"DATAPHONE®" DATA COMMUNICATIONS SERVICE
OVERALL SYSTEM DESCRIPTION
SELECT-A-STATION SERVICE

CONTENTS PAGE

CONTENTS PAGE

Printed in U.S.A.

1. GENERAL

1.01 This section covers the overall system description of the DATAPHONE Data Communications Select-A-Station service, which is hereafter referred to as Select-A-Station service. This service provides for a private line, data only, multistation network over voice bandwidth channels. The descriptive information in this section includes the various equipment and circuit configurations that are used in providing this service.

1.02 The reasons for reissuing this section are listed below. Equipment Test Lists are not affected.

(1) Adds dual control arrangement for sequential and addressable service offerings

(2) Adds extended 2-wire customer interface

(3) Adds information on power and grounding of 833A data station

(4) Adds information pertaining to Switched Maintenance Access System (SMAS) connectors

(5) Adds main features of RL7 (verify) circuit pack

(6) Adds information on balancing of hybrids and designs using 2-wire hybrids.

Revision arrows are used to emphasize the more significant changes.

1.03 Select-A-Station service is intended for applications where a master station communicates with a number of remote stations one at a time and usually in rapid sequence. Point-to-point connections are set up between the master station and each remote station to allow the exchange of voice bandwidth data. A dc continuity connection between the master and remote stations cannot be furnished. Broadcast polling (simultaneous transmission from the master station to all remote stations) is also not provided.

1.04 Transmission between the master station and a remote station can be either duplex or half-duplex. However, when half-duplex transmission is used on a 2-wire local loop, echo and return loss must be considered. When separate bands (within the same voiceband) are used for each direction of transmission, these parameters are not considered.

1.05 An 833A data station at the master station contains selector control units (SCUs) that provide control signals and other functions to one or more data station selectors (DSSs) located in central offices. This signaling is accomplished either by frequency division of the voiceband channel or by a combination of frequency and time division multiplexing. Control signaling to the DSS can only be accomplished from the master station. Control signaling is in band and does not require a separately ordered channel from the master station to the central office.

1.06 This service differs from existing private line multipoint circuits in the following areas:

- Remote stations are completely independent of each other.
- The transmission levels and parameter limits are modified from existing multipoint private line services.
- The maintenance considerations are simplified due to improved equipment design and station segregation.

1.07 A glossary of the most commonly encountered terms and acronyms relating to Select-A-Station service is given in Part 10.

2. FUNCTIONAL DESCRIPTION

2.01 Figure 1 shows the overall circuit arrangement of a Select-A-Station system. The data transmission connections between the customer master station and the remote stations are made by DSSs in central offices. An 833A data station containing SCUs (one for each multistation circuit) is located at the customer master station. A group of dc interface leads between the SCU and the customer equipment provides control over the operation of the DSSs to various degrees, depending upon the service offering and DSS options used. Refer to paragraph 2.04 for more information on service offerings and options. The SCU transmits the required control signaling to DSSs in response to the dc control voltages from the customer equipment. The SCU then receives supervisory signaling from DSSs and provides this to the customer equipment as a dc control voltage. Detailed

information on the dc interface leads is given in Section 598-083-105.

2.02 The customer has full responsibility for the overall communication of data once the connection to a particular remote station is made. The customer provides the terminal equipment at both the master and remote stations, dependent upon application requirements. The voiceband data transmission allowed over the end-to-end channel can be any form providing it will perform properly in the presence of the various channel parameter limits given in Part 4.

2.03 One part of the end-to-end channel consists of 4-wire facilities from the SCU at the master station to the primary DSS at the central office. This part of the channel facility is referred to as a primary link. The channel connection between the primary DSS and other DSSs (secondaries) are also 4-wire facilities and are referred to as secondary links. The facility connection from a DSS to a remote station can be either 2-wire or 4-wire, depending upon the type of remote termination. Normally, 2-wire facilities will be terminated in 150A channel service units (CSUs) while 4-wire facilities will terminate in a data auxiliary set (DAS) 829-type. The customer provided equipment (CPE) connected to the 4-wire termination at the master station must be a valid 4-wire modem (no hybrids) to ensure proper operation of the circuit.

2.04 A total of two service offerings and ▶seven◀ DSS options can be selected by the customer to accommodate customer operating procedures and system structure. The service offerings and DSS options are listed below.

(a) The sequential offering has four options:

- Automatic step DSS option

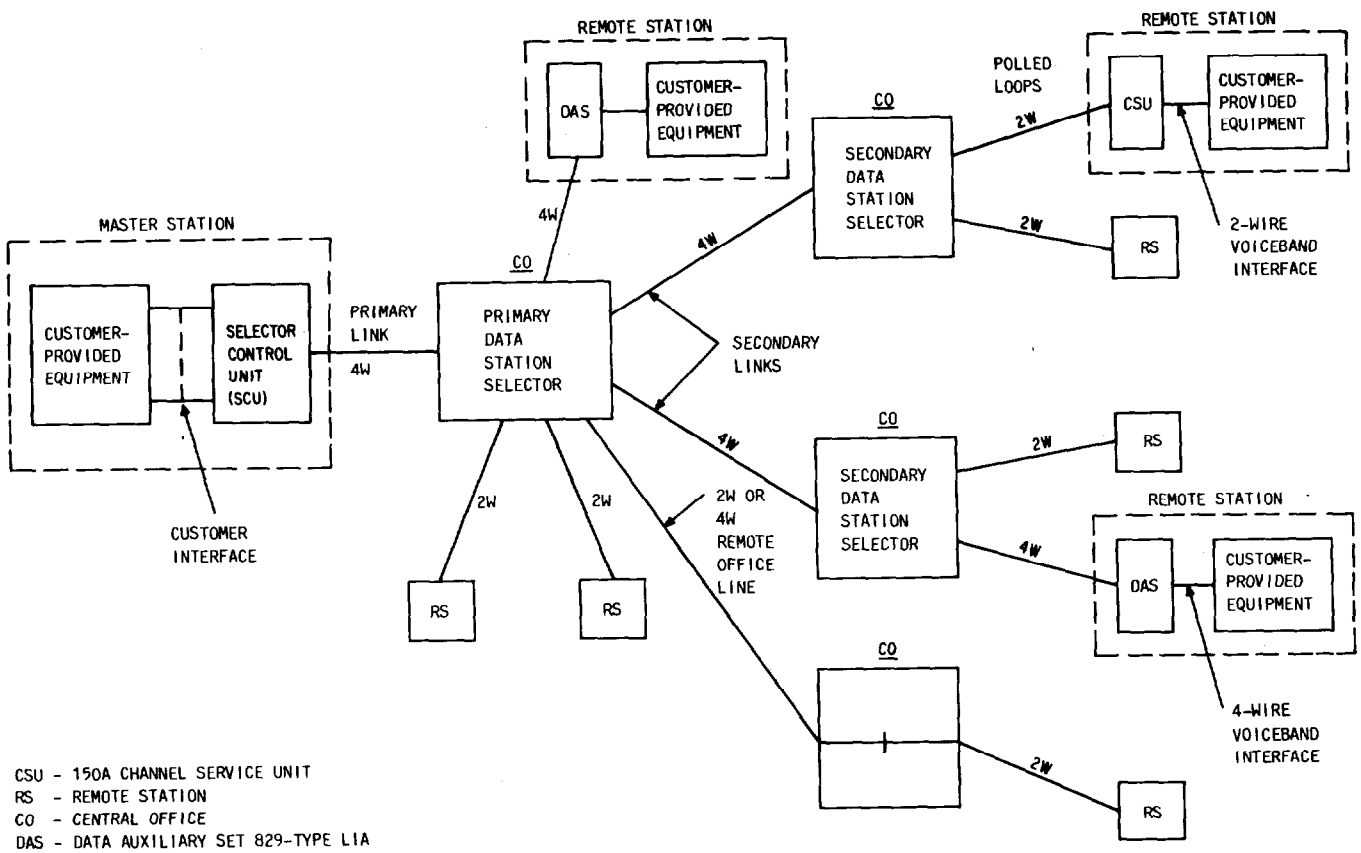

Fig. 1—Select-A-Station Service—Overall Block Diagram

- Automatic step DSS option with reset
- Controlled step DSS option
- ▶Controlled step DSS with dual control option.◀

(b) The addressable offering has three options:

- Single address DSS option
- Double address (error control) DSS option
- ▶Dual control option.◀

Note: Both service offerings and all DSS options have the advantage that no remote station can control the operation of the DSSs. This provides maximum security of the system from outside interference.

The above service offerings and DSS options allow ▶seven◀ types of operation. A summary of the features of each type of operation is given in paragraphs 2.05 through 2.27.

A. Sequential Service Operation

2.05 A functional block diagram of the sequential service is shown in Fig. 2. The DSS operation is described first, followed by a description of how the master station works with the DSS.

2.06 The DSS works automatically in the automatic step and automatic step with reset options. The digital control circuit (RL4 circuit pack [CP]) generates an address and activates the port card. The RL4 CP also activates the analog control circuit (RL5 CP) which sends a signal to port zero. Port zero remains connected for a fixed time (20 ms to 10.24 seconds) so the remote station can return the signal. The digital control circuit (DCC) then generates the next address, and RL5 CP sends a signal to the next port (port 1). This process continues in sequence until the end of the cycle (a maximum of 128 ports). After the last port connection is dropped, there is a quiet (no signal) period lasting one-half the port connection time. The DCC then generates a frame tone lasting one and one-half times the port connection time. This frame tone is sent to the SCU to notify the master station that a new cycle is beginning. The detection time is about 24 ms. The SCU, which consists of DAS 833A-L1B and DAS 829-type L1A, detects the frame tone and passes it to the CPE as a dc voltage.

Automatic Step DSS Option

2.07 The automatic step DSS option of the sequential offering is designed for customers whose order of connections is fixed, whose message is fixed, and who have the capability to time the connections. In this type of operation, the access or connection time is set at installation of the DSS by customer specification. The time period can be set from 20 ms to 10.24 seconds in 51 discrete steps. The number of ports-per-cycle is set at installation for each DSS by means of DSS option switches. This port assignment is made in steps of 8 ports up to 128 ports. No in-service control is provided over the operation of the DSS.

2.08 In order to operate properly, the master station must know when each response begins and which remote station the response comes from. The frame signal is provided to synchronize the master station with the DSS. This signal appears over a dc interface lead (after the 24 ms detection time) and on the customer end-to-end receive pair at the master station. A quiet interval is provided prior to the frame signal to ensure that an unwanted signal from a remote station is not timed and interpreted as a valid frame signal.

2.09 A DSS optioned for automatic step is not recommended for use as a primary DSS in a tandem DSS arrangement since in-service control of the connection time is not available. Connection time control is needed to tandem since a primary DSS output port connecting to a secondary DSS must be held much longer than for a single remote station. A DSS optioned for automatic step can be used as a primary in a nontandem circuit. It can also be used as a secondary DSS in a tandem circuit.

Automatic Step DSS Option With Reset

2.10 The type of operation available with this DSS option has the same features and restrictions as the automatic step DSS option plus a reset feature. In response to a command from the CPE, the SCU generates a control signal. The duration of the control signal must be 10 ms. This causes the DSS to disconnect from the port and begin the cycle again with the quiet period. Thus, the cycle can be reset at any time and as often as necessary but will always begin with port zero.

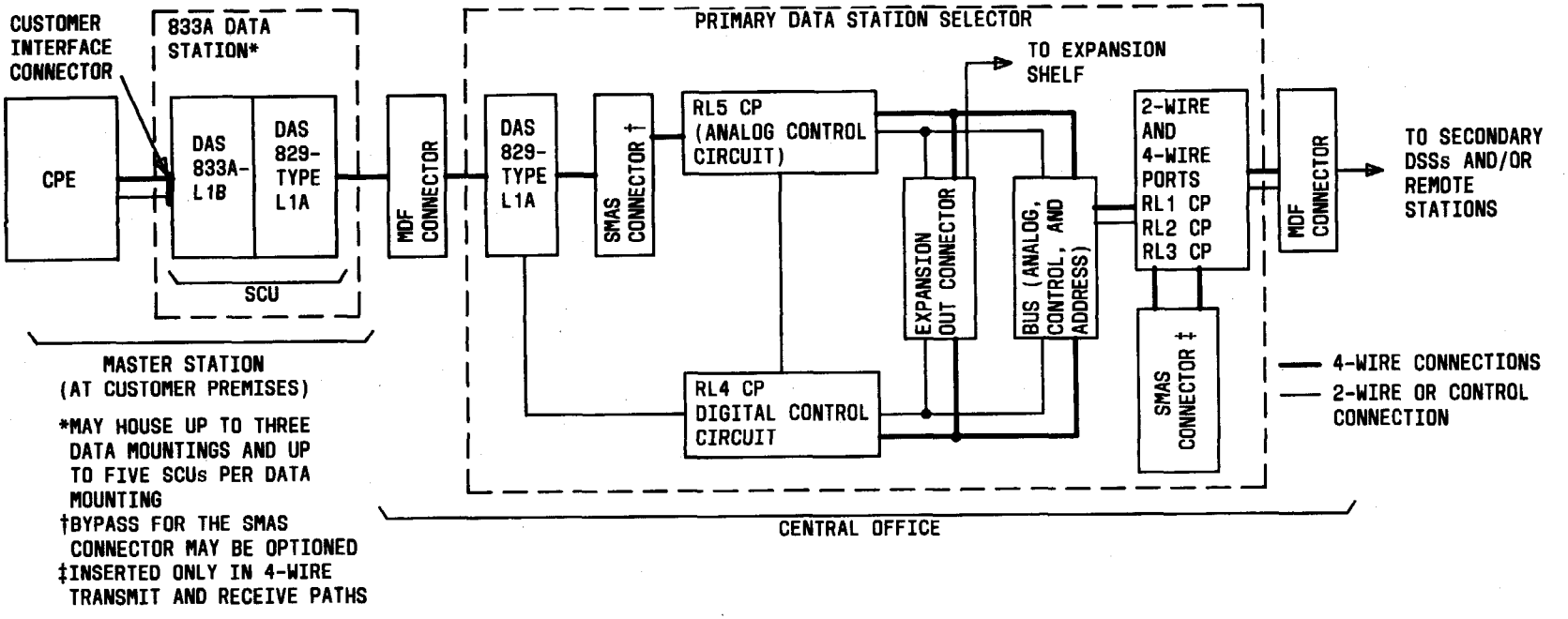

Fig. 2—Functional Block Diagram of Sequential Service Offering

2.11 This DSS option can be selected by the customer to provide a means for rapid resynchronization of priority connections to stations at the beginning of the cycle. The stations can be assigned so that the priority stations are at the beginning of the connection cycle and can be connected more often by resetting at the proper point. The reset function can also be used for rapid resynchronization if time or station identification is lost during some point in the polling cycle.

2.12 These two types of automatic step operation are the least flexible of the various types of operation in that the time duration of each connection is fixed at the DSS. The DSS steps (switches) automatically to the next station in sequence at the end of the fixed connection time. It is expected that the message length from each remote station be reasonably constant to make efficient use of these DSS options.

Controlled Step DSS Option

2.13 This option allows the customer to control the connection time to a port and allows a highly practical tandem arrangement of data station selectors. The connection time is not preassigned, which permits the customer to vary the connection time to any remote station as needed. The SCU generates a primary and/or secondary control signal to signal the DSS to step to the next port. A primary DSS will step after receiving a 10 ms primary control signal, and a secondary DSS will step after receiving a 10 ms secondary control signal. These distinct control signals ensure that the primary DSS can be held on the port that connects to the secondary DSS, while secondary control signals are sent to control the operation of the secondary DSS. The minimum connection time for any port in the controlled step option is 20 ms. The control signal must be 10 ms in duration, and the customer must wait an additional 10 ms before another control signal can be sent to avoid false operation. Customer end-to-end data may be transmitted during this interval. In a tandem arrangement, the primary DSS can be controlled to step through the rest of its ports after a secondary cycle is completed.

2.14 The frame signal is sent for the equivalent of two port steps. This signal appears at the beginning of each cycle of each associated DSS. To obtain a valid frame indication, two control signal transmissions are necessary. One control signal is sent to obtain the frame signal. The frame signal must then continue after the second control signal is sent. This indicates a valid frame to the customer, and the next control signal steps the DSS to port zero.

2.15 As mentioned previously in the automatic step operation, the customer specifies at the time of initial installation (or when service is changed) the number and the ordering of output ports that each DSS will cycle through. Each DSS can cycle through any multiple of eight ports up to a maximum of 128 ports.

▶Controlled Step DSS With Dual Control Option

2.16 This option has all the features and operating characteristics found in the controlled step DSS option. In addition, two SCUs are connected to redundant DSS common equipment by two 4-wire facilities. Either SCU can access all the ports of the system. (See Fig. 3.)

2.17 One link is used for all communications between the SCU and the primary DSS, while the second link serves as a standby.

2.18 The dual control option should only be used in the controlled-step DSS option in the sequential offering because double connections may result in the automatic option.◀

B. Addressable Service Operation

2.19 This service offering allows the customer to vary both the message time and the order of station connections on an in-service basis. A DSS setup for addressable service may be used as a primary or secondary DSS in a tandem arrangement.

> ***Note:*** Instruction(s) or code words will be referred to generally as addresses. These addresses should not be confused with specific port addresses.

Single Address Option

2.20 Figure 4 shows a functional diagram of the addressable service. A connection is dropped by the DSS when a control signal is received from the SCU (at the master station). The RL8 CP (which replaces RL4 CP in this service) generates an acknowledgement signal which is sent back to the SCU. The address digital control circuit, RL9 CP, turns on the address receiver in data set 202T to accept instruc-

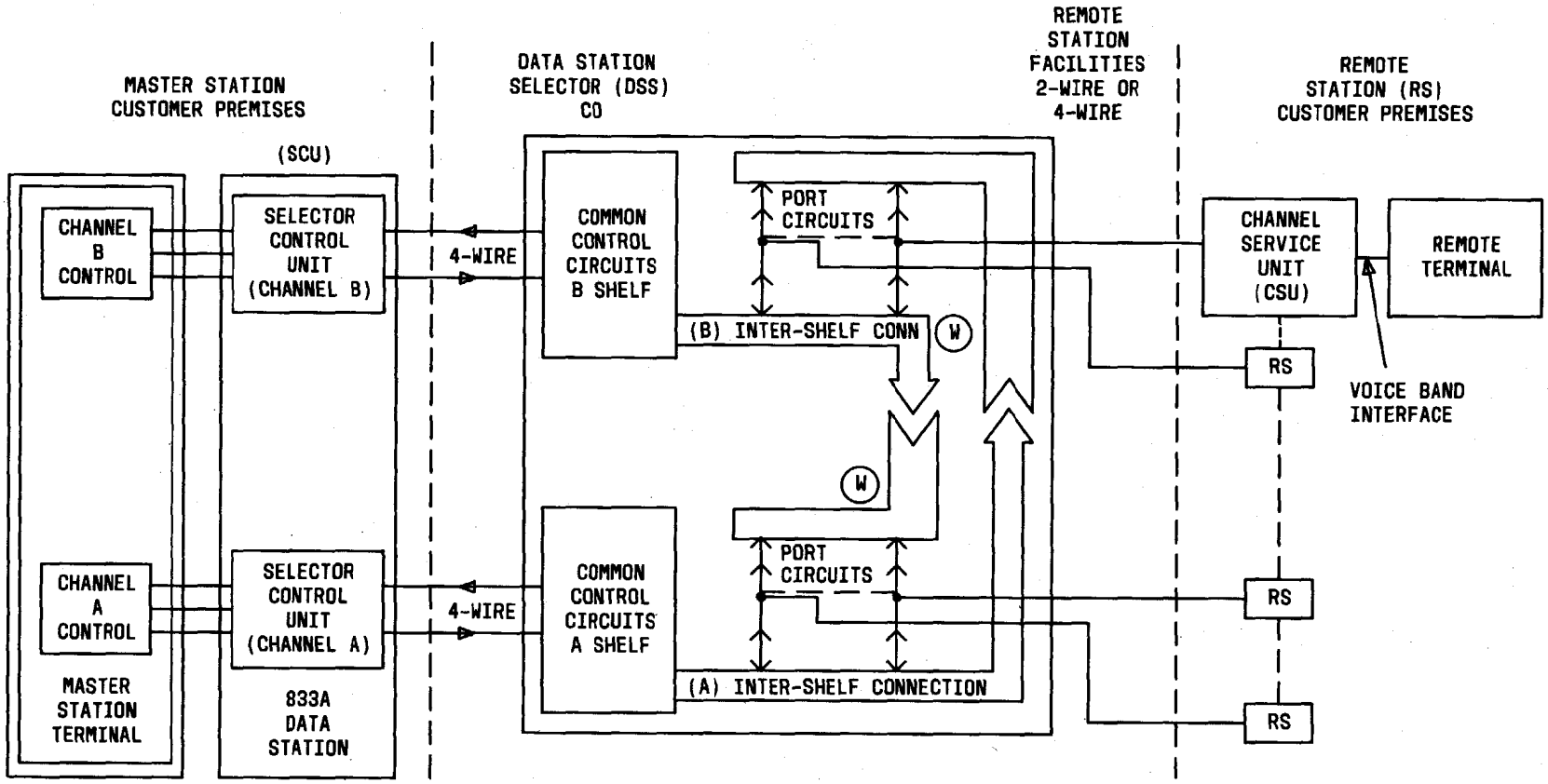

Fig. 3—Dual Control Select-A-Station Service

tions (addresses) from the SCU. After receiving a valid instruction, the DSS stops sending the acknowledgement signal and shuts off the address receiver. According to the instructions, RL8 CP either implements a DSS function or instructs RL5 CP to set up a connection to a port. The DSS will stay connected to a port until another control signal is sent by the master station.

2.21 Errors in an address received by the DSS are detected by a parity check comparison circuit that is part of RL9 CP. When an error is detected, the DSS will inhibit the connection to a port and continue to send the acknowledgement tone to the SCU. The customer equipment must recognize this condition and cause the SCU to send a control signal followed by the valid address. The DSS will also detect some customer-generated errors. For example, if the instruction following the address of port 125 exceeds the optional number of ports-per-cycle, an error will be detected.

2.22 Three addressable ports on each DSS are reserved for special functions. Port 125, when addressed, causes the DSS to go into a sequential mode. Port 126 is used for special control functions that are discussed in paragraph 2.24. Port 127 connects a 1-kHz test tone. Therefore, in the addressable service offering, only ports 0 through 124 on each DSS are available for assignment to a remote station. In a primary DSS, these ports are available to assign to remote stations or secondary DSSs.

> ***Note:*** Each of the special control functions is ended by the DSS when it receives a control signal.

2.23 The sequential mode of the addressable offering is provided so that a number of stations can be connected in a fixed order without the need to send specific port addresses. This allows a reduction in overhead time that would otherwise be needed for addressing. In the sequential mode the operation of the DSS is similar to that of the automatic step option of the sequential service. Port 125 address followed by the address of the port where the sequence starts is sent by the master station. Then the DSS stops sending the acknowledgement tone and begins stepping through the ports automatically, starting at the port designated by the address. If no control signal is received, the DSS will continue stepping through the ports until the end of the cycle. At the end of the cycle, the DSS connects immediately to port zero and begins the sequence again. No frame indication is provided. The cycle can be resynchronized at any time by sending a control signal followed by port 125 address and the starting port address. The port connection time and the number of ports-per-cycle are set as described in paragraph 2.07. However, the maximum number of ports is limited to 125 in the sequential mode. The last setting adds only 5 ports over 120 instead of 8 ports. The DSS will not cycle automatically through the special function ports 125 to 127. If secondary DSSs are in the system arrangement, they should be connected to ports that are not in the primary sequential mode cycle. Ports that connect to secondary DSSs may need to be held for longer periods of time. Ports 120 to 124 should be reserved for secondary DSSs since it is most convenient to exclude these from the sequential mode cycle. If more than five secondary DSSs are in the system, the appropriate number of ports in groups of eight should be reserved for the secondary DSS.

2.24 Port 126 is used to activate two special control functions: the digital loopback command instruction and the report DSS status command instruction. To activate the digital function, the SCU sends the port 126 address followed by the digital loopback command instruction. The data receive and data transmit leads of the data set 202T in the DSS are then connected together so the circuit loops back toward the SCU. A data check can then be made of the data set 202T and the transmission performance of the channel. To activate the report DSS status function, the SCU sends the port 126 address followed by the report DSS status command instruction. The DSS then sends back two code words (addresses). The first word indicates the port connection time for the sequential mode. The second word indicates the number of ports-per-cycle for the sequential mode.

> ***Note:*** The command instruction words were chosen so as to minimize the possibility of mistaking one word for the other.

2.25 Address 127 causes the DSS to transmit a continuous 1-kHz test tone to the SCU. The 1-kHz tone provides a check that the DSS is operating properly on a single address. An error is more likely to occur in transmitting the port 127 address than any other address. If the error is not detected or inhibited by the DSS, false reception of the test tone is least likely to interrupt service.

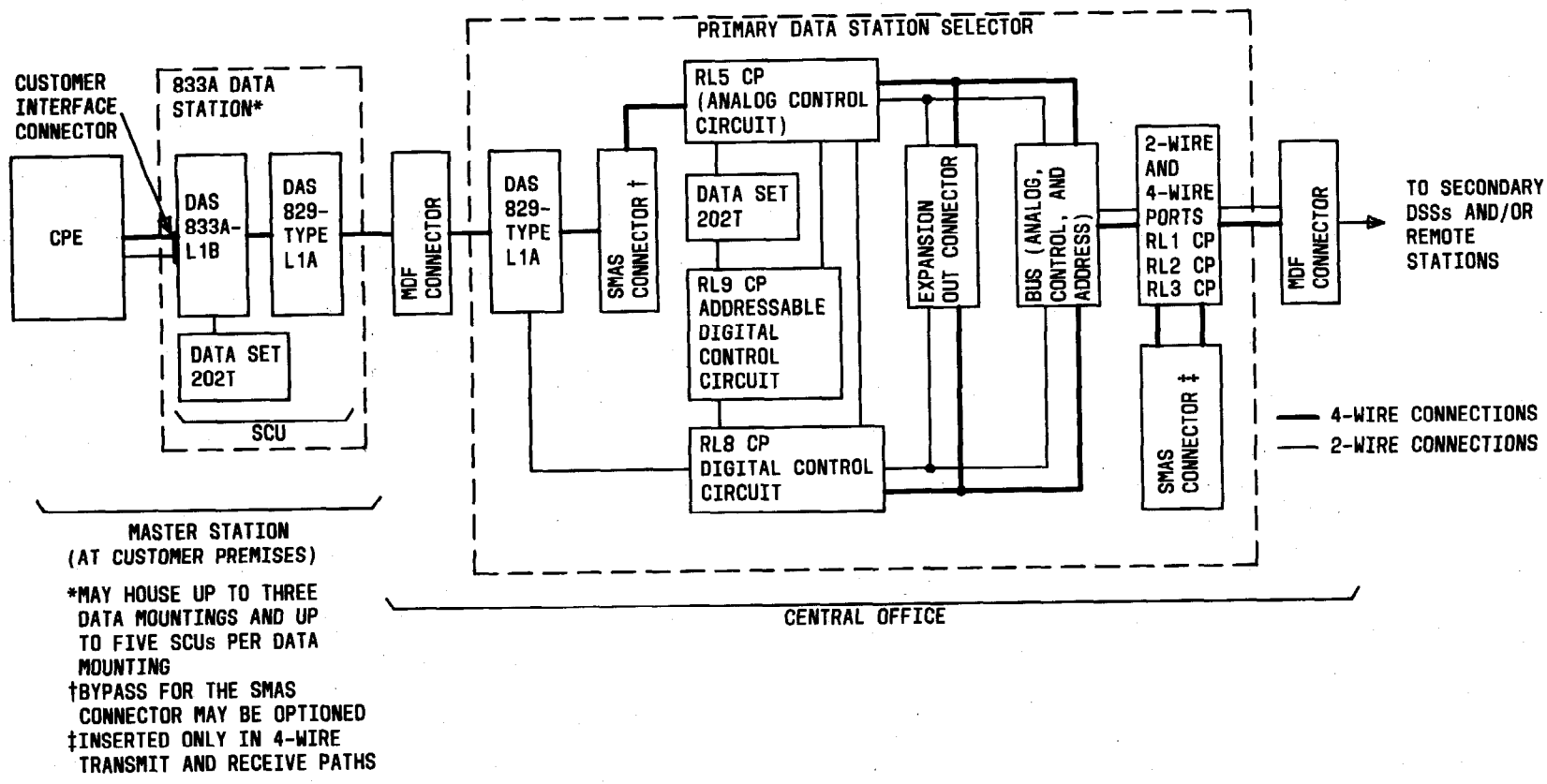

Fig. 4—Functional Block Diagram of Addressable Service Offering

Double Address (Error Control) Option

2.26 If a more powerful error detection scheme is desired than that described in paragraph 2.21, the double address error control option may be requested by the customer. This DSS option requires that each address be sent twice in order to activate the DSS. The two addresses must be identical to each other or an error will be detected. If two different addresses are used (such as the special functions), the first address must be sent twice in sequence and the second address must be sent twice in sequence.

▶Dual Control

2.27 The dual addressable DSS provides dual control for the master station terminal. The terminal is equipped with a second SCU, a 4-wire facility, and redundant common equipment for the primary DSS which can act as a standby control link, enhancing the reliability of the system. (See Fig. 3.)

2.28 In state 1, the user has access to every port via either DSS-A or DSS-B. When commanded to enter the sequential mode, DSS-A automatically sequences through all available ports with even addresses (eg, 0, 2, 4) and DSS-B automatically sequences through all available ports with odd addresses (eg, 1, 3, 5). In order for both DSSs to sequence automatically, each must receive the sequence instruction address 125 followed by a starting address. The starting address for DSS-A must be even and less than the optioned ports-per-cycle maximum to avoid an error condition. The starting address for DSS-B must be odd and less than the optioned ports-per-cycle maximum to avoid an error condition. State 1 is also known as the share-load mode in which one DSS may be in the sequential mode and the other in the addressable mode.

2.29 In state 2, only DSS-A has access to the ports. When in the sequential mode, DSS-A has access to both even and odd ports and the starting address may be either even or odd. The DSS-B is shut down.

2.30 In state 3, DSS-B has access to all ports. When in the sequential mode, DSS-B has access to both even and odd ports and the starting address may be either even or odd. The DSS-A is shut down.◀

3. EQUIPMENT CHARACTERISTICS

3.01 This part covers the characteristics and features of the major equipment components of Select-A-Station service. These include an 833A data station containing ▶one or two◀ SCUs for each circuit, a DSS, and a 150A CSU or DAS 829-type L1A. The engineering rules and design of the primary and secondary links are described in Section 880-480-010.

A. 833A Data Station

3.02 Each SCU provides for connection control of a single circuit consisting of a primary DSS and possibly some secondary DSSs. The SCU is physically designed for mounting in a multiple arrangement since the customer master station generally requires a number of these circuits.

3.03 An 833A data station consists of one or more 56A2 data mountings, each housing a dual power supply, tone oscillator, and up to 5 SCUs. The SCU consists of a DAS 833A-L1B and a DAS 829-type L1A, which are plug-in modules for the sequential service. To provide the addressable service, a data set 202T must be added to the SCU. A DAS 829-type L1A is used to provide a standard 4-wire termination to the channel, while DAS 833A-L1B contains a customer interface connector, tone detectors, and control logic circuits. The data set 202T contains the modulation and demodulation circuits that are required for addressable operation.

3.04 One of the five SCUs can be used as a spare. This spare SCU may be shared among several data mountings provided the data mountings are housed directly above or below one another. This will allow the short interconnecting cables to be used.

3.05 ▶The customer supplied power to the 833A DAS may be either ±24 Vdc or 117 Vac nominal. The power supply must be properly grounded, and a lightning arrester on the ac line is necessary. Refer to Task Oriented Practice Section 598-083-106 for proper strapping of all ground points.◀

B. DAS 829-Type L1A

3.06 The DAS 829-type L1A provides a 4-wire channel termination, hazardous voltage protection, longitudinal balance protection, channel equal-level loopback (manual control only in the 833A data station), level adjustment in the transmit and receive paths, and amplitude equalization.

3.07 The DAS 829-type L1A is available in three basic codes, depending upon the local facilities

to which it connects. The three DAS types for Select-A-Station service are coded DAS 829A-L1A, 829B-L1A, and 829C-L1A. The rules for selecting the proper DAS are given in Section 598-082-100.

3.08 Each DAS-type L1A consists of component apparatus mounted on a printed wiring board (PWB) that plugs into the 56A2 data mounting. The front face of the PWB contains jacks (and accepts a standard 310 plug) for testing and monitoring the transmit and receive circuits. The DAS 829B-L1A and DAS 829C-L1A also have a receive input jack for adjusting the receive level.

3.09 The DAS 829-type L1A, while similar in appearance to existing DAS 829s, has several circuit changes. These changes are as follows:

(a) An LB indicator light emitting diode (LED) is added to the front panel providing a means to verify that loopback has occurred.

(b) Power can be supplied from either a −48 Vdc or a 24 Vac supply. An option strap arrangement is added to select the type supply unit.*

(c) The tone activated loopback circuit can be disabled by strapping pin 40 to pin 31 on the backplane wiring. When not strapped, the tone loopback circuit is enabled.

(d) An option strap arrangement is added to select a gain of either 8 or 16 dB in the loopback path. When used in the 833A data station, the 16-dB option should be used.

(e) Access provided by the TRANS MON jack is moved to the drop side of the transmit pair. The TRANS MON jack is now wired directly to the DT1 and DR1 terminals.

Note: The DAS 829-type L1 (Mfr Disc) must not be used in this service since it does not provide the additional features noted above.

C. DAS 833A-L1B

3.10 Each SCU includes a DAS 833A-L1B which contains control logic circuits, tone detectors, a customer interface connector, and several switches and indicator lamps to control and indicate maintenance functions. The control logic circuit places the SCU in the end-to-end or signaling states based upon the control voltages on the dc interface leads. The tone detector detects the primary and secondary frame signals to verify proper connection operation at the DSS.

3.11 The customer interface connector is a 25-pin connector providing customer access to the end-to-end voiceband channel and the dc interface leads. This connector is the point of connection between the SCU and the customer data terminal. A customer provided interface cable is required for each SCU in the data station arrangement. This cable must not exceed 50 feet in length.

D. Data Set 202T

3.12 Data set 202T is a transmitter receiver for the address information sent between the DSS and the master station. Frequency-shift-keying modulation is used to send and receive the information. The faceplate of the plug-in module has six indicator lamps and three switches. The indicator lamps monitor test functions. The three test switches implement the analog loopback, local self-test, and remote test functions.

E. Data Station Selector J70180AA

3.13 The DSSs are located in telephone central offices, and each connects the customer master station to one of a number of 2- or 4-wire ports. The basic function of the DSS is to break a connection between the primary link and one output port and connect it to another output port. For the automatic step DSS option of the sequential offering, the connection is controlled by an internal timer in the DSS. For the controlled step DSS option of the sequential offering, the connection is controlled by a signal from the SCU. In both types of operation, the DSS transmits frame signals to the master station at the beginning of the polling (switching) cycle. In the addressable service, the connection is controlled by a signal from the master station. No frame signal is provided. Instead, an acknowledgement signal is sent by the DSS after receiving the control signal. This enables the customer station equipment to recognize the fact that the DSS is ready to accept an address.

3.14 The DSS provides a 4-wire channel termination at its input and a 2- or 4-wire channel ter-

*The stamped designation of −48V or N (for normal) indicates the applicable option to be used.

mination at the output ports. The termination at the input is provided by a DAS 829-type L1A. The 4-wire termination at the output is provided by a single circuit pack (RL2 or RL3) which contains transmission circuitry similar to DAS 829-L1A but without the tone activated equal level loopback feature. This feature is not provided because testing will be carried out from the primary link toward the primary and secondary DSSs. Also, it is not desirable to remove the DSS from service by placing a loopback tone on the channel from a remote station since this affects the security of the service. Equal level loopback of secondary links can be accomplished at a primary DSS 4-wire output using manual patching through an amplifier that is part of the optional verify circuit pack (RL7).

3.15 The DSSs can be arranged in several ways in the central office. The basic DSS consists of a dual-shelf assembly for housing common and port plug-in units. The common equipment consists of a DAS 829-type L1A at the input, an analog control circuit pack RL5, a digital control circuit pack (RL4 for sequential, RL8 for addressable), and a power supply RG3. The DSS line equipment consists of the 2-wire RL1 and 4-wire port circuit packs (RL2 or RL3).

3.16 ▶The dual-control start-up arrangement consists of one DSS 2-shelf unit. The lower shelf A is equipped with one DAS 829-type L1A, two common control circuit cards—RL4 and RL5, optional test card RL7, and option card CP1. The upper shelf B is equipped with one DAS 829-type L1A, two common control circuit cards—RL4 and RL5, and two RG3 power circuit cards.

3.17 The DSS has an optional verify circuit pack (RL7). This unit can be shared among several DSS assemblies by plugging into the appropriate DSS, or one can be supplied for each DSS assembly. The verify circuit pack provides the following features:

(a) Monitors an address produced by the DCC card and monitors two addresses if the system is dualized

(b) Reads the address programmed into a 4-wire port

(c) Reads the four addresses programmed into a 2-wire port card

(d) Produces an 8-dB amplification for use in loop-around testing of a 4-wire port card

(e) Produces a −8 dBm tone source for use as a reference tone for 4-wire port cards.◀

3.18 The 2-wire port circuit pack serves up to four 2-wire output ports, while the 4-wire port circuit pack serves only one 4-wire output port. A fully equipped DSS 2-shelf start-up arrangement can serve eighty-four 2-wire ports or twenty-one 4-wire ports or various combinations. Physically, a 4-wire port circuit pack displaces one 2-wire port circuit pack which contains four 2-wire output ports. Additional DSS assemblies can be added to the "start-up" DSS. One shelf of an additional (growth) DSS assembly can increase the total capacity to one-hundred and twenty-eight 2-wire ports. The full additional DSS assembly can also be used to increase the total capacity to forty-three 4-wire ports or various combinations of 4- and 2-wire ports. Further additions of DSS assemblies can be made to increase the number of 4-wire ports in increments of 22 to a total of 128 ports. An expansion control circuit (ECC) pack (RL6) is required when using the additional DSS assembly.

3.19 ▶When the system port circuit requirements specify more port circuits than can be supported by a dualized start-up unit, a dual-control expansion unit is required. A dual-control expansion unit operates similar to a single-control expansion unit and consists of one J70180AA, L1 DSS 2-shelf unit. The lower shelf A is equipped with one ECC card (RL6) mounted in slot A3 and one optional test card (RL7) mounted in slot A18. The unit is programmed for dual operation by option card CP1 located in slot A19. The upper shelf, B, is equipped with one RL6 card mounted in slot B3. An option card, CP1, is not required for the B shelf. A dual-control expansion unit may be used with either dualized sequential or addressable start-up unit arrangement. The dual-control expansion unit is connected to a start-up unit by two 842 307 613 cable asemblies.◀

3.20 The 4-wire port circuit pack is used to connect a primary DSS (a DSS connected to the master station) to a secondary DSS. The 4-wire port circuit pack is also used from a DSS to a 2-wire remote station where 4-wire interoffice facilities are used. It is also used to connect the 4-wire facilities from the DSS to the remote local office and from a DSS to a 4-wire remote station.

3.21 The 2-wire port circuit pack is used to serve 2-wire remote stations over a 2-wire local loop or a 2-wire loop plus a 2-wire interoffice facility on a remote office line.

3.22 ⧫The DSS may come equipped with SMAS connectors in place. These connectors may be removed so jumpers can be run to the main distributing frame (MDF). If jumpers are run to the MDF, ensure that the connections are connected to SMAS or looped around to the DSS. If this is not done, the DSS will not have continuity in any 4-wire circuits.

3.23 A new design of the extended 2-wire customer drop allows extension using a 2-wire port at the J70180AA unit. This arrangement requires either a 4-wire transmission only or an E and M channel unit. Two terminating sets are also required, one at each end of the carrier channel units. The terminating set used to interface the DSS should have an impedance of 900 ohms. The A and B leads should be shorted. (This removes the 1-KHz lineup tone.)⧫

3.24 Before Select-A-Station is placed in service, the 2-wire hybrids should be balanced in accordance with local procedures and applicable Bell System Practices.

3.25 A power distribution panel is located between the two shelves that comprise the DSS assembly. This power section contains fusing, power supplies, and alarms. The power supplies receive their input voltage from the central office (−48 Vdc) battery supply.

F. 150A CSU

3.26 At a 2-wire remote station, the 150A CSU is the point of connection with the customer equipment. This unit is a passive device for terminating a 2-wire metallic loop facility. The CSU provides a balanced termination, padding, current surge protection, hazardous voltage protection, and dc voltage isolation between the channel and the customer terminal. The CSU requires no external customer supplied power. The customer terminal is restricted in that no more than one milliamp of dc current can flow through the CSU termination.

3.27 The CSU includes padding to facilitate signal level adjustment at initial installation. When the CSU is installed, the installer opens a screw switch on the CSU. This switch places a capacitor into the circuit, blocking the dc current flow in the local loop. This releases a relay in the DSS which, in turn, applies a −18 dBm, 1-kHz tone to the line at a −5 transmission level point (TLP). The attenuator pad on the CSU can then be adjusted for a proper receive level of −30 dBm (−17 TLP) at the customer tip (CT) and customer ring (CR) terminals. After the adjustment is completed, the screw switch is closed, allowing dc current to flow. The relay in the DSS is now operated and removes the 1-kHz tone from the local loop. This feature allows the installer to complete installation of the remote terminal without central office assistance. ⧫A carrier extended 2-wire loop requires two people for lineup since the automatic lineup tone from the DSS cannot be activated in the normal manner.⧫ Additional information on the 150A CSU is given in Section 590-101-000.

4. TRANSMISSION REQUIREMENTS

4.01 This part covers the transmission plan that includes the transmission levels and parameter limits for the individual links in the network. There is a departure from the standard 3002 channels that are used for private line circuits in most instances. The primary objective of this plan is to establish transmission requirements that meet the requirements of the service offering. This will ensure reliable transmission of control signaling between the master station and the DSSs and between the master and remote stations for end-to-end data transmission.

4.02 The transmission plan specifies the data levels (expressed also in TLPs) at the DSSs and at the stations. The limits of various data transmission parameters are assigned among the individual links of the circuit to avoid the need for end-to-end (customer station to remote station) tests whenever a new remote station is added to the circuit. Each link is lined up separately.

A. Transmission Level Plan

4.03 Establishment of standard signal powers at certain points in a circuit is fundamental to overall circuit design work. Controlling these signal powers will guard against overloads and crosstalk on adjacent circuits. It also ensures that a good signal-to-noise ratio is maintained overall.

4.04 Accurate measurement of the transmission characteristics of voiceband data circuits depends upon knowledge of the correct test levels to be transmitted and received. The power of the test signal with respect to the TLP at which it is applied will have a major influence on the test results obtained.

4.05 The circuit layout record card (CLRC) issued by the telephone companies may indicate the

expected 1004-Hz loss of the circuit between various test points in two ways: by the designation of the TLP and by the designation of the data level (data modem power).

4.06 Figure 5 shows the data transmission levels expressed in data level and in TLP for a connection to a 2-wire station served from a secondary DSS. The levels for a connection to a 2-wire station on a primary DSS are the same (but no secondary link is involved). The transmission losses given are those with a 600-ohm impedance at the master station, the remote station interface, the 4-wire jack access points of the DSS, and a 900-ohm impedance at the 2-wire line termination of the DSS.

4.07 The basic features shown are the 0 dBm (+13 TLP) transmit level at the remote stations and the fixed loss. The receive level at the DSS is −12 dBm (+1 TLP) for a 2-wire circuit or −16 dBm (−3 TLP) for a 4-wire circuit. The loss in the CSU is adjusted to this value, depending on the loop loss.

4.08 The transmit and receive data levels at the customer interface of the master station are 0 dBm transmit and −16 dBm receive (the same as those for 3002 private line channels). Level adjustment capability is provided in each direction of transmission to accommodate various types of local facilities and distances from the serving central office (CO). The transmit level onto the cable is normally adjusted to range from −8 dBm to −6 dBm. The receive level is adjusted to obtain the required receive level of −16 dBm. The 4-wire levels shown in Fig. 4 at the input and output jacks of the DSSs are −8 dBm transmit and −16 dBm receive.

Note: The transmit level from the DSS when connected to a 2-wire local loop is 10 dB less (that is, −18 dBm). This ensures that the echo signal from the hybrid network in the DSS to-

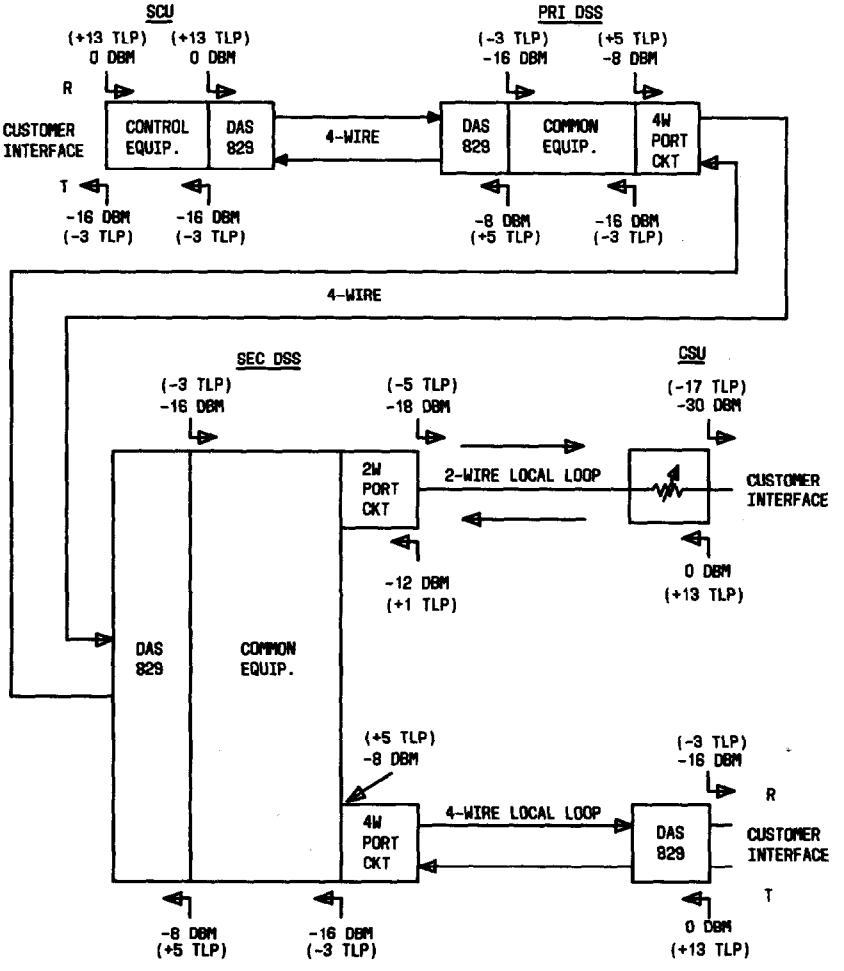

Fig. 5—Data Transmission Levels on 2- and 4-Wire Local Loops

wards the master station is (on the average) 15 dB below the return signal from the remote stations.

4.09 ♦In systems that use the extended 2-wire customer drop as described in paragraph 3.22, the term set to term set loss is 3.5 dB. All data levels appearing on the channel units are normal (−29 dBm and −6 dBm). A 150A CSU is still used to provide the customer termination at the far end and is used to pad the subscriber loop to provide the proper (−30 dBm) level at the customer interface.♦

4.10 Figure 6 shows the transmission plan for interoffice facilities. It also shows two examples of the remote station being served by a DSS in a central office other than the station serving office. The levels given show that the transmit and receive levels on the local loop are the same as when the local loop is connected directly off a DSS. If a DSS is then moved to the remote office, adjustments to the remote station are unnecessary, assuming that the local facilities from the local office are not changed.

Transmission Parameter Limits

4.11 The transmission parameter limits for Select-A-Station service are based on the character-

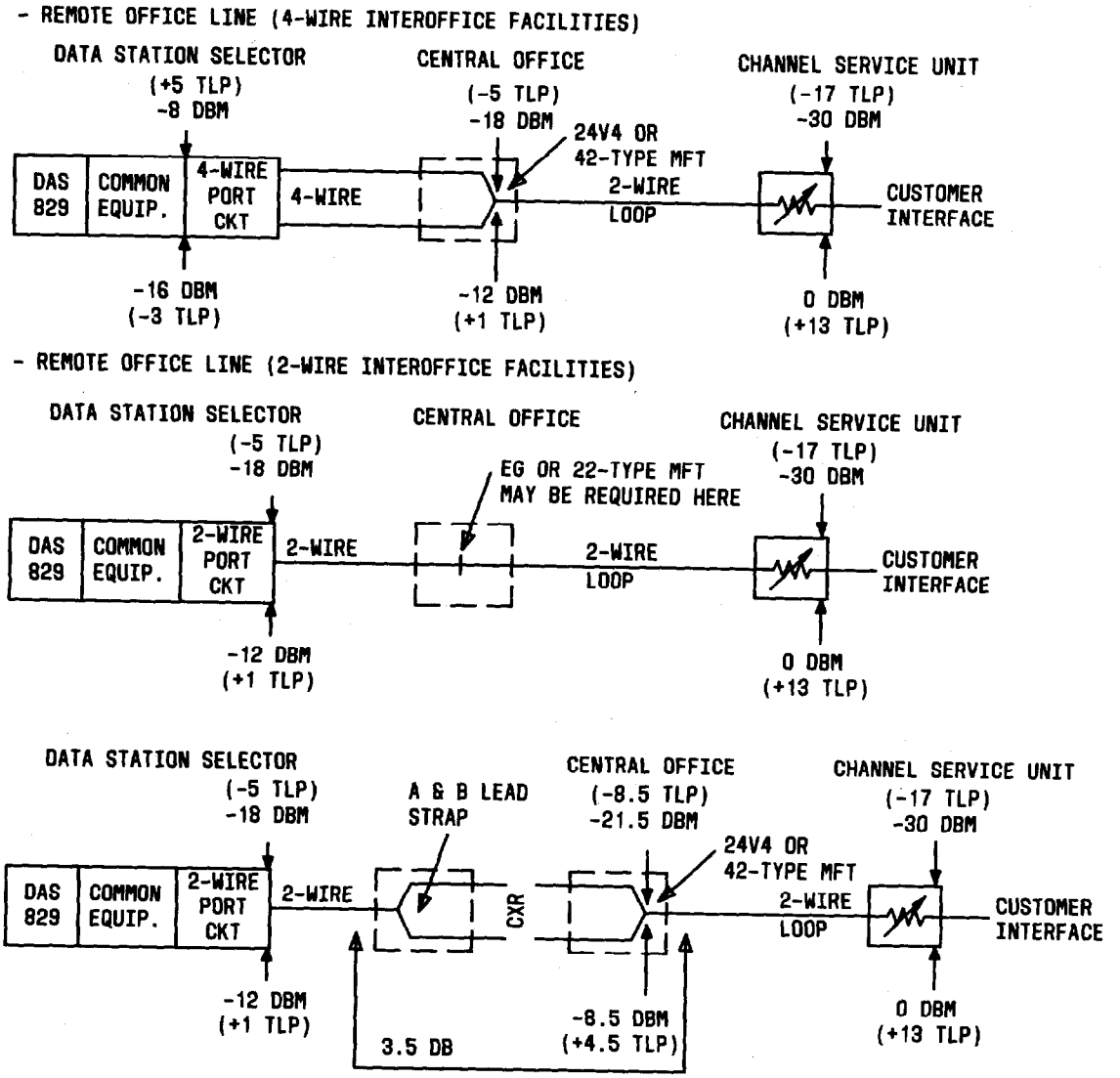

Fig. 6—Data Transmission Levels on Interoffice Facilities

istics of the network described in Parts 2 and 3 and shown in Fig. 5 and 6. The overall network consists of two or three individual links connected in tandem through DSSs, the primary link, the secondary link, and the polled link.

4.12 For the automatic step DSS option of the sequential offering, where tandeming of DSSs is not possible, the circuit consists of two links, a primary link and a polled link. Each of the links of the circuit are designed and measured separately. End-to-end measurements are not made at installation. This avoids taking all the stations out of service when making the measurements. Therefore, it is important that the combined effect of the transmission impairments on each link for each parameter will meet the limits given in Table A. This ensures that measurements on the individual links are sufficient to meet the end-to-end objectives.

Note: End-to-end transmission tests from the master station to the remote stations are not to be made.

B. Preservice Tests

4.13 After the installation of individual links (including the station and CO equipment) has been completed, a series of tests called "lineup" or "circuit order" is performed. These tests must be made to ensure that link parameter limits are met and that station and CO equipment are operating properly.

4.14 All test results should be recorded on a Data Transmission History Card such as Form E-5596. A separate Form E-5596 should also be used to record loopback measurement tests performed at the test center. These test results will serve as benchmarks to be used during maintenance periods and trouble isolation testing.

4.15 Four preservice tests on the primary links, secondary links, and remote office lines are required to check that the limits given in Table A on the following parameters have been met:

- 1004-Hz loss
- C-notched noise

TABLE A

TRANSMISSION PARAMETER LIMITS — 2-WIRE POLLED LINK

MEASUREMENT TEST	PRIMARY LINK	SECONDARY LINK	OBJECTIVES FOR POLLED LINK (NOTE)
1004-Hz Loss Variation			
Circuit Order	±0.5 dB	±0.5 dB	±1 dB
Long-Term Variation	±2.0 dB	±1.0 dB	±2 dB
C-Notched Noise			
1004-Hz Signal to C-Notched Noise Ratio	26 dB	26 dB	26 dB
Impulse Noise			
Number of counts in 15 minutes at the followng threshold levels			
71 dBrnC0	10	10	10
75 dBrnC0	6	6	6
79 dBrnC0	3	3	3
Attenuation Distortion (ref 1004 Hz)			
500 to 2800 Hz	−1 to +3 dB	−1 to +3 dB	−2 to +8 dB
300 to 3000 Hz	−2 to +6 dB	−2 to +6 dB	

Note: Not to be measured.

- Impulse noise
- Attenuation distortion.

The procedures for making these tests are given in Task Oriented Practice Sections 590-105-101 and 598-083-106.

1004-Hz Loss

4.16 The nominal 1004-Hz receive level is −30 dBm for a 2-wire termination and −16 dBm for a 4-wire termination based on a transmit level of 0 dBm at the distant interface. However, variations can be expected. Short-term loss variation may be caused by dynamic regulation of carrier system amplifiers, switching to standby facilities, and some maintenance activities. "Short-term" is meant to be a few seconds or less. Short-term variations are considered to be gain hits, gain changes, or dropouts. Long-term variations, such as component aging, amplifier drift, and other phenomena, are primarily caused by temperature changes affecting local plant. "Long-term" is meant to be periods of days, weeks, or even longer. Long-term variations should not exceed ±6 dB with respect to the nominal receive level for 3-link portions of a network and ±4 dB with respect to the nominal receive level for 2-link portions of a network.

C-Notched Noise

4.17 The C-message noise often is not the principal noise experienced when a signal is present. Quantizing noise in digital carrier systems and the effect of compandors in both digital and some analog systems result in signal dependent noise. The ratio of the received power of a 1004-Hz test tone to the received C-message noise power is therefore not a reliable indication of the signal-to-noise ratio.

4.18 C-notched noise is a measure of the amount of noise on a channel when a signal is present. In making this measurement, a single frequency "holding tone" is applied at the transmitting end of the channel to act as a signal. This tone operates compandors and other signal-dependent devices and simulates a data signal. At the receiving end, the tone is removed by a narrow band elimination filter (notch filter), and the noise is then measured through a C-message filter. The ratio of the received 1004-Hz test tone power to the C-notched noise power indicates the signal-to-noise ratio of the channel. The limit for the received 1004-Hz power to C-notched noise power ratio is a minimum of 21 dB. Since the 1004-Hz receiving power is −30 dBm (60 dBrn) at 2-wire remote stations and −16 dBm (74 dBrn) at 4-wire stations, the nominal C-notched noise limits at the receiver are 39 dBrnC and 53 dBrnC, respectively.

Impulse Noise

4.19 Impulse noise is characterized by large power peaks or spikes in the total noise waveform. It is measured with a 6F or 6H noise measuring set which counts impulses greater than a selected threshold value, using a counter having a maximum counting rate of approximately 7 counts per second. Measurements are made through a C-notched filter. A holding tone is transmitted and notched out at the receiver to activate any compandored facilities in the channel.

4.20 The usual impulse noise measurement involves counting the number of noise peaks exceeding a threshold numerically 6 dB below the received 1004-Hz test tone power. For a −30 dBm receive level, the threshold is 54 dBrnC, and for a −16 dBm receive level, the threshold is 68 dBrnC. The limit is 30 counts in 15 minutes (maximum).

4.21 In addition, there are limits of 18 counts in 15 minutes at a threshold 2 dB below the received 1004-Hz test tone power and 10 counts in 15 minutes at a threshold 2 dB higher than the received 1004-Hz test tone power. These additional limits are designed to cover cases where impulses of relatively high power would interfere substantially with data transmission but the channel would pass the single threshold test.

Attenuation Distortion (Loss Versus Frequency)

4.22 One requirement for the end-to-end channel to provide distortionless transmission is that all signal frequencies experience the same loss over the channel. Typical channels, however, have variation in loss with frequency. To control the magnitude of this variation, attenuation distortion limits for each link are given in Table A.

4.23 Attenuation distortion is a difference in loss at one frequency with respect to the loss at another frequency. It is specified by placing a limit on the maximum loss at any frequency, in a specified band of frequencies, with respect to the loss at a reference frequency. The reference frequency estab-

lished is 1004 Hz. The limit for attenuation distortion on the end-to-end channel is −4 to +14 dB in the 500- to 2800-Hz band. Note that "+" means more loss than the loss at 1004 Hz.

4.24 The preservice test made on a 2-wire local loop to a remote station consists of the 1004-Hz loss measurement. The loss of the loop is padded to 12 dB. The test is made when the CSU is installed and the loop is connected at the MDF to the DSS. The procedures for making this installation and adjustment are given in Section 590-101-000.

5. MAINTENANCE PLAN

5.01 This part describes the maintenance plan for the Select-A-Station service. The plan is based on the use of a test center in each service area for centralized testing, test coordination, and maintenance administration. This part also includes maintenance objectives and test access arrangements. This maintenance plan is intended to provide the following objectives:

- Centralized maintenance administration
- Fault diagnosis from customer trouble reports
- Fault sectionalization by remote tests on common transmission links and system equipment prior to dispatch.

5.02 In order to achieve these objectives, the maintenance plan prescribes the operation of a test center in a given service area to oversee the maintenance administration of the Select-A-Station service. The responsibilities of the test center are covered in Section 666-617-100.

5.03 Maintenance of this service differs from normal voiceband analog bridged multipoint circuits. An isolation capability is designed into the operation of the DSS. The capability of setting up point-to-point connections under the control of the master station prevents trouble such as noise or interference on a facility from affecting communication between the master station and other remote stations or from affecting the master station control of the DSS. The DSS permits no interaction between remote stations or between any remote station to which the DSS is not connected and the master station. The problems of finding the troubled loop and isolating it before the customer can use the remainder of the multipoint circuit is eliminated.

5.04 Trouble on remote station loops can be handled without affecting overall system operation. Troubles on common facilities or in common portions of the DSS will affect many or all portions of the system. To clear this type of trouble, maintenance features are built into the DSS and SCU to facilitate remote testing. These features are to be used by a test center which can access the common portion of the system, perform appropriate tests, and dispatch repair forces as required.

A. Maintenance Requirements

5.05 Three forms of testing are required for this service:

(1) Dc testing on loops

(2) Ac transmission testing on primary and secondary links and remote office lines

(3) Digital and functional tests on the master station SCU and CO DSS equipment.

5.06 To aid the test center, other associated telephone company and Long Lines maintenance centers will be responsible for testing, fault locating, and repairing equipment and facilities used in this service.

5.07 Interstate transmission links may be maintained by Long Lines Serving Test Centers (STCs). These STCs, located near each end of an interstate link, will be responsible for restoring service on those facilities if a trouble occurs. The STCs should respond to requests from the test center for assistance in testing and clearing troubles on interstate links.

5.08 The local loop facilities serving remote stations from each DSS will be tested by the appropriate Repair Service Bureau in the wire center where the DSS is located. If the service is maintained by Switched Access Remote Test System No. 1A (SARTS), testing on local loops can be performed via the Remote Test System No. 1A (RTS-1A) for trouble verification purposes.

B. Test Access Arrangements

5.09 Three arrangements are recommended for providing testing access. Any one of these

three can provide the capability of sectionalization so that the trouble can be identified and appropriate repair forces dispatched. The trouble sectionalization will also be aided by information from the customer, who is able to identify what remote station or stations cannot be reached satisfactorily and whether the problem is intermittent or permanent.

5.10 The first possible access arrangement is the SARTS-1A. This is a standard Bell System maintenance system for special services. If SARTS-1A is available in a given serving area, it can access the transmission links via a SMAS using SMAS maintenance connectors installed within the DSS equipment bay. Testing for trouble sectionalization can be performed by the RTS-1A or, if not available, by a 24A testboard or equivalent. Figure 7 shows this arrangement. All links of the system to which an RTS-1A has access can be tested for trouble sectionalization purposes. This includes interoffice and loop facilities. Preservice testing of primary and secondary links which call for complete data parameter tests should be performed from the jack ended test port (JETP) in a 24A-type testboard located in the same office as the DSSs. These testboards should also be equipped for functional and digital testing of the SCU and DSSs.

5.11 The second access arrangement, shown in Fig. 8, uses a test center through which the primary link is routed. The test center should have jack access to permit breaking into the circuit and testing in either direction on the 4-wire primary link. All sectionalization tests on the primary and secondary links can be made from this test center. When testing secondary links, however, service must be interrupted on the primary link in order to gain access to the secondary link through the primary DSS. All testing of local loops with this approach should be carried out by referral to local test desks (LTDs) in the appropriate wire center where access is by means of a shoe on the main frame. The test center should be equipped for full data parameter transmission

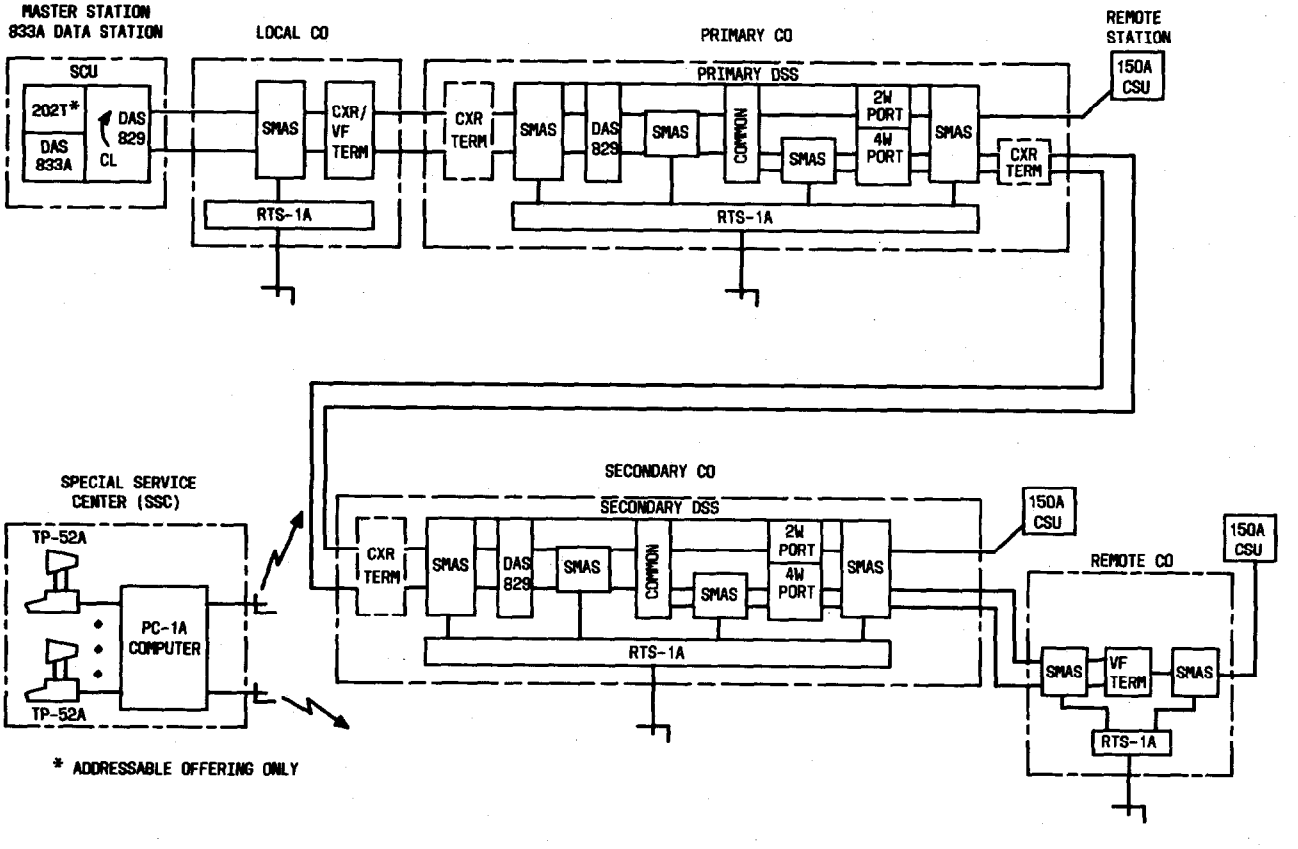

Fig. 7—Switched Access Remote Test System

tests and for functional and digital tests of the SCU and DSSs.

5.12 A manual method for testing secondary links is available through the 4-wire port card jacks at the primary DSS. This will not disrupt the remaining services operating out of that primary DSS.

5.13 The third possible test access arrangement uses a test line from an appropriately equipped test center to the master station. This arrangement, shown in Fig. 9, permits access to the primary link at the SCU interface. A manually controlled access arrangement is provided in the SCU multiple mounting. This can be operated by customer master station personnel under telephone company direction. The test line is a C4 conditioned 4-wire private line channel terminated in a DAS 829-L1A which has means for inhibiting tone activated loopback by a lead on the DAS 829-L1A circuit pack. As shown in Fig. 9, additional amplification (16 dB) is provided in the DAS 833A for level compensation. The test line can be shared among all the circuits originating from the master station. This provides for economical use of the dedicated test line and access equipment. This arrangement will require customer assistance in trouble isolation of SCU problems by having customer personnel manually switch the primary link to the spare SCU in the circuit in place of the original SCU. Both primary and secondary links can be tested with this arrangement. The testing of local loops will require LTD assistance. The test center should be equipped for data parameter transmission testing and digital and functional testing of SCU and DSS equipment.

C. Loop Maintenance

5.14 Two-wire metallic loops are maintained as they would be for regular telephone service. Locating a fault on a loop will be done by the local test desk via shoe access at the MDF or by the RTS-1A test system if SARTS is used. Troubles can be sectionalized to inside or outside the office.

6. TEST EQUIPMENT

6.01 Select-A-Station service will use several varieties of test equipment for installation and maintenance. These can be categorized as transmission test sets, a new special function test set, and

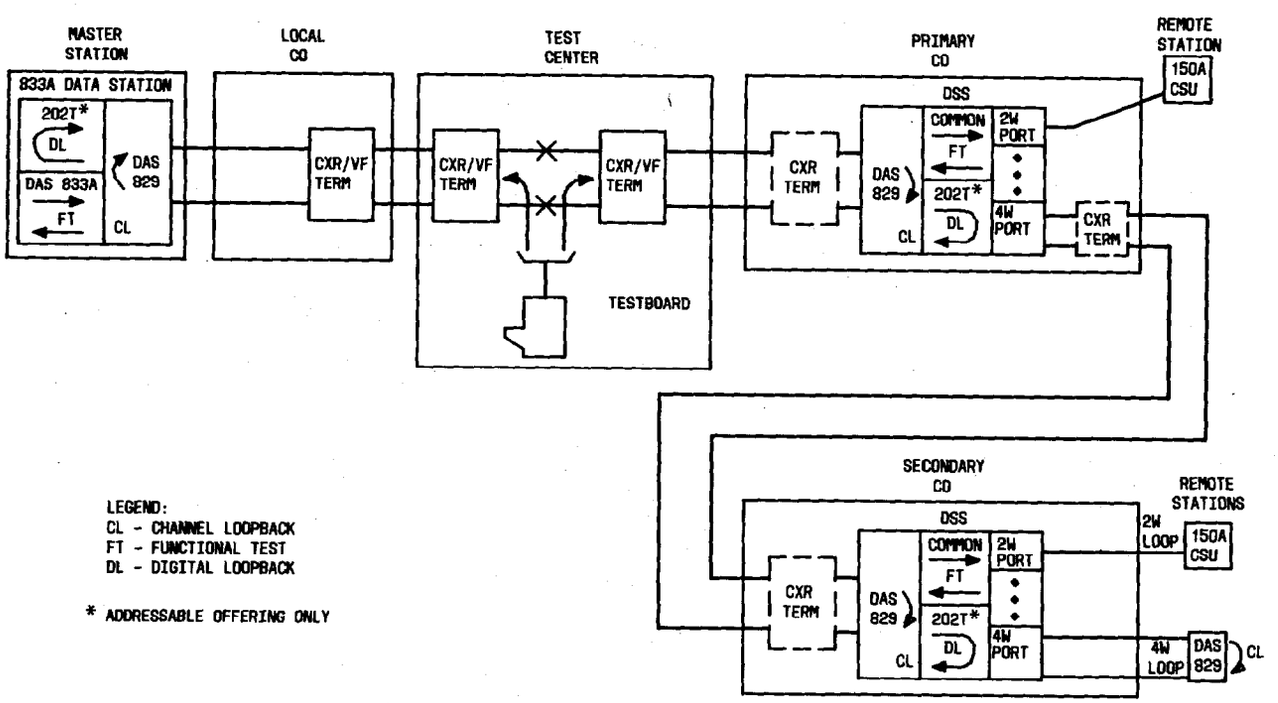

Fig. 8—Test Center on Primary Link

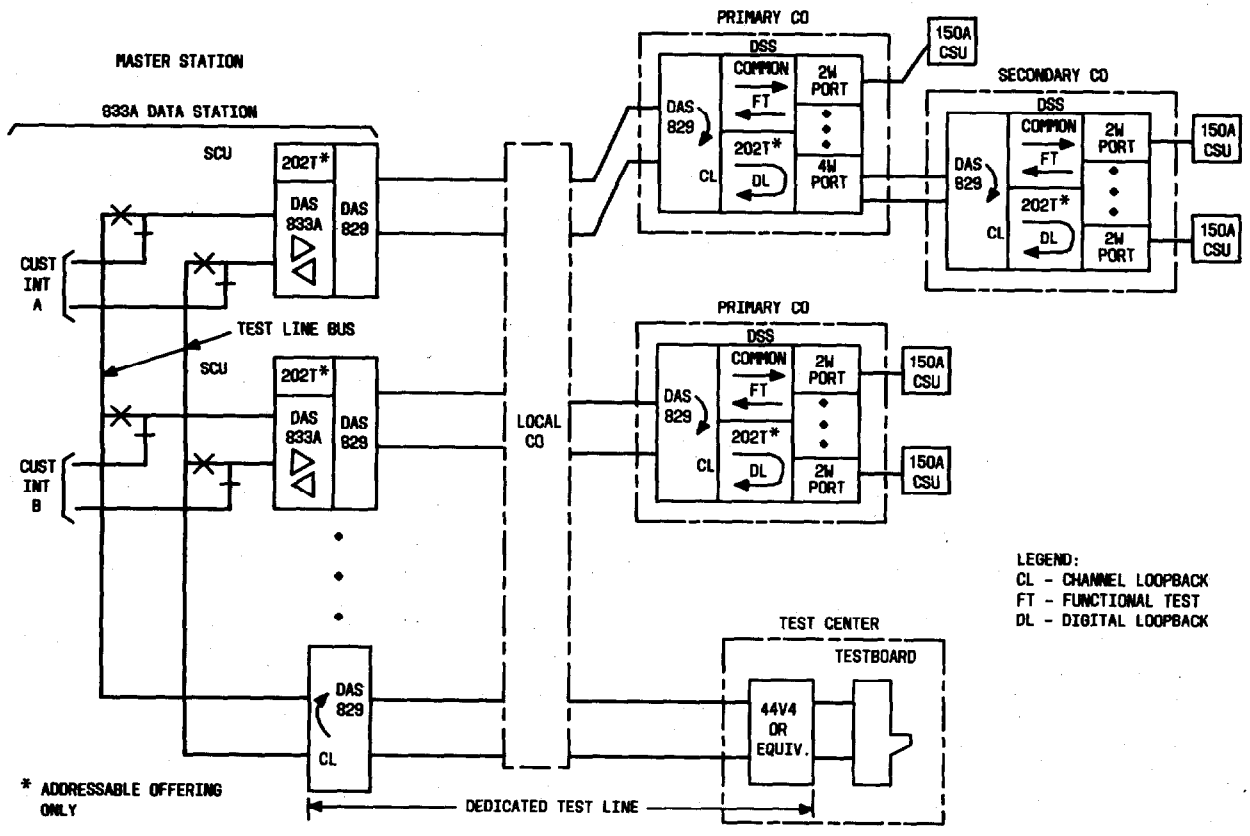

Fig. 9—Test Line to Master Station

data test sets. The types of equipment in each category are discussed in the following paragraphs.

A. Transmission Test Sets

6.02 Installation and maintenance tests on the primary and secondary links and on remote office lines will require a fairly extensive list of test equipment functions. For installation testing, this equipment will be used at the customer master station, at DSS office locations, at test center locations, and at remote offices when a remote office line is used. The test functions associated with standard installation and maintenance testing are listed below:

- 1004-Hz loss
- C-notched noise
- Impulse noise
- Attenuation distortion.

6.03 Test sets such as the J94006F voiceband noise measuring set, or equivalent, and Hewlett-Packard Model 3550B, or equivalent, can be used for initial channel lineup.

B. New Special Function Test Set

6.04 A special test set (the 178A) is required for test center use and for certain testing from a DSS location. It provides for:

(a) Functionally testing the SCU and DSS.

(b) Digitally testing data set 202T in the addressable SCU and DSS in conjunction with a data test set.

(c) Setting up connections through a primary DSS to test over secondary links to a secondary DSS.

(d) Testing through any type of DSS (except an automatic step optioned DSS) to a 4-wire DAS

829-type L1A terminating a remote station. The test set can send the 2713-Hz loopback tone for making loopback tests.

(e) Test access to the channel facilities so that transmission tests can be made.

6.05 To perform these functions, the 178A test set has the following capabilities and features:

(a) Generates precise short duration tone bursts designed to control a sequential DSS or release addressable DSS connections.

(b) Detects short duration tone bursts from sequential or addressable DSSs.

(c) Contains Built-in data set 202T to:

- Send address to an addressable DSS to set up a connection
- Make a digital loop test with data set 202T in either the SCU or DSS.

(d) Tests circuitry to verify proper functional operation of sequential DSS and SCU and makes a connection to a specific port of a controlled step sequential DSS.

(e) Tests circuitry to verify proper functional operation of addressable DSS and SCU and makes a connection to a specific port of an addressable DSS.

(f) Monitors and tests jacks for transmission test sets providing access to the channel for transmission tests. The set also contains a loudspeaker for monitoring purposes.

(g) Permits signals to be sent and received at the normal DSS and SCU operating rate through controls and displays.

(h) Displays, through circuitry, the results of the tests.

6.06 The 178A test set is designed primarily for use at the test center which has voiceband access to the circuit. The test set is portable, which allows it to be used at a DSS or at an SCU. The test set is designed to access the circuit or transmission equipment using standard jacks and test cords. It has transmission level adjustments to adjust to the appropriate signal power at the point in the circuit where it is expected to be used.

C. Data Test Sets

6.07 Several types of data test sets will be required for installation and maintenance tests. For installation and maintenance tests at the master station to verify proper system operation, a 921A data test set will be used. It will interface at the 25-pin customer connector on the DAS 833A in an SCU with the Electronic Industries Association (EIA) interface module of the test set. The initial version of the 921A is not programmed to perform the appropriate tests. Software control logic is being developed for this purpose. The 921A can also be used for start-stop distortion tests from the master station on the addressable version of the service.

6.08 For maintenance testing from the test center, the 178A test set is required to control the DSS plus a data test set for start-stop distortion tests on the addressable SCU or DSS. Either the 921A or 914-type data test sets can provide this function. Either test set can provide a synchronous error rate test. While this type of test does not exercise data set 202T in the same way as it is used in the service, it is adequate to determine steady state performance of data set 202T. Information on peak distortion can be obtained by using the 50 percent sample window. For further information on testing data set 202T with a 914-type data test set, refer to Section 592-031-500.

7. CATEGORIES OF TRANSMISSION PARAMETERS

7.01 The circuit transmission parameters are divided into two categories: interface parameters and facility parameters. The facility transmission parameters that must be tested to ensure that limits are met were given in Part 4 (Preservice Tests). Additional transmission parameters along with a brief description of those parameters and their characteristics are given in the following paragraphs.

A. Interface Parameters

7.02 The voiceband interface parameter specifications are influenced by two considerations: electrical protection of the telephone network and its operating personnel and standardization of private

line design arrangements. The various parameters of this category are as follows:

- Terminal impedance and balance
- In-band data signal power
- Transmitted test signal power
- Control signal power
- Out-of-band transmitted signal power.

A brief description of each of these parameters is given in paragraphs 7.03 through 7.09.

Terminal Impedance and Balance

7.03 The recommended impedance of data terminal equipment is 600 ohms ±10 percent resistive over the voiceband. The impedance of test equipment used for installation tests and trouble tests is 600 ohms resistive. Channels lined up using 600-ohm terminations should be used with 600-ohm terminations to assure transmitted and received signal power meets required limits.

7.04 If the impedance of the customer data terminal equipment is substantially different from 600 ohms, echoes interfering with the data signal may result. The SCU at the central station and the CSU at the remote station provide balanced terminations to the facilities. The customer equipment may be balanced or unbalanced; however, balanced is usually preferred due to local (on premises) noise considerations.

In-Band Data Signal Power

7.05 The maximum allowable transmitted signal power for an end-to-end data signal, averaged over any 3-second interval, is 0 dBm (as measured across a 600-ohm resistor). In meeting the 3-second average power, it is permissible for the instantaneous signal power to exceed the average power by as much as 13 dB. Therefore, at the 0-dBm transmit point, the instantaneous signal power must not exceed +13 dBm (3.46 volts peak across 600 ohms resistive). The total power requirement applies in the frequency band below 3995 Hz (other than dc). All signal energy, spurious or otherwise, must be included when determining whether the transmitted power specification is met. The dc requirement is that the user terminal should cause no more than 1 milliampere direct current to flow through the voiceband channel termination.

7.06 At the master station, the 1004-Hz received data signal power is −16 dBm based on a transmitted power of 0 dBm at the remote station. At the remote station, the 1004-Hz received data signal power is −30 dBm for a 2-wire termination and −16 dBm for a 4-wire termination based on a transmitted power of 0 dBm at the master station.

Transmitted Test Signal Power

7.07 Test signals applied to the circuit must not exceed 0 dBm. A test signal greater than 0 dBm may give erroneous results because of nonlinear channel response with changes in signal power.

Control Signal Power

7.08 The control signaling for the service takes place in the band above 2600 Hz. The power of the customer signal in the band from 2600 to 3995 Hz must be at least 10 dB below the power in the band from 500 to 2600 Hz. Failure to observe this requirement could result in false operations. These control signals will appear at the terminations of the end-to-end channel at levels that may be comparable to the received data signal power. Therefore, if the terminal equipment may be adversely affected by energy above 2600 Hz, the customer should filter out this energy.

Out-of-Band Transmitted Signal Power

7.09 Out-of-band signals are defined to be in the frequency band of 3995 Hz and above. The limits on out-of-band signal power apply to the transmitted signal power at the interface with the end-to-end channel. The out-of-band signal power limits are required to prevent interference with other services carried on telephone company facilities. The objectives for short duration rms powers are:

- The power in the band from 3995 to 4005 Hz should not exceed −18 dBm.
- The power in the band from 4 to 10 kHz should not exceed −16 dBm.
- The power in the band from 10 to 25 kHz should not exceed −24 dBm.
- The power in the band from 25 to 40 kHz should not exceed −36 dBm.
- The power in the band above 40 kHz should not exceed −50 dBm.

B. Facility Parameters

7.10 The facility parameters covered in this part represent potential impairments to a data signal that is transmitted over the end-to-end channel. These parameters are objectives only and are not to be measured in normal preservice and maintenance testing. In all cases, the facility parameters exhibit some variation over a period of time. The parameter objectives, unless otherwise stated, apply to measurements of steady-state phenomena, and the measurements generally last less than 1 minute. The various parameters of this category are as follows:

- C-message noise
- Envelope delay distortion
- Single frequency interference
- Frequency shift
- Phase intercept distortion
- Phase jitter
- Nonlinear distortion
- Gain hits and phase hits
- Dropouts.

A brief description of each of these parameters is given in paragraphs 7.12 through 7.21.

7.11 Transient phenomena (impulse noise, phase hits, gain hits, and dropouts) are measured over longer periods, and events meeting certain criteria are counted. The results of either steady-state or transient measurements may vary by time of day, day of week, season of year, or some other time dependency.

C-Message Noise

7.12 C-message noise is a weighted measurement of the background noise on a channel in the absence of a signal. It is measured with a noise measuring set such as the 3C noise measuring set. The weighting used is provided by a C-message filter.

Envelope Delay Distortion

7.13 Another channel requirement for distortionless transmission is a linear phase versus frequency characteristic. The end-to-end channel will typically only approximate such linearity over the voiceband. Measuring the phase versus frequency channel characteristic directly is difficult because of problems in establishing a phase reference. However, a usable approximation of phase with respect to frequency, called envelope delay, can be measured. The maximum variation in envelope delay over a band of frequencies is called envelope delay distortion. The quality of the channel with respect to its phase characteristic is controlled by limiting the amount of envelope delay distortion allowed. The objective for envelope delay distortion for the end-to-end channel is 1750 microseconds over the 800- to 2600-Hz band. It assumes the use of an 83-1/3 Hz modulating frequency for the measurement.

Single Frequency Interference

7.14 Spurious single frequency tones may interfere with narrowband data signals which are frequency-division multiplexed onto the channel. Message circuit noise will be distributed across the voiceband, so the noise power in each narrowband channel will be less that the total noise power, and the signal-to-noise ratio per channel may be quite adequate. If, however, a single-frequency tone of substantial power is present, it may interfere with one of the narrowband channels. The limit for single-frequency interference is that the noise contribution at any frequency should, when measured with C-message weighting, be at least 3 dB below the C-message noise power at the modem receiver.

Frequency Shift

7.15 Long-haul carrier systems operate in a single sideband suppressed carrier mode. Since the carrier is not transmitted and must be reinserted, there may be a slight difference in frequency between the modulating and demodulating carriers. The resulting frequency shift contributes a constant change at all frequencies in the voiceband. Substantial frequency shift can degrade some data demodulation processes and can cause high distortion in narrowband frequency division multiplex systems. The overall requirement on frequency shift is ±5 Hz.

Phase Intercept Distortion

7.16 When single sideband suppressed carrier transmission systems are used, the phase of the reinserted carrier with respect to the phase of the

modulating carrier is not controlled. The result is phase intercept distortion, which contributes a constant phase shift to all frequencies present in the end-to-end signal. It appears as the phase intercept at zero frequency on a graph of phase versus frequency for carrier-derived channels. Phase intercept distortion will affect any signal in which preservation of the phase relationships in the transmitted waveshape is important. A modem designed to operate over a channel having frequency shift should not experience difficulties due to phase intercept distortion. There is no requirement at this time for this parameter.

Phase Jitter

7.17 Various sources cause the instantaneous phase, or zero crossings, of a signal to "jitter" at rates normally less than 300 Hz. This phase jitter is typically caused by ripple in the dc power supply appearing in the master oscillator of long-haul carriers and then passing through many stages of frequency multipliers. Some phase jitter occurs in short-haul systems from incomplete filtering of image sidebands. Digital carrier systems also will exhibit phase jitter at certain input frequencies. The most common jitter frequencies are 20 Hz (ringing current) and 60 Hz (commercial power) and the second through fifth harmonics of each of these.

7.18 Measurement of phase jitter is made with an instrument sensitive to frequencies within 300 Hz of a 1004-Hz carrier. Noise may strongly influence this measurement; therefore, phase jitter should be measured with a test tone at data level. The objective for phase jitter is 15° peak-to-peak.

Intermodulation Distortion

7.19 Intermodulation distortion is that portion of the channel output which is a nonlinear function of the channel input. It is measured by transmitting four equal level tones, consisting of two pairs of tones, with a composite signal power at nominal data signal level. Two of these tones are closely spaced around a center frequency "A" (860 Hz), and the other two tones are centered around a center frequency "B" (1380 Hz). The second order distortion is determined from the B-A and B+A products, while the third order distortion is determined from the 2B-A product. The signal to second order distortion ratio objective is 25 dB, and the signal to third order distortion objective is 28 dB.

Gain Hits and Phase Hits

7.20 Gain hits and phase hits are defined to be sudden changes in the amplitude or phase of a signal lasting for at least 4 ms and returning to the original value within 220 ms. Changes in amplitude or phase which last for more than 220 ms are referred to as gain or phase changes. Changes that last for less than 4 ms are classified as impulse noise. Limits for gain hits and phase hits are not specified; however, objectives for these parameters are:

Gain hits—no more than eight in 15 minutes $\geq$ 3 dB

Phase hits—no more than eight in 15 minutes $\geq$ 20 degrees.

Dropouts

7.21 A dropout is a decrease in level $\geq$ 12 dB which lasts for at least 10 ms. Deep fading of radio facilities and defective components can cause dropouts. Since dropouts tend to be long with more than 40 percent in excess of 200 ms, they frequently are responsible for serious performance degradations. Limits for dropouts are not specified; however, the objective is no more than two dropouts in 15 minutes.

8. MAINTENANCE TESTING

8.01 Two distinct categories of maintenance testing exist for Select-A-Station service. ⧫These are the common facilities and equipment which affect communication to many or all remote stations and the individual facilities and equipment dedicated to a single remote station. The SCU, primary link, secondary link, and DSSs are in the common facilities category. The local loops, remote office lines, and the 150A CSUs are in the individual facilities category.◆ This part describes the various maintenance features that exist in the common and individual facilities.

A. 833A Data Station

8.02 The 833A data station contains one or more 56A2 data mountings; each equipped with up to five SCUs. Each data mounting includes a power and oscillator supply to serve the individual SCUs. ⧫The maintenance features in the data mounting include LED indicators for monitoring the status of the

power supply. The power is fed in a dual arrangement, so that if one supply fails.the other is there to take the complete load. Failure of either supply will be indicated by the LED indicator. Six LED indicators for status monitoring of the dual crystal controlled oscillators which generate the control tones are also included. A switch is provided to select oscillator "A", oscillator "B", or automatic switching based on internal detectors.

8.03 The LED indicators are also provided on the individual SCUs for the following purposes:

(a) When a circuit is in channel loopback or functional test.

(b) When the transfer to spare (TTS) switch is operated to indicate that a working primary link has been transferred to a spare SCU in place of the original SCU. The spare SCU is discussed in paragraph 8.06.

(c) When the test line (TL) is connected to the particular SCU for test center testing. The customer equipment is disconnected from the transmission channel leads when this occurs.

(d) On data set 202T, when in the addressable offering, displays interface lead status, test status, and power status.

8.04 Two SCU arrangements are available, one for the sequential offering and one for the addressable offering. The SCU provides for transmitting the control signals to the DSS and contains two tone detectors which monitor signals from the DSSs. The two control signals, generated from the common oscillator supply, are used to control the primary and secondary DSSs. The primary control signal is a 2975-Hz tone. The secondary control signal is a 2800-Hz tone. The control signals also serve as test frequencies to verify SCU operation. The output of the tone detectors indicates to the customer equipment the reception of a frame signal with sequential DSSs or an acknowledgment signal with addressable DSSs.

8.05 The tone detectors and control signal oscillators in the SCU will be tested using a manually activated functional test. This test cannot be made if test access is made using a test line to the master station which connects through the SCU interface. This test allows a test center with access on the primary link to send a burst of one of the two tone signals using a 178A test set. Its detection is verified by the SCU sending back the other tone signal. This test exercises the SCU with signals of duration that will be used under normal operation with a DSS. Receipt of the other tone signal indicates that the tone detection and tone generating circuitry as well as both sides of the 4-wire facilities at the upper part of the voiceband are operational. When used in conjunction with the channel loopback test, problems can be distinguished between the primary link and the SCU.

8.06 When at least one spare maintenance SCU is provided, it will operate with an entire multiple arrangement. It can be placed in service by customer personnel by moving the customer interface connector to the spare unit and operating the TTS switch to cause the spare unit to be transferred to the proper channel. The spare SCU offers a simple way to sectionalize trouble to a faulty SCU prior to the customer calling the repair center.

B. Data Station Selector

8.07 The basic maintenance features provided in the DSS are as follows:

(1) Remote tone activated channel loopback at the DSS trunk input

(2) Test jacks for voiceband transmission test sets on the 4-wire input DAS 829-type L1A and each 4-wire output port (but not the 2-wire output ports)

(3) Remote test access to the 4-wire input trunk, each 4-wire output port, and the 2-wire output ports for testing by SMAS local test ports or RTS-1A for SARTS-1A arrangements

(4) Frame tone signals on the sequential DSS and acknowledgment tone signals on the addressable DSS which can be used for test monitoring purposes

(5) Addressable test and report functions on the addressable DSS to aid in testing DSS operation and obtaining DSS status

(6) Test access to the EIA interface associated with data set 202T in the addressable DSS

(7) A 1-kHz tone source with a fixed −8 dBm output power (into 600 ohms) which can be used

for loss lineup and continuity tests on the primary and secondary links (on the optional verify circuit pack)

(8) An 8-dB amplifier to permit equal level loopback at the 4-wire output port of a DSS (on the optional verify circuit pack)

(9) A means to verify the address of a port card and the address that the DSS is acting on (on the optional verify circuit pack).

C. Trunk Input Channel Loopback

8.08 Equal-level channel loopback is provided in the input trunk terminating equipment on primary and secondary DSSs. This loopback is tone activated to permit remote testing from a test center with access to the primary link. The loopback is accomplished in the DAS 829-type L1A. The standard 2713-Hz loopback tone is used to establish and disable the loopback. The loopback detector is controlled by the DSS, and it is activated only when the DSS is in certain states.

D. Jack Access

8.09 The DSS provides jack access to 4-wire input and output ports. The 4-wire channel terminating equipment includes both test and monitor jacks for access to the transmit and receive paths. The test jacks break the circuit path toward the DSS common circuitry and permit a terminating test set to test toward the line through the channel terminating circuitry. The monitor jacks do not break the circuit path but only bridge across it so that high impedance measurements can be made. Location of the jacks is shown in Fig. 10. Test jacks on the channel terminating equipment for the 4-wire output ports permit testing of secondary links and the interoffice portion of 4-wire remote office lines for initial channel lineup and for verification of channel parameters after repairing channel troubles.

E. Switched Maintenance Access System Access

8.10 The SMAS access may be provided to the transmit and receive paths on both sides of the DAS 829-type L1A of the 4-wire DSS input and

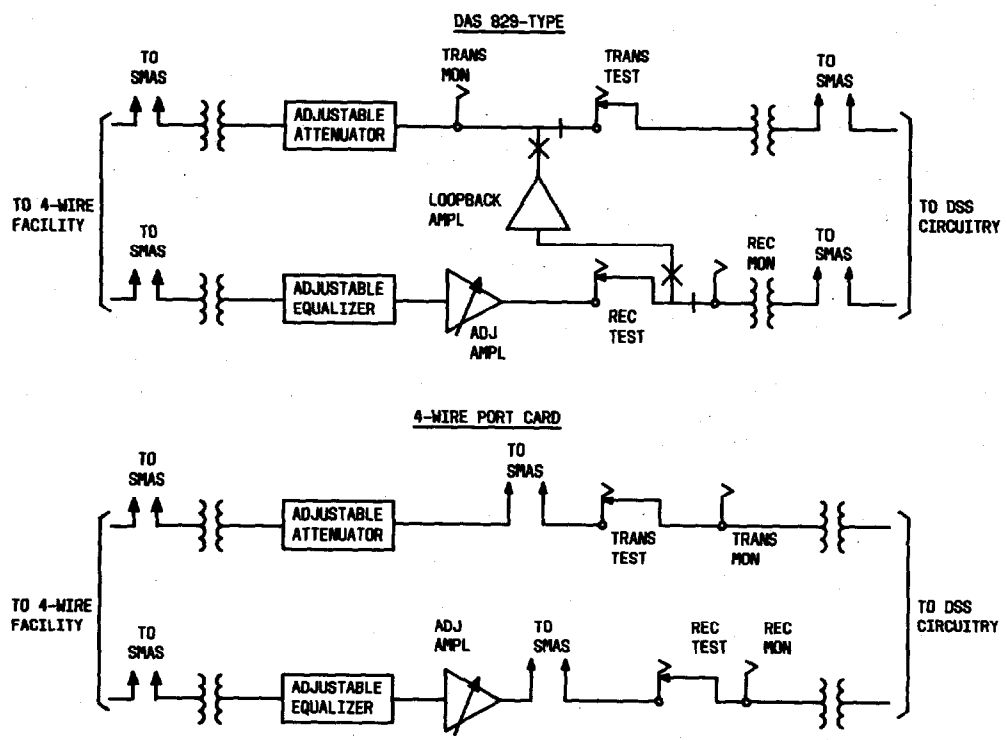

Fig. 10—Test Lines to Master Station Access Leads on DAS 829-Type and 4-Wire Ports

4-wire output ports. Access may also be provided to the output side of 2-wire ports. This permits a SMAS maintenance connector collocated with the DSS to access the circuit if SMAS access testing in the central office is required. The access points are located electrically at the same point in the terminating equipment as the test jacks so that remote measurements made from these points should follow those made from the test jacks.

8.11 The SMAS access to the output terminals at the DSS bay eliminates the need for routing to an intermediate distribution frame (IDF). This saves circuit installation costs and reduces the exposure of these circuits at other IDFs. The internal access points on the 4-wire equipment allows testing at the appropriate end point of a 4-wire facility. Channel testing can be from a 24A testboard that is remote from the DSS bay but within the same central office building. The SMAS access leads do not have to be used if the CO is not equipped with SMAS. They can be bypassed by a shorting connector installed on the back of the DSS assembly.

F. Sequential DSS Features

8.12 The sequential offering of the DSS has a frame signal source which indicates the beginning of the cycle of ports. The number of ports through which the DSS steps (switches) is controlled by an option in the DSS. The frame signal, one for a primary and a second for a secondary, can be monitored by the test center for verification of DSS operation. In the automatic step and automatic step with reset DSS options, the test center can detect the frame signal using the 178A test set. The DSS will transmit the frame signal for the duration of one and one-half port intervals. In the controlled step DSS option, the test center will be able to step the DSS from one port to the next until the frame signal is reached. The DSS will transmit the frame signal as long as no further control tones are received to command the DSS to step to the next port. The frame signal is the equivalent of two port intervals in the controlled step DSS option.

G. Testing Aids in Verify Circuit Pack (RL7)

8.13 The verify circuit pack provides three simple testing aids to assist in performing channel verification tests. The first provides a 1-kHz tone source at −8 dBm. It is used for lining up or verifying transmission levels in any of the DSS channel terminating equipment or other transmission equipment on the circuit. The 1-kHz tone is at the proper power to be placed on the outgoing side of the 4-wire trunk input and the 4-wire output ports. The tone is accessed by a standard patch cord and plugged into the appropriate test jack on one of the 4-wire port circuit packs.

8.14 The second testing aid is an 8-dB amplifier, accessible with two standard patch cords, which permits equal-level loopback tests at the 4-wire input trunk or 4-wire output ports. It may be used at the input trunk if the far-end does not have a means to activate equal-level loopback. In the case of the 4-wire output ports, there is no built-in equal-level loopback.

8.15 The third testing aid provides for address verification of each port circuit pack plugged into the assembly. A three position switch on the verify circuit pack controls this feature. With the switch in its normal position, the port address of any port circuit pack can be determined by depressing a switch on the port circuit pack. The address(es) will appear on a numeric display on the verify circuit pack as long as the switch is depressed. To determine the address of the port being addressed while the system is in operation, the 3-position switch may be set up or down to obtain the addresses presented to the A and B (if dualized) common circuitry. This verification aid will be used when a craft employee operates either the control switches on the individual port circuit packs or the 3-position switch on the verify circuit pack. These operations do not affect customer operation of the DSS.

8.16 Port addresses are set by option(s) on each port circuit pack. The circuit pack is then plugged in and the address verified as indicated above. When the proper address(es) is indicated, the port(s) can be placed into service by operating the service switch on the port circuit pack.

9. REFERENCES

9.01 The following sections provide additional information on facilities and equipment that is associated with Select-A-Station service.

SECTION	TITLE
107-104-010	178A Test Set—Description and Operation
314-410-100	Voice Bandwidth Private Line Data Circuits—Description

SECTION	TITLE
314-410-500	Voice Bandwidth Private Line Data Circuits—Requirements
590-101-000	150A Channel Service Unit—Description, Installation, Maintenance, and Tests
590-105-100	Data Station Selector—J70180AA—Description and Operation
590-105-101	Data Station Selector—J70180AA—Task Oriented Practice
592-031-100	Data Set 202T Transmitter—Receiver—Description and Operation
598-082-100	Data Auxiliary Set 829-Type—Channel Interface Units—Voiceband Private Line Channels—Description
598-083-105	833A Data Station—Description
598-083-106	833A Data Station—Task Oriented Practice
598-083-180	◗DATAPHONE Data Communications Service—833A Data Station Summarizing Specification—Select-A-Station Service◖
666-617-100	◗DATAPHONE Data Communications Service—Test Centers—Administrative Methods—Select-A-Station Service◖
666-617-101	Test Center Procedures—Task Oriented Practice
807-702-150	◗DATAPHONE Data Communications Service—Data Station Selector Equipment Design Requirements—Select-A-Station Service
880-480-010	DATAPHONE Data Communications Service—Description and Engineering Considerations—Select-A-Station Service◖
999-100-147	833A Data Station—How to Operate Manual

10. GLOSSARY

10.01 A list of unique terms used in this section and their definitions are as follows:

Acknowledgement Signal: Signal transmitted from the DSS in the addressable service offering to indicate that the DSS is in an unconnected state.

Address: A bit sequence that activates digital control circuitry. Generally, address refers to port addresses, instructions, and control words.

Addressable: A service offering in which the customer has in-service control of both the duration and order of connections to a number of remote stations.

Automatic Step: A DSS option of the sequential offering in which the duration and order of connections are fixed.

Automatic Step with Reset: A DSS option of the sequential offering in which the duration and order of connections are fixed, but the DSS will reset to the beginning of the connection cycle upon command from the master station.

Benchmark Measurements: These are measurements made on a looped-back or 1-way basis when the circuit is known to meet all requirements. They are performed in conjunction with the installation and circuit order tests and results are recorded for later reference purposes.

Channel Service Unit (CSU): A prepackaged, 2-wire unit that provides an interface between voiceband data station equipment and a 2-wire private line service or polled network service.

Control Signal: A signal transmitted from the master station (SCU) to reset the DSS, step the DSS to the next port, or implement a DSS control function.

Controlled Step: A DSS option of the sequential offering which allows the customer to have in-service control over the duration of the connection. However, the connection sequence is fixed.

Customer Provided Equipment (CPE): Customer equipment located on the customer side of the

telephone company interface and provided by the customer. Examples are digital computers, communication controllers, and magnetic tape readers and recorders.

Data Auxiliary Set 829-Type: Circuit packs used to provide 4-wire terminations for 4-wire facilities.

Data Auxiliary Set 833A: A circuit pack that provides control signaling functions in the SCU at the master station.

Data Level: The data signal power level in dBm averaged over a 3-second period at a point in the transmission path. This level always corresponds to −13 dBm0, which means that the data level is always 13 dB lower than the corresponding TLP.

dBm: The signal power at a point relative to one milliwatt, expressed on a logarithmic basis.

dBrnC: The noise power at a point relative to 10_{-12} watt (−90 dBm) and measured after passing through a C-message filter. This term is also expressed on a logarithmic basis.

Data Station Selector (DSS): A switching device located in central offices and having the capability of making connections between a 4-wire input and up to 128 outputs (sequential service) or 125 outputs (addressable service), any of which may be 2-wire or 4-wire or mixed.

Data Test Center: An office responsible for remote testing of data service. Access to this office may be gained through a dedicated line or SMAS facilities.

Dual Control: A DSS option which provides dual control of the master station terminal.

Duplex Operation: The transmission of signals in both directions simultaneously.

Equal-Level Loopback: A circuit arrangement interconnecting the receive and transmit paths and correcting for any difference in the transmission level at the point of connection. This ensures that signals on the line are maintained at standard data level during loopback tests when a test signal at data level is applied toward a DSS or a 4-wire customer station.

Expansion Control Circuit: Used in expansion units to terminate both incoming and outgoing expansion cables and to perform support functions.

Frame Signal: A signal from the DSS in the central office to the SCU at the master station to indicate the beginning of a connection cycle.

Half-Duplex Operation: The transmission of signals alternately in either direction or for communication in one direction only, including bidirectional simultaneous transmission of tones required solely for control purposes or quick turnaround or synchronization.

Master Station: The station (containing CPE and SCUs) which controls the DSS operation and communicates with remote stations.

Polled Link: The transmission channel between a remote station channel termination and a DSS.

Polling Link: An end-to-end transmit-receive connection between the master station and a remote station.

Primary Link: The 4-wire transmission facility between the master station SCU and a primary DSS.

Remote Office Link: A polled link from a DSS to a remote station using interoffice facilities.

Remote Station: One of many remotely located stations on a multistation circuit that is connected to the master station by DSSs over a polling link.

Remote Test System (RTS): A system that provides the remotely controlled equipment required to perform the testing functions of the SARTS.

SARTS: A standard remote 1-person testing system developed for use during installation, trouble, and routine testing of special service circuits from a centralized test location.

Secondary Link: The 4-wire transmission facility between a primary DSS and a secondary DSS.

Selector Control Unit (SCU): The equipment associated with one circuit located at the master station and used by the customer to transmit control signals to DSSs and receive supervisory signals from DSSs.

Sequential: A service offering to a customer in which the order of connections from the master station to remote stations is fixed by assignment to the DSS output ports.

Serving Test Center (STC): A designated office responsible for testing transmission facilities, station equipment, and central office equipment.

Special Service Center (SSC): This is a test center with responsibility for coordination and control of customer service within a specific serving territory.

Switched Maintenance Access System (SMAS): A relay switched access system for 2- or 4-wire circuits capable of being tested remotely. Tests can also be made locally using jack ports.

Transmission Level Point (TLP): A reference level point on a circuit numerically equal to the algebraic sum of 1004-Hz gains and losses from an arbitrarily defined reference point (0-TLP) to the point of measurement.