SWITCHED DIGITAL DATA SYSTEM
501A-TYPE DATA SERVICE UNIT
DESCRIPTION AND OPERATION

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning the description and operation of a 501A-type data service unit, hereafter referred to as the DSU. Operational information for data auxiliary set (DAS) 821A-type is included, along with a brief description. For detailed information concerning DAS 821A-type, refer to Section 598-085-100. Other than a description of interface signals and customer options, information pertaining to associated customer-provided equipment (CPE) is not given.

1.02 ▶This section is reissued to include changes as a result of verification.◀

1.03 The 501A-type DSU is primarily intended for duplex operation in 4-wire switched applications. The DSU provides the CPE with access to the synchronous switched digital data system (SDDS). The DSU accepts serial, unipolar data and control signals from the CPE and DAS 821A and transmits modified bipolar signals over the local channel to the serving central office (SCO). Serial, modified bipolar signals are received by the DSU from the SCO via the local channel and sent to the CPE as serial, unipolar data and control signals.

1.04 The 501A-type DSU is apparatus-coded as follows:

- 501A-L1/2—operates at 9.6 kb/s—CPE controlled—answer only
- 501A-L1/3—operates at 56 kb/s—CPE controlled—answer only
- 501A-L1/2/4—operates at 9.6 kb/s—CPE controlled—automatic answer and call originate
- 501A-L1/3/4—operates at 56 kb/s—CPE controlled—automatic answer and call originate.

1.05 An optional customer data rate of 4.8 kb/s is provided by the 501A-L1/2 and 501A-L1/2/4

DSUs. The DSU clock is divided by two and each customer data bit is transmitted twice by the DSU.

1.06 DAS 821A-L1 can be ordered separately to provide manual dialing and call supervision. SDDS calls can be manually originated, answered, or terminated by operation of DAS 821A-L1 and must be used with a 501A-L1/2/4 or L1/3/4 DSU (automatic answer and call originate).

1.07 The customer data interface of a 501A-L1/2/4 DSU conforms to the electrical characteristics of Electronic Industries Association (EIA) Standard RS-232-C. The data and clock signals of a 501A-L1/3/4 DSU operating at 56 kb/s conform to the requirements of a balanced direct-coupled interface as specified in CCITT Recommendation V.35, while the control signals conform to EIA Standard RS-232-C.

1.08 The customer automatic calling interface (ACI) of a 501A-L1/2/4 or L1/3/4 DSU conforms to the electrical characteristics of EIA Standard RS-366.

2. PHYSICAL DESCRIPTION

2.01 The basic 501A-type DSU, shown in Fig. 1 with DAS 821A-L1, consists of a transmitter, receiver, control logic, and customer interface circuits mounted on two circuit packs (CPs) interconnected by a flexible cable harness. If the optional ACI is provided, the DSU will contain three CPs. The CPs are contained in a basic housing similar to that of the 208A-type data set. This housing consists of front and rear molded black plastic faceplates mounted on an extruded aluminum frame.

2.02 The 501A-type DSU is approximately 16 inches wide, 11.4 inches deep, 4.3 inches high, and weighs 17.3 pounds.

2.03 The DSU will operate in an environment of 40 to 120°F, with a relative humidity of less than 95 percent.

2.04 Power requirements for the self-contained 83A power unit are 105 to 129 Vac at 57 to 63 Hz. ▶The KS-14532, L24 unshielded power cord, six feet in length, is provided with the DSU. A shielded 3-conductor ac power cord (P3BJ), 5.5 feet in length, may be used in an electrically noisy environment.◀

2.05 An assembly containing a 3-position slide switch and four light-emitting diode (LED) indicators (designated as PWR, NS, LL, and RT) is provided. The DSU is furnished with the assembly mounted at the front. However, the assembly may be optionally mounted at either the front or rear, as required.

2.06 The 501A-type DSUs are equipped with one logic board CP and one analog board CP and, optionally, an ACI CP as shown in Fig. 2. LD3 CP performs the DSU logic functions and is common to all the DSUs. LD1 (9.6 kb/s) and LD2 (56 kb/s) are the analog boards and they

Fig. 1—▶501A-L1/3/4 DSU and DAS 821A-L1 Type◀

determine the DSU service bit rate. An optional LD4 CP provides automatic call originating capability for CPE equipped to originate SDDS calls and also provides interface for 821A-type DASs to manually answer and originate calls. Table A lists DSU service bit rates and CPs.

2.07 All customer options are selected with the switches on LD1 (9.6 kb/s) or LD2 (56 kb/s) CPs with the exception of the ACI call termination options. These options are selected with the screw switch located on LD4 CP.

2.08 All customer data interface leads of a DSU operating at 9.6 kb/s ▶and the ACI leads of both the 9.6- and 56-kb/s DSUs◀ are terminated in a 25-pin connector. CPE used with this DSU must be terminated in a Cinch or Cannon DB-19604-432 ▶or AMP 205784-1, or equivalent,◀ plug and a Cinch DB-51226-1 hood, or equivalent. A DSU operating at 56 kb/s uses a 34-pin connector for the data interface leads. CPE used with a 56-kb/s DSU must be terminated in a Winchester ▶MRA-34P-JTC6-H8, Burndy MS 34PM-124, AMP 5-202431-2, or◀ equivalent. Refer to Fig. 3 for customer interface location.

3. FUNCTIONAL DESCRIPTION

3.01 This part contains a brief functional description of the transmitter, receiver, and customer interface circuits. The interface leads are described and functional descriptions of the DSU options are provided.

3.02 The 501A-type DSU provides for duplex digital transmission and reception of data, in modified bipolar format, over 4-wire local transmission facilities. In normal bipolar format, a binary 0 is transmitted as zero volts and a binary 1 is transmitted as either a positive or negative pulse which is opposite in polarity to the previous binary 1. The SDDS modifies this format such that network control codes incorporate bipolar violations where two successive pulses (1s) have the same polarity. To avoid dc buildup on the line, each bipolar violation has a polarity opposite to that of the previous violation, thus making the sum of the signal voltages equal to zero.

A. Transmitter

3.03 Refer to Fig. 4 for a functional block diagram of the 501A-type DSU. The transmitter consists of transmit logic and line driver circuitry, which accepts digital data from the interface logic in the form of unipolar voltages and transmits balanced, ▶modified◀ bipolar signals over the local loop transmit pair (T1, R1). Customer data is encoded by the transmit logic into a format suitable for transmission. Since a long sequence of zeros does not provide transitions to maintain timing recovery, sequences of six or seven consecutive zeros in the data stream, depending on service bit rate (9.6 or 56 kb/s), are replaced with zero suppression codes (bipolar violation code) to maintain synchronization.

3.04 The line driver converts the binary outputs of the transmit logic into a balanced, ▶modified◀ bipolar signal. The line driver also contains a low-pass filter that prevents the transmission of unnecessary high-frequency energy over the channel. The bipolar signal is then transformer-coupled to the cable pair.

B. Receiver

3.05 The receiver consists of receive logic, clock recovery, and a line receiver. The line receiver may be subdivided into an analog-to-digital (A/D) converter and automatic gain control (AGC) associated with automatic line buildout (ALBO) circuitry. The receiver functions will be discussed in reverse order to simulate signal flow.

3.06 Since local cable pairs may vary in length and gauge, an ALBO network is provided to compensate for these variations. The ALBO network automatically inserts attenuation, which varies with frequency, in order to make the net transmission loss simulate a maximum length of local cable pairs. Because the range of adjustment provided by the ALBO network is limited, a 10-dB fixed line buildout (FLBO) network, which is selectable (in or out), is needed to insert additional loss in the case of extremely short local cable pairs.

3.07 The AGC provides gain and frequency compensation to equalize the cable loss characteristics of a maximum length cable pair. The combination of AGC and line buildout network provides equalization for a cable loss characteristic which is the average of the loss characteristics of standard cable pair gauges (19 through 26 gauge).

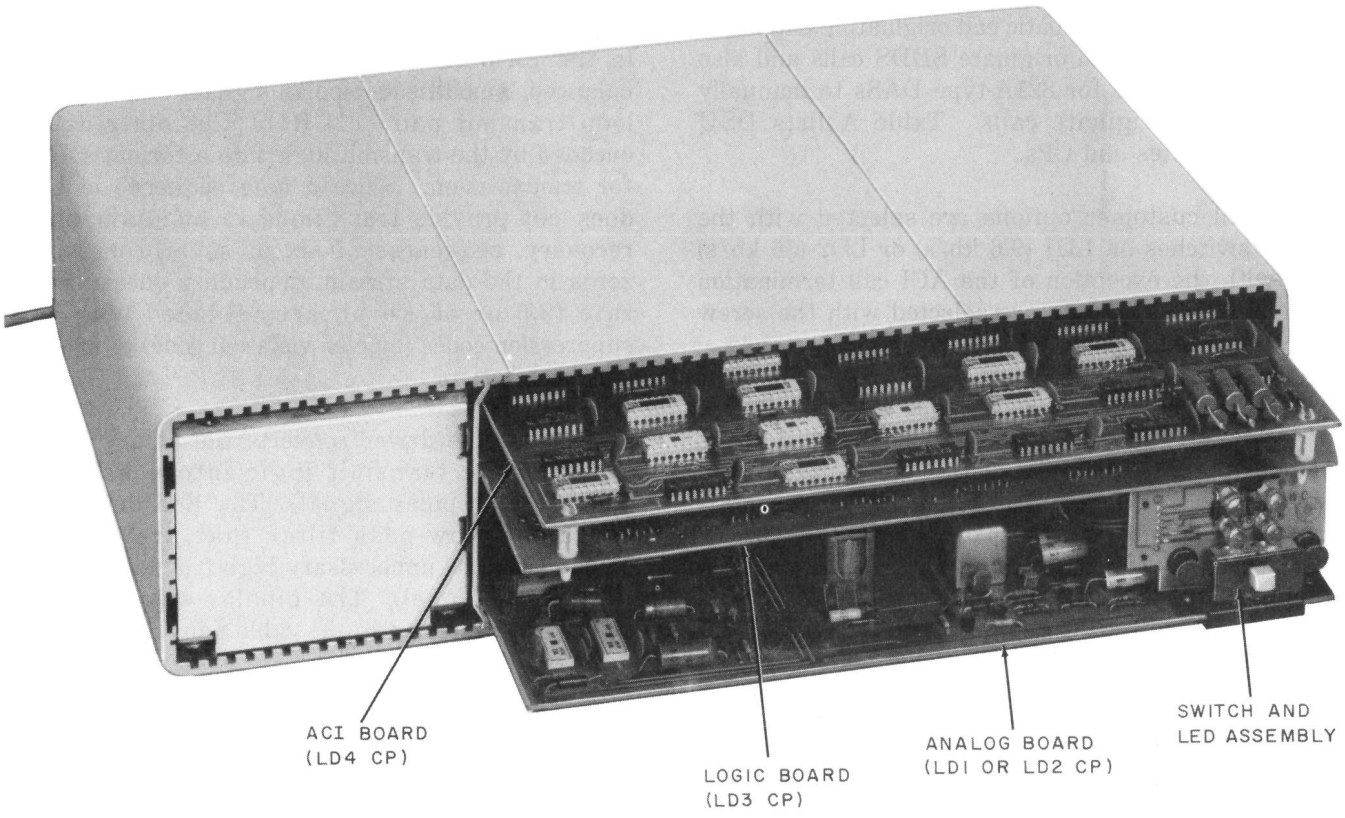

Fig. 2—501A-Type DSU—Front Internal View

TABLE A

DSU SERVICE BIT RATE AND CIRCUIT PACKS

DSU LIST	DSU SERVICE BIT RATE	ANALOG CP	LOGIC CP	ACU CP
501A-L1/2	9.6 kb/s	LD1	↑	
501A-L1/3	56 kb/s	LD2	LD3	
501A-L1/2/4	9.6 kb/s	LD1	↓	LD4
501A-L1/3/4	56 kb/s	LD2		LD4

3.08 The A/D converter slices the signal to produce a binary representation of the received modified bipolar signal.

3.09 The clock recovery circuitry consists of a voltage-controlled oscillator connected in a phase-locked loop. A phase comparator synchronizes the oscillator to the received timing signal. Thus, a sampling clock is derived from the received bipolar signal and is used to sample the data pulses.

3.10 In the receive logic circuitry, the data stream is sampled, converted to the unipolar format, and the data bits reconstructed to fully occupy

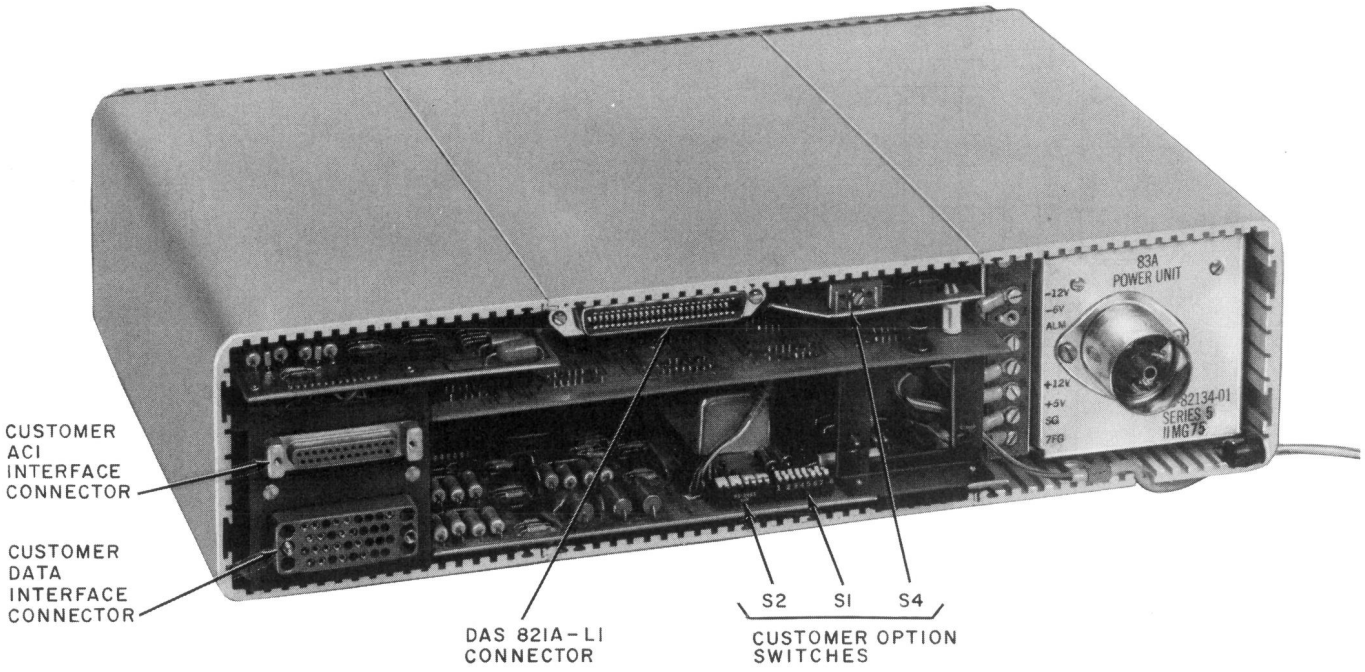

Fig. 3—501A-Type DSU—Rear Internal View

each respective time slot. The data stream then passes through a violation detector to recognize bipolar violation sequences (various control codes and the zero suppression code). When a bipolar violation sequence occurs, the data stream is examined for the presence of a valid control code by the receive logic. After the detection of eight consecutive control codes, the appropriate control state is entered. Control states occur as part of the SDDS call setup and maintenance activity.

3.11 The receiver output logic passes data, monitors violations, and, upon detection of violation, provides control signals to the control interface.

C. ACI and DAS Control Circuits (Optional)

3.12 The optional ACI and DAS control circuits consist of the ACI, call originate sender, and the display logic. Called party address digits are presented by the CPE to the ACI circuits in binary coded decimal (BCD) form. The least significant digit is set on NB1, the next in significance is set on NB2, the next on NB4, and the most significant on NB8.

3.13 Upon direction from either the 821A-type DAS or the ACI, the call originate sender signals the transmit logic to go off- or on-hook. The call originate sender contains logic circuitry to convert the BCD address digits to the ASCII code which is used for SDDS signaling.

3.14 The display logic provides logic functions and drivers to control the 7-segment displays and single LED displays on the 821A-type DAS.

D. Customer Data Interface Circuits (Data Interchange Interface)

3.15 The 501A-L1/2 DSU is provided with 14 interface leads, while the 501A-L1/3 DSU has 18 interface leads for connection to the CPE. These leads and their corresponding pin numbers are given in Table B. Descriptions of the EIA interface leads are given below with the EIA designation for each lead appearing in parentheses with the exception of the IS and LL leads. Additionally, a description of the IS and LL interface lead functions, unassigned by EIA Standard RS-232, is given.

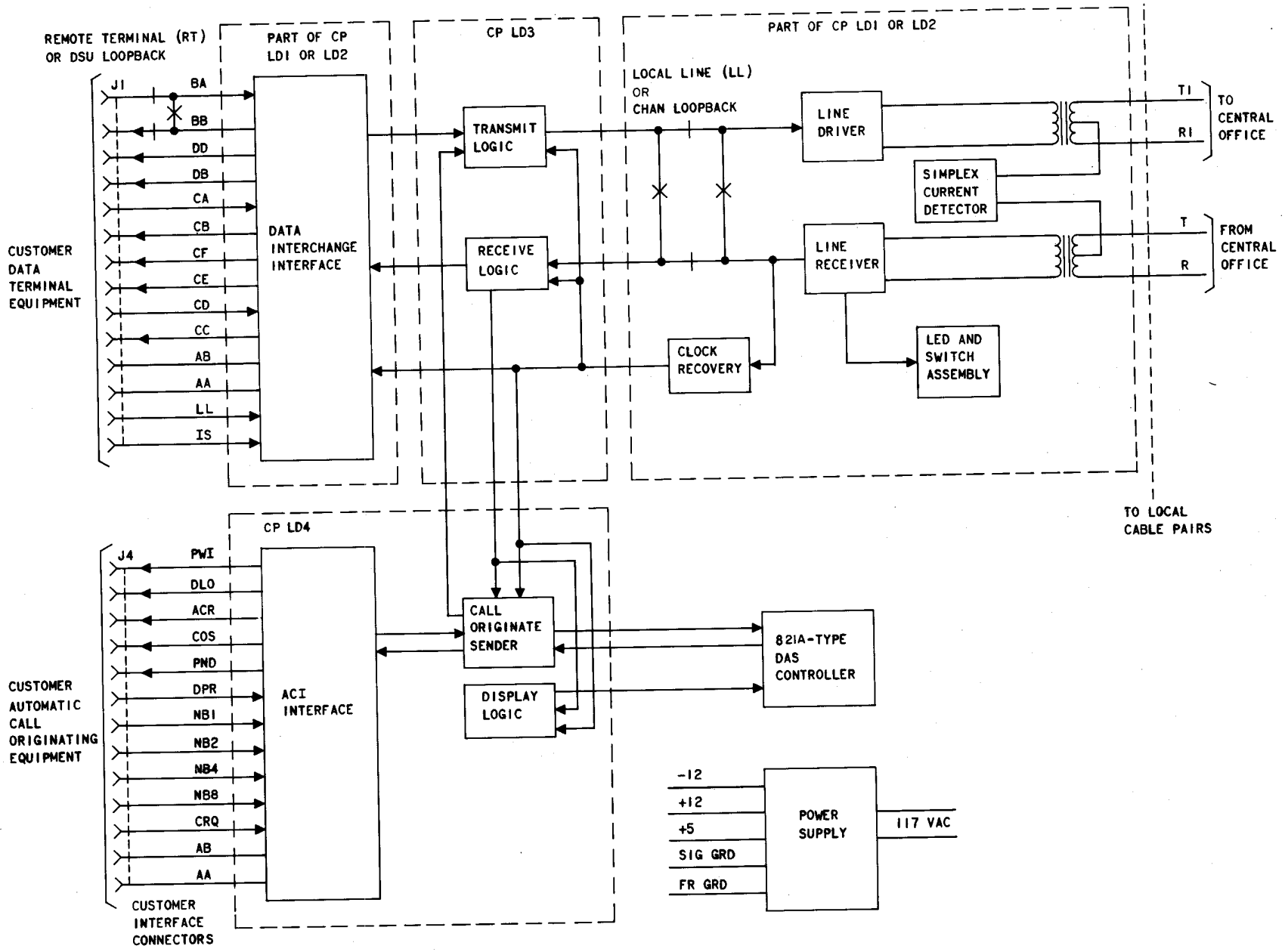

Fig. 4—Functional Block Diagram of a 501A-Type DSU and a DAS 821A-L1 Type

TABLE B

501A-TYPE DSU DATA INTERFACE

EIA PIN NO.	EIA STD DESIG	CCITT CONN TERM.	CCITT STD DESIG	DSU LEAD	9.6-k b/s MNEMONIC	56-k b/s MNEMONIC
1	AA	A	AA	Frame Ground	FG	FG
2	BA	P S	BA(A) BA(B)	Send Data Send Data	SD	SD(A) SD(B)
3	BB	R T	BB(A) BB(B)	Receive Data Receive Data	RD	RD(A) RD(B)
4	CA	C	CA	Request-to-Send	RS	RS
5	CB	D	CB	Clear-to-Send	CS	CS
6	CC	E	CC	Data Set Ready	DSR	DSR
7	AB	B	AB	Signal Ground	SG	SG
8	CF	F	CF	Received Line Signal Detector	RLSD	RLSD
11	Uasgn	K	Uasgn	Local Line	LL	LL
15	DB	Y AA*	DB(A) DB(B)	Serial-Clock-Transmit Serial-Clock-Transmit	SCT	SCT(A) SCT(B)
17	DD	V X	DD(A) DD(B)	Serial-Clock-Receive Serial-Clock-Receive	SCR	SCR(A) SCR(B)
20	CD	H	CD	Data-Terminal-Ready	DTR	DTR
22	CE	J	CE	Ring Indicator	RI	RI
25	Uasgn	NN**	Uasgn	In-Service	IS	IS

* Designated "a" on Winchester connector.

** Designated "n" on Winchester connector.

3.16 ***Frame Ground (AA)—Pin 1:*** This lead is connected to the DSU housing and the local power ground through the third conductor in the power cord. It is connected to signal ground through the power cord as explained in 3.22.

3.17 ***Send Data (BA)—Pin 2:*** The direction of signal flow on this lead is from the CPE to the DSU. The serial, binary data bits on this lead are generated by the CPE for transmission to the remote CPE. Data bits are transmitted only if the following interface lead conditions are met: CC is ***on***, CA is ***on***, CB is ***on***, and CD is ***on***. For the 501A-L1/2 DSU, BA meets the requirements of an EIA interface, while the 501A-L1/3 DSU requires a direct-coupled signal sent over the BA(A) and BA(B) leads.

3.18 ***Receive Data (BB)—Pin 3:*** The direction of signal flow on this lead is from the DSU to the CPE. Signals on this lead are generated by the receiving DSU in response to the data

stream received from the distant DSU. The CPE should sample BB on the negative transitions of DD. The BB interface lead will be held in the mark-hold state (steady 1s) when control signal CF is ***off***. For the 501A-L1/2 DSU, BB meets the requirements of an EIA interface, while the 501A-L1/3 DSU provides a direct-coupled signal given serially on the BB(A) and BB(B) leads.

3.19 ***Request-to-Send (CA)—Pin 4:*** The direction of signal flow on this lead is from the CPE to the DSU. Signals on this lead are generated by the CPE to turn the local data transmitter ***on*** when the switched carrier option is used. The CA lead must be held ***on*** whenever the CPE has data ready for transmission. An ***off*** condition on the CA lead causes the DSU to transmit steady marks if Option XA is installed, or the DSU will transmit a control code [data mode extension (DME) character] if Option XB is installed. An ***on*** condition on the CC lead is required for the above conditions. For DSUs using the continuous request-to-send option, the DSU transmits continuously, regardless of the status of the CA lead.

3.20 ***Clear-to-Send (CB)—Pin 5:*** The direction of signal flow on this lead is from the DSU to the CPE. Signals on this lead are generated by the DSU to indicate to the CPE readiness to transmit data. In response to an ***on*** condition of CA and CD from the CPE, the DSU will complete the handshaking sequence with the distant-end DSU, then enter the data mode. There is no delay before the DSU enters the data mode if Option XA (continuous carrier) is installed. There is a 3-byte delay if Option XB (switched carrier) is installed. If the DSU is equipped with Option YT (switched request-to-send), CB turns ***off*** when CA is turned ***off***.

3.21 ***Data-Set-Ready (CC)—Pin 6:*** The direction of signal flow on this lead is from the DSU to the CPE. An ***on*** signal on this lead indicates that the DSU is connected to an SDDS channel, call originating or call answering functions have been completed, and the DSU is not in a test mode (RT or LL).

3.22 ***Signal Ground (AB)—Pin 7:*** This lead establishes the common ground reference potential for all interface leads. Signal ground is normally connected to frame ground to minimize introduction of noise into the electronic circuitry. The 501A-type DSU provides this connection as a customer option.

3.23 ***Received Line Signal Detector (CF)—Pin 8:*** The direction of signal flow on this lead is from the DSU to the CPE. Signals on this lead are generated by the local DSU and indicate that data is being received and has been received for an 8-byte interval. The CF is turned ***off*** when no data signal is received. When the CF lead is ***off***, the BA lead is held in the mark-hold (binary 1) condition.

3.24 ***Serial-Clock-Transmit (DB)—Pin 15:*** The direction of signal flow on this lead is from the DSU to the CPE. Signals on this lead provide the CPE with transmit signal element timing. For 4.8- and 9.6-kb/s services, DB meets the requirements of an EIA-type interface, while 56-kb/s service utilizes a balanced direct-coupled signal sent over the DB(A) and DB(B) leads. DB is identical to DD.

3.25 ***Serial-Clock-Receive (DD)—Pin 17:*** The direction of signal flow on this lead is from the DSU to the CPE. Signals on this lead provide the CPE with receive signal element timing. For 4.8- and 9.6-kb/s services, DD meets the requirements of an EIA-type interface, while 56-kb/s service utilizes a balanced direct-coupled signal sent over the DD(A) and DD(B) leads.

3.26 ***In-Service (IS)—Pin 25:*** The direction of signal flow on this lead is from the CPE to the DSU. When the DSU is in the automatic mode, an ***off*** condition on the IS lead places the DSU in the not-ready mode while the DSU is on-hook. Optional control of the IS lead is provided by Options XQ and XR.

3.27 ***Data-Terminal-Ready (CD)—Pin 20:*** The direction of signal flow on this lead is from the CPE to the DSU. When the DSU is in the automatic mode, an ***on*** condition of the CD lead simultaneous with a ringing signal on RI causes the DSU to answer the incoming call. CD can be held continuously ***on*** by the CPE in preparation for answering an incoming call. If the CPE turns CD ***off*** while an established call is in progress, the DSU will go on-hook, thus terminating the call.

3.28 ***Ring Indicator (CE)—Pin 22:*** The direction of signal flow on this lead is from the DSU to the CPE. An incoming call causes a ringing signal to appear on this lead. The repetitive signal

consists of approximately 1-second ringing followed by a 3-second off interval.

3.29 ***Local Line (LL) Pin 11:*** The direction of signal flow on this lead is from the CPE to the DSU. When the DSU is in the automatic mode, an ***on*** condition on this lead places the DSU in LL loopback mode.

E. ACI Circuits (Optional)

3.30 The optional ACI (LD4 CP) provides 13 interface leads for connection to customer-provided, automatic call originating equipment. These leads and their corresponding pin numbers are given in Table C. All ACI leads conform to EIA Standard RS-366 as described below, with the EIA designation for each lead appearing in parentheses.

TABLE C

AUTOMATIC CALLING INTERFACE

EIA PIN NUMBER	EIA STD DESIG	ACI LEAD
1	AA	Frame Ground
2	DPR	Digit Present
3	ACR	Abandon Call and Retry
4	CRQ	Call Request
5	PND	Present Next Digit
6	PWI	Power Indication
7	AB	Signal Ground
13	COS	Call Origination Status
14	NB1	Digit Signal Circuit
15	NB2	Digit Signal Circuit
16	NB4	Digit Signal Circuit
17	NB8	Digit Signal Circuit
22	DLO	Data Line Occupied

3.31 ***Frame Ground (AA)—Pin 1:*** This lead is connected to the DSU housing and the local power ground through the third conductor in the power cord.

3.32 ***Digit Present (DPR)—Pin 2:*** The direction of signal flow on this lead is from the CPE to the DSU. The ***on*** condition of this lead indicates that a called party address digit is on interface leads NB1, NB2, NB4, and NB8. PND must be in the ***on*** condition before DPR is turned ***on***, and DPR must then be held ***on*** until PND is turned ***off***. When PND is ***off***, DPR must also be ***off*** to permit the CPE to set the next address digit on the digit signal circuits. DPR must be held ***off*** after the last address digit has been transmitted.

3.33 ***Abandon Call and Retry (ACR)—Pin 3:*** The direction of signal flow on this lead is from the DSU to the CPE. An ***on*** condition of this lead indicates that connection to a remote DSU is unlikely to be established. The CPE must turn CRQ ***off*** when the ACR lead turns ***on***. A default timer starts when CRQ is turned ***on*** and resets each time PND turns ***off***, or a remote ring call progress signal is received. If the timer is not reset within 12 seconds, the ACR lead turns ***on***. Upon connection to a remote station, the ACR lead is not turned on by the timer.

3.34 ***Call Request (CRQ)—Pin 4:*** The direction of signal flow on this lead is from the CPE to the DSU. If PWI is ***on*** and DLO is ***off***, the CPE may turn CRQ ***on*** to originate a call attempt. CRQ must then remain ***on*** during call origination until COS turns ***on***. The CPE may turn CRQ ***off*** after COS turns ***on*** without causing disconnect, unless Option XO is installed. CRQ must be turned ***off*** after a call is terminated and before the next call is initiated.

3.35 ***Present Next Digit (PND)—Pin 5:*** The direction of signal flow on this lead is from the DSU to the CPE. An ***on*** condition of the PND lead indicates that the DSU is ready to accept the next address digit on the digit signal circuits from the CPE. The PND lead is held ***on*** until DPR is turned ***on*** and the next address digit is registered, then PND is turned ***off***. The DSU must turn PND ***on*** following the last address digit.

3.36 ***Power Indication (PWI)—Pin 6:*** The direction of signal flow on this lead is from the DSU to the CPE. An ***on*** condition of the

PWI lead indicates that ac power is applied to the DSU.

3.37 ***Signal Ground (AB)—Pin 7:*** This lead establishes the common ground reference potential for all interface leads. Signal ground is normally connected to frame ground to minimize introduction of noise into the electronic circuitry.

3.38 ***Call Origination Status (COS)—Pin 13:*** The direction of signal flow on this lead is from the DSU to the CPE. An ***on*** condition of this lead indicates that the ACI has completed the call origination sequence and that control of the data channel has been transferred to the data interchange interface.

3.39 ***Digit Signal Circuit (NB1)—Pin 14, (NB2)—Pin 15, (NB4)—Pin 16, and (NB8)—Pin 17:*** The direction of signal flow on these leads is from the CPE to the DSU. Parallel binary-coded digits are set on these leads for addressing a remote DSU. The CPE ***must*** set an end-of-transmission block (ETB) character, and may optionally set an end-of-number (EON) character to conclude address signaling.

3.40 ***Data Line Occupied (DLO)—Pin 22:*** The direction of signal flow on this lead is from the DSU to the CPE. An ***on*** condition of this lead indicates that the DSU is either in manual mode, test mode, or a call is in progress. The DLO lead must be ***off*** prior to initiating a call attempt using the ACI.

F. Simplex Current Detector

3.41 Reversal of the local channel simplex current by the OCU operates a polarity-sensitive relay circuit wired between the center taps of the transmit and receive transformers. Operation of this relay causes a loopback of the local channel between the line driver and line receiver, and also connects the transmit logic to the receive logic. Functionally, this is the remote CHAN loopback which is controlled by the serving test center (STC).

G. Switch and LED Assembly

3.42 A slide switch provides control of the loopback test functions while the LEDs monitor modes. When the switch is positioned to LL (local line loopback), the transmit and receive paths are separately looped toward both the SCO and the customer interface (see Fig. 4). Loopback tests may be performed by the STC or from the CPE location when the CHAN loopback function is performed as described in 3.41. When the switch is positioned to RT (remote terminal loopback), interface leads BA and BB are connected together and disconnected from the CPE. Remote terminal loopback may also be activated remotely from the STC by transmitting a control code sequence containing bipolar violations. Remote terminal loopback is called DSU loopback when originated by the STC. The switch is placed in the center position for normal operation (data mode).

3.43 The LED assembly indications are as follows.

- PWR—Illuminates when ac power is supplied to the DSU and +5 Vdc is available.
- NS—Illuminates when no signal is received over the local transmission facilities.
- LL—Illuminates when the DSU is switched to the local line (LL) loopback mode or when the CHAN loopback code is detected by the simplex current detector.
- RT—Illuminates when the DSU is switched to the remote terminal (RT) loopback mode or when the DSU loopback code is detected by the control code detection circuitry.

H. Customer Options

3.44 The 501A-type DSU is provided with a number of options which may be requested by the customer. Customer options are paired such that one of each pair must be selected when the DSU is installed. The features available as options are listed in Table D and described in the following paragraphs. The options are also described in Reference Guide 590-005-101—Data Service Unit for Dataphone Switched Digital Service.

3.45 ***Signal Ground to Frame Ground:*** With signal ground connected to frame ground (Option YK), signal ground is internally connected to frame ground. The installation of this option depends upon the local noise conditions, ground potentials, and local safety regulations. With signal ground disconnected from frame ground (Option YL), the signal ground is isolated from frame

◆ TABLE D ◆

501A-TYPE DSU OPTIONS

OPTION DEVICE	OPTION DESIG	OPTION FEATURE	CIRCUIT PACK
Switch S1	YK	Signal ground connected to frame ground	LD1 or LD2
	YL	Signal ground disconnected from frame ground	
	YS	Permanent on request-to-send	
	YT	Terminal controlled request-to-send	
	XQ	Enable not ready	
	XR	Disable not ready	
	WV	FLBO network installed	
	WW	FLBO network removed	
Switch S2	XA	Permanent carrier	LD1 or LD2
	XB	Terminal controlled carrier	
	XS	4.8-kb/s data transfer rate	LD1
	XT	9.6-kb/s data transfer rate	
Switch S4	XO	Call termination by CRQ or CD	LD4
	XP	Call terminated by CD only	
Switch and LED Assembly	XM	Switch and LED assembly to rear	LD1 or LD2
	XN	Switch and LED assembly to front	

ground and the customer must specify an alternate means of grounding.

3.46 ***Request-to-Send Operation:*** With continuous request-to-send (Option YS), the DSU operates as if the CA lead is constantly ***on.*** This option is used with CPE which is not capable of switching the CA interface lead. With switched request-to-send (Option YT), the CPE must be capable of switching the CA lead. This option (YT), along with the XB Option, is necessary for half-duplex operation.

3.47 ***Carrier Control:*** After connection to a remote DSU has been established, the following events occur:

(a) With continuous carrier (Option XA)

(1) When the CPE turns ***off*** the CA lead, the CB lead turns ***off*** and the DSU transmits steady marks.

(2) When the CPE turns ***on*** the CA lead, the CB lead turns ***on*** and the DSU transmits data present on the BA lead.

(b) With switched carrier (Option XB) (needed for half-duplex operation)

(1) When the CPE turns ***off*** the CA lead, the CB lead turns ***off*** and the DSU transmits a continuous stream of DME characters. DME characters cause the remote DSU to turn ***off*** the CF interface lead.

(2) When the CPE turns ***on*** the CA lead, the CB lead turns ***on*** after a delay of 3 bytes to permit the remote DSU to turn ***on*** the CF lead. After CB has turned ***on***, the DSU can transmit data present on the BA lead.

3.48 ***Call Termination With CRQ:*** With call termination via CRQ after COS goes ***on*** (Option XO), calls that are originated using the ACI are terminated by turning CRQ or CD ***off***. Both CD and CRQ must be held ***on*** after COS turns ***on*** to maintain the call-on state. With call not terminated via CRQ after COS goes ***on*** (Option XP), CRQ can be turned ***off*** after COS turns ***on*** without terminating the call. The CD lead must remain ***on*** to prevent terminating the call.

3.49 ***Control of Not-Ready Condition by CPE:*** With enable not ready (Option XQ), the IS interface lead is controlled by the CPE. If the CPE turns ***on*** the IS lead, when the DSU is in the call-off mode, the DSU will transmit repeated idle control sequence codes to the OCU. If the CPE turns ***off*** the IS lead when the DSU is in the call-off mode, the DSU will transmit repeated not-ready control codes to the OCU. With disable not ready (Option XR), the DSU functions as if the IS lead were continuously ***on***. The DSU transmits repeated idle control sequence codes to the OCU when the DSU is in the call-off mode.

3.50 ***4.8-kb/s Interface Using a 9.6-kb/s Channel:*** This option is available only on the 501A-L1/2 or 501A-L1/2/4 DSU. With the 4.8-kb/s data transfer rate (Option XS), a 4.8-kHz clock signal is provided on DB and DD interface leads. With the 9.6-kb/s data transfer rate (Option XT), the DSU functions as described throughout this section.

3.51 ***Loopback Switch and LED Assembly Position:*** This physical option determines the location of the loopback switch and LED assembly. With Option XM, the assembly is located at the rear of the DSU. With Option XN, the assembly is located at the front of the DSU.

I. Telco Option

3.52 ***FLBO Network:*** For DSU installations where the local loop may be too short for proper operation of the line receiver, an FLBO network is optionally provided to insert additional attenuation. With Option WV, the FLBO is installed. With Option WW, the FLBO is removed. Refer to the section entitled Digital Data System—Local Loops—Engineering Guidelines (880-601-115) for criteria to determine use of this option.

4. OPERATION

4.01 This part contains information concerning the manual operation of the 501A-type DSU and the DAS 821A-L1.

A. 501A-Type DSU Operation

4.02 Attendant operation of the DSU is limited to the slide switch and observation of the LED indications as follows.

- For local line loopback, position the slide switch to LL and observe illumination of the respective LED.
- For remote loopback, position the slide switch to RT and observe illumination of the respective LED.
- At completion of loopback tests, restore the slide switch to center position.

B. DAS 821A-L1 Operation

4.03 The DAS 821A-L1 is available on an optional basis to provide a means of manually originating, answering, and terminating SDDS calls. In addition, call progress indications and limited test features are provided by the DAS 821A-L1.

If a call is originated or answered manually, the operator must depress the MM switch which will extinguish the MM indicator before data can be

transferred through the data exchange interface.

Manual Call Originating

4.04 Depressing the CALL switch on the DAS while in either the manual or automatic mode initiates a call request and illuminates the CALL LED. The DSU enters the off-hook mode and transmits synchronization characters to the SCO. In response to "dial tone" from the SCO, the PROCEED LED illuminates. A 7-digit address of the station being called, followed by an ETB character (# on the dial pad), can then be entered on the DAS 821A-L1 dial pad.

4.05 If the station address is accepted by the central office switching equipment, the PROCEED LED extinguishes. If the call is established, the REMOTE RING LED illuminates until the call is answered by the remote DSU. If the call cannot be established, the RECALL LED illuminates and the DAS displays a 2-digit call progress code as follows:

CODE	DEFINITION
10	Station Busy
11	Station Not Ready
20	Time-Out
21	Trunk Busy
30	Invalid

The appropriate action to the received code must be taken in order to complete the call.

4.06 To attempt a subsequent call, the CALL switch must be depressed to clear the central office switching equipment and extinguish the RECALL LED. Depressing the CALL switch for the second time initiates a new call request.

Manual Call Answering

4.07 When the data station is in manual mode, an incoming call causes the audible ringer to sound and the CALL LED to flash. The incoming call can then be answered by depressing the CALL switch. A valid connection is indicated by the illumination of the CONNECT LED.

In order for the CPE to answer automatically, the MM LED must be extinguished.

Manual Call Termination

4.08 Calls can be terminated while the data station is in manual mode (MM) by depressing either the CALL or NR (not-ready) switch. Depressing the CALL switch extinguishes the CALL LED and permits the data station to accept subsequent calls. If the call is terminated by depressing the NR switch, the CALL LED also extinguishes but the data station enters the not-ready mode which blocks all incoming calls.

Not-Ready Mode

4.09 The not-ready mode can be entered by either of two means:

- Depressing the NR switch when the data station is in manual mode
- CPE turns ***off*** the IS interface lead when the data station is in automatic mode.

Either action causes the data station to block all incoming calls. Any station which attempts to originate a call to a remote station that is in the not-ready mode receives a not-ready call progress code. The data station can be returned to the normal operating condition by again depressing the NR switch ***or*** by the CPE turning ***on*** the IS lead (reverse procedure for entering not-ready mode).

5. REFERENCES

5.01 The following BSPs contain additional information pertaining to the 501A-type DSU and DAS 821A-L1:

SECTION	TITLE
590-005-101	Data Service Unit For Dataphone Switched Digital Service—Reference Guide
595-300-180	Switched Digital Data System—501A-Type Data Service Unit—Summarizing Specification

SECTION	TITLE
595-300-200	Switched Digital Data System—501A-Type Data Service Unit—Installation and Connections
595-300-300	Switched Digital Data System—501A-Type Data Service Unit—Maintenance
595-300-500	Switched Digital Data System—501A-Type Data Service Unit—Test Procedures
598-085-100	Switched Digital Data System—Data Auxiliary Set 821A-Type—Identification
880-601-115	Digital Data System—Local Loop—Engineering Guidelines

5.02 Detailed information concerning the 501A-type DSU is contained in CD- and SD-1D253-01.