D4 DIGITAL DATA BANK

DESCRIPTION AND APPLICATION ENGINEERING

DIGITAL TRANSMISSION SYSTEMS

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1. GENERAL

1.01 This practice contains the description and application engineering for the D4 DDB-OCU (D4 Digital Data Bank Office Channel Unit), D4 DDB-MJU (D4 DDB-Multipoint Junction Unit), and D4 DDB-SRMX (D4 DDB-Subrate Multiplexer).

1.02 This practice is reissued to include information for the DDB-MJU and DDB-SRMX.

1.03 The DDB-OCU terminal provides an interface between 4-wire digital data loops and DS0 equipment, such as the 64 kb/s universal cross-connect frame (DSX-0A). The DDB-MJU combines DDS (Digital Data System) formatted data channels (DS-0A) to form multipoint circuits consisting of a control station and two or more branch stations. The DDB-SRMX time-division multiplexes groups of five, ten, or twenty DDS subrate data channels into single 64 kb/s DS-0B channels. All three functions are accomplished by equipping a standard D4 channel bank with a subset of existing common equipment and dataport plug-ins and one or more of the new digital data bank plug-ins.

1.04 Since these functions require no changes to existing D4 equipment or associated office wiring, conversion to the new DDB terminals can be performed quickly and easily in response to customer needs. The DDB terminals can be shared with standard D4 functions within the same channel bank.

2. PHYSICAL DESCRIPTION

2.01 The OCU circuit pack is physically the same size as the standard D4 channel unit. That is approximately 1-5/16 inches wide, 4-7/16 inches high, and 10-1/8 inches deep. The plug-in pin connectors are identical to standard D4 channel units. The QMJU and SRMU circuit packs are plugged in place of the ACU and TU packs and are 2 inches wide, 4-7/16 inches high, and 10-1/8 inches deep. The faceplates for each unit are shown in Fig. 1.

3. FUNCTIONAL DESCRIPTION

DDB-OCU

3.01 The DDB-OCU provides the conversion of digital data loop signals to DS-0A office cross-connect signals. Each loop is terminated in a new J98726HA-1 OCU plug-in. This unit gains access to the 4-wire customer loop signals through D4 drop side wiring connections (T, R, T1, R1 leads). Since all transmission functions required to transform these signals into the DS-0A format are contained within the OCU, channel unit drop leads ordinarily used for E&M signaling (E, SG, M, SB leads) connect the OCU to the DS-0 signals. As a result, the OCU only requires power and clock signals from the D4 bank.

DDB-MJU

3.02 A multipoint network is composed of any number of outlying stations and a common control point, connected together by means of MJUs located in a central office.

3.03 The MJU splits the signal from the control station into identical branch signals for transmission toward outlying stations. The MJU also com-

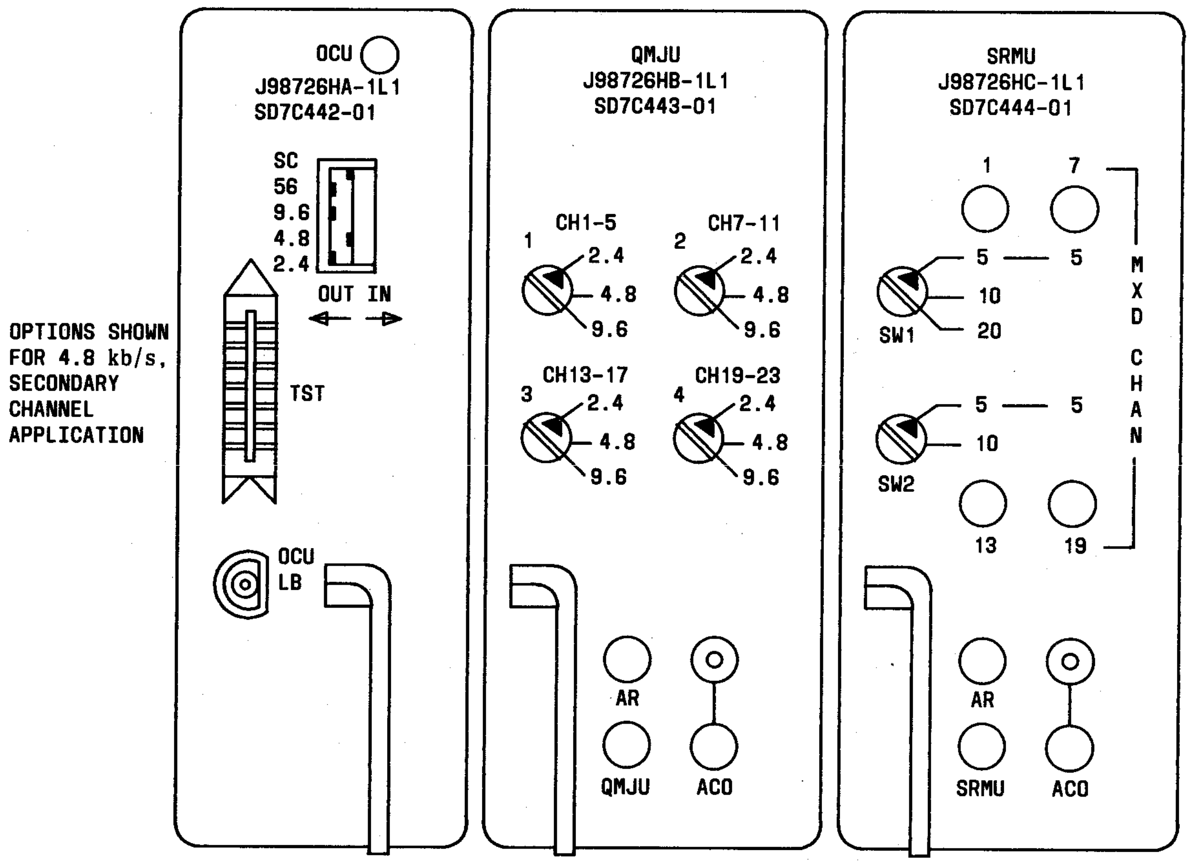


Fig. 1—DDB-OCU, QMJU, and SRMU Circuit Pack Faceplates

bines branch-originated signals and allows the signals from an active station to be transmitted to the control station. A typical MJU circuit is shown in Fig. 2.

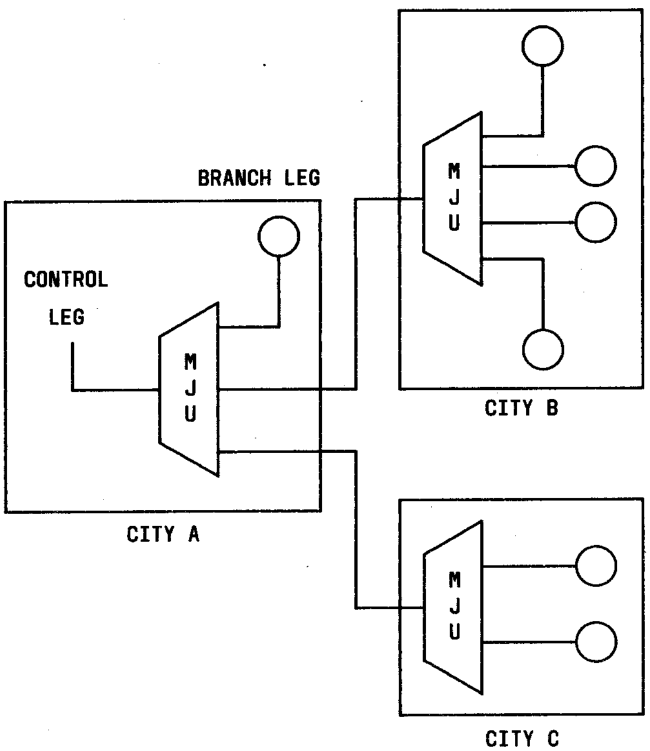


Fig. 2—Typical Multipoint Circuit

3.04 To prevent garbled data towards the control station, only one branch station may transmit data at any given time. Data transmission directly between branch stations is not provided, and all stations must operate at the same basic rate. These circuits are implemented with MJUs consisting of one control leg (Port 0) and two-to-four branch legs (Ports 1-4). Multipoint circuits requiring additional branches are then formed by cascading branch legs of MJUs to the control legs of others, as shown in Fig. 2. This allows circuits to be arranged with an unlimited number of branches.

3.05 The DDB-MJU implements the MJU function by interfacing the control and branch signals with dataports to a new J98726HB-1 QMJU plug-in. This plug-in performs all of the processing needed for four MJUs.

DDB-SRMU

3.06 The subrate multiplexing function consists of time-division multiplexing a group of 5, 10, or 20 subrate data channels into a single 64 kb/s DS-0B channel. If the multiplexer is a 20-channel multiplexer, then all channels must operate at the 2.4 kb/s service rate. Due to the nature of the DDS signal format, the 10-channel multiplexer can accept any combination of 2.4 and 4.8 kb/s channels (not over 10 channels). The 5-channel multiplexer can accept any combination of 2.4, 4.8, and 9.6 kb/s channels (not over 5 channels).

3.07 In digital data applications, the multiplexing function takes place with two types of input signals as shown in Fig. 3. In one case, the subrate services are first byte-stuffed to a universal 64 kb/s DS-0A rate in separate OCU equipment and then cross-connected as DS-0A inputs to the multiplexer. In the second case, the customer loop signals can be directly input to the multiplexer and the multiplexing performed without any external office cross-connection appearance of the DS-0A signal.

3.08 The subrate multiplexing function is implemented in the DDB-SRMX by interfacing the subrate and DS-0B signals with dataports to a new J98726HC-1 SRMU plug-in. This plug-in performs all the processing necessary for either one 20-channel multiplexer, two 10-channel multiplexers, four 5-channel multiplexers, or one 10- and two 5-channel multiplexers.

4. TERMINAL DESCRIPTIONS

4.01 Only D4 channel bank shelves (including those in portable banks) that have been wired for dataport operation can be used for DDB-OCU, DDB-MJU, and/or DDB-SRMX applications. These include all D4 banks that have printed wiring backplanes (SD-3C304-02) and any that have had standard wiring modifications to upgrade the hardwired backplane to full dataport capability (SD-3C304-01, Option V).

4.02 The D4 channel bank is made up of a unit of 4 shelves, organized into 2 independent digroups of 24 channels each. Depending on the configuration of common equipment plug-ins, the DDB terminal functions can occupy the entire bank or be shared with a normally operating D4 digroup (split-bank operation). In the case of the DDB-OCU, shar-

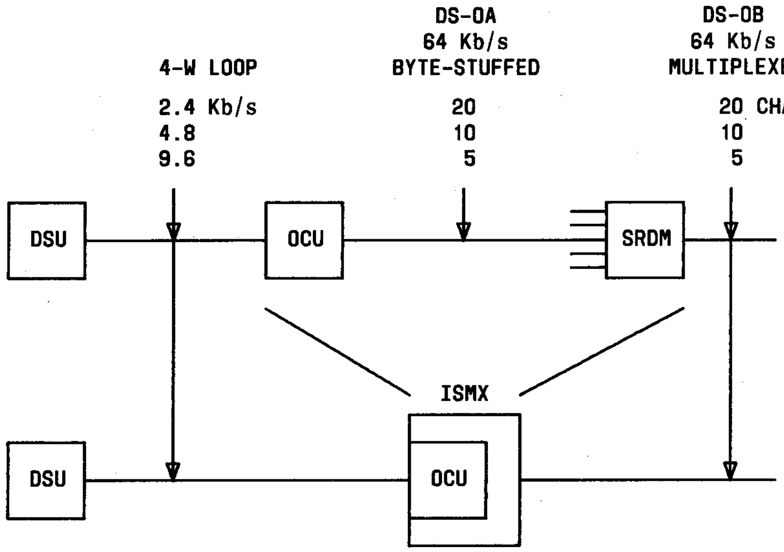


Fig. 3—D4 Subrate Multiplexing Functions

ing is also possible within a D4 digroup operating in any standard D4 mode (Modes 1-5). Use of the D bank can also be split between the D4 and DDB-OCU, DDB-MJU, or DDB-SRMX applications.

A. DDB-OCU Stand-Alone Arrangement

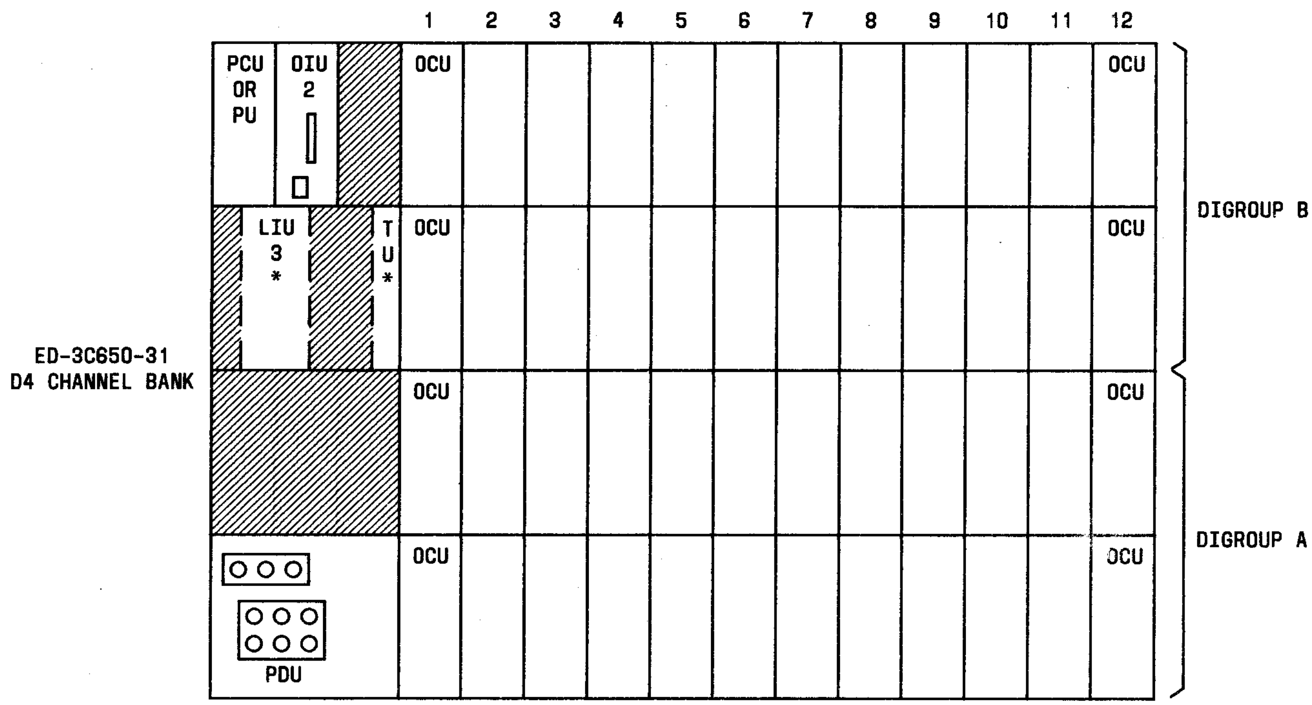
4.03 When the channel bank is used exclusively for DDB-OCUs, it must, at a minimum, be equipped with a J98726AK PDU (power distribution unit), a J87380C PCU (power converter unit) or 325A PU (power unit), and a J98726AL-2 OIU-2 (office interface unit) (Fig. 4). The PDU provides fusing for the office -48 V power and interfaces the office alarm system while the PCU converts the -48 V to +5, +12, and -12 voltages required by the OCUs. The 325A PU provides a higher output power than the J87380C PCU allowing a maximum of 48 OCUs to be equipped in the D4 bank.

4.04 The J98726HA-1 OCU provides the conversion of digital data loop signals to DS-0A office cross-connect signals. The OCU terminates standard DDS (Digital Data System) 4-wire loops at customer service rates of 2.4, 4.8, 9.6, and 56 kb/s. The unit is fully compatible with customer premises equipment meeting existing DDS requirements.

4.05 The OCU provides standard SCC (secondary channel capability) at all customer service rates. SCC allows a customer with a suitable data service unit to transmit data over a second, low-speed channel while simultaneously transmitting primary channel data. Maximum secondary channel data rates provided are 133-1/3, 266-2/3, 533-1/3, and 2666-2/3 bits-per-second for the primary channel service rates of 2.4, 4.8, 9.6, and 56 kb/s, respectively.

4.06 Two option switches are located on the faceplate of the OCU. One switch determines the primary service rate and the other switch selects secondary channel capability. If the SCC option is allowed, the secondary channel data rate is automatically selected according to the primary rate selected. The OCU design eliminates the need for FLBO (fixed line buildout) and other miscellaneous options found on existing DDS OCUs.

4.07 The OCU has several maintenance features designed for rapid trouble sectionalization. Loopbacks at the output of the OCU (loop interface) and at the customer premises station (via a reversal of loop sealing current) are actuated with standard OCU and channel loopback commands. The OCU also has the capability to latch the OCU and channel loopbacks to allow testing with unrestricted data patterns. The latching loopback command sequence can be performed with existing DDS test equipment. An LED on the OCU faceplate indicates when either a standard or latching OCU loopback has been activated. Faceplate jack access allows connection to KS-20908 and KS-20909 DTS for digital testing towards



TOTAL CAPACITY: 40 OCUs WITH J87380C PCU 48 OCUs WITH 325 PU

* LIU-3 AND TU REQUIRED ONLY FOR LOCAL TIMING (OPTIONAL)

Fig. 4—D4 DDB-OCU Stand-Alone Arrangement

the near (loop) or far (DSX-0) end of the circuit by using standard dataport procedures.

4.08 In the stand-alone arrangement, timing for the OCUs must be provided by the OIU-2. If an office composite clock is available at the bay, the OIU-2 is optioned for EXT (external) timing. If no external office timing is available, the bank can be configured to provide its own timing by equipping a J98726AH LIU-3 (line interface unit) and inserting a J98726AA TU (transmit unit) in either half of the D4 bank. The OIU-2 is then optioned for local timing to the digroup containing the TU.

B. DDB-OCU Split-Bank Arrangement

4.09 In the split-bank arrangement, one-half of the D4 bank is dedicated for DDB-OCUs while the other half is operated in D4 Mode 3 (Fig. 5). The additional common equipment plug-ins (LIU-3, ACU, TU, RU, and TPU) are needed only for the digroup operating in Mode 3. Either half may be used for the standard D4. A full complement of 24 OCUs can then be equipped in the DDB-OCU digroup.

4.10 An OIU-2 or OIU-4 must be equipped and optioned for external, local, or loop timing in the split-bank arrangement. Since the OIU provides synchronization for the entire bank, both halves must have identical timing requirements. The OIU must be optioned to the half containing the TU in the local or loop timing mode. When optioned for loop timing, the DDB-OCU half is synchronized to the frequency of the incoming D4 DS-1 signal.

C. DDB-OCU Shared Digroup Arrangement

4.11 In this arrangement, OCUs may be equipped anywhere spare slots are available in a normally operating D4 (Modes 1-5). If no OCU-DPs are present, a maximum of 16 OCUs can be equipped in the bank. This maximum number must be reduced by one for every two low-power OCU-DPs equipped.

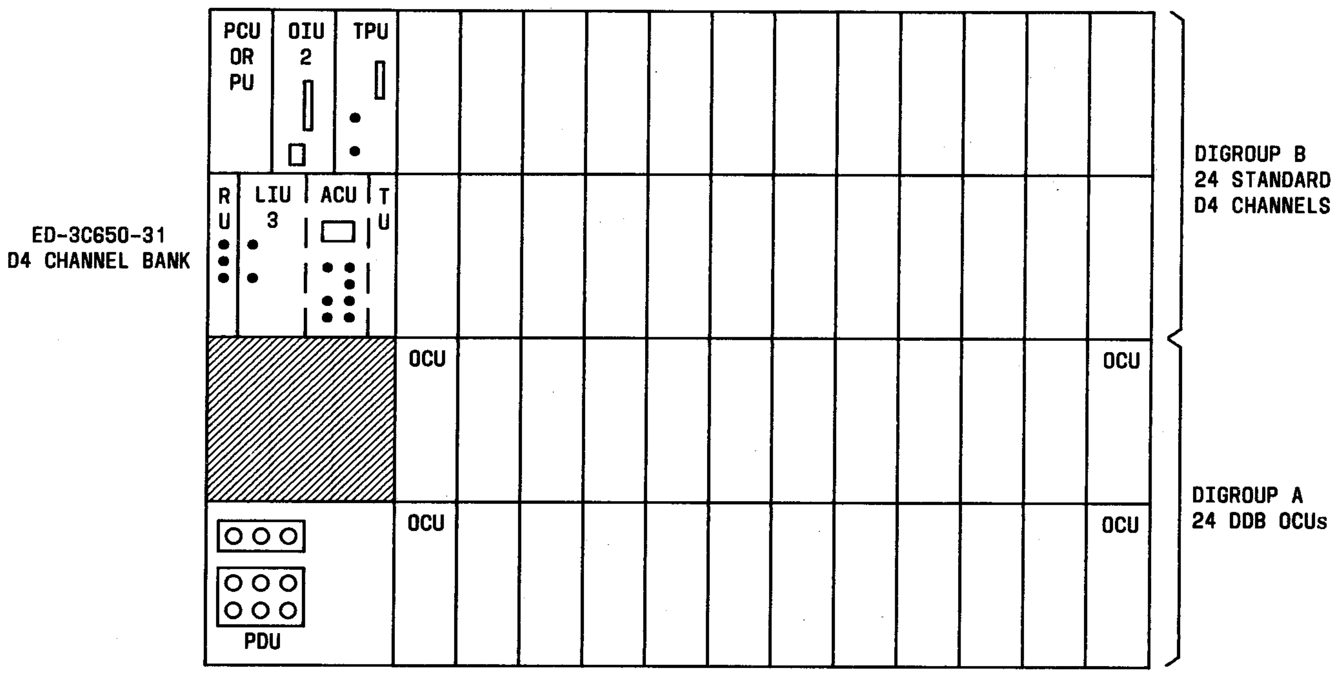


Fig. 5—D4 DDB-OCU Split-Bank Arrangement

There are no power restrictions when a 325A PU is used.

D. DDB-MJU Stand-Alone Arrangement

4.12 When used exclusively as a DDB-MJU as shown in Fig. 6, the channel bank is first equipped with a J98726AK PDU (power distribution unit), a J87380C PCU or 325A PU, a J98726AL-2 OIU-2 or J98726AY OIU-4, a J98726AH LIU-Mode 3 (line interface unit), and a J98726AD TPU (trunk processing unit). These plug-ins are standard D4 equipment and require no modifications for DDB-MJU use. The PDU provides fusing for the office -48 volt power and interfaces the office alarm, while the PCU converts the -48V to +5, +12, and -12 volt supplies required for the remaining plug-ins. The 325A PU provides a higher output power capacity than the J87380C PCU to allow the bank to operate without restrictions on the number of dataports equipped. The OIU provides timing for the bank from either an external composite clock source or from the bank's internal free-running oscillator. The OIU-4 also offers a slip alarm feature when the bank is externally timed that is not found on the OIU-2. Clocking signals for the bank are generated in the LIU-3, while the TPU is needed for setting the proper channel counting sequence. The QMJU CP and J98726AB RU are placed in their associated common equipment positions for each half of the D4 bank to be used as a DDB-MJU.

4.13 The MJUs in the DDB-MJU are formed by equipping standard subrate DS0-DP or OCU-DP plug-ins in specific channel unit positions that correspond to their use as control or branch interfaces. See Fig. 6 for a typical DDB-MJU stand-alone arrangement. The dataports can be existing J98726DA-2 (DS0-DP) and J98726DB-2 (OCU-DP) low power units, or J98726DH (DS0-DP) and J98726DJ (OCU-DP) all-rate units. Five channel unit positions are necessary for the control, and four branch legs are necessary for each MJU. Channel units need only be equipped for the number of branches required. A maximum of 4 MJUs can be provided within the 24 possible channel unit positions in each half of the D4 bank. A total capacity of eight MJUs is available in the bank. The QMJU performs all of the multipoint signal processing and alarm control for the four MJUs of each half of the bank, while the RU is used to return the processed data to the channel units. Each of the four MJUs served by the QMJU can be operated at any of three possible service rates of 2.4, 4.8, or 9.6 kb/s. The rate

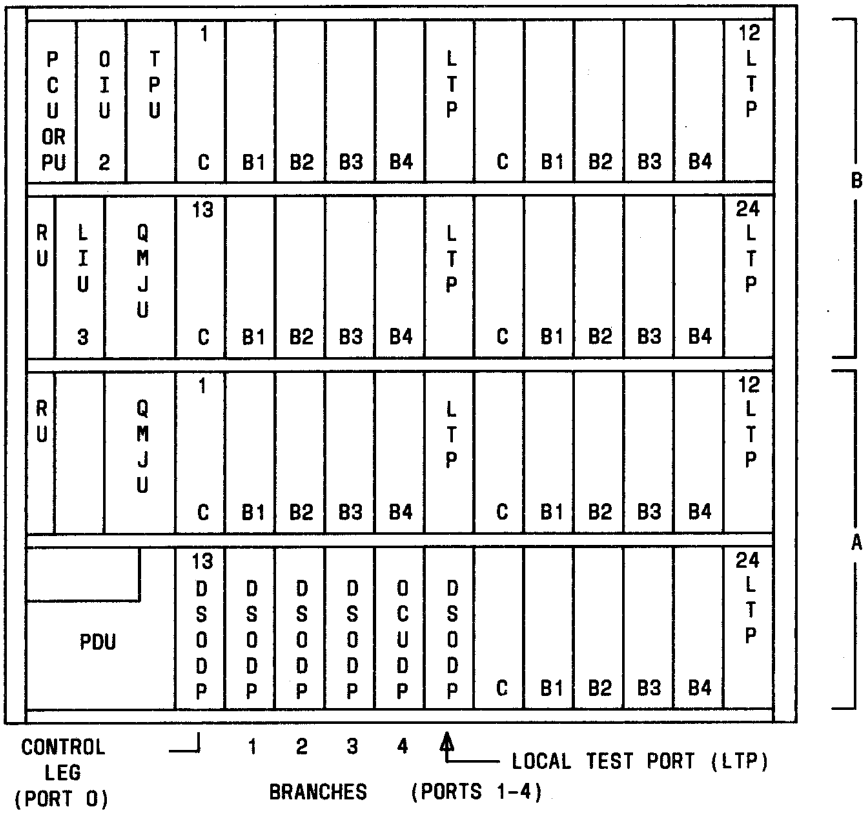


Fig. 6—D4 DDB-MJU Stand-Alone Arrangement

selection for each MJU is made by setting faceplate switches on the QMJU (Fig. 1). Additional switches inside the QMJU are provided to set the hub identification code associated with multipoint circuit testing procedures. (See AT&T Practice 314-901-011.) The QMJU also provides indicators for alarms and an office ACO (alarm cut-off) switch.

E. DDB-MJU Split-Bank Arrangement

4.14 Since the plug-ins common to both halves of the D4 bank (PCU, OIU, PDU, LIU-3, and TPU) are the same as with standard D4 Mode 3 (DS-1) operation, it is possible to operate one half of the bank as a DDB-MJU and the other as a DS-1 facility terminal. Figure 7 shows how this is done by equipping a J98726AA TU (transmit unit) and a J98726AC ACU (alarm control unit) in their normal positions associated with the DS-1 facility channels. Either half of the bank may be chosen to operate as the DS-1 terminal, and any standard voice and data channel units can then be used in the digroup. Use of the D4 bank can also be split between DDB-MJU functions and DDB-OCU or DDB-SRMX functions.

F. DDB-SRMX Stand-Alone Arrangement

4.15 The common equipment plug-ins required for the DDB-SRMX stand-alone arrangement are identical to those used in the DDB-MJU (see Fig. 8) except that the QMJU is replaced with the SRMU plug-in. Multiplexers are then formed by equipping standard dataport plug-ins in specific channel unit positions according to their function as individual or multiplexed channel interfaces. For example, in Fig. 8, the unmultiplexed subrate signals of a 5-channel multiplexer are connected to D4 channel positions 14-18. The two possible multiplexer interfaces (loop or DS-0A) are accommodated by equipping either an OCU-DP or DS0-DP for each subrate channel. Data from these channels is processed in the SRMU and the resulting multiplexed DS-0B signal is output by a DS0-DP in channel 13. A 5-channel multiplexer

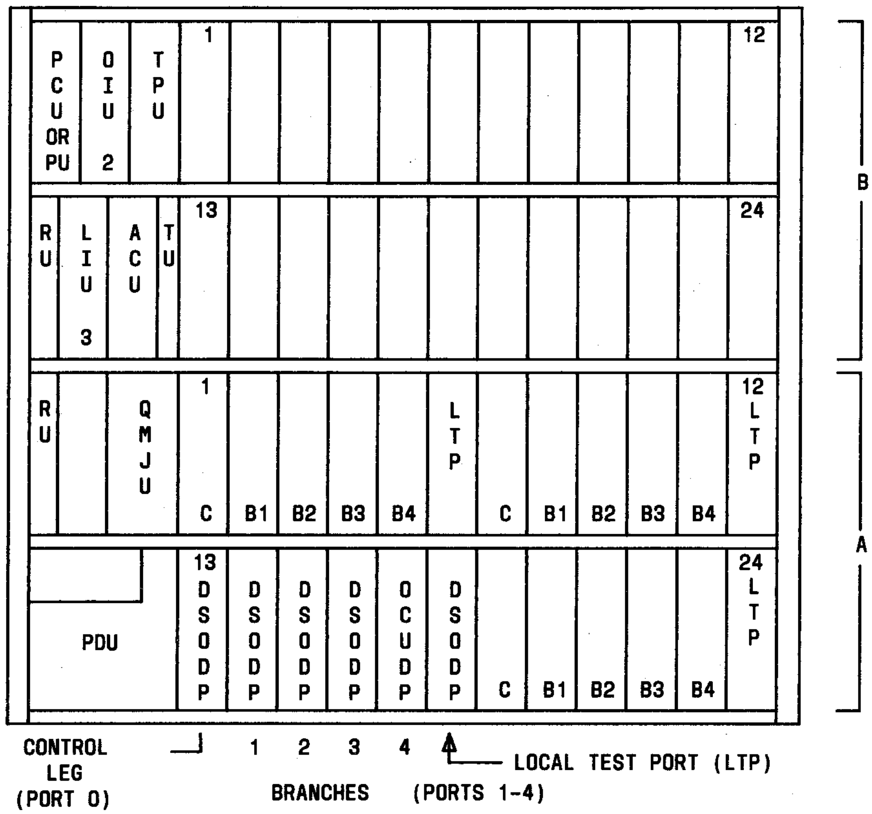


Fig. 7—D4 DDB-MJU Split-Bank Arrangement

takes a total of six channel unit positions on the D4 shelf.

4.16 The SRMU performs all of the multiplexing and alarm control functions for one-half of the D4 bank. The 24 channels associated with the SRMU can be arranged as:

- Four 5-channel multiplexers
- Two 10-channel multiplexers
- One 20-channel multiplexer or
- One 10-channel and two 5-channel multiplexers.

Configuration of the shelves is determined by faceplate switches on the SRMU (see Fig. 1). The SRMU also provides indicators for alarms, loss of subrate framing on incoming DS-0B signals at the appropriate multiplexed channel positions (1, 7, 13, or 19), and an ACO (office alarm cut-off) switch.

G. DDB-SRMX Split-Bank Arrangement

4.17 The use of the D4 bank can be split between DDB-SRMX functions and D4, DDB-MJU, or DDB-OCU functions. When split with D4 functions, the D4 digroup must be operated in Mode 3 as a DS-1 facility terminal (Fig. 9). Either half of the bank can serve the non-DDB-SRMX function.

5. ENGINEERING CONSIDERATIONS

A. Loop Transmission Guidelines

5.01 Customer loops are terminated by the DDB with either OCU or OCU-DP channel units. These units are designed to conform to existing DDS loop engineering practices as detailed in AT&T 880-601-115. The local loop must be nonloaded and have a total length corresponding to no more than 34 db

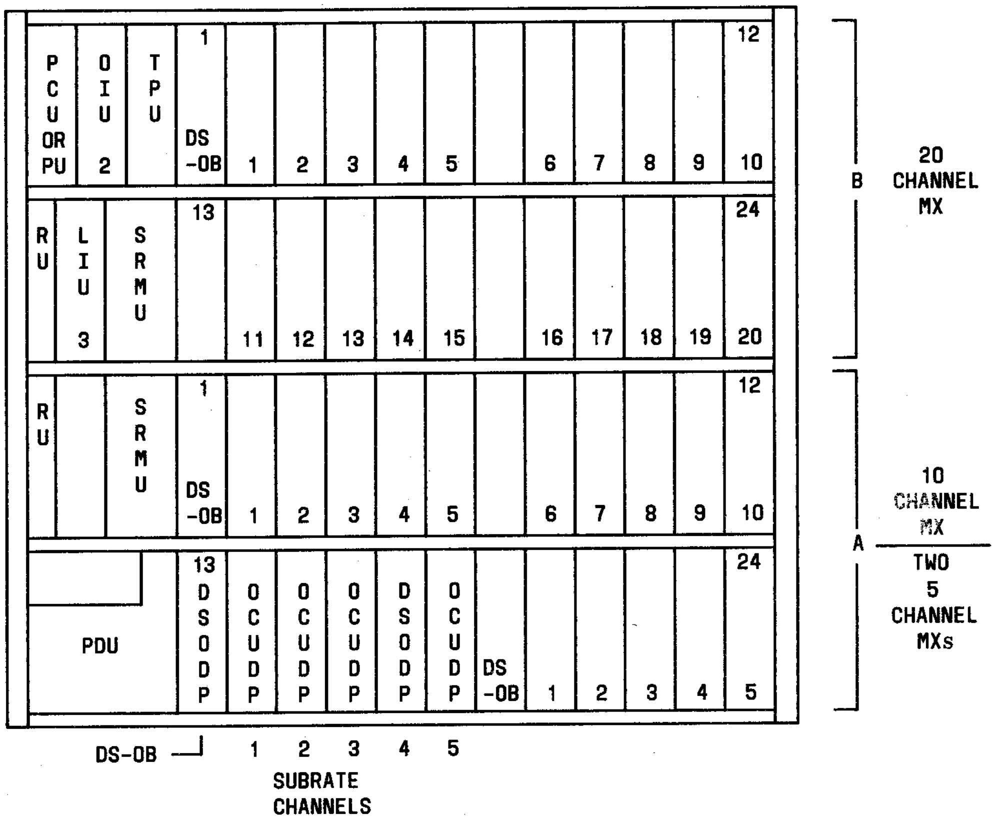


Fig. 8—D4 DDB-SRMX Stand-Alone Arrangement

of actual loss as measured at a frequency of one-half of the primary channel speed (1.2 to 28 kHz). Loops can have mixed gauges and a limited number of bridge taps. The OCU and OCU-DP are also compatible with the existing DDS 56 kb/s loop repeater (J70177AT) in applications requiring extended 56 kb/s (nonsecondary channel) range. Any nonrepeatered loops engineered for nonsecondary channel operation can be later converted to the secondary channel mode without limitation or additional restrictions. Loops containing 56 kb/s loop repeaters cannot be used in the secondary channel mode.

B. Office Cabling—Existing D4 Installations

5.02 In many instances, the DDB terminals can be equipped in an existing D4 bay installation without further office cabling changes. Wiring associated with the DSX-1, power, alarms, ringing, etc., can remain in place. Sometimes there may be some additional wiring required for synchronizing the DDB terminals to an external source. This is covered in more detail in **E, Synchronization.**

5.03 All loop and DS-0 transmission paths into and out of the DDB-MJU and DDB-SRMX use the standard T, R, T1, R1 leads associated with each D4 channel unit position. In addition, the DDB-OCU uses the E, M, SB, and SG leads. Both loop and DS-0 signals can be carried on these leads with the standard 26-gauge unshielded cables typically wired to D4 banks.

5.04 D4 bays used for DDB terminal applications must be located within a cable distance of 1500 feet of any cross-connected equipment operating at the DS-0A signal level. If a DS-0A cross-connect frame is not required in the office, the DS-0A cross-connects can be performed directly at the CDF (channel distribution frame). In the case of the DDB-OCU, E and SG leads serve as the DS-0A output pair and the M and SB leads serve as the DS-0A input pair as shown in Fig. 10.

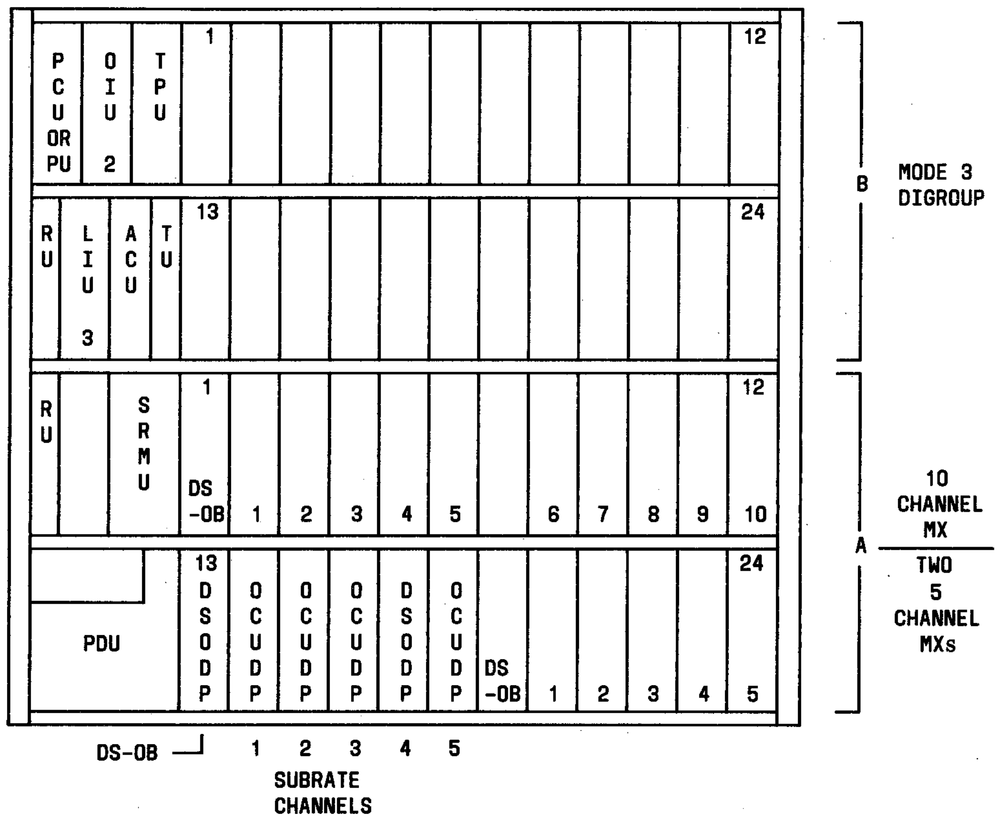


Fig. 9—D4 DDB-SRMX Split-Bank Arrangement

5.05 In offices with DSX-0 panels, two DS-0 cabling approaches are possible. If no change to the existing D4 CDF wiring is desirable, tie pairs can be provided between the CDF and the DSX-0. Cross-connects can then be prewired at the CDF to limit circuit order crosswiring to the DSX-0 only. Using the other approach, new cables can be run directly between the DSX-0 and the DDB terminal. This approach is easier for connectorized D4 installations because the existing CDF cables may be unplugged and the cables to the DSX-0 connected. In both approaches, it is recommended that the total cable distance between the D bank and DSX-0 be limited to 750 feet to prevent any DS-0 cross-connect from exceeding the basic limitation of 1500 feet as outlined in paragraph 5.04.

5.06 The DDB-SRMX presents a special cabling consideration when used in the ISMX application, where both loop and DS-0 signals are connected to the same bank. For this case, it may be desirable to retain the wiring to the existing CDF for the loop signals and route the multiplexed DS-0B signals directly to a DSX-0 panel. To accomplish this, a special Y cable adapter (ED-3C670-22 Group 1) is available that can simply be inserted between the D4 bank connectors and the existing CDF cable connectors. As shown in Fig. 11, one leg of this adapter passes only those channels associated with loop signals (channels 2-6, 8-12, 14-18, and 20-24) to the frame over the existing cabling, and the other leg connects the DS-0B channels (1, 7, 13, 19) to a new cable to the DSX-0.

C. Office Cabling—New Bay Installations

5.07 In new bay installations, consideration should be given to any need for changing between D4 channel bank and DDB applications. If full flexibility is desired, the bay should be engineered with all required D4 office cabling. In cases where the bay will always remain dedicated to DDB use, wiring need only be provided for power (-48 volts), transmission (channel unit T, R, T1, R1 leads and E, SG, M, SB leads if DDB-OCU), office alarms (MJ, MJR, MJV,

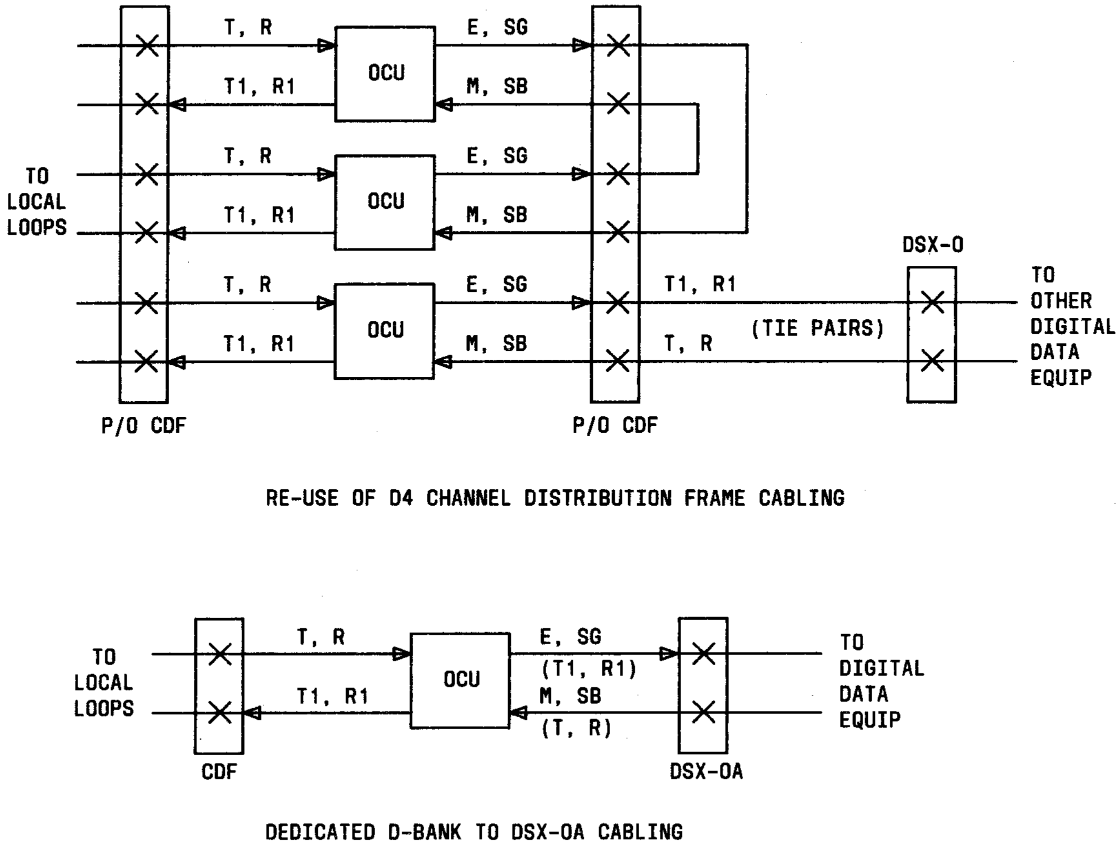


Fig. 10—D4 DDB-OCU Office Cabling Alternatives

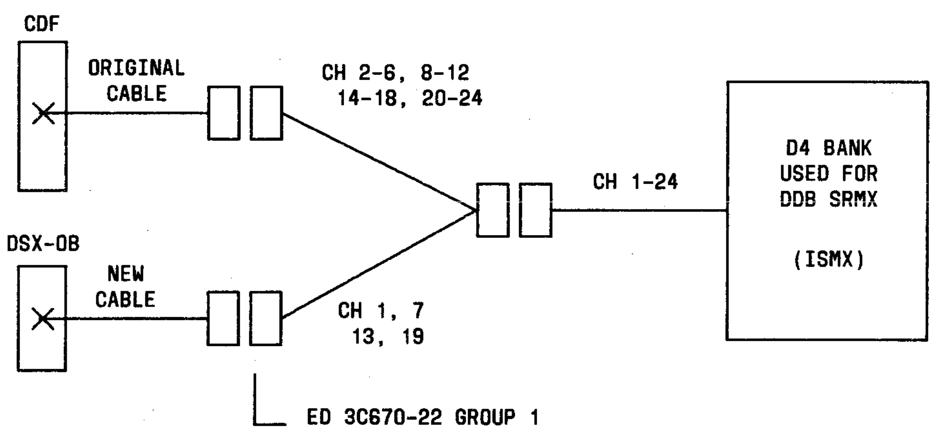


Fig. 11—Use of Y Cable Adapter for D4 DDB-SRMX

MJVR leads), and office timing (LX, LY leads). The channel unit cabling may also be arranged in any of the methods outlined in paragraphs 5.04 and 5.06.

D. ABATS and SARTS/SMAS Interface

5.08 In applications in which remote testing is desired, the DDB equipment can be connected to existing ABATS and SARTS/SMAS arrangements. In ABATS-equipped offices, channels assigned to loops are connected to LATS I panels for conducting automated metallic loop tests, and DS-0A channels are connected to LATS II panels for digital testing. Since LATS II panels are cabled to DSX-0 frames, the DDB equipment presents no unique considerations for engineering these in an office. Connection of LATS I panels to DDB equipment, however, requires a change to the existing office engineering method. The LATS I panel, which was originally designed to mount in a DDS OCU bay, serves eighty 4-wire loop circuits. In its DDS OCU application, the LATS I panel connects to ten 4-wire loop circuits at a time (corresponding to the ten OCUs per shelf in the DDS bay) via a direct connectorized cable between the OCU shelf and the LATS panel. Having passed through the LATS panel, these circuits are then connected, ten at a time, to the office distribution frame via another connectorized cable. These arrangements are shown in Fig. 12. Since the LATS panel is connectorized in modules of 10 circuits and the D4 bank is connectorized in modules of 24 circuits (or, for some types of D4 banks, not connectorized at all), the existing connectorized cable for connecting to the OCU-side of the panel cannot be used with the D4 bank. This problem can be eliminated by cabling the OCU-side of the LATS I panel to the office distribution frame and cross-connecting to DDB loop circuits as required. The connectorized cable required for this arrangement is exactly the same as the one used for connecting the loop side of the LATS panel to the frame (ED-73435-20, GR 4, or NE-01413-20, GR 2 cable assemblies), so no new cable codes are necessary. This approach also has the advantage of allowing easy per-circuit cutover to SMAS loop test access when desired, especially if unitized SMAS D4 banks are initially used with the LATS. The LATS panels can be mounted in miscellaneous relay racks or at the top of D4 bays. Each panel requires the space normally occupied by one D4 bank.

5.09 In the case of SARTS/SMAS test access, the DDB channels are wired to SMAS maintenance connectors for loop and DS-0 tests. Existing engineering methods for wiring D4 banks to SMAS can be used for this purpose, including those for unitized D4 bay arrangements. In most instances, existing offices are arranged with voice frequency SMAS connectors that can be used to perform both DDS loop and DS-0A tests. In the case of DS-0A testing, satisfactory test results are obtained from voice fre-

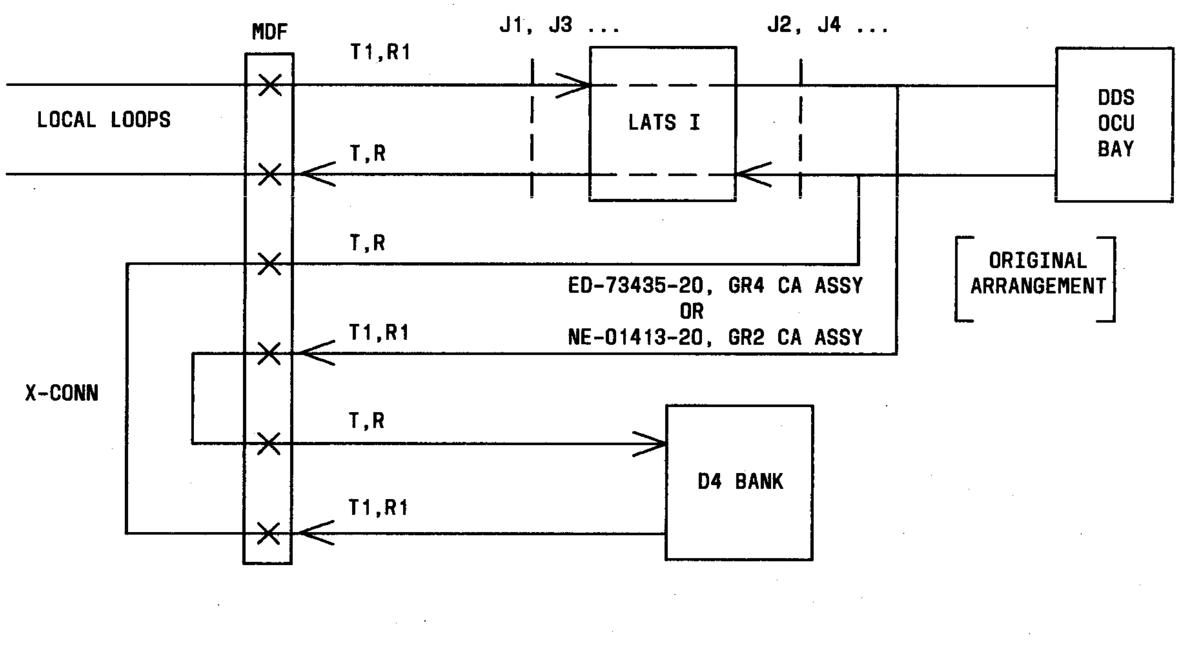


Fig. 12—D4 LATS 1 Cabling Arrangement

quency SMAS connectors for all tests except circuit monitoring. Since little information regarding the status of a DDS circuit can be obtained by monitoring, loss of this feature poses few problems compared to the benefits of sharing SMAS connectors for both voice and data applications; e.g., when DDB and standard D4 digroups share the same unitized D4 bay.

5.10 It should be noted that DS-0A testing with the monitoring capability can be performed with Type 3 maintenance connectors equipped with Option Y or Type 4 maintenance connectors equipped with J1P033AU List 6 MCCs (Maintenance Connector Controllers). In the case of the Type 4 MCC, all of the Type 4 connectors associated with a given DS-0A compatible MCC must be dedicated to DS-0A testing. DDS loop testing should only be performed with standard voice-frequency compatible SMAS connectors and not the DS-0A types mentioned above. Also, DS-0A type SMAS connectors should not be used for mixed voice and DS-0A testing, since the monitor function of these connectors is not adequate for voice circuits. For these reasons, the DS-0A type SMAS connectors should only be used for DDB applications that can justify their dedication to DS-0A testing.

E. Synchronization

5.11 In general, all equipment providing digital data services must be synchronized to a common frequency source, (e.g., the ATT-C Basic Synchronization Reference Frequency), and DS-0 signals must only be cross-connected between equipment that is synchronized to the same composite clock source. For DDB arrangements, three synchronization methods are possible: local, loop, or external. For each case, both halves of the D4 bank receive the same timing.

5.12 Usually, this clock is provided externally by cabling a single composite clock tap from an office timing supply (e.g., DDS nodal timing supply, local timing supply, synchronization distribution expander, etc.) to the top channel bank in the bay as is presently done in D4 dataport applications. Total cable distance from the office timing supply to the D4 bay must follow existing DDS engineering rules as found in AT&T 880-603-101 and AT&T 880-603-102 and, in general, cannot exceed 1500 feet. The clock signal is then multipled in the standard D4 manner to all remaining channel banks within the bay. Each bank requiring external timing is then equipped with an OIU-2 or OIU-4 unit set for the EXT option. In the case of the DDB-OCU, the OIU-4 can only be used in the EXT mode for the split-bank or shared digroup DDB-OCU arrangements. Also, when the OIU-4 is used, a minor backplane wiring change to the D4 bank is required to enable the slip alarm feature. (See SD-3C304-02, Option G.)

5.13 The DDB terminals can also be locally or loop timed in various applications by setting the appropriate options on the OIU-2 or OIU-4. In the case of the DDB-OCU, local timing is only possible by equipping the LIU-3 and TU (see paragraph 4.09). When locally timed, an internal free-running oscillator in the LIU-3 serves as the DDB frequency source. The loop timing option can only be selected when the bank is split between DDB functions and a D4 mode 3 digroup. In this case, the OIU is optioned to receive timing from the digroup operating in the D4 mode, thereby synchronizing the DDB half to the incoming DS-1 line.

5.14 Generally, use of local or loop timing should be limited to applications in which DS-0A cross-connections are made only between channel units in the same bank. Other cross-connections are possible by extending the OIU-2 or OIU-4 composite clock outputs to equipment outside the bank; however, this can cause many administrative problems that are best avoided by providing a separate office timing supply.

F. Office Power

5.15 Power for the DDB terminals is provided by the -48 volt office battery. Normal operation of the equipment is maintained over the standard D4 voltage range of -42.5 to -53 volts. Total current drain for a fully equipped DDB terminal arrangement (per D4 bank) is shown in Table A. No changes to the standard D4 PDU fuses are necessary.

TABLE A

EQUIPMENT POWER REQUIREMENTS

DDB-OCU (48 OCUs)	1.6 amps
DDB-MJU (e/w DSO-DP)	0.8 amps
DDB-SRMX (e/w DSO-DP)	0.9 amps
DDB-SRMX (ISMX)	1.6 amps
Split-bank (D4 + SRMU or QMJU)	1.7 amps

6. CIRCUIT PROVISIONING CONSIDERATIONS

A. DDB Terminal Capacity Restrictions

6.01 The DDB-OCU, DDB-MJU, and DDB-SRMX can be equipped with one of two codes of power converters: either the new 325A PU or the original J87380C PCU. When equipped with the 325A PU, the D4 bank can be fully equipped with any combination of low-power OCU-DPs (J98726DB-2 or J98726DJ-1) and DS0-DPs for any of the dedicated DDB-OCU, DDB-MJU, or DDB-SRMX arrangements, or for any arrangements that split the bank with a Mode 3 D4 digroup. Although high-power OCU-DPs (J98726DB-1) are compatible with the DDB terminals, their use is not recommended due to the need to limit shelf temperatures by requiring vacant slots adjacent to them. Further, if split between DDB-OCU and DDB-MJU or DDB-SRMX functions, the bank can be fully equipped with any combination of J98726HA-1 OCUs, OCU-DPs, and DS0-DPs.

6.02 When equipped with the J87380C PCU, the D4 bank can be fully equipped with any number of DS0-DPs for any of the dedicated or split-bank DDB terminal arrangements. However, due to the output power capacity limitations of the PCU, the total number of OCU-DP or OCU plug-ins equipped in the bank must be restricted.

6.03 For the dedicated DDB-OCU, a total of 40 OCUs can be equipped in any of the 48 possible channel unit positions. Further, if the dedicated DDB-OCU is operated in the local timing modes by equipping an LIU-3 and TU, the number of OCUs must be limited to 36. When the DDB-OCU is operated in a split bank arrangement with a D4 Mode 3 digroup, 24 OCUs can be equipped in the DDB-OCU half and any mix of voice and DS0-DP channel units as well as a maximum of four low power OCU-DPs can be equipped in the Mode 3 half. Conversely, should the Mode 3 digroup require a full 24 OCU-DPs, the DDB-OCU digroup must be limited to 12 OCUs.

6.04 Fully dedicated DDB-MJU or DDB-SRMX terminals, or arrangements that share both functions in the same bank, are limited to a maximum of 32 low-power OCU-DPs. Also, if these functions are shared with the DDB-OCU function, a maximum of 32 OCU-DP and OCU plug-ins (in any combination) are permissible in the bank. Further, when split between a D4 Mode 3 digroup and the DDB-MJU or DDB-SRMX functions, the bank must be limited to a maximum of 28 OCU-DPs. In all of the above cases, DS0-DPs and/or voice channel units can be used to fill out the remaining bank slots.

B. D4 Common Equipment Option Settings

6.05 For proper operation, the DDB-terminals require selection of specific options on the D4 OIU and TPU plug-ins. When equipped with an OIU-2, the D/T option, when present, must be set to D and the timing mode set to EXT, LOC, T, or LT. The LT option can only be used when the bank is shared with a D4 Mode 3 digroup. The digroup selection option can be set to either A DGP or B DGP (depending on which half of the bank is first put to use) in any timing mode except LT, where the selection must correspond to the D4 Mode 3 digroup. If equipped, the OIU-4 is also optioned in the same manner.

6.06 On the TPU, channel counting options must be set to SEQ for each half of the bank (A or B) containing a QMJU or SRMU. If the bank is split with D4, the options corresponding to the D4 Mode 3 digroup can be set for any of the three possible sequences. Further, the DSX-1 equalizer card inside the TPU should not be equipped for any digroups equipped with DDB functions. When the bank is split, the card must be equipped for the D4 Mode 3 digroup.

C. QMJU Provisioning Considerations

6.07 Each QMJU plug-in implements four MJU functions in one-half of a D4 bank, designated 1-4 on the faceplate. Each MJU has an associated data rate selection switch on the faceplate that is set to the corresponding customer service rate of 2.4, 4.8, or 9.6 kb/s. This unit also has a 7-position rocker switch located internally that determines the hub identification code returned to MJU test systems during circuit testing. Table B defines the switch settings that correspond to these codes. MJUs are defined by the assignment of particular D4 channel unit positions to each control or branch function as shown in Table C.

D. SRMU Provisioning Considerations

6.08 The SRMU implements from one to four subrate multiplexers in one-half of the D4 bank as determined by the settings of faceplate switches SW1 and SW2. Setting switch SW1 to 5-5 configures the top shelf containing D4 channels 1-12

TABLE B

HUBID LOCATION CHART

HUB ID CODE	HUBID SWITCH POSITION 2	3	4	5	6	7
01						X
02					X	
03					X	X
04				X		
05				X		X
06				X	X	
07				X	X	X
10			X			
11			X			X
12			X		X	
13			X		X	X
14			X	X		
15			X	X		X
16			X	X	X	
17			X	X	X	X
20		X				
21		X				X
22		X			X	
23		X			X	X
24		X		X		
25		X		X		X
26		X		X	X	
27		X		X	X	X
30		X	X			
31		X	X			X
32		X	X		X	
33		X	X		X	X
34		X	X	X		
35		X	X	X		X
36		X	X	X	X	
37		X	X	X	X	X
40	X					
41	X					X
42	X				X	
43	X				X	X
44	X			X		
45	X			X		X
46	X			X	X	
47	X			X	X	X
50	X		X			
51	X		X			X
52	X		X		X	
53	X		X		X	X
54	X		X	X		
55	X		X	X		X
56	X		X	X	X	
57	X		X	X	X	X
60	X	X				
61	X	X				X
62	X	X			X	
63	X	X			X	X
64	X	X		X		
65	X	X		X		X
67	X	X		X	X	X
71	X	X	X			X
72	X	X	X		X	
73	X	X	X		X	X
74	X	X	X	X		
75	X	X	X	X		X
76	X	X	X	X	X	

Where X is shown, set associated rocker switch to OPEN position, and remaining switches CLOSED. (Switch position 1 is not used)

TABLE C

MJU FUNCTION/D4 CHANNEL POSITION

MJU FUNCTION	D4 CHANNEL POSITION MJU 1	MJU 2	MJU 3	MJU 4
Control (Port 0)	1	7	13	19
Branch 1 (Port 1)	2	8	14	20
Branch 2 (Port 2)	3	9	15	21
Branch 3 (Port 3)	4	10	16	22
Branch 4 (Port 4)	5	11	17	23

into two 5-channel subrate multiplexers whose functions are defined by particular D4 channel unit positions as shown in Table D. Similarly, setting switch SW2 to 5-5 configures the bottom shelf containing D4 channels 13-24 into two 5-channel multiplexers as shown in Table E. Setting switch SW1 to 10 configures the top shelf into one 10-channel multiplexer and, similarly, setting switch SW2 to 10 configures the bottom shelf into one 10-channel multiplexer as shown in Table F. When SW1 is set to 20, both shelves are configured into one 20-channel multiplexer as shown in Table G. Switches SW1 and SW2 can be set independently, allowing the top and bottom shelves to be configured in any desired manner. In the 20-channel case, the setting of SW2 is irrelevant and can be left in either the 5-5 or 10 position. Each multiplexer can support any combination of subrate data channel rates, provided the maximum speed is not exceeded as shown in Table H.

TABLE D

DDB-SRMX SHELF CONFIGURATION
WITH SW1 SET TO 5-5

MUX CHANNEL	D4 CHANNEL POSITION SW1 = 5-5	
	MUX 1	MUX 2
DS-0B	1	7
1	2	8
2	3	9
3	4	10
4	5	11
5	6	12

TABLE E

DDB-SRMX SHELF CONFIGURATION
WITH SW2 SET TO 5-5

MUX CHANNEL	D4 CHANNEL POSITION SW2 = 5-5	
	MUX 1	MUX 2
DS-0B	13	19
1	14	20
2	15	21
3	16	22
4	17	23
5	18	24

6.09 When provided over nonclear channel facilities, secondary channel service must only be assigned to the subrate multiplexer channels (channel numbers refer to the multiplexer, not D4 shelf positions) as shown in Table I.

TABLE F

MUX/D4 CHANNEL POSITION
WITH SW1 AND SW2 SET TO 10

MUX CHANNEL	D4 CHANNEL POSITION	
	SW1 = 10 MUX 1	SW2 = 10 MUX 2
DS-0B	1	13
1	2	14
2	3	15
3	4	16
4	5	17
5	6	18
6	8	20
7	9	21
8	10	22
9	11	23
10	12	24

E. Dataport Channel Unit Considerations

6.10 The DDB-MJU and DDB-SRMX require that only subrate OCU-DPs be equipped when interfacing customer loops. In the case of the new all-rate OCU-DP (J98726DJ), the unit can be set to any speed except 56 kb/s. Also, this unit must be used when secondary channel service is required. It is optioned by setting its SC switch to IN. The subrate error correction options on the OCU-DPs can be set to IN or OUT for DDB operation, and normally are set to OUT. It should be noted that when DDB-derived channels are connected to a DS-1 facility, error correction associated with the D4 facility terminal dataport will correct any facility errors. The SLC/D4 option found on OCU-DPs should also be set to the D4 setting. Other miscellaneous options on these units (e.g., FLBO, CRTC, CSU/DSU) are set according to standard practice.

6.11 Any DS0-DP (subrate, 56 kb/s, or new J98726DH all-rate) can be used in the DDB-MJU and DDB-SRMX applications. The SLC/D4 option found on these DS0-DPs should always be set to the D4 setting. When subrate DS0-DPs are used, the error correction option is normally set to OUT. When the unit serves as the DS-0B interface of a subrate multiplexer, the error correction option *must* be OUT. Also, if the 56 kb/s DS0-DP is used, its error correction must always be optioned OUT, since the two time slot format of this type of error correction

TABLE G

CHANNEL POSITION WITH SW1 SET TO 20

MUX CHANNEL	D4 CHANNEL	MUX CHANNEL	D4 CHANNEL
DS-OB	1		
1	2	11	14
2	3	12	15
3	4	13	16
4	5	14	17
5	6	15	18
6	8	16	20
7	9	17	21
8	10	18	22
9	11	19	23
10	12	20	24

TABLE H

SUBRATE MAXIMUM SPEED

MULTIPLEXER	MAXIMUM SPEED
5-channel	9.6 kb/s
10-channel	4.8 kb/s
20-channel	2.4 kb/s

is incompatible with the DDB operation. In general, use of this unit is not recommended since it offers no additional features for DDB applications. When using the all-rate DS0-DP, the error correction option is also set OUT whenever the unit is carrying a DS-0B signal. The 56 kb/s error correction option on this unit must not be used for DDB applications. The all-rate DS0-DP must also be used when secondary channel service is desired.

7. DDB TERMINAL TESTING AND MAINTENANCE CONSIDERATIONS

A. Manual Testing Arrangements

7.01 Manual testing procedures for the DDB-OCU, DDB-MJU, and DDB-SRMX are nearly identical to standard D4 dataport practices and include D4 bank power, clock, and alarm checks, local loop qualification measurements, and digital error rate tests. These are detailed in AT&T 365-170-200, D4 DDB Office Channel Unit Task Oriented Practice, AT&T 365-170-210, D4 DDB Multipoint Junction Unit Top Oriented Practice, and AT&T 365-170-220, D4 DDB Subrate Multiplexer Task Oriented Practice.

7.02 Whenever local loops are terminated on the DDB equipment, they must be qualified for digital data service by using procedures and requirements found in AT&T Practice 314-410-510, Digital Data System Local Loop Tests and Requirements. Jack access to the local loop from the OCU or OCU-DP slot is provided by a standard J98726MF D4 Channel Unit Extender. The required loop tests include measurements of insertion loss, background noise, simplex and foreign voltages, and loop and insulation resistance,

7.03 All necessary digital testing to confirm operation of the DDB terminals can be performed with the KS-20908 and KS-20909 data test sets. Clock signals for these sets are obtained directly from the DDB terminal by connecting an ED-3C792-30 D3/D4 test interface unit to the OIU faceplate TST jack. An ED-3C793-30 D3/D4 dataport loopback connector is then plugged into the dataport faceplate TST jack to gain access to any DS-0 signal path. From this access point, standard digital loopback and straightaway tests can be performed towards either the near or far sides of the circuit using standard dataport procedures. These access points are illustrated in Fig. 13 for the DDB-MJU and DDB-SRMX arrangements and in Fig. 14 for the DDB-OCU arrangement. As seen, access is provided for each individual customer channel, allowing all necessary tests to be performed without disturbing other customers or other branches of a multipoint circuit. Also, as with standard D4 applications, use of the loopback connector in the TST jack of the OCU or dataports without KS type test sets plugged in causes loopback of both near and far directions of transmission.

7.04 Also shown in Fig. 13 are the loopbacks made possible when the all-rate DS0-DP is equipped. These are controlled by a standard latching

TABLE I

ASSIGNABLE MULTIPLEXER CHANNELS FOR SECONDARY CHANNEL SERVICE

MULTIPLEXER	ASSIGNABLE MULTIPLEXER CHANNELS
Twenty-channel	2, 3, 6, 8, 11, 12, 13, and 18
Ten-channel	2, 3, 6, and 8
Five-channel	2 and 3

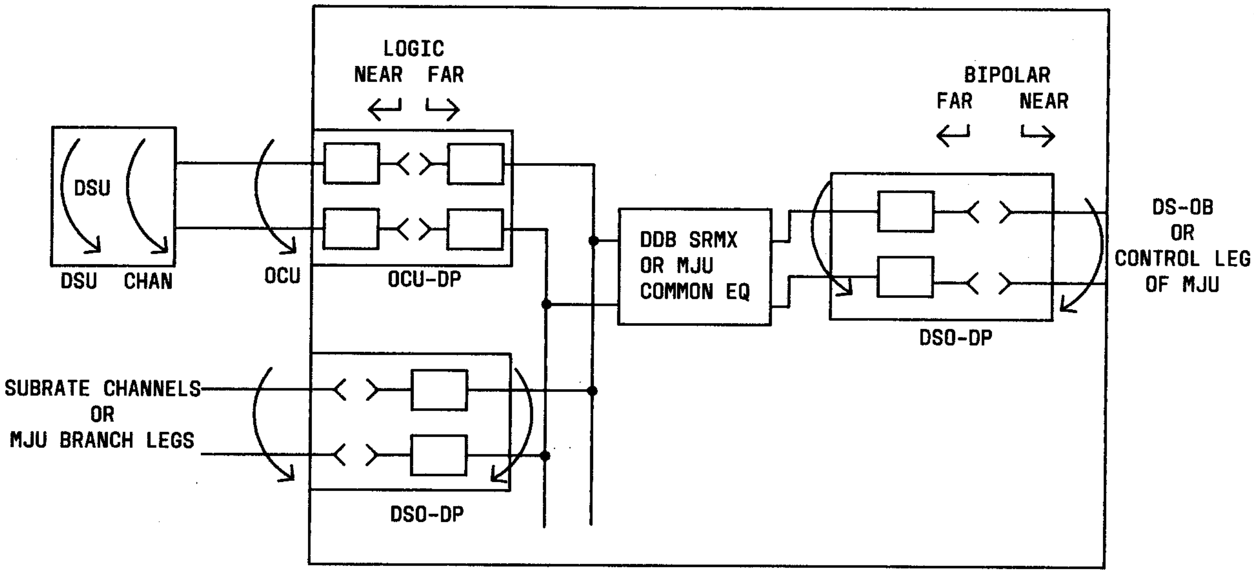
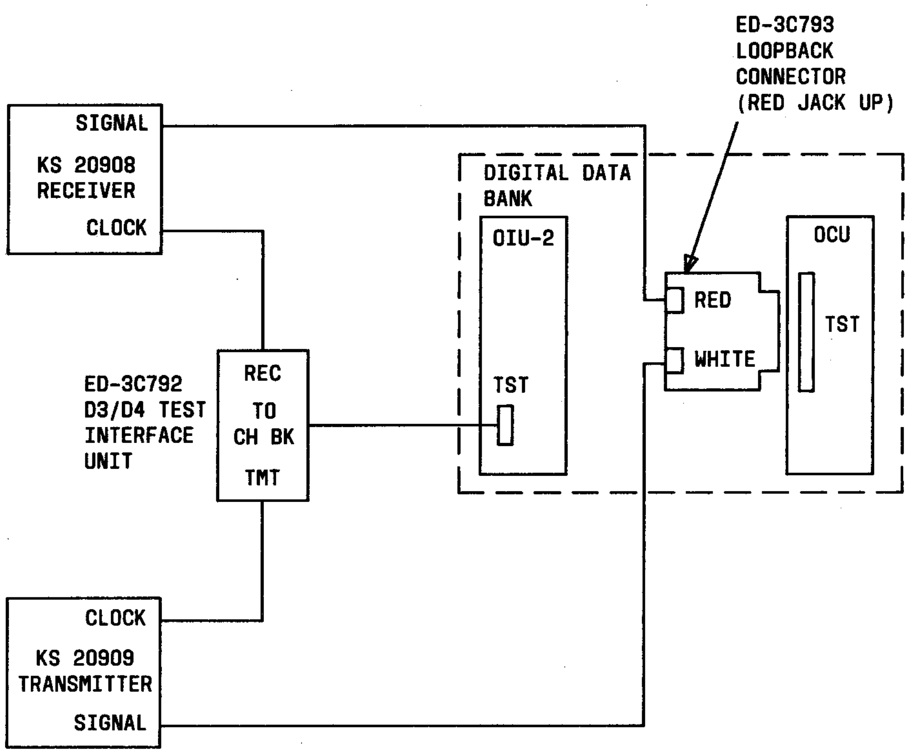


Fig. 13—D4 DDB-QMJU or DDB-SRMX Test Access Points

loopback sequence from the KS test sets, ABATS, or SARTS. By using these new DS0-DP loopbacks in addition to those normally provided on the OCU-DPs, troubles can be remotely sectionalized to any interface associated with the DDB equipment. For the DDB-SRMX arrangement, the loopbacks shown on the DS-0B interface cannot be exercised from any individual customer channel (DS-0A) test access point. These loopbacks can only be controlled from a DS-0B access point.

7.05 The QMJU also has several testing features designed for proper maintenance of multipoint circuits. By sending specific commands to the control leg, the MJU can be put into branched, blocked, or loopback states, as shown in Fig. 15. The branch state allows a test path between the control leg and one branch while preventing the other branches from interfering with the test. The MJU is returned to normal from this state when testing is completed. In situations where a streaming customer terminal interferes with a multipoint circuit, the block state allows the offending branch to be indefinitely blocked and restored when the problem is corrected. The loopback state causes the control leg and all branches of a given MJU to be looped back within the QMJU. As with DDS-style MJUs, all of these commands can address one of several MJUs in tandem to allow testing of multipoint circuits from a single test access point.

7.06 The command sequences referred to in the above tests cannot be sent to the control leg by the KS-20909 test set and are ordinarily sent from an automated test system such as ABATS or SARTS. The DDB-MJU incorporates a new feature to allow the use of the portable DDS test sets for externally performing these MJU tests, as well as additional tests. This feature is enabled by connecting the transmitter and receiver to a DS0-DP that is equipped in the normally vacant slot associated with each DDB MJU. The local test channel assignments for each MJU are shown in Table J. Then, by sending specific byte patterns with the transmitter byte encoder, the MJU can be placed in any of the test states (branch, block, etc.) that are ordinarily controlled by the auto-



NOTE: KS TEST SETS USED IN LOGIC NEAR/FAR MODES

Fig. 14—D4 DDB-OCU Digital Test Access

mated test systems. In addition, by sending other byte pattern commands, the test channel can be used to monitor the near or far transmission paths on the control leg or any branch, display the HUBID setting, display the test state status, and reset the MJU to its normal state. Further, since the interface to the test channel is a standard DS-0A signal, these tests can also be performed from another location by simply remoting the channel.

7.07 Some locations also use the DDS 950A test board for performing various preservice and long-term tests. The MSU (multipoint signaling unit) in this test board is incompatible with MJUs that have secondary channel capability. These include the DDB-MJU, the DDS HL 223/4 MJU, and the DACS/SRDC MJU. Future modifications are planned to allow use of the 950 test board.

B. Automated Test System Considerations

7.08 The DDB-MJU and DDB-SRMX are fully compatible with the existing test capabilities of ABATS Generic 3 and SARTS PC 1A, Generic 2.4 (or later) and its associated RTS-5A. In the case of the DDB-MJU equipment, these systems can control all of the test features discussed in the previous part, except for the MJU loopback test state. This feature, as well as improved latching loopback control and new loopback test word patterns will be included in ABATS Generic 4 and the new SARTS DIGITEST system with RMS-D.

7.09 When using ABATS, the new Generic 4 and its associated BATS hardware upgrade are required to test MJUs carrying 2.4 kb/s secondary channel service. Nonsecondary channel multipoint service at 2.4 kb/s can be tested with ABATS Generic

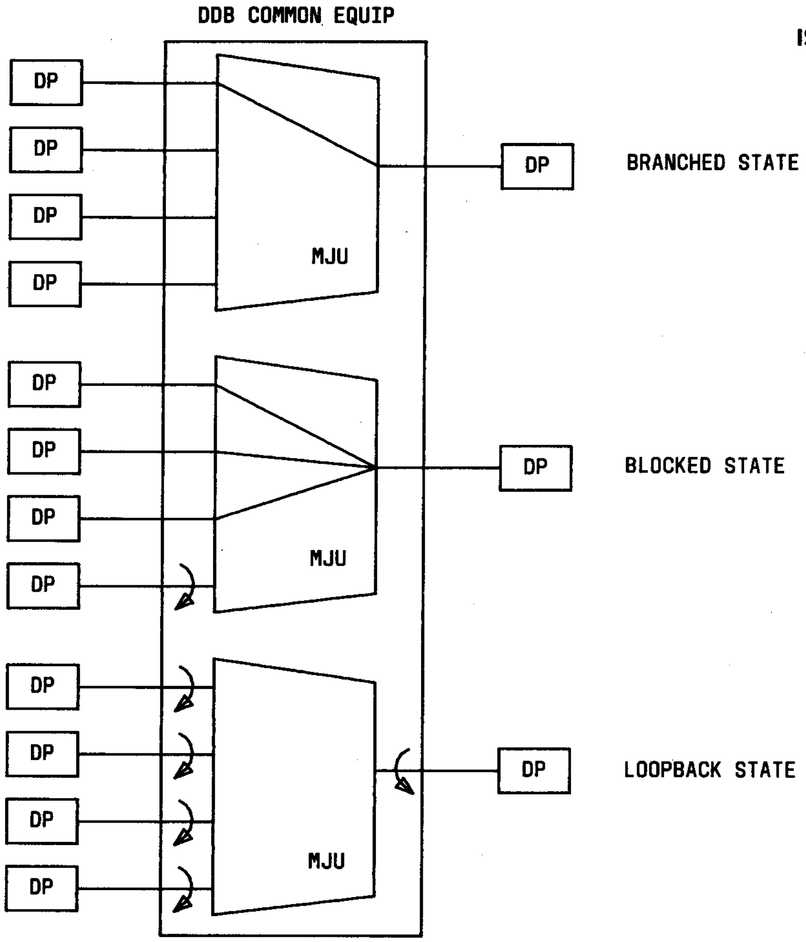


Fig. 15—D4 DDB-MJU Test States

TABLE J
MJU LOCAL TEST CHANNEL ASSIGNMENTS

MJU	LOCAL TEST CHANNEL POSITION (D4 CHANNEL POSITION)
1	6
2	12
3	18
4	24

3, if necessary, by setting the DDB-MJU speed to 9.6 kb/s. This setting has no adverse effects for nonsecondary channel customers, but may cause administrative confusion.

C. Alarms

7.10 When the D4 bank is dedicated for use as a DDB-OCU terminal, an office alarm (major visual and audible) is caused only by a blown fuse in the PDU. This alarm cannot be silenced until the fuse is replaced. When both DDB-OCU and D4 plug-ins share the same bank, all standard D4 alarms and trunk processing sequences operate normally without regard to the terminal presence.

7.11 In the case of the DDB-OCU, an office alarm (major visual and audible) is caused only by a blown fuse in the PDU. As with standard D4, fuse alarms can be silenced only by replacing the fuse. For the DDB-MJU and DDB-SRMX, a major office alarm is caused by a blown fuse, power converter output failure, QMJU, SRMU, or other common equipment failures. Except for a blown fuse, these alarms can be silenced by pushing the ACO control on the QMJU or SRMU faceplate. To aid in sectionalizing bank troubles, separate alarm LEDs (light-emitting diodes) are provided on the QMJU and SRMU faceplates to indicate failures of these units. LEDs are also provided on the SRMU faceplate to indicate when framing of the associated incoming DS-0B signal is lost. Since this condition is ordinarily the result of a carrier facility failure, an office alarm is sounded by the associated facility terminal equipment.

7.12 When the bank is shared between DDB and D4 functions, all standard D4 alarms and trunk processing sequences operate normally for the D4 digroup.

D. Routine Maintenance

7.13 The DDB-OCU, DDB-MJU, and DDB-SRMX require no routine maintenance.

8. APPLICATIONS

A. DDS Network

DDB-OCU

8.01 The DDB-OCU terminal can be applied anywhere in the DDS network that currently requires DDS OCU bays equipped with driver-terminators. Since all local loops terminating in hub offices are converted to the DS-0A format for test access and circuit cross-connection, the DDB-OCU terminal is primarily applied in these locations. Figure 16 shows the DDB-OCU as used in hub offices with existing ABATS testing arrangements.

DDB-MJU and DDB-SRMX

8.02 The DDB-MJU and DDB-SRMX terminals may be used anywhere in the DDS network that currently requires DDS ISMX, SRDM, and MJU equipment. This includes both DDS hub and end offices.

8.03 As seen in Fig. 16, The DDB-SRMX and MJU equipment can serve as direct replacements

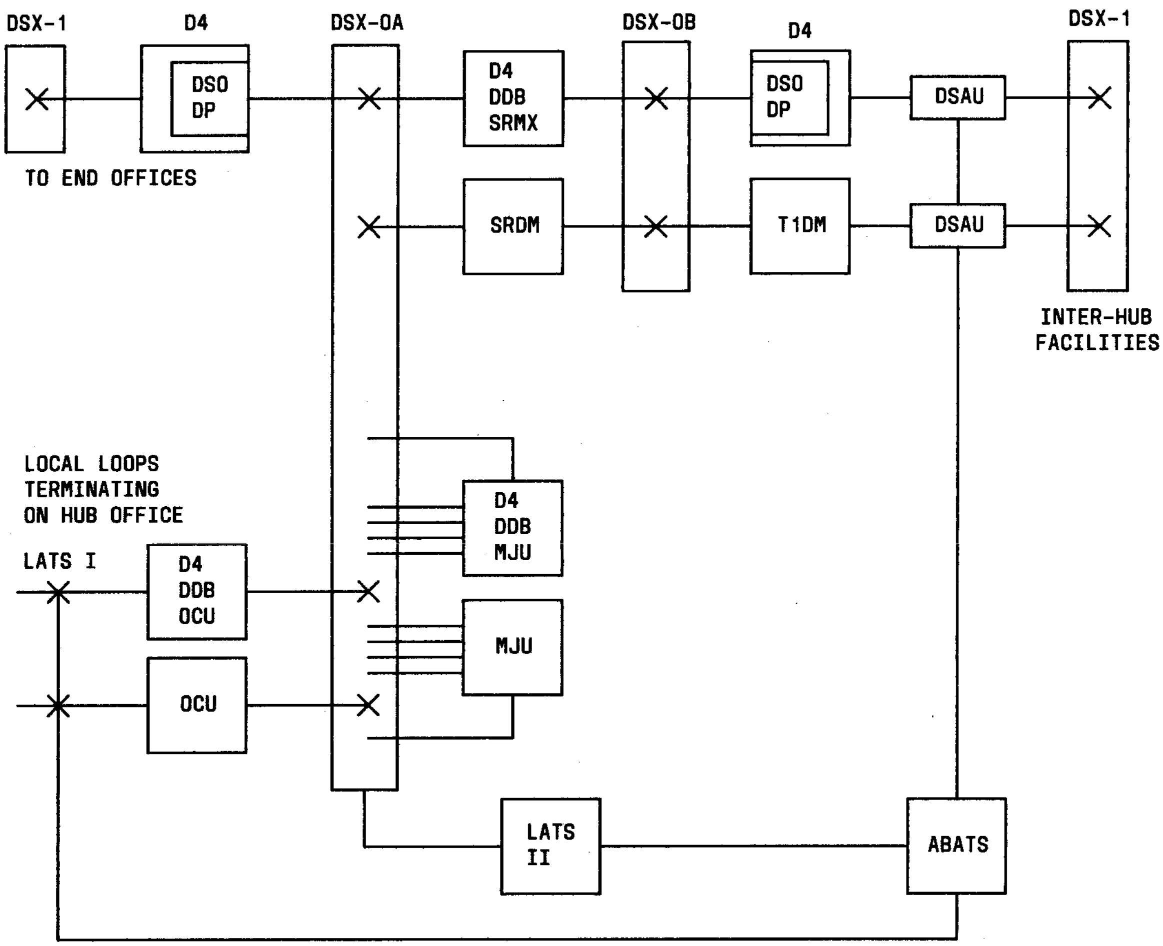


Fig. 16—DDS Hub Growth with D4 DDB

for their DDS counterparts at hub offices. If standard D4 channel banks are also used for the hub DS-1 terminal function, all of the hub transmission functions can be performed with D4-based equipment. This is an important consideration in hubs that are planned for cutover to the DACS/SRDC, in which all cross-connects, multipoint bridging, and test access are done at the DS-1 signal level. Fig. 17 shows how the D4-based hub equipment can be reused for multiplexing local loops into the DACS/SRDC and for other non-DDS applications.

8.04 At DDS end offices, the DDB-SRMX can serve as a direct replacement for the DDS OCU bay with ISMX (Fig. 18). In this application, the DDB-SRMX collects subrate customers served by local loops, SLC® 96 carrier, and other subtending offices by selection of OCU-DP or DS0-DP channel interfaces. The latching loopback of the all-rate DS0-DP provides trouble sectionalization capability between the DDB-SRMX and downstream carrier systems, allowing problems to be positively isolated in or out of the end office. The 56 kb/s customers are collected in standard D4 banks, which also serve as DS-1 transmission terminals toward the hub and subtending offices. The entire DDS end office function is then performed with D4-based equipment. Existing DDS T1DM or T1WB5 multiplexers can also be used for the DS-1 transmission functions. In these cases, the DDB-OCU can provide access for 56 kb/s loops.

8.05 The DDB-SRMX can also be applied in DDS end offices that are initially served by D4 dataport. In this application, as the number of dataport channels grows in the end office, they can be rolled to the DDB-SRMX and multiplexed to make more efficient use of the facilities to the hub. This can be easily accomplished since the OCU-DP that initially serves the customer loop is simply reused in the DDB-SRMX arrangement.

A. Non-DDS Network

8.06 The DDS network architecture that is based on the original DDS equipment concentrates all customer services from a large geographical area into a hub for centralized test access, multipoint bridging, and all circuit cross-connection. As a result,

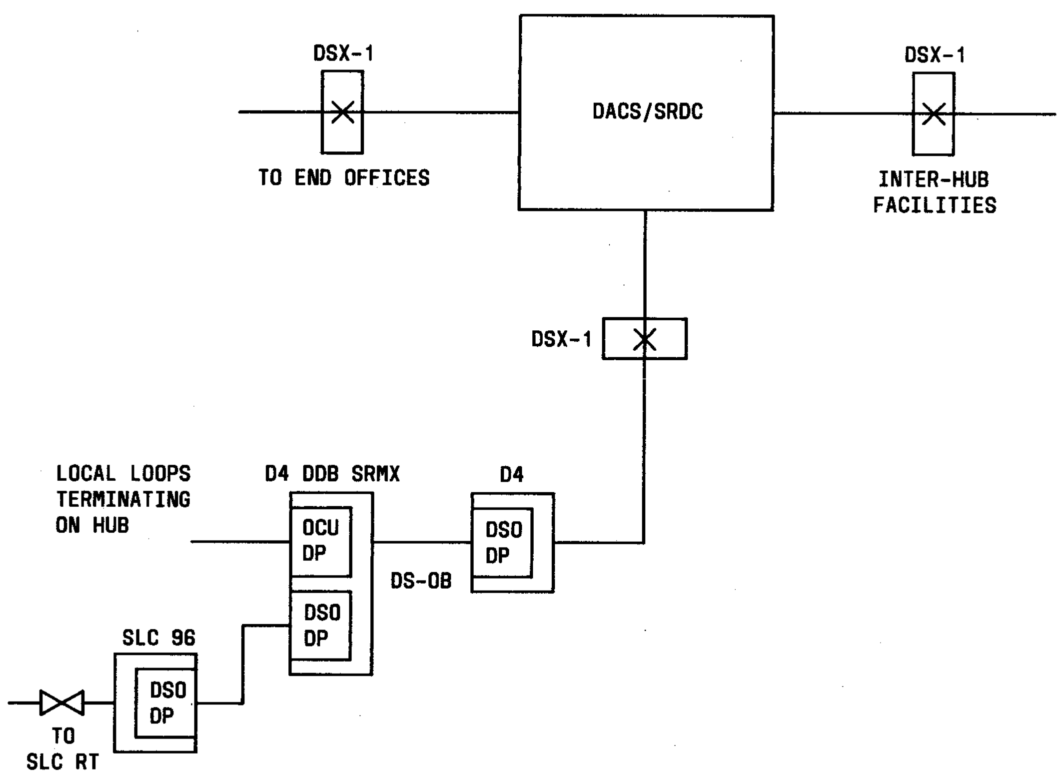


Fig. 17—Hub Office using D4 DDB and DACS/SRDC

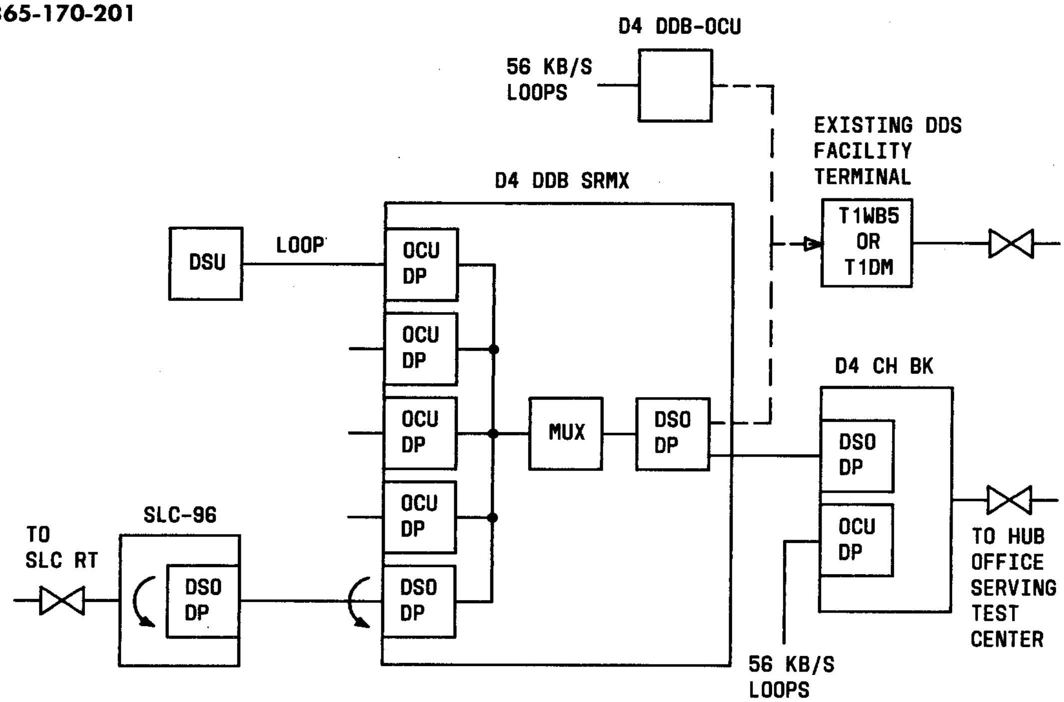


Fig. 18—D4 DDB Applications in DDS End Office

many circuits that might be served locally at end offices must be backhauled to the hub office. Digital data testing capabilities included in SMAS/SARTS (switched maintenance access system/switched access remote test system) offer the ability for performing the necessary tests directly in the end office. Since the D4 and DDB equipment can duplicate all of the functions of a DDS hub, essentially any office equipped with SARTS RTS-5A can become a 'local hub' and provide all of the services of the large DDS-style hubs at a much lower equipment and facilities cost. This type of hub is shown in Fig. 19. All services in the hub are brought to the DS-0A signal level for cross-connection and multipoint bridging and tested with RTS-5A.

8.07 This arrangement results in advantages for both intraoffice and interoffice circuits. Figure 20 shows an example of where both ends of a customer circuit are served by loops from the same end central office. Normally, both ends of the circuit would be routed over carrier facilities to the nearest hub office and connected together through a test access point. The same circuit can be served locally by cross-connecting two DDB-OCUs through a SMAS connector. The circuit is still provided with remote test access and interoffice facilities are eliminated.

8.08 Figure 21 shows how the DDB-OCU concept can be applied to interoffice circuits that are connected directly between end offices rather than through an intermediate hub office. In this example, the DDB-OCU allows a DS-0A SMAS access point in an end office, and standard D4 banks connect the two offices with direct facilities. The DDB-OCUs and DS0-DPs can be arranged in the corresponding channels of separate digroups within the same D4 bank to simplify circuit administration. As shown in Fig. 21, a single test access point is sufficient to sectionalize troubles by using the built-in loopback capabilities of the OCU, OCU-DP, and DS0-DP. Further economies result on such circuits by using the DDB-SRMX to efficiently pack many data channels on the interoffice facilities and by using the DDB-MJU to perform bridging nearest to the serving office.

8.09 Since each hub function is implemented in equipment that can be shared with many other services, such hubs can be located in areas with very small requirements for digital data service. If the hub then grows to the point where a DACS/SRDC becomes attractive, the DDB equipment can be reused in the hub and at other offices.

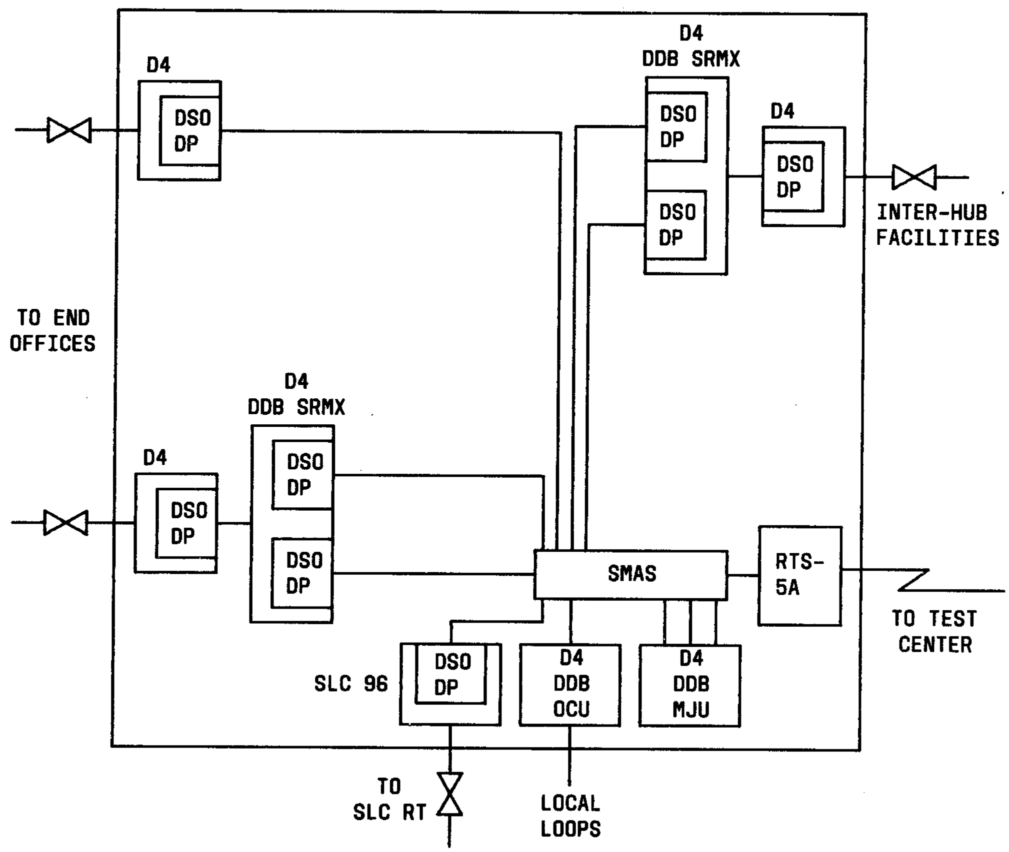


Fig. 19—D4 DDB Local Hub Arrangement

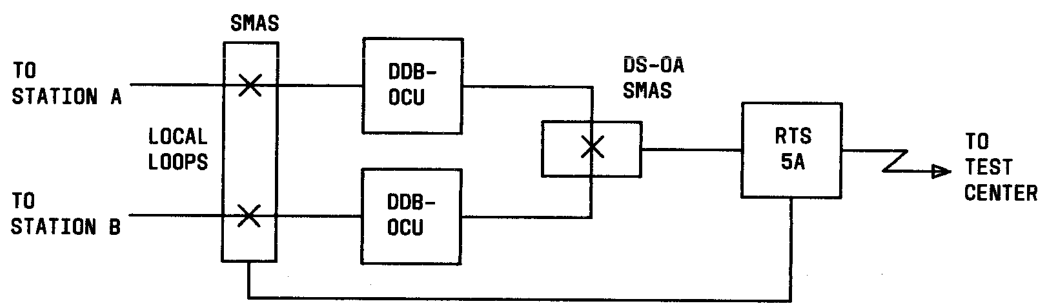


Fig. 20—Intraoffice Application With Both Ends of Customer Circuit Served by Same Central Office

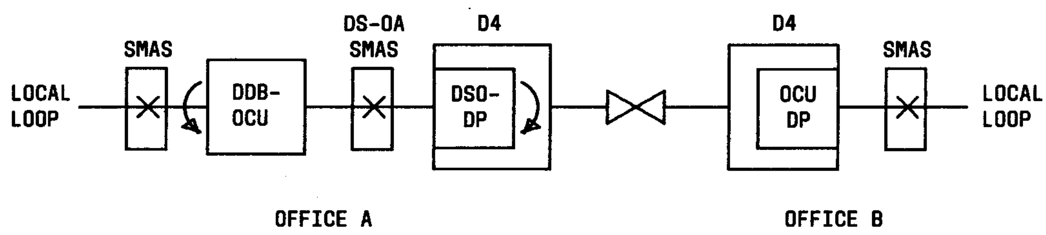


Fig. 21—Interoffice Application With Circuits Directly Routed Between End Offices