# VUSET* DS151A DATA STATION

# DESCRIPTION, INSTALLATION, AND MAINTENANCE

## 1. GENERAL

**1.01** This section covers VUSET DS151A Data Station which is manufactured by Plantronics, Incorporated. The data station, which includes the DS151A data mounting and from one up to eight Plantronics 09092 data sets, is primarily for use in the VUSET Data System. The system is installed as part of DATAPHONE data communications service.

*—Registered trademark of Plantronics.

†—Registered trademark of AT&T.

**1.02** Whenever this section is reissued, the reason(s) for reissue will appear in this paragraph.

**1.03** The VUSET Data System is an on-line data entry or inquiry-response communications system for use on the switched telephone network. The system is composed of the VUSET Data Station and the VUSET Data Terminal which has associated with it a telephone which has either TOUCH-TONE† service or a rotary dial type set. If a rotary dial type set is used, it must be modified with an auxiliary TOUCH-TONE pad. Inquiries from the terminal end to the computer via the data station, are made using the TOUCH-TONE pad. The data terminal is described in Section 578-160-100.

**1.04** The data station provides the interface between the switched telephone network and the customer's computer. The data station receives dual tone multi-frequency (DTMF) signals entered from a TOUCH-TONE pad and transmits frequency-shift keying (FSK) signals in an ASCII (American National Standard Code for Information Interchange) code over the switched telephone network. The data station and the computer communicate in a character serial ASCII code.

**1.05** Descriptive, operating, and maintenance information on the data station is given in the attached reprint of the Installation, Operation, and Maintenance Practice 09732 prepared by Plantronics, Inc.

## 2. UNIVERSAL SERVICE ORDER CODED (USOC) OPTIONS

**2.01** Table A lists the USOC options for the 09092 data set. The complete description of the data set options is contained in Section 3 of the attached manual.

**TABLE A**
**09092 DATA SET OPTIONS**
**UNIVERSAL SERVICE ORDER CODE (NOTE)**
**DM8++**

| OPTION CODE | FUNCTION |
|---|---|
| A1 | 300 baud data speed |
| A2 | Other speed selected as specified in Option B. |
| B3 | 150 baud data speed |
| B4 | 110 baud data speed |
| C5 | Even parity |
| C6 | Odd parity |
| D7 | Reception of TOUCH-TONE character ## by data set results in disconnect. |
| D8 | Data set does not disconnect in response to TOUCH-TONE character ##. |
| E9 | Clear-to-send lead CB follows EIA RS-232C. |
| E10 | Clear-to-send lead CB goes **on** when EIA leads CC (data set ready) and CD (data terminal ready) are **on**. |
| F11 | Echoplex "ON" |
| F12 | Echoplex "OFF" |

*Note:* Refer to Section 590-000-100 for determination of the USOC suffix.

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## DS151A

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# VuSet™ DATA STATION
## DS151A

## 1. SYSTEM DESCRIPTION AND OPERATION

### VuSet General System Description

**1.01** The VuSet system is an on-line, data entry or inquiry response system which uses a TOUCH-TONE® telephone as the data entry device. The VuSet system is installed as part of DATA-PHONE® service using the exchange telephone network as its transmission medium.

**1.02** The system includes the VuSet Data Terminal Model DS150A which is the remote data display device, and the VuSet Data Station Model DS151A, which provides the interface between the telephone network and the customers' computer (DTE). See Figure 1.

**1.03** Communication from the remote terminal site over the telephone lines to the data station is Dual Tone Multi-Frequency (DTMF) signalling entered through the TOUCH-TONE telephone or accessory pad.

**1.04** The data station and the computer communicate in character-serial ASCII code.

**1.05** Frequency Shift Keying (FSK) signalling is used from the data station, over the phone lines back to the remote data terminal.

**1.06** Call origination occurs at the data terminal end as the data station is not capable of call origination and the terminal cannot automatically answer an incoming call.

**1.07** The interface between the data station and the computer conforms to EIA Standard RS-232-C. Control circuits are described in the Interface Connections section.

### Data Terminal

**1.08** The DS150A Data Terminal (Figure 2) is installed with a standard 12 button TOUCH-TONE telephone used to make the initial connection with the computer and transmit data. An accessory pushbutton pad must be added for data entry with a rotary dial phone.

**1.09** Data transmitted through the telephone lines to the data station may be optionally displayed on the terminal CRT as a verification of data entry accuracy and acceptance/transmittal by the data station.

**1.10** Computer data transmitted from the data station to the terminal in FSK is demodulated within the terminal and displayed on the CRT.
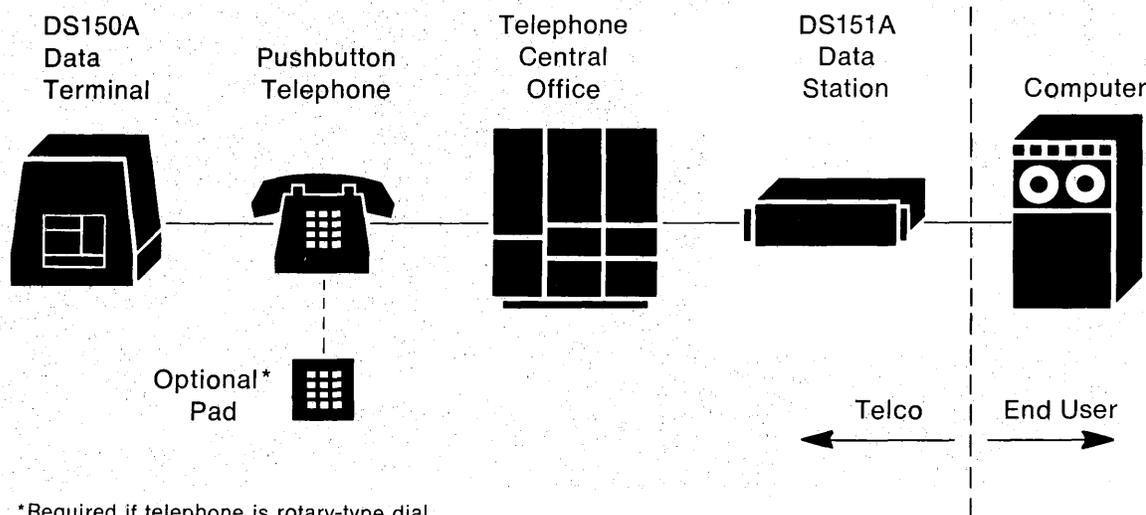


**Figure 1,** Simplified VuSet System

### Data Station

**1.11** A single DS151A Data Station (Figure 3) can include up to eight line cards (Data Sets) allowing that many lines to access the computer at one time. For heavier line traffic, additional data stations can be installed.

**1.12** Each Data Set provides:

**a)** Decoding of incoming TOUCH-TONE DTMF signals.

**b)** Handshaking and data interchange with the computer (DTE).

**c)** Frequency Shift Keying (FSK) modulation of computer generated data for transmission over the telephone network to the data terminal.

**1.13** The data format is a start/stop, 10 unit ASCII code transmitted at 110, 150 or 300 baud. The FSK Mark and Space frequencies are F2 Series 2225 Hz and 2025 Hz, respectively.

**1.14** Interface with the telephone line is direct, with the data set handling the line supervision.

### System Operation

**1.15** The user originates a call to the computer in the normal manner with the terminal TALK/DATA switch in either position. Calls are automatically answered by the data set which returns a 2225 Hz answerback tone to indicate completion of "handshaking" with the computer.

**1.16** The user places the data terminal on-line by moving the DATA/TALK switch to the DATA position, if necessary.

**1.17** Data is entered from the terminal end via the telephone or accessory pushbutton pad. The data set translates the TOUCH-TONE DTMF signals to ASCII code for the computer.

**1.18** Computer generated ASCII data is converted to FSK by the data set and transmitted to the terminal for demodulation and display.

**1.19** Disconnection is initiated by one of the following:

**a)** The terminal user disconnects or hangs-up in the usual manner. The data set will disconnect after a selected time-out interval (nominally 10 seconds).



**Figure 2,** VuSet DS150A Data Terminal Installation
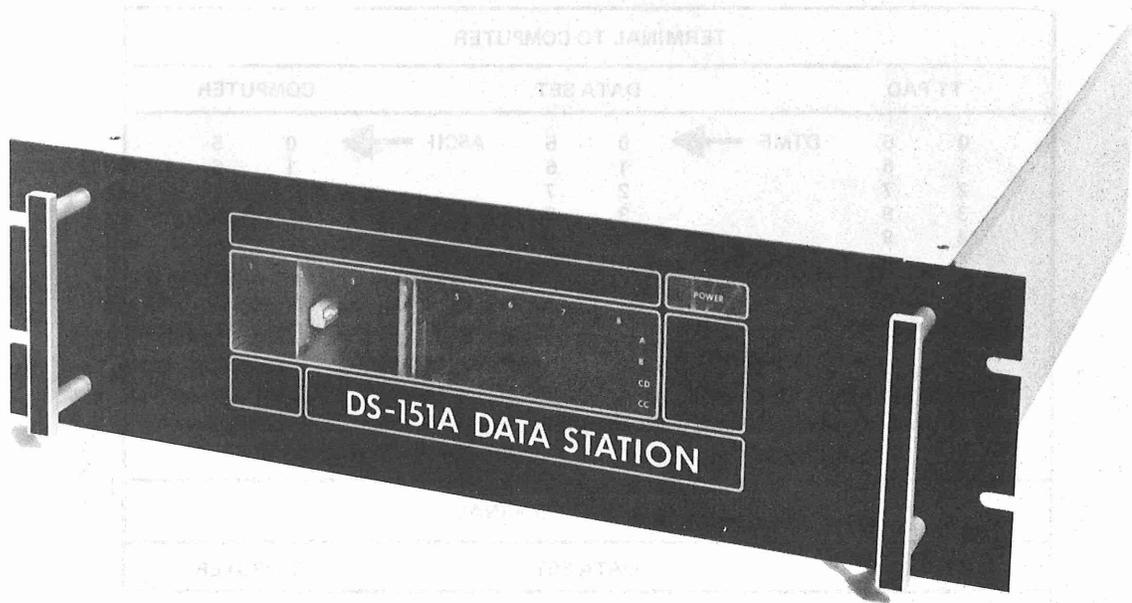
**Figure 3,** VuSet DS151A Data Station

b) The data set will time-out after cessation of input from either the data terminal or from the computer.

c) Disconnect is initiated by the computer by control of the EIA-CD lead.

d) The data set may be arranged to immediately disconnect on the receipt of the ## characters from the TOUCH-TONE pad associated with the data terminal.

**1.20** Control codes are software controlled.

**1.21** Table A shows character by character data flow through the system. The terminal and data set operate in a half-duplex communications mode.

### System Programming

**1.22** Questions concerning programming shall be referred to systems support personnel.

**TABLE A**
**VuSet Data Flow**

| TERMINAL TO COMPUTER | | |
|---|---|---|
| **TT PAD** | **DATA SET** | **COMPUTER** |
| 0   5   DTMF ➤ | 0   5   ASCII ➤ | 0   5 |
| 1   6 | 1   6 | 1   6 |
| 2   7 | 2   7 | 2   7 |
| 3   8 | 3   8 | 3   8 |
| 4   9 | 4   9 | 4   9 |
| * | *  } Characters | CAN   (CTL X) |
| # | #  } converted by | CR |
| ## | ##  } Data Set | EOT   (1) |

(1) Switchable option at the data set. Data set may be set to immediately disconnect upon receipt of ##. In this mode, EOT is not sent to the computer.

| COMPUTER TO TERMINAL | | |
|---|---|---|
| **VUSET** | **DATA SET** | **COMPUTER** |
| A-Z | | A-Z |
| 0-9 | ◄ FSK    ◄ ASCII | 0-9 |
| @[]\/\\_! | | @[]\/\\_! |
| "#$%&'() | | "#$%&'() |
| *+,−./: | | *+,−./: |
| ;<>=? | | ;<>=? |
| SPACE | | SPACE |
| NON-PRINT. ERASES SCREEN AND INITIALIZES DISPLAY | | CR |
| NON-PRINT. CAUSES SCREEN TO BLINK | | DC1 |

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## 2. DATA STATION DESCRIPTION

### General

**2.01** The VuSet Data Station consists of the following principal assemblies. (See Figs. 4 & 5).

| Component | Quantity |
|---|---|
| a) Data Mounting* | 1 |
| b) Data Set(s)  (channel board) | up to 8 |
| c) Power Supply Board | 1* |
| d) Extender Board | 1* |
| e) AC Power Cord | 1* |
| f) Telephone Line Connector Cable | 1 (TelCo provided) |
| g) RS-232-C Interface Cable | 1 (TelCo user provided) |
| h) DTE Simulator Test Cable (optional) | 1 |
| j) DTE Simulator (optional) | 1 |

*included with Data Mounting

### Data Mounting

**2.02** The DS151A Data Mounting is a cabinet containing the interconnect wiring and mechanical package for the Data Set, Power Supply, Extender Board and DTE Simulator circuit boards and connections for the Power, Interface, and Test Cables.

**2.03** The Data Mounting measures 19 inches wide by 5-1/4 inches high by 23-1/2 inches deep (48.26 x 13.34 x 59.69 cm), and weighs approximately twenty pounds (9.07 kg) when all board locations are filled. It can be placed on a desk or shelf or rack mounted in either 19" or 23" racks. (48.26 or 58.42 cm).

**2.04** It provides space and interconnection for a common power supply board and up to eight data set boards. A tenth circuit board location is reserved for storage of the maintenance extender board. (See section 4.08 for connector pin assignments.)

**2.05** The rear panel (Figure 5) provides receptacles for connections to the computer and the
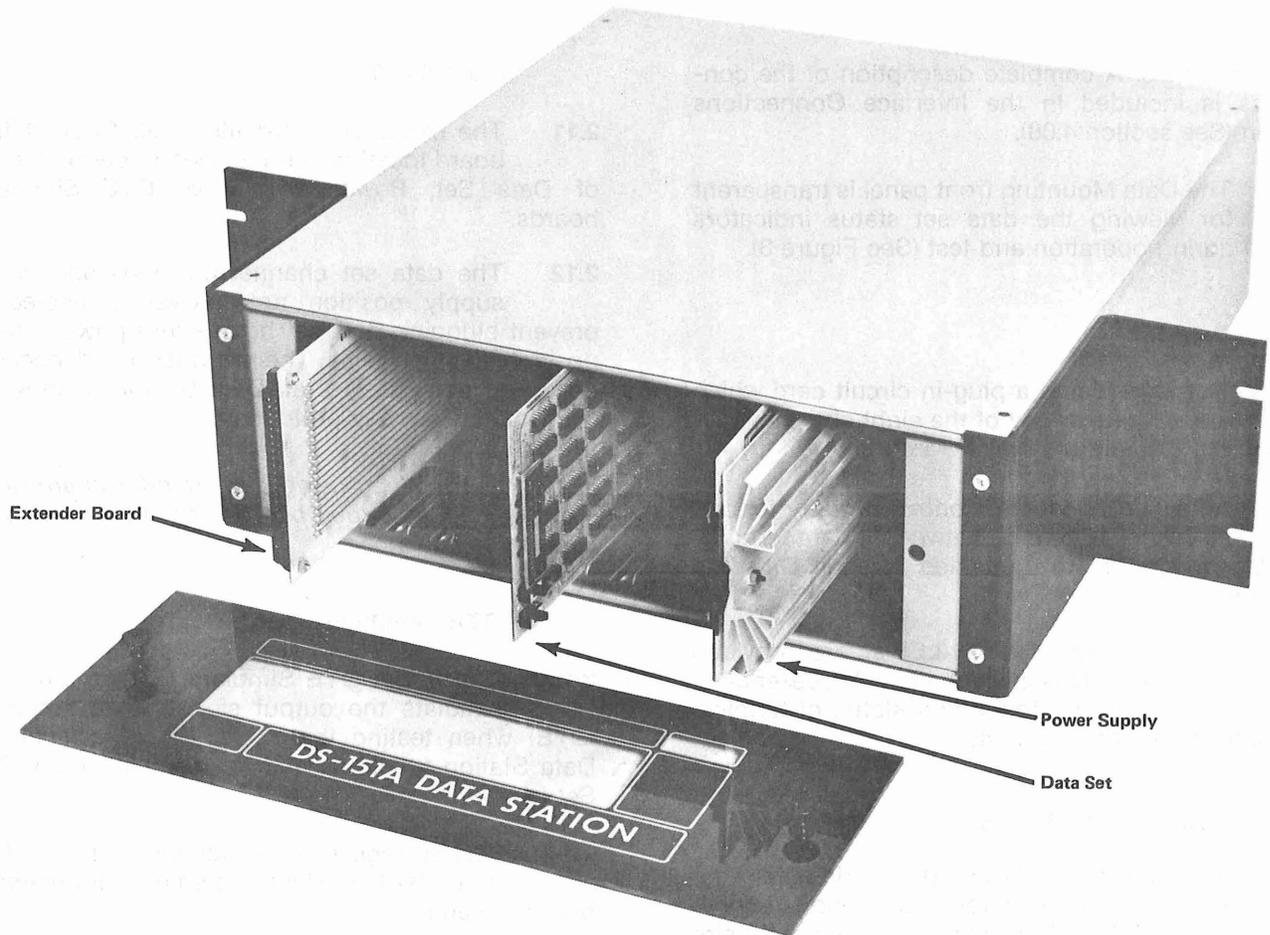


**Figure 4,** DS151A Data Station (One Channel Installation Shown)

1 Amp, Slow-Blow Fuse

DTE Simulator Test Connector

Telephone Line Connector & Cable

Power Connector & Cord

DTE Connector & Cable
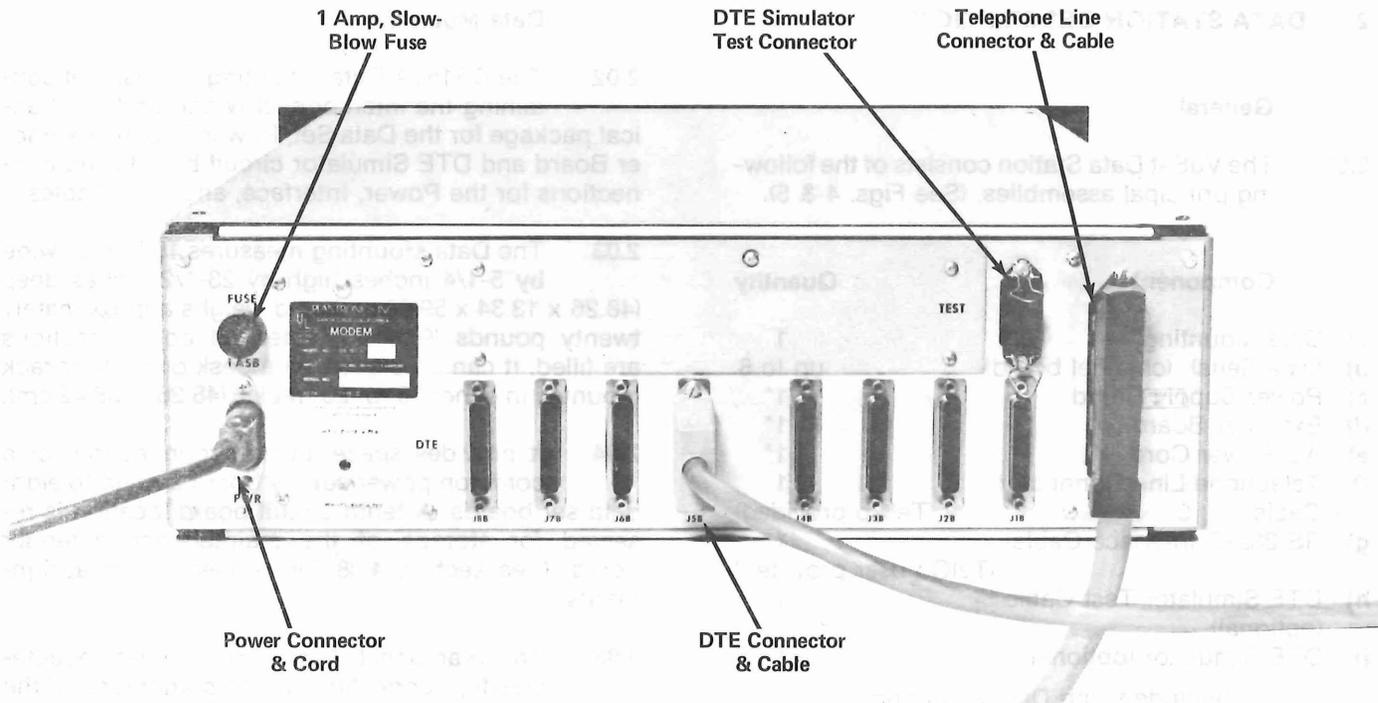
**Figure 5,** Data Station Rear Panel

telephone lines. A complete description of the connectors is included in the Interface Connections section (See section 4.08).

2.06 The Data Mounting front panel is transparent for viewing the data set status indicators (LED's) during operation and test (See Figure 3).

### Data Set

2.07 The Data Set is a plug-in circuit card which will operate in any of the eight channel locations in the Data Mounting.

2.08 All of the signal and control circuitry for one communication link between a data terminal and the computer are contained in each Data Set assembly.

2.09 Four indicator lamps (LED's) are provided on each Data Set which indicate presence of DTMF A and B group tones and status of terminal and data set ready conditions.

### Power Supply Board

2.10 The Power Supply board provides the regulated power and reference oscillation frequency to all Data Sets in the Data Station and occupies the far right circuit board position in the Data Mounting.

### Extender Board

2.11 The extender board fits in all Data Station board locations and is used to permit testing of Data Set, Power Supply or DTE Simulator boards.

2.12 The data set channel positions and power supply position are keyway protected to prevent plugging data set boards into power supply position and vice versa. The extender board, because of its universal use for all Data Station boards can override this keyway protection.

CAUTION: *When using the extender board do **not** mismatch circuit boards and their connection positions.*

### DTE Simulator Board

2.13 The VuSet DTE Simulator Board is used to simulate the output signals of a computer (DTE) when testing the VuSet Data Terminal and Data Station functions and is operable in any Data Set location.

2.14 The storage position for the DTE simulator is the far left, which is also used for extender board storage.

## Data Station Specifications

**2.15** *Input Signal from Remote Terminal*

**a)** Format: DTMF (2 out of 7 A & B tones; 12 combinations)

**b)** Allowable input levels: 0 to —40 dBm

**c)** Repetition rate: 8 characters/second maximum at 300 baud (one character/125 milliseconds)

**d)** Repetition rate with Echoplex ON: 5 characters/second maximum at 300 baud (one character/200 milliseconds)

**e)** Input impedance: 900$\Omega$ ± 10%, ac coupled

**f)** DC loop resistance: 82$\Omega$ at 120 mA maximum

**g)** Character recognition time: 40 milliseconds minimum

**h)** Frequency (A or B) recognition bandwidth: ± 3%

**j)** Allowable input amplitude difference: $|F_A - F_B|$ = 6 dB

**2.16** *Output Signal to Remote Terminal*

**a)** Format: frequency-shift keying (FSK)

**b)** FSK frequencies: 2025 Hz = Space (F2S)
2225 Hz = Mark (F2M)

**c)** Signal stability: 2125 Hz ± 1% center frequency
200 Hz ± 2% modulation

**d)** FSK signal levels: adjustable from —28 dBm to +5 dBm (factory set at —3 dBm (nominal)).

**e)** Output impedance: 900$\Omega$ ± 10%, ac coupled

**f)** DC loop resistance: 82$\Omega$ at 120 mA maximum

**g)** Data rate: 300 baud maximum as transmitted by DTE

**h)** Disconnect Time-out: 4 to 65 seconds (continuously adjustable).

**j)** Receive to transmit turnaround: (CB "OFF" to CB "ON") approximately 10 ms.

**2.17** *Noise Performance*

**a)** Insensitive to power line noise at 60 Hz and related harmonics.

**b)** Insensitive to impulse noise from atmospheric static and switching transients found on unconditioned telephone lines when adequate earth ground is provided. In-band signals can not exceed —40dBm.

**2.18** *DTE Input/Output Signals*

**a)** Data format: eight-level serial ASCII code including Odd or Even parity (switch selectable) plus one start and one stop bit.

**b)** Signal levels: EIA Standard RS-232-C compatible

**c)** DTMF/ASCII character conversion:

| DTMF | ASCII |
|------|-------|
| 0 — 9 | 0 — 9 |
| * | CAN |
| # | CR |
| ## | EOT |

**d)** Data rate: 110, 150, or 300 baud (switch selectable).

**e)** Data transfer relay: Character output to DTE 17 to 25 ms. after DTMF "OFF".

**2.19** *Power Requirements*
Single phase, grounded 117 Vac ± 10%, 60 Hz, 10 watts maximum. 8 foot power cord provided.

**2.20** *Physical Characteristics*

**a)** Dimensions: 19 inches wide (48.26 cm)
(23" optional)
5-1/4 inches high (13.34 cm)
23-1/2 inches deep (56.69 cm)

**b)** Weight: Approximately 20 pounds fully loaded. (9.07 kg)

**c)** Data Station: Up to eight individual data channels, one extender or DTE simulator board, one power supply board.

**2.21** *Operating Environment*

**a)** Temperature: 0° C to 50° C (operating)
—10° C to 65° C (storage)

**b)** Maximum relative humidity: 90% (no condensation)

**c)** Altitude: 10,000 feet maximum (3048 m)

**2.22** *Data Station Options*

See Table B

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**TABLE B**
**Data Station Options**

| FUNCTION | OPTION | COMMENT |
|---|---|---|
| Data Rate | 300 Baud<br>150 Baud<br>110 Baud | —Factory Set Position.<br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -<br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - |
| Parity Select | Even Parity<br>Odd Parity | —Factory Set Position.<br>- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - |
| ## Disconnect | No Disconnect by<br>Data Set<br>Immediate Disconnect | —EOT Transmitted to DTE. Factory Set<br>Position.<br>—No EOT Transmitted to DTE. |
| CB Logic Select | CB=True "Clear to<br>Send"<br>CB Goes "ON" When<br>Both CC & CD Are<br>"ON" | —Per EIA RS-232-C. Factory Set Position.<br><br>—Data Set functions as RS-232-C but gives<br>appearance of CB=CC to accomodate<br>some computers. |
| Auto Time-Out | Continuously variable<br>from 4 sec to 65 sec. | —Factory set at 10 sec (nominal). |
| Digital Loopback<br>DLB | ON or OFF<br>Switch Selectable | —FSK character return and no ASCII<br>data to DTE. |
| Echoplex | ON or OFF<br>Switch Selectable | —FSK character return and simultaneous<br>ASCII data to DTE. Factory set OFF. |

## 3. DATA STATION OPERATION

### Data Set Functions

**3.01** Each data set board of the DS151A Data Station provides all the signaling functions for two-way half duplex communications between remote data terminals over the phone lines, and interfaced DTE's. Figure 6 is a functional block diagram of a data set channel. Table E indicates the selectable functions.

**3.02** The line and supervisory control circuits manage the line seize, hangup and handshaking routines. The line seize and isolation components couple the phone line with the line relay, connecting a 1:1 transformer to the rest of the circuitry through a balanced hybrid.

**3.03** The hybrid separates the FSK and DTMF signal paths for two-way communications between terminal and data set.

**3.04** The receiver consists of filters, demodulator, DTMF decoder and ASCII converter stages. Data obtained is sent to the DTE via the EIA interface.

**3.05** When Echoplex is enabled at the data set (Switch S3-6 & 7) the transmitter generates FSK signals for character return to the terminal simultaneously with transmission of ASCII data to the computer.

**3.06** When the digital loop back test (DLB) switch S2 is ON, character input is returned to the terminal and is sent to the computer but CB is held OFF so DTE does not respond. The data set will answer automatically without a DTE interface connection.

### Status Indicators

**3.07** The DS151A data station is designed for unattended operation, and has no operating controls. In operation, system status is indicated by LED's mounted at the front edge of each data set board, visible through the front panel.

**3.08** *Power Indicator.* This LED on the power supply board (Figure 9) works from the +12V regulated supply and is driven by the 120 kHZ reference. When ON it indicates the validity of both power (+12 vdc only) and reference oscillator outputs.

**3.09** *Channel Indicators.* The four LED's on each data set board (See Figure 8) work as follows:

A  Represents detection of A group DTMF tones

B  Represents detection of B group DTMF tones

CD Represents the Data Terminal Ready Signal from the DTE (computer). This must be ON for the channel to operate except in loopback test mode.

CC Represents the Data Set Ready to the DTE. It can be forced ON by S1 to "Busy Out" the channel; or, it turns ON when the line is seized in response to an incoming call.

**NOTE:** A and B lamps will be ON for as long as the tones are actually on the line (i.e., for as long as any DTMF pushbutton is actuated).
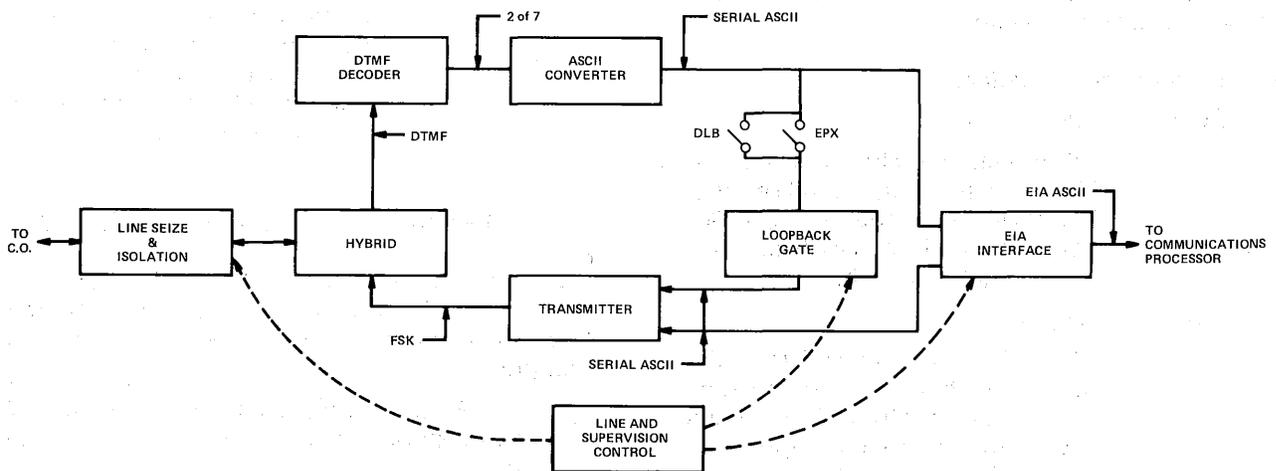


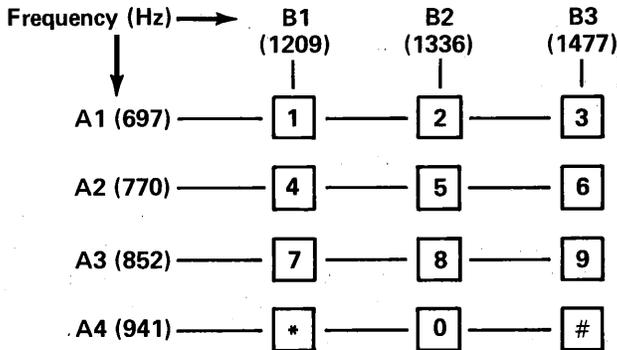**Figure 6,** Block Diagram of Data Channel

Frequency (Hz) ➡

| | B1 (1209) | B2 (1336) | B3 (1477) |
|---|---|---|---|
| A1 (697) | 1 | 2 | 3 |
| A2 (770) | 4 | 5 | 6 |
| A3 (852) | 7 | 8 | 9 |
| A4 (941) | * | 0 | # |

**Figure 7,** Telephone Dial Frequency Conversion

### Phone Answering and Line Seize

**3.10** The data set seizes the line for any one of two conditions:

**a)** Sensing of ringing on T/R

**b)** Overriding "Busy Out" setting of S1.

**NOTE:** The DTE (computer) must provide CD "ON" (Data Terminal Ready) for 3.10 a) to function.

**3.11** The data set turns on CE (Ring Indicator) when ringing on T/R of a direct line is sensed. The CE generated follows the applied ringing cycle. This triggers line seize by the data set, as does the setting of S1 to ON.

### Channel Establishment

**3.12** Call set-up or "hand-shaking" procedures between the communications line, the data set and the computer are shown in Table C and are explained below. The EIA leads are defined in the Interface Connections section.

**3.13** *Connection Procedure*

Event 1    OFF or IDLE state

All interchange signals are in the "OFF" or marking condition with the possible exception of CA (Request to Send), or CD (Data Terminal Ready) or both.

Event 2    Ringing

When ringing is applied from the communications line to the data set, the data set turns "ON" circuit CE to the computer. Signal CE goes "ON" and "OFF" in response to the ringing cycle.

Event 3    Circuit CD, Data Terminal Ready normally turned "ON" by computer in response to ringing but may have been "ON" previous to this time. CD "ON" tells the data set that the computer is prepared for a call to be established and receive data.

Event 4    The data set answers the call and trips ringing. Circuit CE goes permanently "OFF".

Event 5    After a delay of 2 to 5 seconds, circuits CC and CF go "ON" to the computer indicating the transmission path is cut through and data transmission may begin. Also, to signal the establishment of the communications path, the data set signals the remote terminal by applying the answer back tone (2225 Hz) to the communications line.

NOTE: CC and CF are tied together within the DS151A. CF "ON" indicates pseudo-existence of received carrier (the Vuset terminal and DTMF pad do not generate a carrier signal) and is supplied only because it may be a requirement of the computer.

Event 6    The computer may respond with CA "ON" indicating it is requesting permission to transmit data as it becomes available. This circuit may be "ON" previous to this time, including IDLE condition.

Event 7    Before the computer is permitted to transmit data, the data set turns "ON" circuit CB. This control of CB is employed in the data mode of the data set so it may choose when to permit computer transmission, i.e. CB will go "OFF" when CA is "OFF" or digital loopback test in progress.

### Terminal Communications to Computer

**3.14** Once the calling path is completed, the data set is in the data mode. The data set is now on-line and the remote terminal may begin inquiries to the computer.

**a)** DTMF pushbutton is actuated, generates DTMF on telephone lines and is received by the data set.

**b)** When the pushbutton is released, DTMF is removed from the lines. The data set delays data transmission approximately 25 ms. 10 ms. after the stop bit is transmitted, CB turns ON.

**TABLE C**
**Channel Establishment Events**

| Event | Communications Line Status | Data Set Signals | Computer Signals |
|---|---|---|---|
| 1 | OFF/IDLE | (4) $\overline{CB}$, $\overline{CC}$, $\overline{CE}$, $\overline{CF}$ | CA, CD |
| 2 | RINGING | CE ⟶ | |
| 3 | | | ⟵ CD [1,3] |
| 4 | CALL ANSWERED | $\overline{CE}$ ⟶ | |
| 5 | PATH COMPLETE | CC, CF ⟶ 2225 Hz | |
| 6 | | | ⟵ CA [1] |
| 7 | | CB [2] ⟶ | |

(Events 4 and 5 bracketed as 2-5 seconds)

**NOTES:**
1. May be turned "ON" at this time or anytime previous, including IDLE condition.
2. CB is turned "OFF" and "ON" during data transmission. This permits the data set to control ability of computer to transmit.
3. In the case of CD, it has to be "OFF" for at least 50 ms for computer generated termination of call before going "ON" again.
4. $\overline{CB}$ indicates CB "OFF"

**3.15** During reception of DTMF signals or transmission of the received data to computer, circuit CB (Clear to Send), when implemented (see Options) is "OFF" to the computer. Also, during this time the data set will not accept data from circuit BA (transmitted data) regardless of CB implementation. The CB flag is "ON" at all other times.

**3.16** Character return options to the VuSet Terminal may be enabled as follows:

**a)** If Echoplex character return is enabled at the data set (S3-6, 7) data entered at the terminal location will be transmitted in ASCII/FSIC back to the terminal simultaneously with transmission to the computer.

**b)** If Echoplex is **not** enabled, any character verification to the terminal must be computer originated.

**c)** If the Digital Loopback (DLB) switch, S-2 is ON, the data set is in a test position and the input character is repeated back in FSK over the line to the remote terminal (approx. 100 to 200 ms delay) and data to the computer.

**3.17** The reason for the 25 ms transmission delay is to allow for settling down of the pushbutton DTMF contacts and establishing a data receive-print enable condition at the remote terminal. Thus, the minimum input is nominally 70 to 90 ms per character (including aprroximately a 12 to 18 ms DTMF recognition time, the 25 ms transmission delay and a 33 ms character transmission time at 300 baud and a small DTMF stabilizing and setting time). Transmission at 110 baud lengthens the character transmission time to roughly 100 ms which increases this minimum input time.

**3.18** All received DTMF signals are translated by the data set to the appropriate ASCII code (see Table D). 25 ms after the end of the DTMF signal, the assembled ASCII code is transmitted to the computer; 10 ms after the stop bit is transmitted, CB turns ON.

**3.19** Receipt of an initial DTMF # is translated to ASCII CR. Receipt of a second consecutive DTMF # is translated as ASCII EOT. All subsequent consecutive #'s are also translated as EOT. Receipt of any other DTMF character causes the next # to be translated as CR and the cycle starts over. Optionally, the ## may initiate immediate disconnect by the data set (see Disconnect).

**TABLE D**
**DTMF/ASCII Character Conversion**

| DTMF DIGIT | ASCII CHARACTER | $b_1$ | $b_2$ | $b_3$ | $b_4$ | $b_5$ | $b_6$ | $b_7$ | $b_8$[2] |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 1 |
| 2 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 1 |
| 3 | 3 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 0 |
| 4 | 4 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 5 | 5 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 |
| 6 | 6 | 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 |
| 7 | 7 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 1 |
| 8 | 8 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 9 | 9 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 |
| * | CAN(CTL X)[3] | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| # | CR [3] | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 1 |
| ##[1] | (EOT) [3] | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |

NOTES: 1. See On-Line Operation for explanation
2. Bit 8 is parity bit, shown in even parity
3. Non-printing characters

**3.20** The DTMF frequency plan is arranged in two groups of four tones — low group (A) and a high group (B). A character or a digit is represented by two frequencies, one from each group. (See Fig. 7)

**3.21** Only 12 of the possible 16 combinations are used on standard TOUCH-TONE sets, and these represent the ten numerals (0 through 9) along with the symbols * (star) and # (number sign). The DS 151A data set is capable of decoding only these 12 standard combinations.

### Computer Communications to Terminal

**3.22** This follows the EIA Standard RS-232-C criteria for the interface to the data set. The serial ASCII data on the BA (Transmitted Data) lead keys the transmitter to generate FSK tones representing the computer data input. This transmitted data will be at the speed clocked by the DTE (up to a maximum of 300 baud).

### Line Disconnect and Hang-Up

**3.23** There are three procedures which will cause the data set to disconnect the telephone line and signal the IDLE (ON HOOK) status to the computer.

**3.24** *Computer Disconnect*
Computer turns CD (Data Terminal Ready) "OFF" for at least 50 milliseconds. The data set turns CB "OFF" to the computer and disconnects from the telephone line. The data set then turns CC and CF "OFF" to the computer.

**3.25** *Data Set Time-Out*
Time-out is included in the data set to provide a disconnect command after a selectable interval. This disconnect command occurs when the selected time-out period has expired after cessation of DTMF reception or ASCII data activity in either the transmit or receive directions. The data set disconnects from the telephone line. The data set also turns "OFF" CC, CF and CB (if not "OFF" already) to the computer. The computer may respond by turning "OFF" CD.

**TABLE E**
**Data Set Selectable Functions**

| FUNCTION | SWITCH NUMBER | SWITCH POSITION | RESULTING CONDITION | COMMENTS |
|---|---|---|---|---|
| Line Seize | S1 | OFF<br><br>ON | Auto Answer<br><br>Manual Seize | — Direct connection Factory set position<br>— Appears busy to dial-up line. Permanently ON to private line ckt. (no time-out in effect). |
| Digital Loop back Select (DLB) | S2 | ON<br><br>OFF | Auto Loopback<br><br>Computer Control | — FSK character return test<br><br>— EIA interchange ckt. Factory Set position |
| Data Rate | S3-1 and S3-2 | Both ON<br>S3-1 ON<br>One OFF<br>Both OFF | 300 baud<br>150 baud<br><br>110 baud | — Factory set position<br><br>— Terminal must be set for same rate |
| Parity Select | S3-3 | OFF<br>ON | Even parity<br>Odd parity | — Factory set position<br>- - - - - - - - - - - - - - - - - - - - - |
| ## Disconnect | S3-4 | OFF<br><br>ON | No disconnect by Data Set<br>Immediate discon-nect | — EOT transmitted to DTE<br><br>— No EOT transmitted to DTE Factory set position. |
| CB Logic Select | S3-5 | ON<br><br>OFF | CB = true "Clear to send:<br>CB goes ON when both CC & CD are ON | — Per EIA RS-232-C Factory Set position<br>— Data set functions as RS-232-C but gives appearance of full duplex to accomodate some computers. |
| Echoplex | S3-6,7 | Both OFF<br><br>Both ON | Echoplex Data Return<br><br>Computer Control | — FSK character return & ASCII data to DTE Factory set position<br>— EIA Interchange Circuit |
| Auto Time-Out | R56 | Screw adjust | Continuously vari-able from 4 sec to 65 sec | — Factory adjusted at 8-12 sec(nom) clockwise rota-tion increases time-out delay.<br>Approximately 10 sec per rotation 4-turns max. |
| Transmit Level Adjust | R139 | Screw adjust | Continuously vari-able −28 dBm to +5 dBm | — Factory adjusted at −1 to −3 dBm nom. Clockwise rotation increases level. 4 turns max. Check at installation. |

Status Indicators   Transmit Level Adjustment R139   Time-Out Adjustment R56

DLB

Status Indicators   ON   OFF   LINE SEIZE   S1 S2 S3
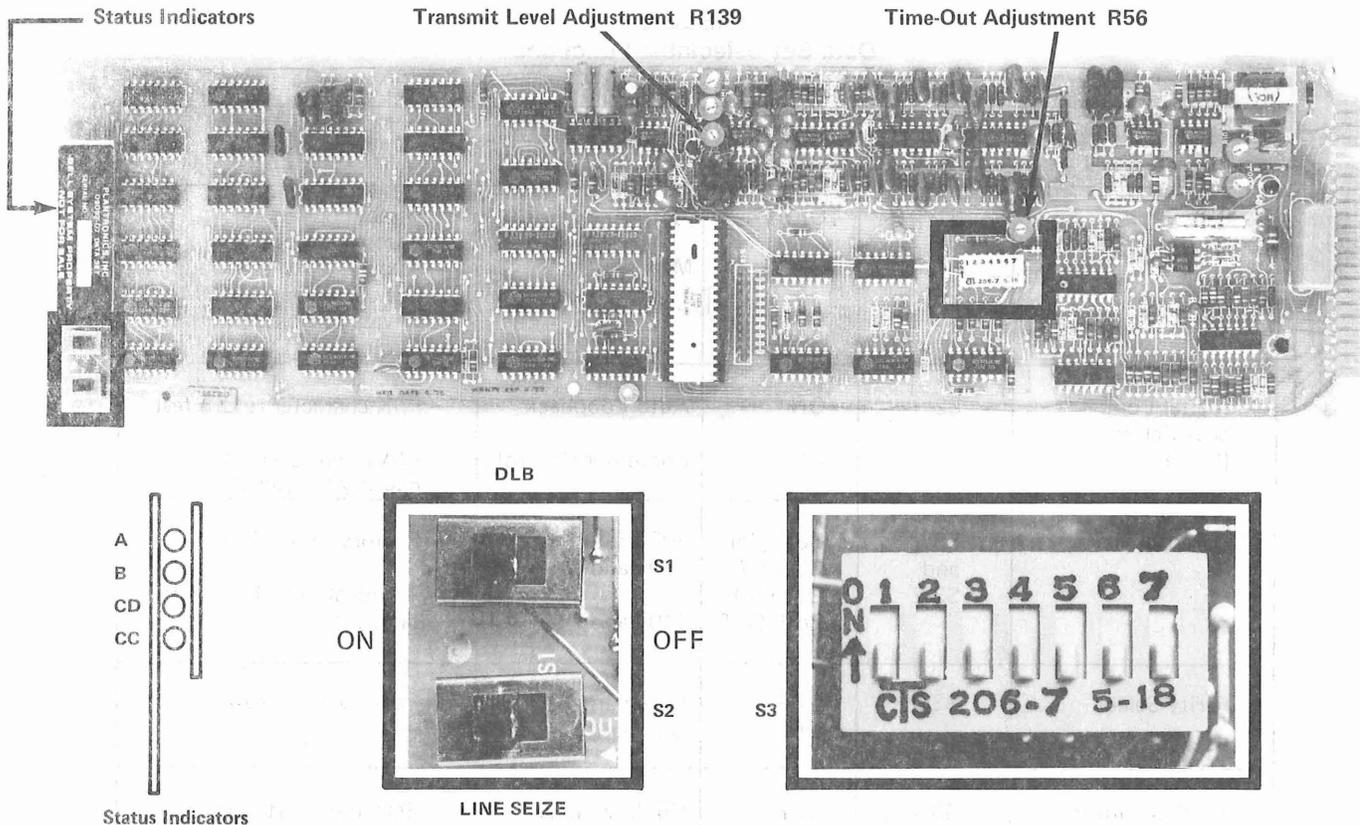
**Figure 8,** Data Set Board

**3.26** *Data Set ## Disconnect*
By option (see Tables B and E) the data set will initiate immediate disconnect, using the sequence described in the data set time-out, upon receipt of two consecutive DTMF ##'s. In this mode of operation EOT is not transmitted to the computer.

**3.27** After disconnect by any of these three methods, the data set returns to the IDLE condition to await another call.

**3.28** The data set does **not** sense when the remote terminal operator has prematurely hung up without going through some sort of disconnect sequence. Instead, the data set will timeout while waiting for some activity in either direction. For example, if the DTE continued to transmit, no timeout would occur until it stopped and timeout interval was complete.



Power ON Light
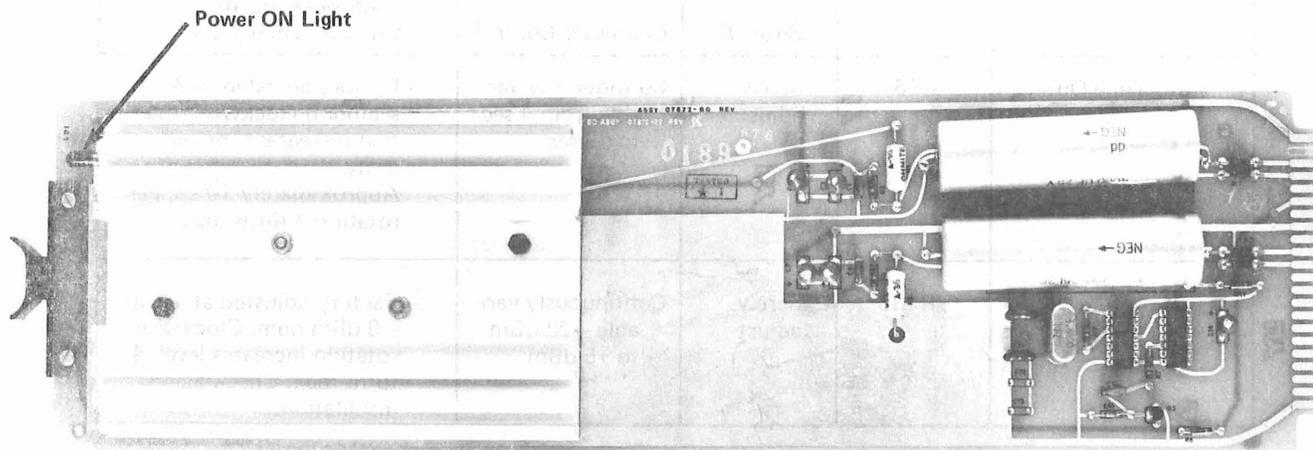
**Figure 9,** Power Supply Board

## 4. DATA STATION INSTALLATION & CONNECTIONS

### Unpacking and Inspection

**4.01** Damage occuring during shipment is deemed the responsibility of the carrier and claims should be made directly with such carrier. Claims covering damage sustained in shipments via U.S. mail should be filed directly with Plantronics. For Service Policy see Section 9.

### Storage and Shipment

**4.02** To protect the equipment during storage or shipment, use the best packaging methods available:

a) Use the Plantronics provided packing and carton or, if not available:

b) Cover the equipment with a protective wrapping

c) In a corrugated container (350-psi bursting strength), pack the equipment securely with 2-inch rubberized hair pads or a 6-inch layer of excelsior against all surfaces. Insert fillers between pads and container for a snug fit.

d) Mark container "ELECTRONIC INSTRUMENT" and seal with strong tape or metal bands.

### Site Requirements

**4.03** The following facilities are required where the data station is to be installed:

a) Access to the communications network, 25 feet (7.62 m) maximum.

b) Access to the DTE via a maximum of 50 feet (15.24 m) of cable.

c) Mounting space on a 19 or 23 inch rack or cabinet or on a horizontal surface.
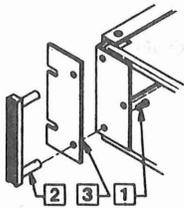


REMOVE ☐1 FLAT HEAD SCREWS, 05227-04, ☐2 HANDLES, 07758-00, AND ☐3 PANEL BRACKETS, 07755-00 FROM DATA MOUNTING SHELF ASSEMBLY.

INSTALL ☐4 MOUNTING BRACKET 09832-00, USING ☐1 SCREWS, 05227-04 (SAME SCREWS AS WERE USED TO ATTACH ☐2 HANDLES); AND ☐6 KEPS NUT 07755-00 USE ☐5 PAN HEAD SCREWS, 09841-01, TO MOUNT UNIT TO KS CABINET.
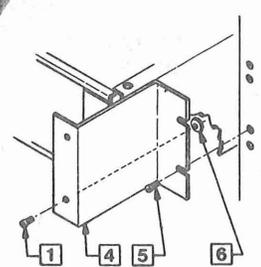
**NOTES:** 1) IF UNIT HAS COVER KIT, 07757-00 REMOVE COVERS AND NEOPRENE STRIPS PRIOR TO INSTALLING ☐4 23-INCH MOUNTING BRACKETS.
2) FOR SHELF-MOUNTING, USE FEET, 07619-00. PEEL OFF BACKING AND APPLY TO ALL FOUR BOTTOM CORNERS OF UNIT.

**Figure 10,** 23" Rack Mount Bracket Installation

**d)** Three-wire single phase 117V, 60-Hz grounded power receptacle within reach of the 8-foot (2.44 m) power cord supplied with the data station.

### Mounting

**4.04** Before installation, equipment should be checked to verify that it includes the required circuit cards and options. Remove the snap-on front panel of the shelf and verify receipt of:

**a)** One power supply board

**b)** One universal extender board, used for test purposes

**c)** Data set board(s), one for each communications channel up to a maximum of eight, are packaged individually and are not shipped in the data mounting.

**4.05** The DS151A Data Station occupies three vertical mounting spaces on a standard 19 or 23 inch rack or cabinet. Overall dimensions are 19 inches wide by 5-1/4 inches high by 23-1/2 inches deep (48.26 x 13.34 x 59.69 cm); maximum weight is about 20 pounds (9.07 kg).

**4.06** An Instruction Card for attaching the 23" mounting brackets (Figure 10) is provided with the Data Station. Be sure to retain the screws removed with the front handles as they are used to attach the mounting brackets.

**4.07** The data station can also be installed on a table, shelf, or other horizontal surface. Power and signal connections are made on the rear panel. Adhesive backed rubber feet are provided with the Data Station and should be mounted to the sheet metal bottom for table or shelf installation. Remove the front handles and the 19 inch rack mount brackets per Figure 10.

### Interface Connections

**4.08** Interface connections are made with two types of connectors that plug into receptacles mounted on the rear panel (Figure 11). Each channel installation requires a data set board, a connection to the DTE, and a connection to the network via the telephone tip/ring (T/R). DTE receptacles correspond to the eight channel positions. Up to eight incoming telephone T/R pairs are interfaced through the telephone line connector.

**4.09** The wiring between the board and the receptacles is performed by an interconnect assembly within the data mounting (see Fig. 13). The power and reference frequency drives from the power supply board are bussed to the data set board connectors;
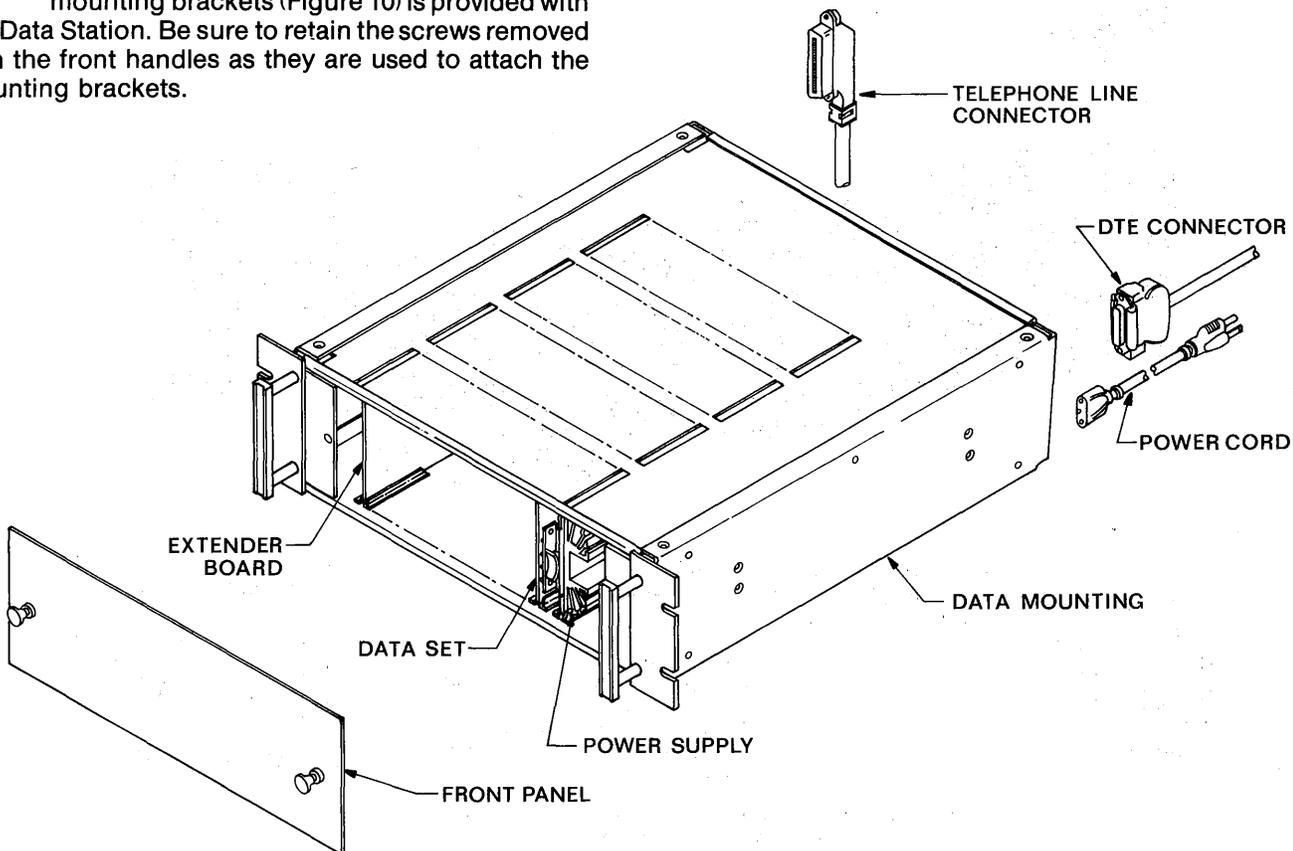


**Figure 11,** Data Station Components (One Channel)

the T/R connectors are directly wired to the corresponding data set connector location. No wiring is required for installation or operation. Switch settings on each data set allow for selection of optional functions.

**4.10** *DTE Connector* — The customer provided cable from the DTE (computer) should terminate with a Cinch or Cannon DB-19604-432 plug mounted in a Cinch DB-51226-1 hood assembly or equivalent. This cable should not exceed 50 feet (15.24 m). The pin assignments of the computer connector are shown in Table F. The table also indicates whether these signals are inputs or outputs with respect to the data station.

**4.11** *EIA Standard* — All data and control circuits operate within the specifications for interchange circuits as stated in the Electronic Industries Association Standard RS-232-C, "Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange".

Control functions, signal condition and binary state interpretations for the interchange circuit voltages are shown in Table G.

**4.12** *Telephone Line Connector* — Connected to each of the pin pairs on the telephone line connector is the incoming Tip and Ring. These circuits provide the analog data signal path between the data set and the remote data terminal. Also derived from each line pair is the supervisory ringing signal. This connector is a 25 pair AMP Champ 229974-1 or equivalent. The cable from the telephone line should terminate with an AMP Champ 2-552001-1 or equivalent (KS-16690L1).

**4.13** *Test Connector* — A connector which enables test signals from the DTE Simulator board to be transmitted to any of the data set channels is provided when the DTE Simulator is installed in the extender card storage position. The test receptacle is an Amphenol type 57-40140 or equivalent. The test cable must terminate at the test receptacle end with an Amphenol type 57-30140 or equivalent. The other end of the test cable connects with the data set channel DTE connector(s) as required for test and must terminate in a Cinch or Cannon DB-19604-432 plug mounted in a Cinch DB-51226-1 hood assembly or equivalent.

### Installation

**4.14** Figure 11 shows a typical one-channel data station installation; the procedure described here is applicable for all installations. Select one of the eight channel positions available and make note of that number (N). The channel connections are given in Table F.

**4.15** Remove the snap-on front panel and verify (install as required) the proper location of circuit boards. The power supply board plugs into its connector near the side of the data mounting closest to the power transformer (mounted on the inside rear panel) with the heatsink facing that side. The data set boards plug into the next eight slots, and the last connector to the left is a position for an extender board or DTE simulator. Make sure that the data set is in the correct position for the selected channel position (N).

**4.16** On the rear panel install the power cord. (DO NOT CONNECT TO MAINS). Check the fuse (1A Slow Blow).

**4.17** Connect the computer cable to the DTE receptacle of the selected channel location.

**4.18** Connect telephone line cable from connector block to J20 using pin assignments given in Table F and as follows:

**a)** Remove (2) two screws from J20.

**b)** Remove (1) one screw from KS-16690L1 cable connector hood and (1) one screw from cable clamp.

**c)** Slide hood off connector block.

**d)** Connect (1) one screw through connector bottom mounting hold to J20.

**e)** Reassemble KS-16690L1 connector and attach cable clamp screw.

**f)** Insert top screw in connector and attach to J20 top hole.

### Setup and Alignment

**4.19** There are two adjustment controls and six switch settings on each data set. (See Fig. 8.) Data set selectable functions and their factory set positions are shown in Table E and Figure 12. If any adjustments are required to be made at the time of installation, refer to the maintenance section for setup and transmit level adjustment procedures.

**4.20** Verify that the data set board with required set-up is installed on the proper location and that the communication connections are properly made.

**4.21** Replace the snap-on front panel and mount the data station in the appropriate width rack.

**4.22** The power cord may now be connected to a live mains outlet to supply 117 Vac, 60 Hz 1A power. The power indicator lamp on the power supply board should be lit.

**4.23** Perform digital loopback test (DLB) per section 6.06.
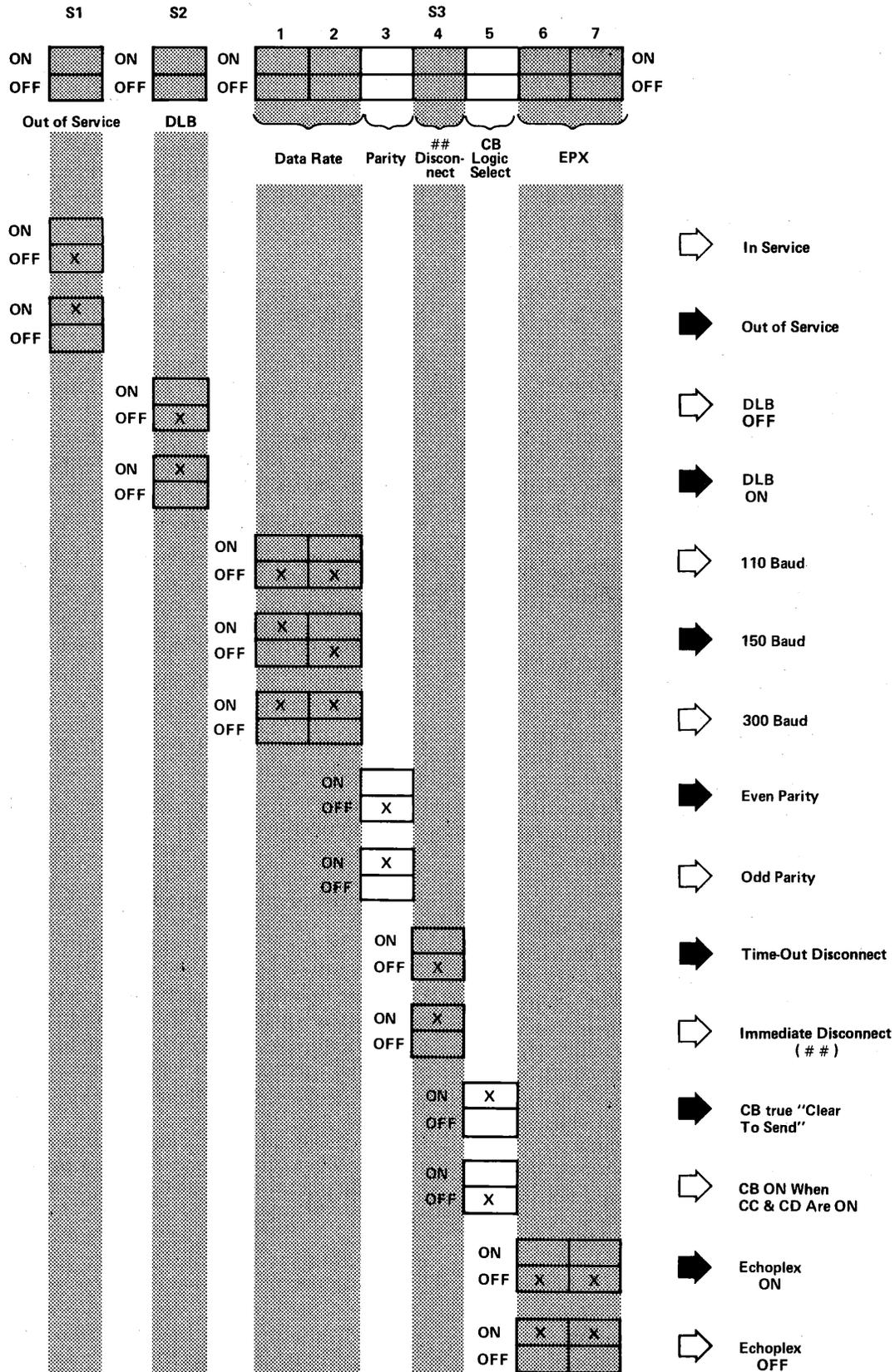
**Figure 12,** Data Set Switch Positions
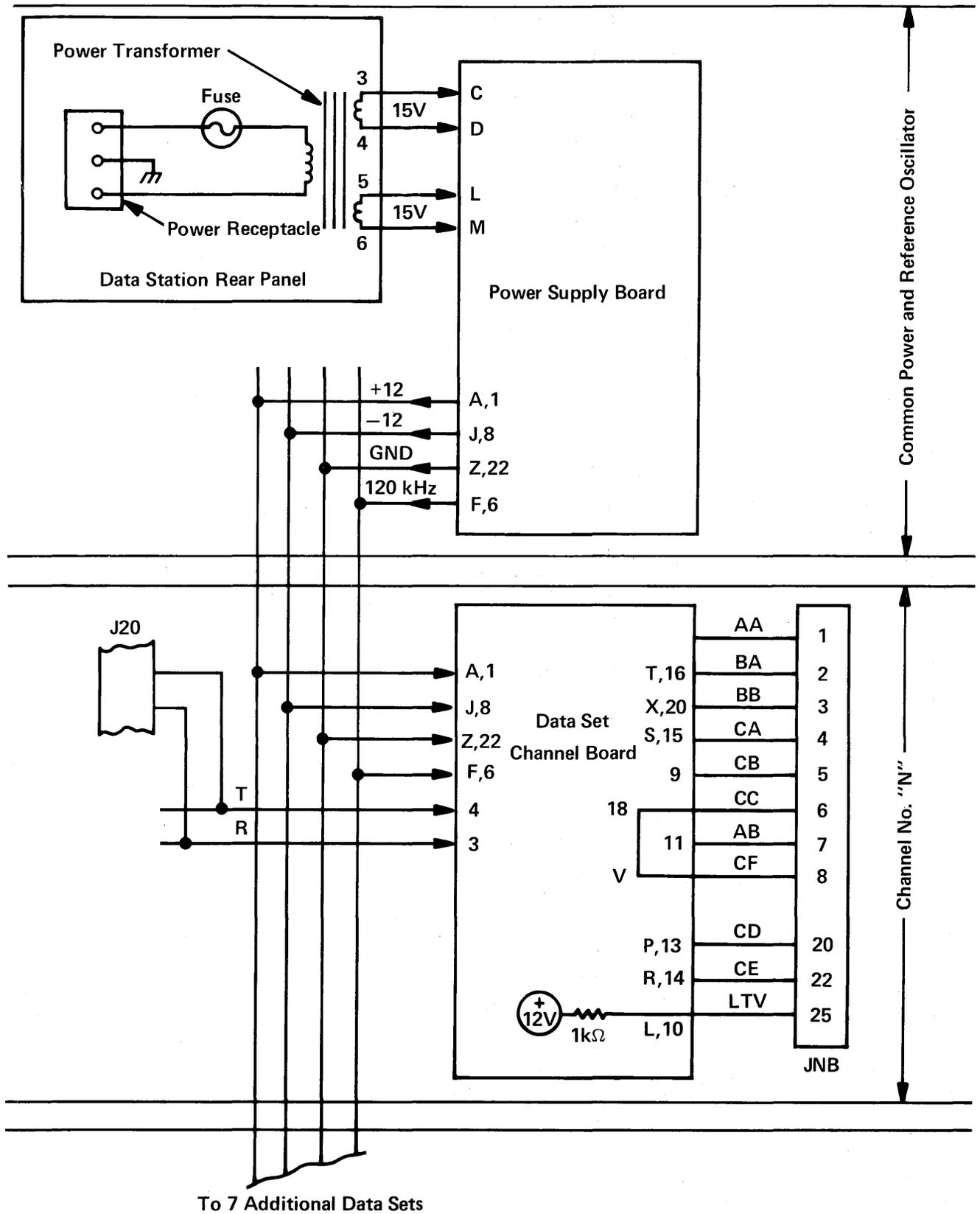
**Figure 13,** Data Station Interconnection Diagram

## TABLE F
## Data Station Connector Layout

DS151A Data Station (rear)

Power Connector

DTE Connectors

Test Connector

J20 Line Connector

J8B  J7B  J6B  J5B  J4B  J3B  J2B  J1B

Power Cord-8ft.
(Supplied With Data Station)

117 Vac
60-Hz

### Data Station Line Connector Pair Assignments at J20

| Data Station Channel Number[1] |     | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
|--------------------------------|-----|----|----|----|----|----|----|----|----|
| Pin Number                     | (T) | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
|                                | (R) | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 |

NOTE: 1. Channel Number (Or Position) 8 is The One Nearest The Power Supply Board.

Line Cable
(e.g. WECO B25A)

Connecting Block (e.g. WECO 66E-25)

Line Terminals

16  15  14  13  12  11  10  9  8  7  6  5  4  3  2  1

Paired Wire

T(8)  R(8)  T(7)  R(7)  T(6)  R(6)  T(5)  R(5)  T(4)  R(4)  T(3)  R(3)  T(2)  R(2)  T(1)  R(1)

Telephone Lines

**TABLE G**
**DTE Connector Signal Pin Assignment**

| PIN | CIRCUIT | I/O[1] | FUNCTION |
|---|---|---|---|
| 1 | AA | ------- | Protective Ground |
| 2 | BA | I | Transmitted Data |
| 3 | BB | O | Received Data |
| 4 | CA | I | Request to Send |
| 5 | CB | O | Clear to Send |
| 6[2] | CC | O | Data Set Ready |
| 7 | AB | ------- | Signal Ground |
| 8[2] | CF | O | Carrier Detector |
| 20 | CD | I | Data Terminal Ready |
| 22 | CE | O | Ring Indicator |
| 25 | LTV | ------- | Loop Test Voltage (+12V) |

[1]Input or output with respect to the Data Station

[2]CF is supplied by internal strapping of pin 8 to CC, pin 6, to simulate carrier to the computer.

| Voltage* | Binary State | Signal Condition | Control Function |
|---|---|---|---|
| − | 1 | Mark | Off |
| + | 0 | Space | On |

\* Signals will be recognized as "1", "Mark", or "OFF" when the voltage is more negative than −3.0V. Signals will be recognized as "0", "Space", or "ON" when the voltage is more positive than +3.0V. Signals in the transition region between −3.0V and +3.0V are not uniquely defined. All voltages are measured with respect to Circuit AB (Signal Ground).

Extender Board
DTE Simulator
Converter

Data Set
Board
Connectors 1-8

Power Supply Connector

**\*1**
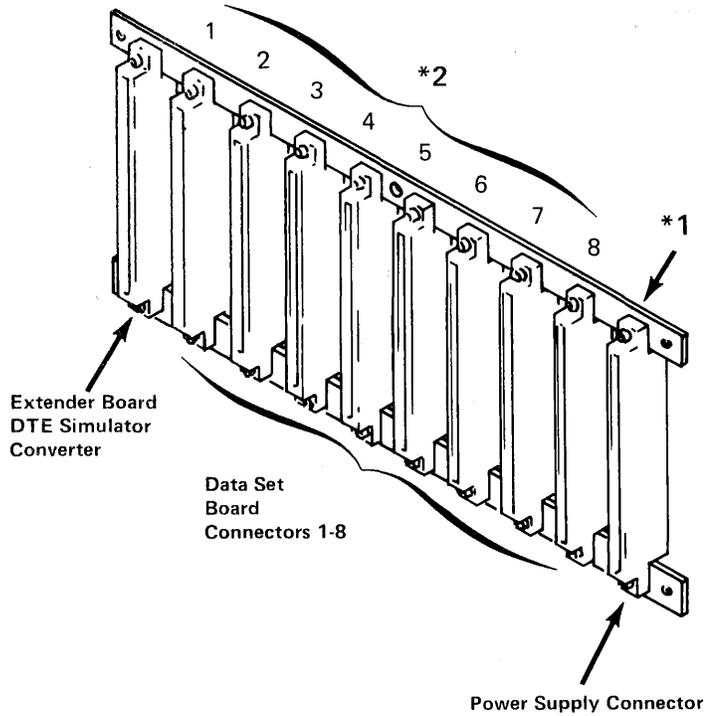
| | | | |
|---|---|---|---|
| +12vdc | 1 | A | +12vdc |
| Key | 2 | B | Key |
| 15vac | 3 | C | |
| 15vac | 4 | D | |
| | 5 | E | |
| 120kHz | 6 | F | 120kHz |
| | 7 | H | |
| −12vdc | 8 | J | −12vdc |
| | 9 | K | |
| 15vac | 10 | L | |
| 15vac | 11 | M | 3 & 4 and 10 & 11 are |
| | 12 | N | power transformer |
| | 13 | P | |
| | 14 | R | Secondaries to power |
| | 15 | S | supply rest of connectors |
| | 16 | T | are bussed outputs to the |
| | 17 | U | eight data set channel |
| | 18 | V | board positions. |
| | 19 | W | |
| | 20 | X | |
| | 21 | Y | |
| GND | 22 | Z | GND |

Power Supply Connector
FRONT VIEW

**\*2**

| | | | |
|---|---|---|---|
| +12vdc | 1 | A | +12vdc |
| | 2 | B | |
| RING | 3 | C | |
| TIP | 4 | D | |
| Key | 5 | E | Key |
| 120kHz | 6 | F | 120kHz |
| | 7 | H | |
| −12vdc | 8 | J | −12vdc |
| CB(5) | 9 | K | |
| LTV(25) | 10 | L | |
| HB(7) | 11 | M | |
| | 12 | N | |
| CD(20) | 13 | P | |
| CE(22) | 14 | R | |
| CA(4) | 15 | S | |
| BA(2) | 16 | T | |
| EPX(18) | 17 | U | |
| CF(8) | 18 | V | CC(6) |
| | 19 | W | |
| BB(3) | 20 | X | |
| | 21 | Y | |
| GND | 22 | Z | GND |

Channel Board Connectors
FRONT VIEW

NOTE: All used edge connectors are fed to opposite edge connectors. If special testing is to be accomplished, observe the following rules.

Grounding a connector grounds its opposite (grounding edge connector 1 grounds edge connector A)

Tapping a connector to force +12 or −12 vdc condition will create bucking voltages. BOTH SIDES must be tapped (forcing connector 18 also forces V).

**Figure 14,** Data Station Circuit Board Edge Connection Legend

## 5. PRINCIPLES OF OPERATION

### Power Supply Board

**5.01**    Figure 15 is a block diagram of the power supply board. The 15 Vac from each of the two secondary windings of the power transformer mounted on the data station rear panel is rectified and filtered. Integrated circuit regulators generate ±12 volts regulated dc; their current drive capabilities are augmented by transistors, with short circuit current limiting resistors. The reference frequency is obtained from a crystal controlled oscillator, divided down to 120 kHz. A buffer transistor drives the power indicator LED (L1), as well as the 120 kHz buss with a resistor for short circuit protection.

### Data Set

**5.02**    Figure 16 is a block diagram of the data set identifying the user accessible controls shown in Figure 12. This board provides all the signaling functions for two-way (half-duplex) communication between remote terminals over the phone lines.

**5.03**    DTMF tone inputs from the terminals are received, converted to ASCII characters and transmitted to the processor. The setting of test switch S2 (Digital Loopback) permits the characters to be repeated back to the terminal in FSK form and not transmitted to the computer.

**5.04**    Serial ASCII data from the computer is received by the data set via the DTE interface; the data is transmitter to the remote terminal (via the phone lines) using FSK modulation.

**5.05**    The character conversion code from the DTMF digits entered is given in Table D. Further explanations of the operation of the blocks shown in Figure 16 are as follows:

### Hybrid

**5.06**    The hybrid has amplitude and phase balance control (factory set) to cancel out the FSK signal and allow the DTMF signal to pass through to the receiver section during reception.
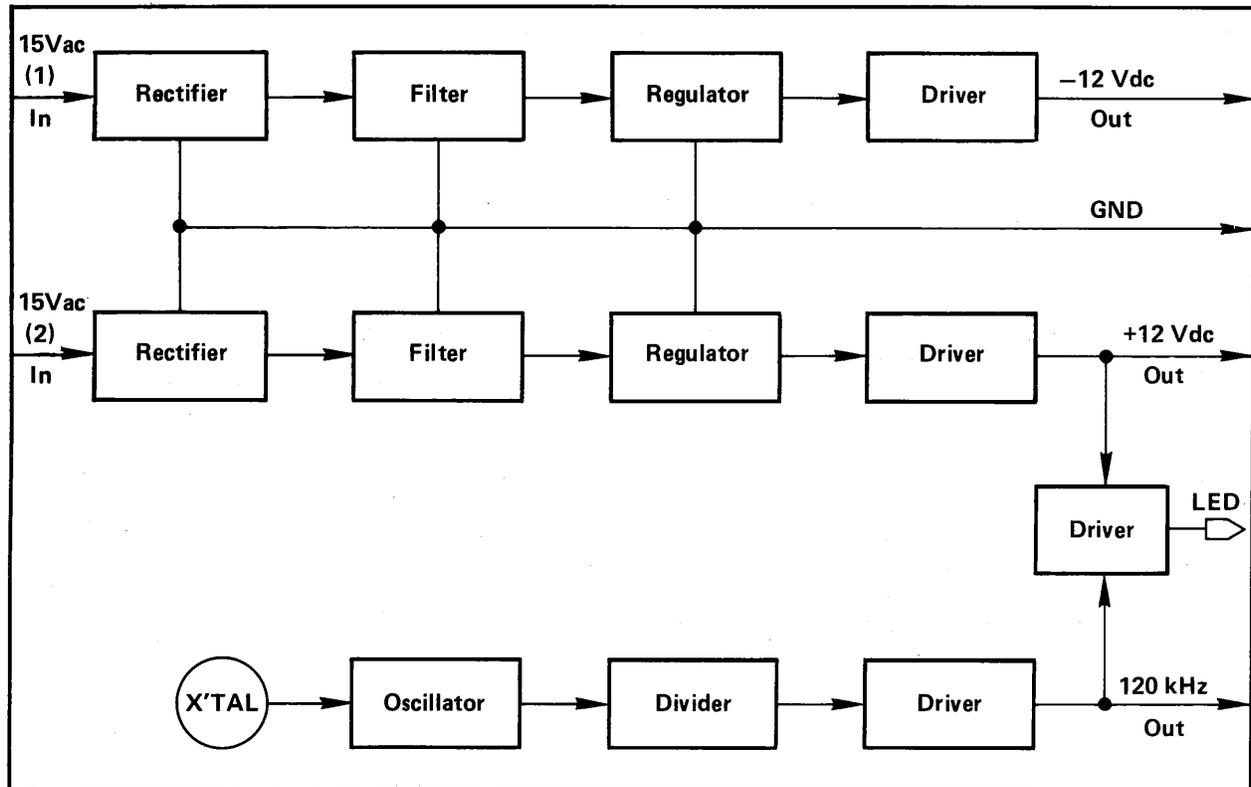


**Figure 15,** Power Supply Block Diagram

**Figure 16,** Data Set Block Diagram

**5.07** When transmitting, FSK is applied to the isolating transformer through the other half of the hybrid which contains the line matching resistor (900 Ω).

### Receiver

**5.08** The receiver consists of an amplifier, band pass filters, and limiters. Each circuit includes two stages of active filter followed by limiters for symmetrical clipping; the limiter outputs are saturated logic level square waves corresponding to the A and B group frequencies present on the phone line input.

### Decoder

**5.09** Detection of DTMF tones is accomplished by a clocked digital means for measuring the period of the input frequency, utilizing the 120 kHz system reference. Frequency detection with separate circuits for the A and B group DTMF tones occurs in a two-step procedure.

**5.10** The reference frequency is divided down to provide a 10-kHz clock for a two decade divider. Selected outputs of these dividers drive consecutive sidetones of a sequential four-stage decoder so that each stage represents the period corresponding to one of the four A group (and similarly three B group) frequencies.

**5.11** The limiter output is used to clock a decade counter which provides a pulse for every five cycles of the frequency present at the input. The pulse has two functions; it latches the outputs of the four-stage decoders, and its leading edge restarts the dividers. These steps are repeated, and in this way, the decoder outputs are continually updated to respond to changes in output signals with frequencies within the group pass band. Overflow represents lower frequency and resets decoders, while higher frequencies do not enable enough counts to set the first decoder stage.
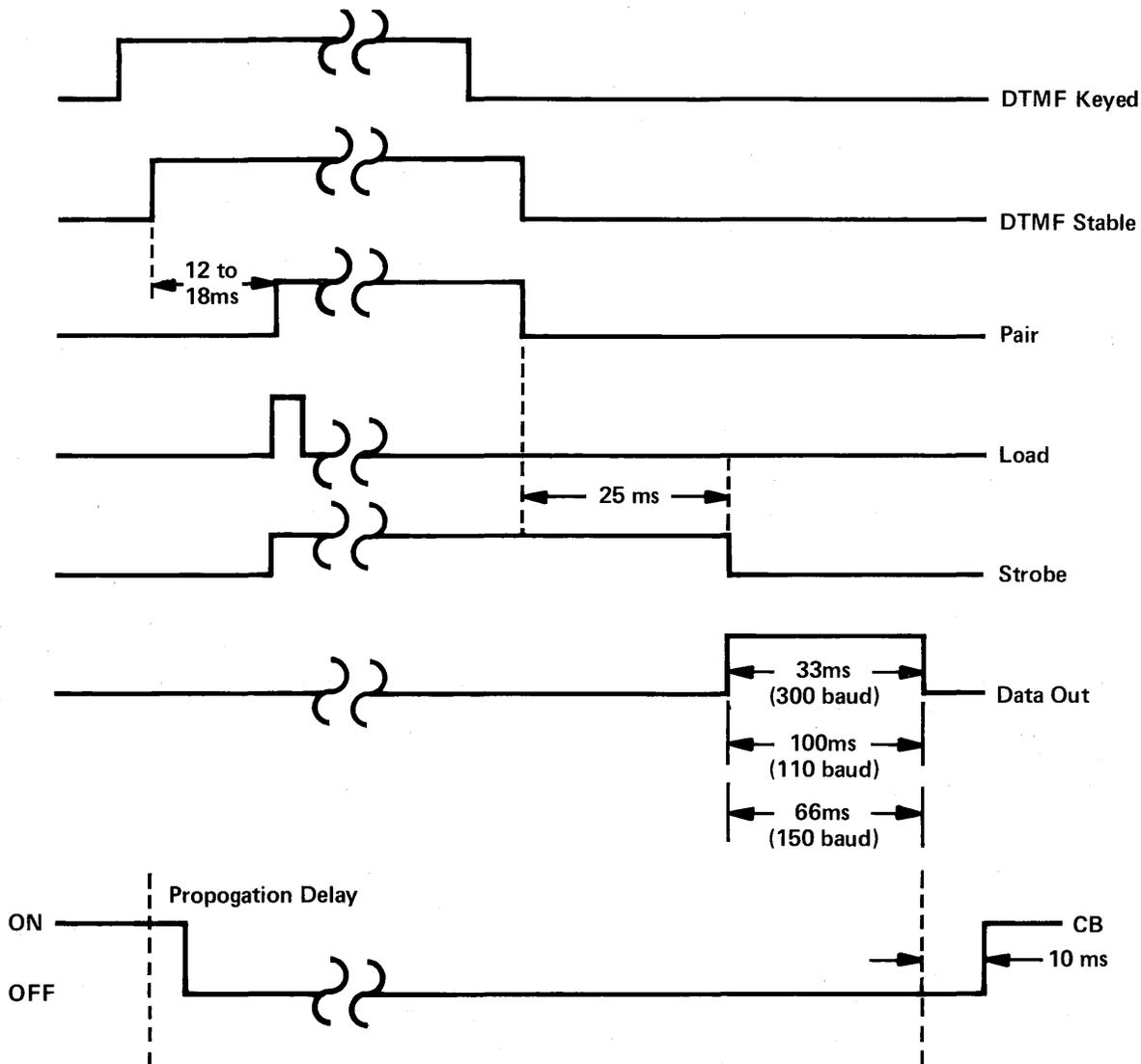
**Figure 17,** Timing Diagram

## Timing

**5.12** These circuits generate the clock determining the baud rate, as well as three internal control signals, all of which are required for the serializer.

**5.13** The clock is generated by division of the 120 kHz system reference. The baud rate of the output data is determined by the setting of S3-1 and S3-2 for one of the three rates.

**5.14** The internal control signals PAIR, STROBE and LOAD are generated as follows: the latched decoder outputs are sensed to indicate the detection of any group frequency.

**5.15** The presence of a tone pair is determined to generate PAIR. The decoders are continually updated in response to input signals; therefore to ensure data integrity, PAIR is delayed by 12 milliseconds before it is set. Simultaneous to setting PAIR, STROBE AND LOAD are generated. LOAD sets the appropriate ASCII code into the serializer ready to be transmitted. After the DTMF pair (both tones) disappear from the line, PAIR drops and the data set waits 25 ms before resetting STROBE. This starts the outpulsing of the data as shown by DATA OUT.

### Decoder Serializer

**5.16** The latched decoder outputs are first connected to their duo-decimal (i.e. 1 of 12) equivalents. Two devices with fixed code programming, convert #, ##, * to ASCII control character equivalents; CR, EOT, CAN or Control X, respectively.

**5.17** An LSI device (U/ART) utilizes the timing signals to generate serial ASCII to the DTE and loopback circuits. When in the idle state, the serial output line is marking. The time between the low to high transition of data strobe and the mark to space transition of the serial output line is one clock cycle (1/16 bit time) if the transmitter had been idle.

**5.18** The serial output lead provides the start bit (low) followed by 7 data bits. The data bits are presented to line LSB (Least Significant Bit) first. The parity bit as computed by the transmitter follows the last data bit.

**5.19** The stop bit will follow the parity bit. All bits are 16 clock periods in length. If the transmitter data bits holding register has been loaded while the previous character was being transmitted, the new character's start bit immediately follows the previous character's last stop bit.

### DTE Connectors

**5.20** Each of the eight channels can be connected to DTE (computer) equipment via the DTE receptacles (J1B through J8B) on the data station rear panel as described in Section 4 of this manual. (The pin assignments are given in Table G).

### DTE Circuits

**5.21** These circuits provide the interface for signaling between the data station and the computer, conforming with EIA Standard RS-232-C. The equations following each circuit description illustrate the content of the signal in Boolean algebra terms wherein the dot between signal abbreviations ($\cdot$) means "and" and the solid line over the signal($\overline{\phantom{x}}$) means signal NOT or the absence of that signal or condition. The symbol (+) means OR.

**5.22** *Circuit AA — Protective Ground.* This conductor is electrically bonded to the data mounting frame. The data mounting frame is grounded to earth by the ground lead in the 3-wire power cord.

**5.23** *Circuit AB — Signal Ground.* This circuit establishes the common ground for EIA interface circuits. Within the data mounting the circuit is connected to protective ground by means of a wire strap.

**5.24** *Circuit BA — Transmitted Data from Computer to Data Set.* This conductor is used by the computer to present the data to be FSK modulated by the data set and transmitted onto the communications network. An open circuit is defined as MARK by the data set.
$$BA = CD \cdot CC \cdot CA \cdot CB \cdot (\overline{DTMF} \text{ or } \overline{BB})$$

**5.25** *Circuit BB — Received Data, from Data Set to Computer.* This circuit delivers the data received over the communications network to the computer after being translated into 10-unit serial binary data. $BB = CD \cdot CC \cdot DTMF$.

**5.26** *Circuit CA — Request to Send, from Computer to Data Set.* This circuit is a request by the computer to be permitted to release data on circuit BA. **Requires "ON" response on circuit CB (Clear to Send) before data can be transmitted.** Transmission of data also requires simultaneous "ON" condition of circuit CC (Data Set Ready) and, where implemented, CD (Data Terminal Ready).
$$CA = CC \cdot CD.$$

**5.27** *Circuit CB — Clear to Send from Data Set to Computer.* This circuit is a response to "ON" condition of circuit CA (Request to Send)."ON" condition of circuit CB indicates that the data set is ready to transmit data generated by the computer. "OFF" condition indicates pushbutton signals are being received and assembled by the data set or the data set is in the loopback test mode. CB "OFF" may also indicate that the computer has not executed a Request to Send on circuit CA per EIA RS-232-C. Receipt of DTMF signals takes priority over CPU generated data.
$$CB = CD \cdot CC \cdot CA \cdot \overline{DTMF} \cdot \overline{DLB} \cdot \overline{Time\ Out}$$

**5.28** *Circuit CC — Data Set Ready, from Data Set to Computer.* An "ON" indication on this circuit shows that the data set is connected to the communications line. An "OFF" condition will appear
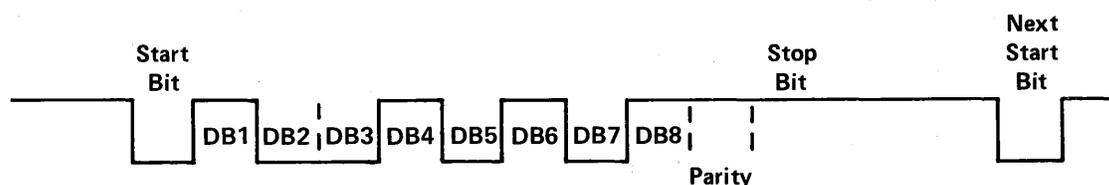


**Figure 18,** Typical 8-Bit Transmitted Character

at all other times and is an indication that the computer is to disregard signals appearing on any other circuit in the interface. If a timed out "no traffic" condition appears during a call with circuit CD (Data Terminal Ready) in the "ON" state, the data set will then set circuit CC "OFF". The computer should interpret this as a lost or aborted call.

$$CC = CD \cdot \overline{Time\ Out} \cdot \overline{EOT}$$

**5.29** *Circuit CD — Data Terminal Ready, from Computer to Data Set.* The computer must place this lead in the "ON" state to prepare the data set to be connected to the communication line and to maintain the connection to the line once it is established. The data set is equipped for automatic answer of received calls, thus, the "ON" state of circuit CD allows the data set to be connected to the line in response to incoming ringing. An open circuit is defined as "OFF" by the data set. CD = CE

**5.30** An "OFF" state on the CD lead will cause the data set to be removed from the communications channel allowing any "in-process" transmission. The lead must be maintained in the "OFF" state, for at least 50 milliseconds to ensure disconnect, and shall not be turned on again until circuit CC (Data Set Ready) is turned "OFF" by the data set.

**5.31** *Circuit CE — Ring Indicator, from Data Set to Computer.* An "ON" on this circuit indicates that a ringing signal is being received from the communications channel. The "ON" shall appear approximately coincident with the "ON" segment of the ringing cycle (during rings). The "OFF" condition shall be maintained during the "OFF" segments of the ringing cycle and at all times when ringing is not being received. CE = Ring Detector

**5.32** *Circuit CF — Carrier Detector, from Data Set to Computer.* Normally this circuit, when "ON" indicates that data carrier is being received from the distant end. In the method of operation used by the data set, CF is internally connected to circuit CC (Data Set Ready) so as to carry simultaneous signals and thereby simulate DTMF carrier detection to the computer. CF = CC

**5.33** *Circuit LTV(+12V).* This is a permanent "ON". This circuit allows for external strapping of +12V to other connector pins to simulate connection to the computer.

## Controls

**5.34** Control circuits manage the system start/stop and handshaking routines and internal signaling as required to perform the functions selected by the switches. The components are dispersed over the circuit board, but are grouped together under this heading for convenience in explaining functions such as:

**5.35** *Ringing Detection —* Ringing on T/R of a dial-up line is sensed by high impedance optical coupling to generate an internal signal indicating a ring detected. This signal will generate CE, which follows the applied ringing cycle. This sets a latch, the output of which is switched through S1 to generate OH. If S1 is set out of service, a permanent OH is generated to "Busy Out" the channel to incoming calls. OH then drives the line circuits to seize the line.

**5.36** *Automatic Time-out —* In the circuit for automatic time-out, PAIR (indicating DTMF tones) and a signal (indicating DTE inputs) are connected so that either indicator can restart the time-out interval. When both indicators are inactive, a timing capacitor charges through R56 until it passes a threshhold, resetting the "Off Hook" latch. This removes OH, and the line circuits release the line.

$$\overline{Time\ Out} = BB + BA + PAIR$$

**5.37** *## Disconnect —* Included is circuitry for detection of special character entry, i.e., two consecutive # entries, for the optional disconnect feature.

**5.38** *Clear to Send Option —* Logic circuitry is provided for the CB option (S3-5) described in Table E.

## Transmitter

**5.39** The transmitter consists of an oscillator, filter, and two transistor switches. The oscillator idles at the MARK frequency; one transistor switches a resistance into the circuit to shift to the SPACE frequency. The output of the oscillator is processed through a band pass filter to remove FM sidebands. The second transistor acts as an ON/OFF switch which transmits the FSK signal to the balanced hybrid circuit when "CC" goes high. Transmit level adjustment is obtained from R139 which adjusts the amplitude of the FSK signal.

**5.40** The transmitter is keyed with data from both computer (DTE) input via EIA circuits, and input from the loopback gate.

## 6. MAINTENANCE & TEST PROCEDURES

### General

**6.01**    This section covers maintenance procedures for the DS151A Data Station. The modular design (i.e., a complete channel per board) enables system malfunction causes to be traced to one of three areas: system hookup, data set or power supply board. Instructions to ensure proper hookup are given here, followed by flow chart type procedures for fault isolation to the replaceable sub-assembly (circuit board) level. Problems reported from the field can often be resolved by a discussion with the user over the telephone, saving a trip to the installation site.

### Initial Setup

**6.02**    Remove the front panel and check the following:

**a)**    The power supply board is inserted in the connector closest to the power transformer, with the heatsink facing the nearest side panel.

**b)**    The data set boards are inserted in any intermediate position EXCEPT the last one away from transformer. (This is a position for storage of extender board or DTE simulator if required).

**c)**    The location of the channel under test.

**6.03**    On the rear panel check the following:

**a)**    The specified fuse (1A Slow Blow) is installed in the fuseholder.

**b)**    The telephone cable connector is plugged in.

**c)**    The DTE (computer) cable connector is plugged into proper receptacle corresponding to the channel under test and the connector is secured with both screws.

### "Power ON" Test

**6.04**    Install the power receptacle on the rear panel. Plug cord into a live mains outlet providing 117 Vac (±10%), 60 Hz, 1 amp. power that is single phase, 3 wire and grounded. Reference: National Electrical Code 1971, Chapter 8, Article 800, Communications Circuits. The power indicator lamp at the front of the power supply board should be lit (ON). Peak to peak ground to neutral should not exceed 25 volts.

### False Alarms

**6.05**    With the boards and connectors installed correctly, the status indicators should operate as described in 3.07. Some false alarms that may be reported are as follows:

**a)**    If "the channel does not work", check CD lamp. This must be ON, indicating that the DTE (computer) is connected to the proper channel and ready for communications, by providing CD ON.

**b)**    On noisy lines, A and B lamps may flicker, as random noise may have components in the band of the data set filter circuits. However, unless there is excessive inband noise at frequencies corresponding to DTMF tone pairs, no erroneous responses will result.

**c)**    Erroneous data. Contact bounce on DTMF pad and excessive noise on the lines may reduce maximum input rates (5 char/sec), or cause multiple character printing when in DLB or Echoplex loopback modes. When this occurs, hang up and recall, using another telephone terminal installation to identify the cause of the problem.

### Digital Loopback Test (DLB)

**6.06**    In this test the incoming TOUCH-TONE signal is decoded and looped back internally. There is no need for connection to the DTE itself. For the test, the communications channel must be connected to a Plantronics VuSet Data Terminal and pushbutton phone, or an equivalent equipment capable of generating TOUCH-TONE signals and receiving FSK data. Proceed as follows:

**a)**    Set data set loopback switch S2 in On position.

**b)**    At the remote terminal, set up a connection to the data set. If dial-up service is used, dial the applicable number.

**c)**    From the remote terminal transmit a TOUCH-TONE signal and observe the returned FSK signal (100-200 ms delay) to confirm that it coincides with the proper DTMF/ASCII conversion, (see Table D).

### DTE Simulator

**6.07**    The Plantronics DTE Simulator provides a test set-up which interfaces on the DTE side of a VuSet data set under test simulating some of the reception and transmission functions of Data Terminal Equipment and providing test messages through the data set to the VuSet terminal.

**6.08**    The DTE Simulator is a printed circuit board which plugs into one of the eight data set locations in the data station, reducing the station capacity by one channel. Connection to the data set to be tested is made by attaching the DTE Simulator Test Cable provided with the simulator from the DTE connector of the simulator channel location to the

**TABLE H**
**Troubleshooting Guide**

## I. Initial Installation

| SYMPTOM | CAUSE | ACTION |
|---|---|---|
| 1. Power Lamp off | 1. Unit unplugged<br><br><br>2. Loose fuse<br>3. Open fuse<br><br>4. Defective Power Supply | 1. Plug AC power cord into rear of Data Mounting and into 115 Vac Receptacle<br>2. Reset fuse into fuse holder<br>3. Replace fuse with 1 amp Slo-Blo fuse<br>4. Replace Power |
| 2. Ringing heard in Handset Receiver but Data Set does not answer (seize line) | 1. Wrong number dialed<br>2. DTE Cable not connected<br>3. DTE Cable not available<br>4. Data Set in wrong slot in Mounting<br>5. Line Pair (Tip & Ring) connected improperly<br>6. Defective Data Set | 1. Verify phone number<br>2. Connect DTE Cable<br>3. Put S2 ON.<br>4. Relocate Data Set<br><br>5. Verify Line Connection. Ref Par. 4.14 and 4.15<br>6. Replace Data Set |
| 3. Phone answers but no tone heard in Handset Receiver | 1. Transmit Level (R139) turned down<br>2. Defective Data Set | 1. Adjust Transmit Level Reference Figure 8<br>2. Replace Data Set |
| 4. CC Light not ON after Data Set seizes line | 1. Defective Data Set | 1. Replace Data Set |
| 5. CD Light not on after line seizure | 1. DTE Cable not connected properly<br>2. S2 (DLB) is ON.<br>3. Defective Data Set | 1. Connect DTE Cable<br><br>2. Normal Operation<br>3. Replace Data Set |
| 6. CD Light comes on after ringing | 1. Normal Operation | 1. None |
| 7. Answerback Tone heard in Handset but no TOUCH TONES heard | 1. Polarity Reversal<br><br>2. Defective TOUCH TONE Pad | 1. Install Polarity Guard on telephone set<br>2. Replace Phone or TOUCH TONE Pad |
| 8. Tone from Data Set and TOUCH TONES are heard but A & B Lights on Data Set do not come on | 1. Defective Data Set | 1. Replace Data Set |
| 9. Tones from Data Set and TOUCH TONES are heard but only one of the A, B Lights come on | 1. Defective Data Set<br>2. Defective TOUCH TONE Pad | 1. Replace Data Set<br>2. Replace telephone |

DTE connector of the data set to be tested. Figure 18 is a functional block diagram of the simulator test set-up. The DTE Simulator may also be used in the extender card storage position and used in conjunction with the TEST connector (see 4.13) when all data set positions are full. A special test cable is required to use the TEST connector option.

**6.09** The Simulator performs the handshaking functions of a DTE (computer front end processor) and provides a fixed format stored program for testing of VuSet data set and terminal functions.

**6.10** Begin simulator test functions by performing the following:

a) Install the simulator board and attach test cable to simulator location DTE connector and DTE connector of data set under test.

b) Set baud rates of simulator, data set and terminal to the same setting. (See Figures 12 and 21.)

c) Set DLB switch (S2) on data set under test to OFF position. This allows TOUCH-TONE inputs to the data set to be transmitted to the simulator.

d) Dial up the channel location of the data set under test.

e) Receive F2M (2225 Hz) answerback tone.

f) To disable auto time-out, set line sieze switch (S1) on data set to out of service.

g) Set terminal data switch to DATA position. Confirm DATA lamp is on.

h) Clear terminal screen by momentarily depressing CLEAR switch.

j) Enter TOUCH-TONE #. This starts a test message from the simulator approximately two minutes in duration. The test pattern is run nine times before stopping. The first eight runs are exactly as shown in Figure 19. The last half of the ninth run is missing the final two characters of the bottom row. While the test message is in progress observe the terminal screen for correct character display and video monitor functions. Automatic disconnect will occur, depending upon

data set time-out setting, approximately ten seconds after completion of the test message unless a TOUCH-TONE character other than # is entered.

k) Entry of another #, not separated from the test start entry, will immediately terminate the test message followed by time-out interval, unless disabled by S1.

l) Enter TOUCH-TONE*. A pattern of mark and space reversals from the simulator will be transmitted to the terminal screen consisting of 62 characters in this pattern:
U*U*U*U*U*U*U*U*U*U*U*U*U*U*, etc. Automatic time-out will occur after completion of this test pattern if another TOUCH-TONE character is not entered.

m) Either the "all character" test or the "reversal" test may be run as much as needed by simply alternating # and * entries. Two or more consecutive # entries will terminate the test operation. Auto time-out will then be in effect unless disabled at S1.

**Fault Isolation Procedure**

**6.11** Table H is a summary of problems that may be reported, and references to locate the applicable maintenance sections. Starting with a check of the installation, the procedure continues through a checkout of the data station. When specific problems have been encountered, either as reports from the field, or as determined by testing, the procedure may be started directly at the relevant stage.

**Installation Verification**

**6.12** Check fuse, board and cable installation as described in Section 4 of this manual. To assist in verification of data set problems, it may be useful to try another location in the data mounting. Is installation complete?

**Yes** — Go to 6.13

**No** — Complete installation (see 6.02)

```
@ABCDEFGHIJKLMNO

PQRSTUVWXYZ       —

!"#$%&'()*+,-./

0123456789:;[=]?
```

BLINKING DISPLAY

FOLLOWED BY:

```
@ABCDEFGHIJKLMNO

PQRSTUVWXYZ       —

!"#$%&'()*+,-./

0123456789:;[=
```

NON-BLINKING DISPLAY

**Figure 19,** DTE Simulator and Automatic Test Station Test Message (#)

### Power Indication

**6.13** Power indication is provided by the LED on the power supply board. Is power indicator lamp ON?

**Yes** — Go to 6.15

**No** — Replace power supply board. If problem persists, check transformer output as follows:

**6.14** Check the output of the power transformer secondaries. Measure at power supply board connector pins C-D, L-M (see Figure 15). Is 15 Vac Power received?

**Yes** — Replace power supply board. Repeat 6.13

**No** — Return data mounting for repairs. The circuit boards may be reclaimed.

### Problem Identification

**6.15** For a general checkout, continue through the steps described here. If a data station has been returned as a failure, but no specific items are recorded, tests such as 6.04 through 6.10 may be performed to ascertain a specific item. If a specific failure has been reported, refer to Table H for related sections of the procedure.

**6.16** Dial the telephone number for the channel under test. The channel should trip ringing within two ring cycles. Is ringing tripped?

**Yes** — Go to 6.18

**No** — Continue.

### Channel Does Not Answer

**6.17** The channel may be busied out. Check S1 on the board (see Table E and Figure 12). Is S1 ON?

**Yes** — Go to next step

**No** — Turn S1 OFF and repeat 6.15

**6.18** Is CD lamp ON?

**Yes** — Go to step 6.21

**No** — Continue

**6.19** Check DTE connection (see Table F). Is DTE connected to the proper receptacle?

**Yes** — Go to next step

**No** — Connect DTE correctly and repeat 6.18

**6.20** The DTE must provide CD ON. Check with user and verify that CD ON level corresponds to Table G. Is CD ON level provided?

**Yes** — Replace data set board, return for repair if ring is not tripped.

**No** — Notify user; computer interface (DTE) must conform to table G.

**6.21** Is CC lamp ON?

**Yes** — Go to step 6.24 if troubleshooting. If checking out, go 6.28.

**No** — Continue.

**6.22** Refer to Table F for connectors and pin arrangements. Is the line connected?

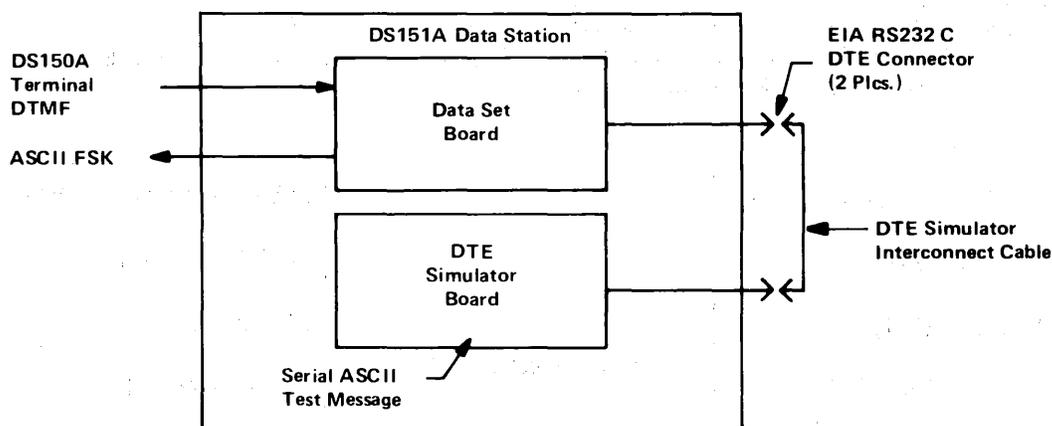**Yes** — Go to next step.

**No** — Connect per Table F, repeat 6.21.



**Figure 20,** DTE Simulator Test Block Diagram

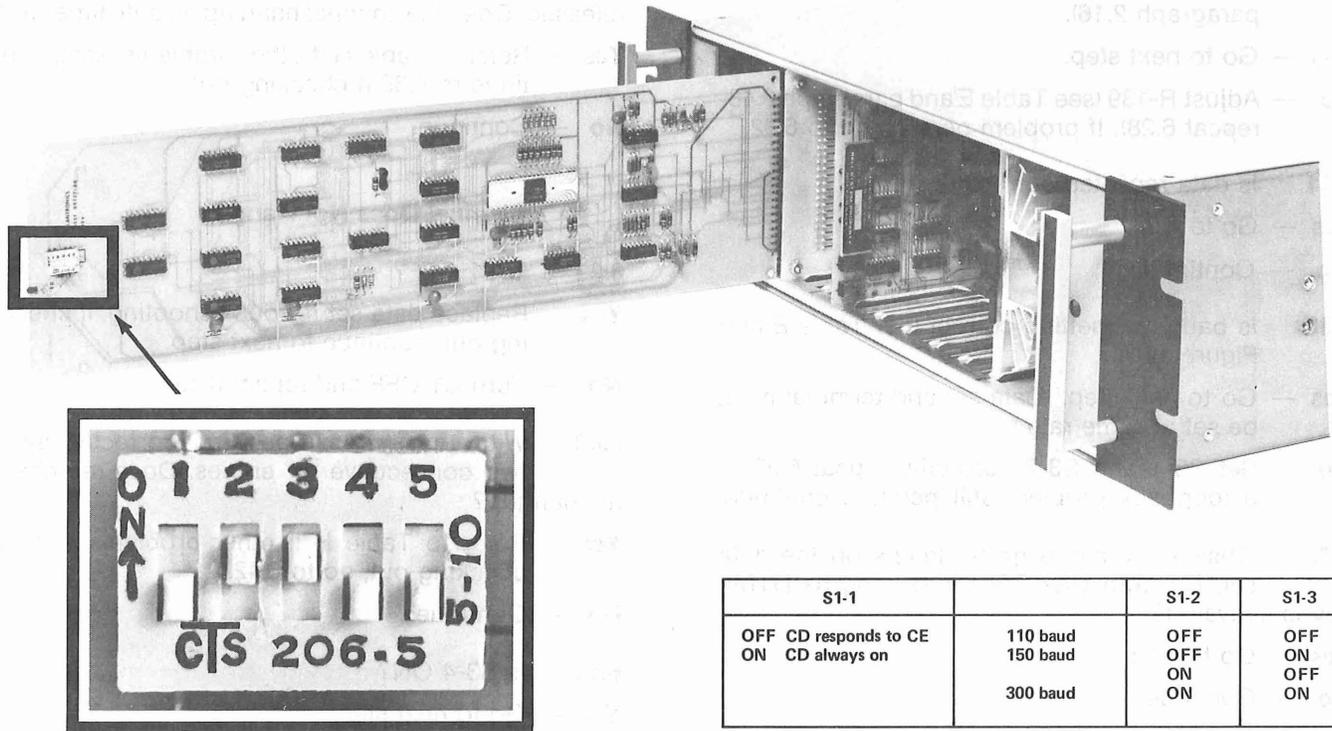| S1-1 | | S1-2 | S1-3 |
|---|---|---|---|
| OFF  CD responds to CE | 110 baud | OFF | OFF |
| ON    CD always on | 150 baud | OFF | ON |
| | | ON | OFF |
| | 300 baud | ON | ON |

**Figure 21**   DTE Simulator Board Switch Settings

**6.23**  Is the line connected to the data set functioning?

**Yes** — Go to next step.

**No** — Connect a functioning line, repeat 6.21.

**6.24**  Set S1 to ON position. CC should turn on within 2-5 secs.

**Yes** — Go to next step.

**No** — Go to 6.16.

**6.25**  Remove power by pulling data set out of connector for approximately 5 seconds to reset the data set circuitry. Repeat the call. Does CC lamp turn ON?

**Yes** — Go to 6.28

**No** — Continue.

**6.26**  Replace channel board and return for repair. Repeat 6.31. Does CC lamp turn ON?

**Yes** — Go to step 6.28.

**No** — Continue.

**6.27**  Install the replacement (working) data set in another location within the data mounting. Reconnect per Section 4 and repeat the test call. If no spare locations available, see "yes" below. Does the channel answer?

**Yes** — The previously used channel location is at fault. The data mounting may be utilized as now connected. However, if all the channel locations are required to be operating, reclaim the circuit boards, replace the data mounting and return for repairs.

**No** — Replace entire data station; return for repair.

**Data Transfer (Loopback Test)**

**6.28**  With a complete Plantronics VuSet System connected as described in Section 1, check data transfer. Enter DTMF numeric character from the terminal, using slow and deliberate movements to activate the keys. Is any character repeated back to the terminal?

**Yes** — Go to 6.30.

**No** — Continue.

**6.29**  Is S2 (Loopback) switch ON? (see Table E and Figure 12).

**Yes** — Go to next step.

**No** — Turn S2 ON, repeat 6.28. If there is still no character display go to 6.32.

**6.30** Is transmit level correct? (see specifications, paragraph 2.16).

**Yes** — Go to next step.

**No** — Adjust R-139 (see Table E and paragraph 6.48, repeat 6.28). If problem persists go to 6.32.

**6.31** Is data repeated correctly?

**Yes** — Go to 6.33.

**No** — Continue.

**6.32** Is baud rate setting correct (per Table E and Figure 12)?

**Yes** — Go to next step. (Data set and terminal must be set at same rate.)

**No** — Set S3-1 and S3-2 correctly, repeat 6.28. If a loopback problem still persists, continue.

**6.33** Observe A and B group lamps on the data set. Do both stay ON for as long as DTMF key is activated?

**Yes** — Go to 6.35.

**No** — Continue.

**6.34** Is received signal level within specification?

**Yes** — Go to next step.

**No** — Select line with adequate level.

**6.35** Observe A and B group lamp on the data set. Do both stay OFF when no key is activated?

**Yes** — Go to 6.37.

**No** — Continue.

**6.36** Check line condition; is noise within specification?

**Yes** — Replace data set, return for repairs.

**No** — Select line within noise specification.

### Parity Errors

**6.37** Is parity switch (S3-3) set correctly (Table E and Figure 12)?

**Yes** — Replace data set, return for repair, if troubleshooting. If checking out, go to next step.

**No** — Set S3-3 as required, repeat 6.28. If there is still no character return or erroneous output, replace data set and return for repair.

**NOTE:** See paragraph 6.05 (False Alarms) to verify that the data set is indeed faulty.

**6.38** Stop data transfer, from both terminal and the computer. After the time-out interval (4-65

seconds) as set by R56 (see 6.47), the line should be released. Does the channel hang up on auto time-out?

**Yes** — Refer to Table H if other problems exist; continue to 6.39 if checking out.

**No** — Continue.

### Channel Does Not Hangup

**6.39** Is S1 OFF?

**Yes** — Replace data set if troubleshooting; if checking out, continue to next step.

**No** — Turn S1 OFF and repeat 6.38.

**6.40** With the system operating correctly, input two consecutive "#" entries. Does the channel hangup?

**Yes** — Refer to Table H if other problems exist; if checking out, go to 6.42.

**No** — Continue.

**6.41** Is S3-4 ON?

**Yes** — Go to next step.

**No** — Turn S3-4 ON, hangup and repeat test at 6.40.

**6.42** With S3-4 ON, the data set accepts the two consecutive "#" entries and immediately releases the line from T/R connection. Verify that the data set also drops CC and CF to the OFF condition when the line is released. Is the line released for ## input?

**Yes** — Go to next step.

**No** — Replace data set, return for repair.

**6.43** Does removal of CD for 50 ms (minimum) by DTE cause data set to release the line?

**Yes** — Refer to Table H if other problems exist; if checking out, continue to 6.44.

**No** — Replace data set, return for repair.

### Busy Out Not Working

**6.44** With the data set connected as described in Section 4, dial the channel as in 6.16. When the data set answers automatically, turn S1 ON (see Table E and Figure 12). The line should be permanently seized; CC & CD LED's go out momentarily (no data set time-out in effect). Does S1 operate as described?

**Yes** — Refer to Table H if other problems exist; if checking out, go to 6.45.

**No** — Replace data set, return for repair.

### CB Option Not Working

**6.45**  If the CB option described in Table E is to be checked out, verify that the DTE provides the required signals.

**6.46**  With the system connected, dial the data set as in 6.16. Test the working of the CB option (S3-5). Is CB option obtained as specified?

**Yes** — Go to next step.

**No** — Replace channel board, return for repair.

### Auto Time-Out Adjustment

**6.47**  The auto time-out interval can be adjusted within the approximate range of 4 to 65 seconds by screw driver adjustment of R56 (see Figure 8 for location). Turn clockwise for increasing.

**NOTE:**  This is a four (4) turn potentiometer with internal clutch. It provides an adjustment of approximately 10 seconds per turn. It is suggested that when changing a setting determine present time-out and adjust directly to desired time-out.

### Transmit Level Adjustment

**6.48**  Establish a connection to the data set under test. Set S1 ON to permanently hold the line. Measure the ac voltage output across tip and ring with the data set transmitting steady MARK tone. The output signal can be adjusted by operating R139 over the following range:

**TABLE J**
**Transmit Levels**

| Voltage | Line Impedance | Corresponding Power |
|---|---|---|
| 38 mV RMS<br>1.7 V RMS | 900Ω | −28 dBm<br>+5 dBm |
| 30 mV RMS<br>1.35 V RMS | 600Ω | −28 dBm<br>+5 dBm |

**6.49**  This completes the fault isolating procedure for the DS151A Data Station. If all the steps have been successfully followed, the Data Station will also be completely checked out at this stage.

## 7.   SPARE PARTS LIST

**7.01**   The following replaceable subassemblies and components of the VuSet Data Station are available from Plantronics when ordered by the part number indicated.

| PART # | DESCRIPTION |
|---|---|
| 07727-02 | Data Mounting |
| 09092-04 | Data Set Board |
| 09093-00 | Power Supply Board |
| 09094-00 | Extender Board |
| 09220-00 | DTE Simulator Board and Cable |
| 07779-01 | AC Power Cord |
| 09804-00 | Data Set Packing Kit (Set of 5) |
| 09805-00 | Data Station Packing Kit (Set of 5) |
| 09172-00 | Fuse Kit (Set of 4) |
| 09095-00 | Data Station Cover Kit |

## 8.   REFERENCES

### EIA Standard RS-232-C

**8.01**   All data and control circuits operate within the specifications for interchange circuits as stated in the Electronic Industries Association Standard RS-232-C, "Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange".

## 9.   VuSet WARRANTY & SERVICE POLICY

### Warranty

**9.01**   The Plantronics VuSet Data Terminal and Data Station are warranted free from defects in workmanship and materials for a period of eighteen (18) months from date of shipment. Excluded from this warranty are parts which are considered to be subject to wear and tear in normal usage, such as cords, cables and external controls and and decorative finishes.

**9.02**   Material found defective will, at Plantronics option, be either repaired or replaced on site or returned to Plantronics by prepaid freight for repair or replacement. Material repaired or replaced shall be re-warranted for a period of ninety (90) days from date of repair or replacement or the unexpired portion of the original warranty. Plantronics shall not be liable under this warranty unless:

**a)**   Plantronics is notified in writing by the customer of the failure.

**b)**   Such defect or failure has not been caused by misuse, neglect, improper installation, unauthorized repair, alteration or accident.

**9.03**   Repaired material in warranty shall be refurbished to a like new condition with refurbishment costs borne by the customer. Inspection and repair testing costs shall be borne by Plantronics.

**9.04**   Extra inspection and testing costs incurred by Plantronics in evaluating material under warranty which is found not defective shall be borne by the customer.

**9.05**   Material returned for refurbishment only during the warranty period shall be returned to a like new condition with inspection, test and refurbishment costs borne by the customer.

**9.06**   Missing parts will be replaced and charged at spare parts prices.

### Subassembly Warranty

**9.07**   The warranty period for VuSet subassemblies is the same as that for end item Data Terminals and Data Stations. Subassemblies are date coded at the time of subassembly acceptance but are warranted from the time of end item shipment. The customer must, therefore, provide Plantronics with the date code of items from which failed subassemblies have been removed to establish repair charges for warranted or non-warranted failures.

**9.08**   If a failed subassembly is returned to Plantronics without such end item date code information, the manufacturing date on the subassembly will be used to establish warranty status.

### Factory Service

**9.09**   Factory repair service is provided by Plantronics for products that are out of warranty, for the normal lifetime of the product. The warranty period for such repaired units will be thirty (30) days from the date of customer installation. Information regarding date of installation and failure data will be furnished to Plantronics by the customer.

**9.10**   If material is returned for repair and is determined to be beyond repair, Plantronics will notify the customer and, if agreed, will ship a replacement unit at the contract price in effect for new material within five (5) working days.

**9.11**   Transportation costs of units returned for repair will be borne by the customer and units will be adequately packed to prevent shipping and transportation damage. Return transportation costs for repaired or replacement units will be borne by Plantronics.

**Refurbishment Out of Warranty**

**9.12** VuSet materials may be returned to Plantronics for refurbishment to a like new condition at the contract refurbishment rate. Transportation costs of material returned to Plantronics will be borne by the customer and return transportation costs of refurbished material by Plantronics.

**9.13** Out of Warranty material returned for refurbishment shall be tested by Plantronics. Material requiring repair prior to refurbishment will be billed at the contract repair and refurbish rate in effect.