1A054 bay supported cable racks. Frame base covers and ac outlets per ED-97795 are to be selected for bay line-ups that contain T4M STFs. This is covered in detail in ED-2C447-01, Installation Guide for High Speed Digital Transmission Equipment.

5.09 The documents X-84300, Building Engineering Standards, and X-74500, Engineering Design Requirements, are part of NEBS. Specification X-74300 applies primarily to building and line engineering and specifies standards for CO layout and design. Specification X-74500 applies to all new systems of CO equipment covering only that portion of design concerning the spatial and environmental equipment-building interface.

SUBDIVISIONS OF EQUIPMENT AND DETAILED INDEX

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

EQUIPMENT CODE	AT&T RATING OF UNIT	TITLE	EQUIPMENT DRAWING	CIRCUIT DRAWING
ED-2C219-( )	Std	Regenerator Enclosure and Umbilical Assembly	ED-2C219-( )	SD-99618-01
ED-2C220-( )	Std	STF FL Shelf Assembly	ED-2C220-( )	SD-99613-01
ED-2C223-( )	Std	FLTS Interconnect PWB Assembly	ED-2C223-( )	SD-99619-01
ED-2C224-( )	Std	FLTS Terminal Board Assembly	ED-2C224-( )	SD-99619-01
ED-2C225-( )	Std	Terminal Strip Panel Assembly	ED-2C225-( )	SD-99613-01
ED-2C226-( )	Std	Fuse and Filter Panel Assembly	ED-2C226-( )	SD-99613-01
ED-2C227-( )	Std	Alarm Shelf Assembly	ED-2C227-( )	SD-99613-01
ED-2C228-( )	Std	STF Power Supply Shelf Assembly	ED-2C228-( )	SD-99613-01
ED-2C229-( )	Std	PSC Shelf Assembly	ED-2C229-( )	SD-99613-01
ED-2C230-( )	Std	STF Jack and Hybrid Shelf Assembly	ED-2C230-( )	SD-99613-01

EQUIPMENT CODE	AT&T RATING OF UNIT	TITLE	EQUIPMENT DRAWING	CIRCUIT DRAWING
ED-2C231-( )	Std	STF Regenerator Shelf Assembly	ED-2C231-( )	SD-99613-01
ED-2C232-( )	Std	Heat Baffle Assembly	ED-2C232-( )	—
ED-2C233-( )	Std	STF VMR Shelf Assembly	ED-2C233-( )	SD-99613-01
ED-2C235-( )	Std	DNOW Panel Assembly	ED-2C235-( )	SD-99613-01
ED-2C236-( )	Std	Order Wire Jack Panel	ED-2C236-( )	—
ED-2C237-( )	Std	Test Set Enclosure and Cover Assemblies	ED-2C237-( )	—
ED-2C238-( )	Std	Office Regenerator Interface Assembly	ED-2C238-( )	SD-99617-01
ED-2C239-( )	Std	Line Regenerator Interface Assembly	ED-2C239-( )	SD-99617-01
ED-2C240-( )	Std	VMR Protection Evaluation Circuit Pack	ED-2C240-( )	SD-99612-01
ED-2C241-( )	Std	VMR Evaluation Circuit Pack	ED-2C241-( )	SD-99612-01
ED-2C530-( )	Std	Method of Cabling Plan for T4M	ED-2C530-( )	SD-99610-01 SD-99613-01
J98721A (T4BT)	Std	Span Terminating Frame for up to 6 2-Way T4M Lines on 7-Foot 0-Inch Uniframe Bay Framework	J98721A-( )	SD-99610-01 SD-99613-01
J98721B (T4BT)	Std	Span Terminating Frame for up to 11 2-Way T4M Lines on Dual 7-Foot 0-Inch Uniframe Bay Framework	J98721B-( )	SD-99610-01 SD-99613-01
J98721E (T4TE)	Std	21E Fault Locating Test Set for Portable Use on T4M Lines	J98721E-( )	SD-99619-01
J98721F (T4TE)	Std	21F Regenerator Test Set for T4M Regenerator Bench Tests	J98721F-( )	SD-99617-01
J98721G (T4TE)	Std	21G Transmission Test Set for Portable Use on T4M Lines	J98721G-( )	SD-99618-01
J98721H (T4TE)	Std	21H Portable Violation Monitoring Test Set for Portable Use on T4M Lines	J98721H-( )	SD-99615-01
J98721J (T4TE)	Std	21J Portable Signal Generator for Use on T4M Lines and Regenerator Bench Tests	J98721J-( )	SD-99616-01
J98721K (T4GP)	Std	Common Equipment Plug-In Complements for T4M Span Terminating Frames	J98721K-( )	SD-99612-01 SD-99613-01
J98721C	Reserved			
J98721D	Reserved			

Circuit Schematic Index

CIRCUIT DRAWING	J98721 EQPT CODE
SD-99610-01	A,B
SD-99612-01	ED-2C240 ED-2C241, K
SD-99613-01	ED-2C220, ED-2C225, ED-2C226, ED-2C227, ED-2C228, ED-2C229, ED-2C230, ED-2C231, ED-2C233, ED-2C235, A, B, K
SD-99615-01	H
SD-99616-01	J
SD-99617-01	ED-2C238, ED-2C239, F
SD-99618-01	ED-2C219, G
SD-99619-01	ED-2C223, ED-2C224, E

TABLE A
APPARATUS AND CIRCUIT PACKS

CODE	USAGE	COMMON LANGUAGE
3A Regenerator	Line—Short Equalization	T4RG3A0AAA
3B Regenerator	Line—Medium Short Equalization	T4RG3B0AAA
3C Regenerator	Line—Medium Long Equalization	T4RG3C0AAA
3D Regenerator	Line—Long Equalization	T4RG3D0AAA
3E Regenerator	21G Test Set Only	T4RG3E0AAA
4A Regenerator	RR—Office Receiving Short Equalization	T4RG4A0BAA
4B Regenerator	RR—Office Receiving Medium Short Equalization	T4RG4B0BAA
4C Regenerator	RR—Office Receiving Medium Long Equalization	T4RG4C0BAA
4D Regenerator	RR—Office Receiving Long Equalization	T4RG4D0BAA
4E Regenerator	TR—Office Transmitting Regenerator	T4RG4E0BAA
402A Switch	1 by 10 Coaxial Switch	T4SW400BAA
403B Switch	2 by 2 Coaxial Switch	T4SW500CAA
404B Switch	1 by 2 Coaxial Switch	T4SW600DAA
132A Power Unit	-48 Volt Input Converter	T4PUA00AAA
136B Power Unit	-48 Volt Fault Locating Power Converter	T4PUB00AAA
142A Power Unit	+140 Volt Input Converter	T4PUC00AAA
146B Power Unit	+140 Volt Fault Locating Power Converter	T4PUD00AAA
127D Apparatus Blank	Standin for KA-Type Circuit Packs	—
133A Apparatus Blank	Standin for 403B and 404B Switches	—
	and, 1/2 KM- and KN-Type Circuit Packs	—
134A Apparatus Blank	Standin for 4-Type Regenerator Pairs	—
139A Apparatus Blank	Standin for KB- and KC-Type Circuit Packs	—
140D Apparatus Blank	Standin for T4M STF Power Units	—
100A Card Storage Unit	Provides Record and Operation Information	—

CIRCUIT PACKS

CODE	USAGE	COMMON LANGUAGE
KA1	VMR High Speed	T4CPA01AAA
KA2	VMR Framing	T4CPA02AAA
KA3 (Mfr Disc.)	VMR Protection Evaluation	T4CPA03AAA
KA4 (Mfr Disc.)	VMR Service Evaluation	T4CPA04AAA
KA5	VMR Line Driver	T4CPA05AAA
KA6	PDM Multiplexer	T4CPA06AAA
KA7	PDM Framing	T4CPA07AAA
KA8	PDM Line Driver	T4CPA08AAA
KA9 (Mfr Disc.)	DS4G Scrambler	T4CPA09AAA
KA10	DS4G Line Driver	T4CPA10AAA
KA11	DS4G Output Distribution	T4CPA11AAA
KA12 (Mfr Disc.)	DS4G Oscillator and Framing	T4CPA12AAA
KA13	PDM Dummy	T4CPA13AAA
KA30	DS4G Signal Source	T4CPA30AAA
KB1	PSC Per Channel	T4CPB01AAA
KB2	PSC VMR End Timing	T4CPB02AAA
KB3	PSC VMR End Decision	T4CPB03AAA
KB4	PSC VMR End Control	T4CPB04AAA

TABLE A (Cont)
APPARATUS AND CIRCUIT PACKS

CODE	USAGE	COMMON LANGUAGE
KB5	PSC Head End Timing	T4CPB05AAA
KB6	PSC Head End Decision	T4CPB06AAA
KB7	PSC Add/Drop Interface	T4CPB07AAA
KB8	PSC E-Type Interface	T4CPB0BAAA
KB9	PSC Per Channel Dummy	T4CPB09AAA
KC1	Energy Detector	T4CPC01AAA
KG1	Fault Locating Pilot Generator	T4CPG01AAA
KG2*	Maintenance Unit	T4CPG02AAA
KG3 through KG18	Build-Out Cards for 19-AWG (0.083 μF/mile) Wire	T4NL†
KG23	Dummy Load Cord Coil	T4CPG23AAA
KG24	Load Coil Card	T4CPG24AAA
KG25 through KG39	Build-Out Cards for 22-AWG (0.083 μF/mile) Wire	T4NL†
KG40 through KG55	Build-Out Cards for 19-AWG (0.062 μF/mile) Wire	T4NL†
KH1 (A&M)	Manhole Maintenance Package	T4CPH01AAA
KH2	Manhole Maintenance Package	T4CPH02AAA
KJ1	Dummy Switch-Service	T4SW200EAA
KJ2	Dummy Switch-Protection	T4SW300EAA
KK1	Dummy 1 by 10 Switch	T4SW100AAA
KL1	Hybrid Circuit	—
KM1	Fault Locating Pilot Detector	T4CPM01AAA
KN1	Alarm Input Logic-A	T4CPN01AAA
KN2	Alarm Input Logic-B	T4CPN02AAA
KN3	Alarm Main Logic	T4CPN03AAA
KN4	Alarm Output Logic	T4CPN04AAA
KN5	Alarm Relay Driver	T4CPN05AAA

Note: Besides those codes listed above, additional circuit packs are involved in the makeup of the T4M system, but these are not expected to be accessible to operating company craftspersons. These include those circuit packs internal to the MMP, regenerators, power units, and the test sets.

* The KG2 circuit pack must be equipped with a 1094-type filter prior to its installation. The proper filter codes shall be selected in accordance with Section 855-353-101.

† See Section 795-209-417 for T4NL common language codes.

TABLE B

GUIDE FOR T4M PLUG-IN ADMINISTRATION

FEATURE OR OPTION PER SD-99613-01		WITH PROTECTION SWITCHING (See Note D) Ⓩ				WITHOUT PROTECTION SWITCHING Ⓨ			
		ALARM REMOTING Ⓢ		WITHOUT ALARM REMOTING		ALARM REMOTING Ⓢ		WITHOUT ALARM REMOTING	
		−48V Ⓦ	+140V Ⓧ	−48V Ⓦ	+140V Ⓧ	−48V Ⓦ	+140V Ⓧ	−48V Ⓦ	+140V Ⓧ
COMMON PLUG-INS PER J98721K (See Notes F, G & H)		LISTS 1, 2, 4, 8 & 10 Ⓩ Ⓦ Ⓢ	LISTS 1, 2, 4, 9 & 10 Ⓩ Ⓧ Ⓢ	LISTS 1, 2 & 8 Ⓩ Ⓦ	LISTS 1, 2 & 9 Ⓩ Ⓧ	LISTS 1, 3, 4 & 8 Ⓨ Ⓦ Ⓢ	LISTS 1, 3, 4 & 9 Ⓨ Ⓧ Ⓢ	LISTS 1, 3 & 8 Ⓨ Ⓦ	LISTS 1, 3 & 9 Ⓨ Ⓧ
PER LINE PLUG-INS (See Note C)	CHANNEL 1 Ⓥ	See Note A ED-2C240−( ) CP KN5 CP 132A Pwr Unit	See Note A ED-2C240−( ) CP KN5 CP 142A Pwr Unit	See Note A ED-2C240−( ) CP 132A Pwr Unit	See Note A ED-2C240−( ) CP 142A Pwr Unit	See Note A ED-24240−( ) CP KN5 CP 132A Pwr Unit	See Note A ED-24240−( ) CP KN5 CP 142A Pwr Unit	See Note A ED-24240−( ) CP 132A Pwr Unit	See Note A ED-24240−( ) CP 142A Pwr Unit
	CHANNEL 2, 4, 5, 8, 10, OR 11 Ⓠ	See Note A ED-2C241−( ) CP KB1* CP 403B Sw 404B Sw 132A Pwr Unit	See Note A ED-2C241−( ) CP KB1* CP 403B Sw 404B Sw 142A Pwr Unit	See Note A ED-2C241−( ) CP KB1* CP 403B Sw 404B Sw 132A Pwr Unit	See Note A ED-2C241−( ) CP KB1* CP 403B Sw 404B Sw 142A Pwr Unit	See Note A ED-2C241−( ) CP 2 ea-KJ1 CP 132A Pwr Unit	See Note A ED-2C241−( ) CP 2 ea-KJ1 CP 142A Pwr Unit	See Note A ED-2C241−( ) CP 2 ea-KJ1 CP 132A Pwr Unit	See Note A ED-2C241−( ) CP 2 ea-KJ1 CP 142A Pwr Unit
	CHANNEL 3, 6, OR 9 Ⓠ	See Note A ED-2C241−( ) CP KB1* CP KB8 CP 403B Sw 404B Sw 132A Pwr Unit	See Note A ED-2C241−( ) CP KB1* CP KB8 CP 403B Sw 404B Sw 142A Pwr Unit	See Note A ED-2C241−( ) CP KB1* CP 403B Sw 404B Sw 132A Pwr Unit	See Note A ED-2C241−( ) CP KB1* CP 403B Sw 404B Sw 142A Pwr Unit				
	CHANNEL 7 (See Note F) Ⓠ	See Note A ED-2C241−( ) CP KB1* CP KN5 CP 403B Sw 404B Sw 132A Pwr Unit	See Note A ED-2C241−( ) CP KB1* CP KN5 CP 403B Sw 404B Sw 142A Pwr Unit			See Note A ED-2C241−( ) CP 2 ea-KJ1 CP KN5 CP 132A Pwr Unit	See Note A ED-2C241−( ) CP 2 ea-KJ1 CP KN5 CP 142A Pwr Unit		

*See Note E.

NOTES

A. The following plug-ins are required in addition to the per line plug-ins shown in the table.

   4E Regenerator
   4( ) Regenerator – See Note B
   KA1 CP
   KA2 CP
   KA5 CP

B. The proper code of 4-type regenerator must be selected per section 855-353-101.

C. One of each plug-in is required unless indicated otherwise.

D. When protection switching option Ⓩ is selected, one option Ⓣ is required for each channel not equipped for service. This provides one KB9 CP for each of these unequipped channels. Therefore (10−x) KB9 CPs are required where x is the number of service channels (2-11) equipped.

E. When equipping new channels into an existing system, the KB1 CPs replace the existing KB9 CPs.

F. When the T4M STF is to be equipped beyond six 2-way channels, a common plug-in per J98721K,L7 is required. This provides a KA11 CP.

G. In addition to the common plug-ins per J98721K, a build out must be selected from the KG3 through KG18 CPs for 19-AWG 0.083μF/mile wire pairs; from the KG25 through KG39 CPs for 22-AWG 0.083μF/mile wire pairs; or from the KG40 through KG55 CPs for 19-AWG 0.062μF/mile wire pairs.

H. For each additional fault locating subspan after the first, a common plug-in per J98721K,L11 is required. This is option Ⓡ and provides a KM1 CP.

TABLE C

GUIDE FOR T4M STF APPARATUS BLANK ADMINISTRATION*

FEATURE OR OPTION SELECTED			WITH PROTECTION SWITCHING (Z)																		WITHOUT PROTECTION SWITCHING (Y)																	
			ALARM REMOTING (S)									WITHOUT ALARM REMOTING									ALARM REMOTING (S)									WITHOUT ALARM REMOTING								
			−48V (W)					+140V (X)				−48V (W)					+140V (X)				−48V (W)					+140V (X)				−48V (W)					+140V (X)			
J98721K LISTS EQUIPPED			LISTS 1, 2, 4, 8 & 10 (Z W S)					LISTS 1, 2, 4, 9 & 10 (Z X S)				LISTS 1, 2 & 8 (Z W)					LISTS 1, 2 & 9 (Z X)				LISTS 1, 3, 4 & 8 (Y W S)					LISTS 1, 3, 4 & 9 (Y X S)				LISTS 1, 3 & 8 (Y W)					LISTS 1, 3 & 9 (Y X)			
APPARATUS BLANK CODE			127D	133A	134A	139A	140D	127D	133A	134A	139A	140D	127D	133A	134A	139A	140D	127D	133A	134A	137A	140D	127D	133A	134A	139A	140D	127D	133A	134A	139A	140D	127D	133A	134A	139A	140D	127D	133A	134A	139A	140D
NUMBER OF STF CHANNELS EQUIPPED	J98721A FRAME	2	16	29	4	4	4	16	29	4	4	4	16	30	4	5	4	16	30	4	5	4	17	28	4	20	4	17	28	4	20	4	17	29	4	20	4	17	29	4	20	4
		3	12	27	3	3	3	12	27	3	3	3	12	28	3	5	3	12	28	3	5	3	13	26	3	20	3	13	26	3	20	3	13	27	3	20	3	13	27	3	20	3
		4	8	25	2	3	2	8	25	2	3	2	8	26	2	5	2	8	26	2	5	2	9	24	2	20	2	9	24	2	20	2	9	25	2	20	2	9	25	2	20	2
		5	4	23	1	3	1	4	23	1	3	1	4	24	1	5	1	4	24	1	5	1	5	22	1	20	1	5	22	1	20	1	5	23	1	20	1	5	23	1	20	1
		6	0	21	0	2	0	0	21	0	2	0	0	22	0	5	0	0	22	0	5	0	1	20	0	20	0	1	20	0	20	0	1	21	0	20	0	1	21	0	20	0
	J98721B FRAME	2	44	29	10	4	10	44	29	10	4	10	44	30	10	5	10	44	30	10	5	10	45	28	10	20	10	45	28	10	20	10	45	28	10	20	10	45	28	10	20	10
		3	40	27	9	3	9	40	27	9	3	9	40	28	9	5	9	40	28	9	5	9	41	26	9	20	9	41	26	9	20	9	41	26	9	20	9	41	26	9	20	9
		4	36	25	8	3	8	36	25	8	3	8	36	26	8	5	8	36	26	8	5	8	37	24	8	20	8	37	24	8	20	8	37	24	8	20	8	37	24	8	20	8
		5	32	23	7	3	7	32	23	7	3	7	32	24	7	5	7	32	24	7	5	7	33	22	7	20	7	33	22	7	20	7	33	22	7	20	7	33	22	7	20	7
		6	28	21	6	2	6	28	21	6	2	6	28	22	6	5	6	28	22	6	5	6	29	20	6	20	6	29	20	6	20	6	29	20	6	20	6	29	20	6	20	6
		7	23	18	5	2	5	23	18	5	2	5	23	20	5	5	5	23	20	5	5	5	24	17	5	20	5	24	17	5	20	5	24	18	5	20	5	24	18	5	20	5
		8	19	16	4	2	4	19	16	4	2	4	19	18	4	5	4	19	18	4	5	4	20	15	4	20	4	20	15	4	20	4	20	16	4	20	4	20	16	4	20	4
		9	15	14	3	1	3	15	14	3	1	3	15	16	3	5	3	15	16	3	5	3	16	13	3	20	3	16	13	3	20	3	16	14	3	20	3	16	14	3	20	3
		10	11	12	2	1	2	11	12	2	1	2	11	14	2	5	2	11	14	2	5	2	12	11	2	20	2	12	11	2	20	2	12	12	2	20	2	12	12	2	20	2
		11	7	10	1	1	1	7	10	1	1	1	7	12	1	5	1	7	12	1	5	1	8	9	1	20	1	8	9	1	20	1	8	10	1	20	1	8	10	1	20	1

*The quantities given are maximums and assume one fault locate line and no spare units stored in frame.

Bell Telephone Laboratories, Incorporated

Dept 4345-SG-ASL