"VUSET*" DS150C DATA TERMINAL

DESCRIPTION, INSTALLATION, AND OPERATION

COMMUNICATION DISPLAY TERMINALS

1. GENERAL

1.01 This section covers the VUSET DS150C data terminal manufactured by Plantronics, Inc., of Santa Cruz, California.

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

1.03 The data terminal is a display device for data entry or inquiry/response data systems using either the switched telephone network or private-line facilities. The terminal, by changing an internal option switch, can be configured either for alphanumeric input using the adjunct keyboard or for numeric only using the TOUCH-TONE† telephone pad.

1.04 Descriptive information, installation procedures, and operating procedures covering the data terminal are contained in the attached reprint of the practice prepared by Plantronics, Inc.

1.05 Information covering the maintenance of the data terminal is contained in Section 578-160-105.

1.06 Information covering the alphanumeric application of the VUSET System (alphanumeric keyboard used with the data terminal) is contained in Section 578-160-101.

1.07 Information covering the adjunct alphanumeric keyboard is contained in Section 578-160-103.

*Registered trademark of Plantronics, Inc.

†Trademark of AT&T.

2. UNIVERSAL SERVICE ORDER CODED (USOC) OPTIONS

2.01 The USOC options for the DS150C data terminal are presented in Table A. The description of the options is presented in Part 4 of the attached reprint.

TABLE A

USOC DMZ __ (NOTE)

OPTION	FUNCTION
A1	300-baud data speed
A2	110-baud data speed
B3	64-character display
B4	128-character display
C5	Carriage return
C6	Start of text
D7	DC1 screen blink code
D8	DC2
E9	Echoplex
E10	Local copy
F11	Numeric
F12	Alphanumeric

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

PLANTRONICS
Santa Cruz

VuSet® DATA TERMINAL
DS150C FOR NUMERIC SYSTEM APPLICATION

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1. SYSTEM DESCRIPTION AND OPERATION

VuSet General System Description

1.01 This manual covers operation of the DS150C Data Terminal for numeric (TOUCH-TONE)® system application only. For alphanumeric applications using the Plantronics Alphanumeric Keyboard, refer to Keyboard Practice 10612-00. 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 DATAPHONE® service using the exchange telephone network as its transmission medium.

1.02 The system includes the VuSet Data Terminal Model DS150C, 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 DS150C 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 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.
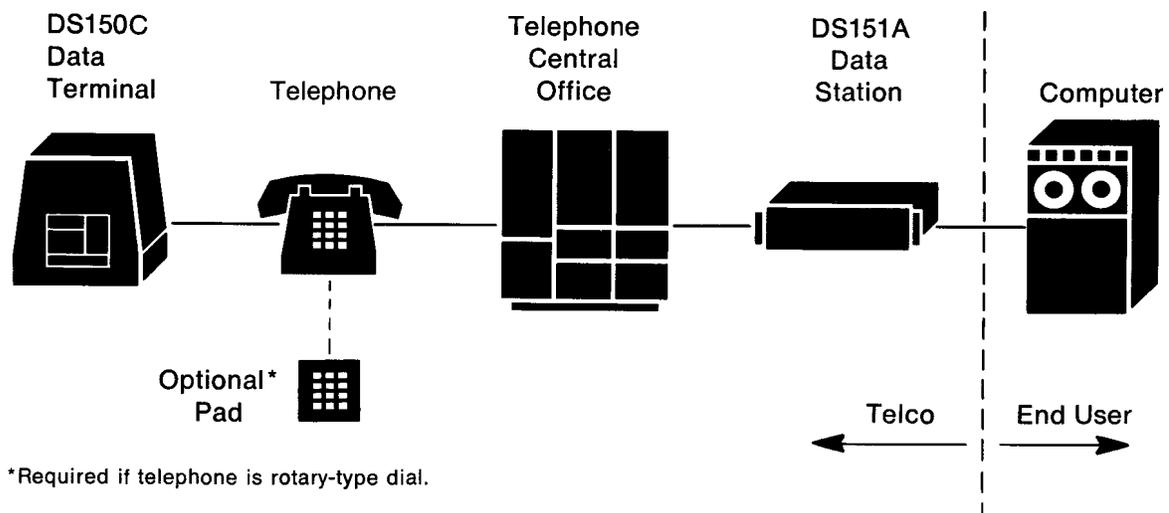
Figure 1, Simplified VuSet Numeric System

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 TALK position. Calls are automatically answered by the data set which returns a 2225 Hz answerback tone to indicate completion of "hand-shaking" with the computer.

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

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 Disconnect is initiated by one of the following:

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

Figure 2, VuSet DS150C 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 on the DS151A Data Station.

d) The data set may be arranged to immediately disconnect on the receipt of the (double pound sign) ## 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.

2. DATA TERMINAL DESCRIPTION AND OPERATION

VuSet Data Terminal Description

2.01 The terminal consists of a receive-only data set, display electronics, small CRT screen, a CLEAR switch, a DATA/TALK switch, and two indicator lights.

2.02 The terminal weighs approximately 10 pounds and measures about 8 inches wide by 9 inches deep.

2.03 The terminal accepts bit-serial FSK-ASCII data from the computer. Data is optionally selectable for display into a 64 character format (four lines of 16 characters) or a 128 character format (eight lines of 16 characters) display on the CRT. (Factory set for 128 characters.)

2.04 Receipt of an ASCII "carriage return" (CR) or "start of text" (STX) code (factory set for STX) erases the display CRT and initializes the system so that the next incoming character will be displayed on the upper left-hand position of the screen. Should the terminal receive more than 64 or 128 characters (option switch selected) before the system is initialized, overflow information will over-write, commencing at character position number one in the upper left-hand position of the screen.

2.05 Figure 4 shows the complete repertoire of ASCII print characters which can be displayed.

2.06 A blinking feature is included to alert the viewer. Receipt of an ASCII DC-1 or DC-2 function character (factory set for DC-2) will cause all information on the CRT to blink approximately once per second. The blink operation will be terminated upon receipt of a clear and home command (option switch selectable, CR or STX function character) or activation of the CLEAR switch on the VuSet front panel.

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 0-9 ®₁\>_! "#$%&'() *+,—./: ;<>=? SPACE	⬅ FSK		⬅ ASCII	A-Z 0-9 ®₁\>/! "#%&'() *+,—./: ;<>=? SPACE
NON-PRINT. ERASES SCREEN AND INITIALIZES DISPLAY (Switch selectable)				CR or STX
NON-PRINT. RETURNS DISPLAY TO START OF PRESENT LINE (Switch selectable)				CR
NON-PRINT. INDEXES DISPLAY TO SAME CHARACTER POSITION NEXT LINE (Switch selectable)				LF
NON-PRINT. CAUSES SCREEN TO BLINK (Switch selectable)				DC-1 or DC-2

Indicators

2.07 Terminal status is shown by two indicator lights (LED's) below the display screen.

2.08 *POWER.* The POWER lamp indicates status of AC power to the terminal and must be illuminated for the terminal to operate.

2.09 *DATA.* The DATA lamp indicates the status of the telephone line connection.

• When the DATA indicator is ON steady, it indicates that a connection has been established, the terminal is receiving the 2225 Hz Mark tone from the data set, and the terminal may display received data when sent.

• The DATA lamp flashing at a steady rate indicates an incomplete connection, i.e., ringing, busy signal, disconnected call, etc.

• When the DATA lamp is OFF, the terminal will not receive data.

Controls

2.10 *POWER.* A two-position ON/OFF rocker switch located in the back of the terminal which controls the power supply. Power must be ON to operate the terminal.

2.11 *DATA/TALK.* The DATA/TALK switch is a two-position toggle.

• In DATA (up) position, the terminal is connected to the telephone.

• When the telephone handset is lifted from its cradle, the terminal is connected to the line. The telephone receiver may be used to monitor the call, however, the transmitter will be disconnected. The telephone cannot be used for voice communication with the switch in DATA position.

• When the switch is moved to its TALK (down) position, the terminal is disconnected and voice communications are possible.

2.12 *CLEAR.* When the CLEAR switch is activated downward and released, the display screen is erased and initialized to receive subsequent data.

2.13 The screen can also be cleared by receipt of a clear and home command option (option switch selected, CR or STX function character) from the computer.

Data Terminal Operation

2.14 Figure 5 is a copy of the VuSet Terminal Operators Instructions provided with each terminal for operator use at each terminal location.

a) Connection with the computer is established with the telephone by dialing the appropriate access number. Check that POWER is ON, lift the handset, wait for the dial tone and call the computer telephone number.

b) Any characters remaining on the terminal CRT screen may be erased with the CLEAR switch.

c) When the answerback tone (2225 Hz) is heard, place the DATA/TALK switch in the DATA position. The DATA lamp on the terminal will light, indicating transmission may begin.

d) The handset cannot be returned to the cradle without disrupting the connection. Loss of DATA indication at any time during the transaction (except
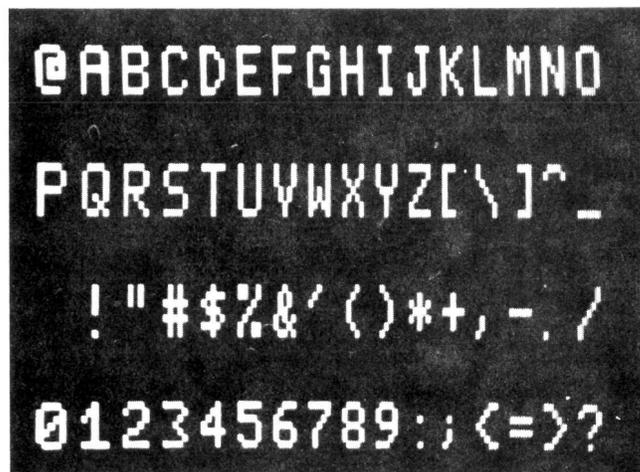

Figure 4, Display Repertoire

when a TOUCH-TONE button is depressed) may require a disconnect and re-initiation of the call.

e) The telephone pushbutton dial or accessory pad is used for data entry. Dial or pad buttons must be pushed slowly and firmly when entering data due to entry speed limitations.

f) When the "Echoplex" character return option is enabled at the data set, character entry from the TOUCH-TONE pad will be returned for verification to the terminal CRT simultaneous with its transmission to the computer.

g) The data rate for the system is normally 300 baud. If slower rates are required for particular installations, both terminal and data set channels must be set to the SAME desired rate during installation.

h) Disengagement from the telephone line is accomplished by placing the handset back on the telephone cradle or by the disconnect options described in paragraph 1.19.

j) The DATA/TALK switch may then be actuated downward to the TALK position restoring normal telephone operation.

Data Terminal Operation With TOUCH-A-MATIC® Telephone

2.15 The remote VuSet Data Set should be set for ECHOPLEX "OFF".

2.16 The VuSet Data Terminal/TOUCH-A-MATIC combination should be properly installed, per section 4.

a) The VuSet Terminal shall be in the Data Mode and Powered "ON".

b) The TOUCH-A-MATIC telephone is to be used for automatic data entry. The data is placed in the telephone set's memory in the same manner as a telephone number is entered. The appropriate BSPs on the TOUCH-A-MATIC telephone operation shall be adhered to.

c) The TOUCH-A-MATIC telephone has the capability to intermix manual and automatic dialing as follows:

d) If at any time information is keyed in manually, the RECORD OFF button must be depressed before additional data can be entered from memory. (The RECORD lamp will not light at any time, but depressing the RECORD OFF button will remove the set from the "Last Number Dialed Mode" and allow additional automatic dialing.)

e) If the set is equipped with the "One-Touch Calling"[1] option, the initial number must be dialed automatically (even if the one-touch calling switch is in the OFF position). This allows the dial tone detector to complete its function and then additional data may be entered automatically or manually if desired. The rule given in b (1) above would apply after the first number was automatically dialed.

NOTE: One-Touch calling permits the automatic turn on of a speakerphone connected to the TOUCH-A-MATIC telephone and the automatic dialing of the number desired by depressing one memory button.

Data Terminal Model DS150C Specifications

2.17 *Data Specifications.*

Display Format: 5 x 7 Character dot matrix 64 characters (four lines of 16 characters) or 128 characters (eight lines of 16 characters)

Input Signal/Format: FSK-ASCII Format Space = 2025 Hz Mark = 2225 Hz

Input Data Rate: 110, 150 or 300 baud (10, 15 or 30 characters/second) option selectable at installation. Asynchronous operation.

Receive Level Sensitivity: 0 to —40 dBm (referenced to telephone line)

2.18 *Power Requirements.*

Operating Voltage: Single phase, grounded, 117 Vac ± 10%, 60 Hz, 8 foot power cord provided

2.19 *Physical Characteristics.*

Weight: 10 pounds (approximately) (4.54 kg)

Dimensions: 9-1/4 inches deep (23.50 cm) 7-7/8 inches wide (20.00 cm) 8-1/8 inches high (20.64 cm)

2.20 *Operating Environment.*

Temperature: 0° to 50°C (operating) —10° to 65°C (non-operating)

**Moisture:** 0 to 90% relative humidity (no condensation)

Altitude: 10,000 feet maximum (operating) (3048m)

VuSet
Visual Data Terminal

The combination of the VuSet terminal and a TOUCH-TONE ® telephone using the exchange telephone network provides the user with an on-line inquiry/response system. The system affords instant yet economical retrieval of data by using the telephone to communicate with a data source such as a computer.

The telephone is a standard TOUCH-TONE telephone set or it may be a rotary telephone with an auxiliary TOUCH-TONE pad. Using the TOUCH-TONE telephone set all dialings of telephone numbers and data input is entered via the TOUCH-TONE buttons. Using a rotary set, the telephone number is dialed on the telephone set but data is entered via the pad.

The VuSet data display terminal is used as a receive-only display vehicle for data entry or inquiry/response system. The terminal has a three-inch Cathode Ray screen which can display 64 or 128 alpha numeric characters on 4 or 8 lines, 16 characters per line. There are two red indicator lamps marked POWER and DATA and three control switches marked CLEAR, DATA/TALK and POWER
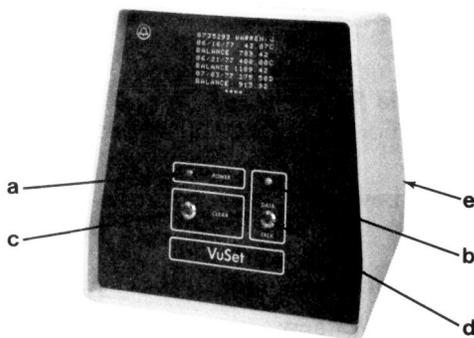
EQUIPMENT DESCRIPTION

INDICATORS:
The status of the system is indicated by two red lamps on the front panel below the display screen indicated as POWER and DATA.

a) *POWER Lamp* indicates the status of the power supply. It must be lit for the terminal to operate properly. If the lamp is dark, check the POWER switch on the back of the terminal (e). If it is in the ON position and the light is still dark, check the POWER connection on the back of the terminal and the AC wall outlet. Also check to make sure there is power into the building.

b) *DATA Lamp* indicates the status of the connection. When the lamp is off the VuSet is not receiving data. When the lamp is on it indicates that a connection from the data source to the VuSet terminal is established and received data will be displayed. The data lamp will flash when there is an incomplete connection (busy or ringing). If the line is busy, hang up and re-dial.

CONTROLS:
Two switches on the front panel of the VuSet terminal are shown as CLEAR and DATA/TALK. A POWER switch is located on the back panel.

c) *CLEAR Switch* is a two-position toggle switch. In the center position the terminal operates normally. Received data will remain on the screen indefinitely, provided that the POWER lamp remains on and the DATA lamp remains off. When this switch is operated downward and released (the switch returns to the NORMAL position), all data on the screen is erased.

d) *DATA/TALK Switch* is a two-position toggle switch that controls the use of the associated telephone set.

In the DATA (up) position, the telephone set is used in conjunction with the VuSet terminal. The telephone can not be used for voice communication with the switch in the DATA position.

In the TALK (down) position, the telephone functions normally and voice communication is possible.

e) *POWER Switch* is a two-position ON/OFF rocker switch located in the back of the terminal which controls the power supply. Power must be on to operate the set. However, at the end of the business day power may be turned off.

TO PLACE A CALL TO THE DATA SOURCE:
- Verify that the POWER lamp is on.
  - —If the lamp is off, make certain the POWER switch is on, the plug is in the power outlet and power is available at the outlet.
  - —If the lamp remains off report the trouble to the Telephone Company.
  - —If characters appear on the screen use the CLEAR switch to erase.
- Operate the DATA switch to the DATA (up) position.
- Select an idle line on the telephone where required.
- Lift the handset.
- Listen for dial tone.
- Dial required number.
  The DATA lamp flashes during dialing.
- Listen for the ringing signal. (If you hear a busy signal, hang up and try again.)
- Wait for high pitched answerback tone which indicates the called station is ready to receive data. The DATA lamp lights steadily. CLEAR screen as necessary.
- *LEAVE THE HANDSET OFF-HOOK.* A high pitched tone continues to signal during the transaction.
- Use the TOUCH-TONE dial/pad to enter data as locally directed. Push dial or pad buttons slowly and firmly.

TO DISCONNECT A CALL:
- Replace the handset onto the switchhook—hang up—DATA lamp will go off.
- Depress the CLEAR switch (down) and release to clear display screen, if desired.
- To restore the telephone for normal voice communication, push the DATA/TALK switch (down) to the TALK position.

TO REPORT TROUBLE:
Trouble that is encountered on Telephone Company provided equipment should be reported by calling __ _____ . In the report, indicate that the trouble is "DATAPHONE® Service Trouble."

09862-02
REV. A

®Registered Servicemark of AT&T Co.

Bell System

Figure 5, VuSet Terminal Operators Instruction Card

3. PRINCIPLES OF OPERATION

Functional Overview

3.01 The VuSet terminal attaches to a standard DTMF telephone set for interface to the telephone network. The telephone's pushbuttons are used to establish the communication path to the data terminal equipment (DTE, computer). The DTMF pad is then used for data entry to the DTE.

3.02 Figure 6 is a functional block diagram of the VuSet terminal. The terminal is a receive-only device which displays received ASCII-FSK data. Figure 7 is the interconnect diagram for the terminal subassemblies.

3.03 The FSK signals pass through the telephone set to the demodulator board. With the DATA/TALK switch in the DATA position, the transmitter in the handset is electrically replaced with the VuSet terminal. The function is filtering and demodulation of the data from FSK to ASCII.

3.04 The bit-serial, character-serial data is then passed onto the data converter card where it is converted to a 7-bit parallel character-serial form. The data is decoded for various operations, typically; write, blink and erase. Data is stored in a refresh-type memory and is used to address a character generator. Output of the character generator is a video pulse train.

3.05 The video pulse is passed on to the display circuits and modulates the CRT scanning beam on and off in proper synchronization such that the beam dots form characters on the screen. Each character is made up of a 5 x 7 dot matrix.

Demodulator Board Circuit Description

3.06 Demodulator functions are shown in Figure 8. FSK data enters the photo coupler isolating circuit from the telephone network. The signal is then presented to the bandpass filters which are tuned to the f2 frequencies and passed through a notch filter to remove f1 frequencies. The filter output is taken through a limiting amplifier which feeds the phase-locked loop demodulator.

3.07 The phase-locked loop demodulator accepts FSK Mark and Space signals, corrects small frequency phase errors, compensates for temperature changes and presents the data to the level converter.
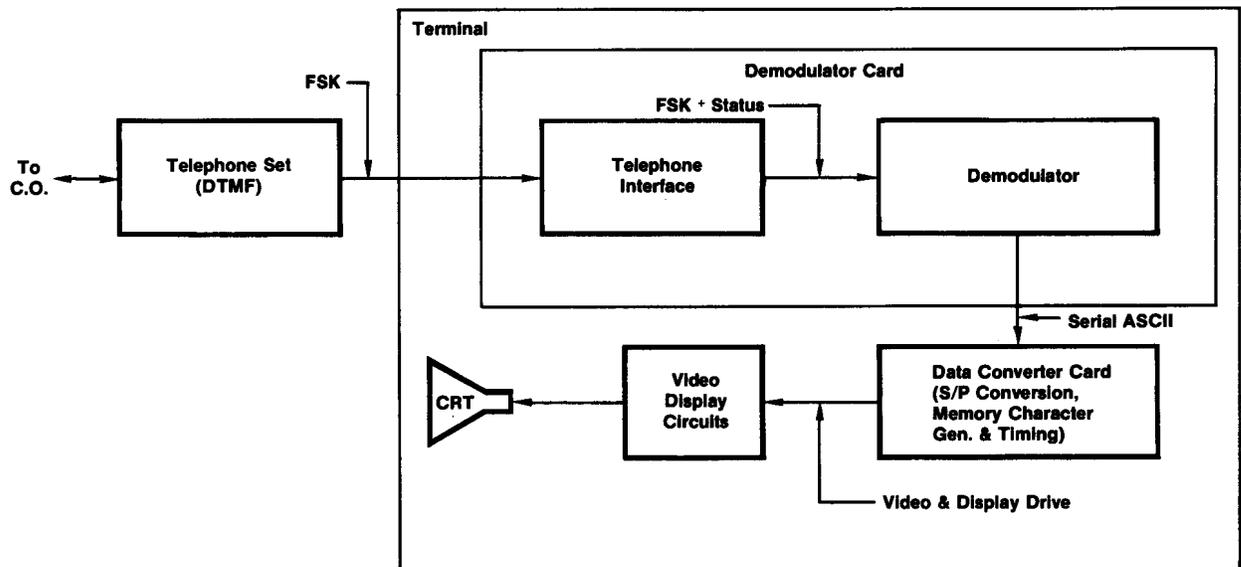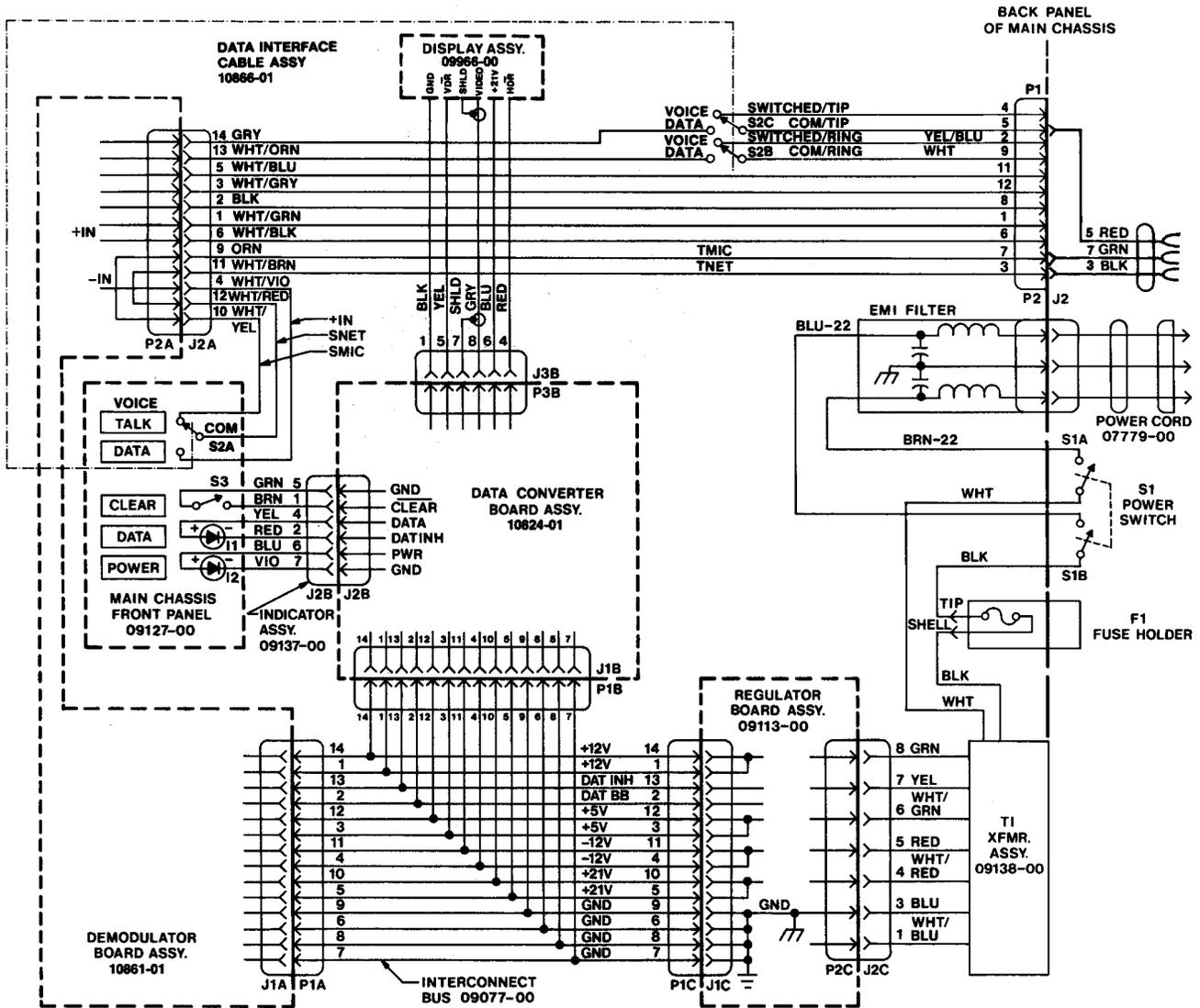

Figure 6, Terminal Function Block Diagram

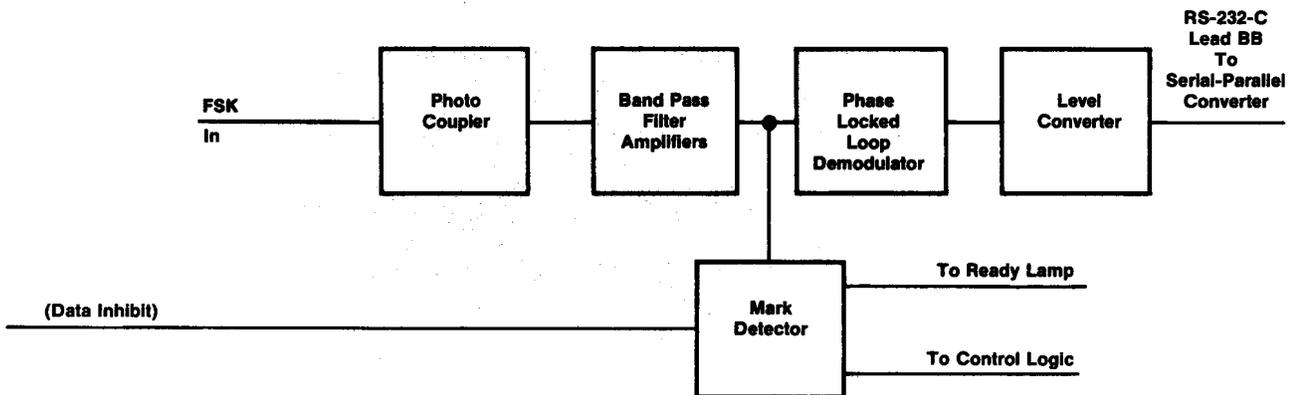**Figure 7,** Terminal Interconnect Wiring Diagram

Figure 8, Demodulator Functional Block Diagram

3.08 The level converter changes the demodulator output from EIA voltage levels of more negative than +3V (Mark) and more positive than -3V (Space) to corresponding logic level states of one (1) and zero (0), respectively, for processing in the data terminal.

Data Converter Board Circuit Description

3.09 Terminal logic serial to parallel conversion, Figure 9, depicts the flow of data through the logical portion of the terminal. When the carrier detector senses a carrier, the serial-to-parallel converter is enabled to accept data. As a start pulse Mark-to-Space transition is detected, control signals step the data into the serial-to-parallel converter bit by bit. The start bit is stepped out of the converter by control logic just as the last information bit steps in. Control logic now stops further bits from entering the converter, holds the seven information bits on the parallel data buss momentarily, alerts other control logic and the decoders ahead with a control signal called OPERAND (or OPD) and prepares to accept a new character in the converter.

Blink Decoder

3.10 This decoder tests for control character DC-1 or DC-2 (depending on setting of switch S1-7) which is used to create a CRT screen blinking condition. The presence of the selected control character (DC-1 when S1-7 is on and DC-2 when S1-7 is off) will cause the entire screen to blink at a 1-Hz rate until cancelled by a clear and home command (switch selected CR or STX function character) or actuation of the CLEAR switch on the VuSet front panel.

Clear and Home Decoder

3.11 This decoder tests for function characters CR or STX, CR and LF (depending on the setting of switch S1-6. When S1-6 is set to ON, a CR function character is decoded to initiate a clear and home operation. A clear and home operation consists of clearing the CRT screen, stopping the blink operation, and resetting position counters to zero. Resetting the position counters to zero causes the next character displayed on the CRT screen to appear in the first character position in the upper left-hand corner.

3.12 When S1-6 is set on OFF, an STX function character is decoded to initiate a clear and home operation. CR and LF function characters are also decoded to initiate additional CRT operations. Decoding a CR function character causes the next character displayed on the CRT screen to appear at the start of the present line. Decoding an LF function character causes the next character displayed on the CRT screen to appear in the next line at the next sequential character position.

Write Command Decoder

3.13 The final decoder, operates only upon receipt of the strobe signal and samples for legal characters. This is a test of bits 6 and 7.

3.14 If bits 6 and 7 are both zeros, the character is a control or function character and ignored. If either bit 6 or 7 is a one, or both are a one, the character is legal and a write command is issued to permit this character to enter the memory (RAM). Only six of the 7 bits are stored in the memory. Bit 6 is eliminated since bit 7 actually performs the same function, but in
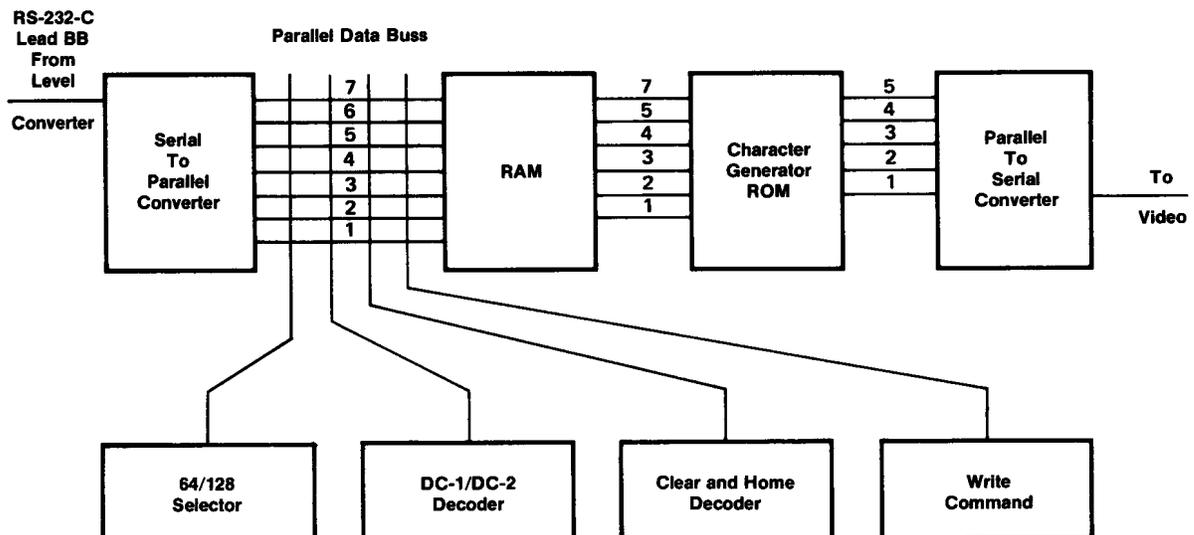

Figure 9, Data Converter Signal Flow Block Diagram

the opposite logical state. (If bit 6 is a one, but 7 is a zero and vice versa.) This allows a clear memory to display all space characters (there is never a time when the memory does not contain data) and converts the lower case letters to upper case (a limit of the character generator).

Random Access Memory (RAM)

3.15 When a WRITE command signal is issued, the character on the parallel data buss will be stored in a specific location of the memory. The RAM is capable of storing 64 or 128 (switch selectable) characters. If more than the maximum number of characters (64 or 128) are received in one message, the overflow character (65th or 129th) will replace character one and so forth. Receipt of a clear and home command (switch selected CR or STX function character) or actuation of the CLEAR switch on the VuSet front panel clears memory.

3.16 A line and address counter determines the specific location in memory for storage of each character. When a clear and home command (switch selectable CR or STX function character) is received or the CLEAR switch on the VuSet front panel is actuated, the counter is reset to zero. Each time a legal character is accepted for display, the counter advances and the character is stored in a new memory location. When the last character of a message is received, the counter stops at that memory address and waits for the next character. It is possible to have a short message stay on the CRT screen and accept a new short message for display following the original message.

3.17 The VuSet terminal has the capability of printing on the CRT screen without destroying the information stored in the memory. To keep information on the screen, the terminal will periodically repeat a read operation to refresh the screen or keep it glowing.

Character Generation by the Read Only Memory (ROM)

3.18 The VuSet ROM is a 64 x 7 x 5 dot generator. It will accept 64 different character codes and reform them into 7 rows of 5 dot positions for each character. When a READ command is issued by control logic, information is transferred out of the Memory (RAM) and passed through the character generator (ROM) in the same precise order in which it was stored.

3.19 The purpose of ROM is to transform the ASCII coded characters into rows of dots that are swept onto the CRT screen row by row. The ROM is manufactured to accept ASCII format data

and output dots for printable characters on the screen. The codes and dots cannot be changed. Each dot position is logically a one or zero. A one becomes the lighted portion of a character on the screen; the zero allows the screen to remain dark at its specific location.

3.20 The ROM is set up and then, as shown in Figure 10, sends out five dots (or lack of dots) representing the top row of the first character in a continuous stream that is stepped out of the ROM and through the parallel to serial converter. Then the top row of the second character, third, fourth, etc., are sent until all sixteen character positions of the first text line are out. A text retrace counter advances by one and the same row repeats itself slightly lower vertically than the first sweep. This counter again advances so that the row of dots is repeated on four horizontal traces which make up the first or top row. An address counter then advances permitting the second row to be output four times.

3.21 The procedure continues until the first line of text is complete, or after thirty-two sweeps (horizontal traces). Separation between text lines equals or is less than the text lines. The ROM output is blanked by the converter while the blank horizontal lines are swept. Then, the second text line commences just like the first. After the required number of sweeps, the entire message is on the screen. The refresh program is simply a repetition of the original message at a 60-Hz rate. This continuous process stops only when the VuSet is turned off.

Control Logic (Figure 11)

3.22 Accepting serial data and converting to printed words on the CRT screen is a complex operation. The master clock, always running, drives the control operation through a series of dividers that become counters or steppers. The end counters or steppers run continuously or on command only, depending upon their function.

3.23 *Start-Stop Control.* When the start bit is sensed, a stepper begins to increment at the selected bit rate (300, 150 or 110 bps). This allows each bit to be stepped through the serial-to-parallel converter. When the start bit is stepped out, the stepper continues for two more cycles and stops, waiting for the next character. OPERAND (see paragraph 3.09) indicates a character is on the parallel data buss and is part of the last two cycles.

3.24 *Memory Control.* This control has several functions:

a) The write address counter increments for each legal character as it is received and is only reset to zero by a manual clear or clear and home command.
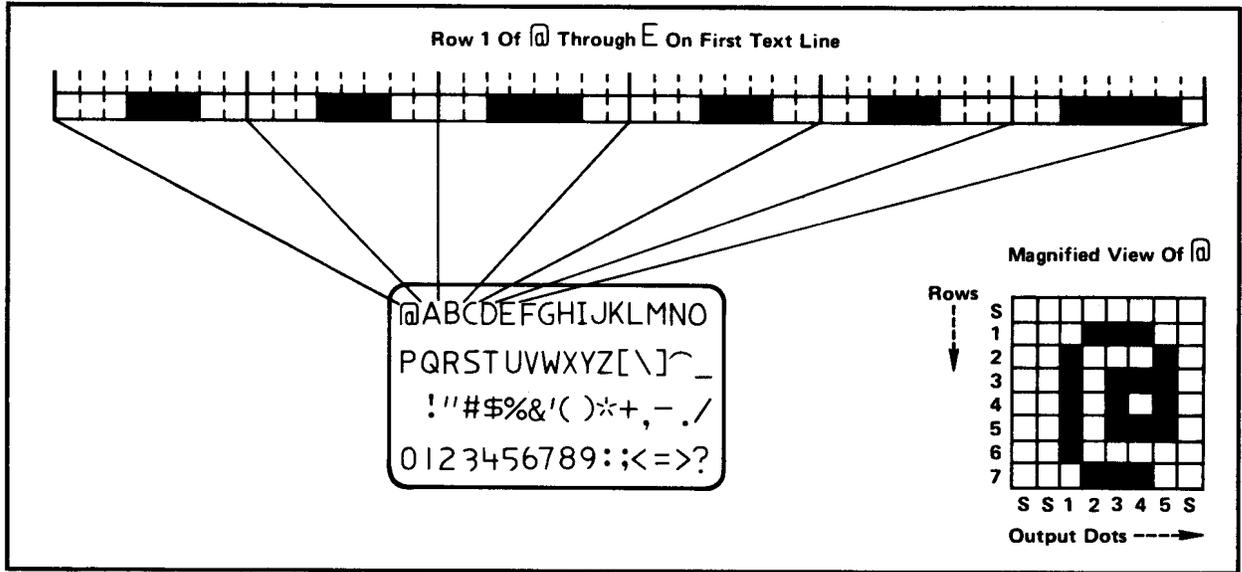
Figure 10, Character Generation
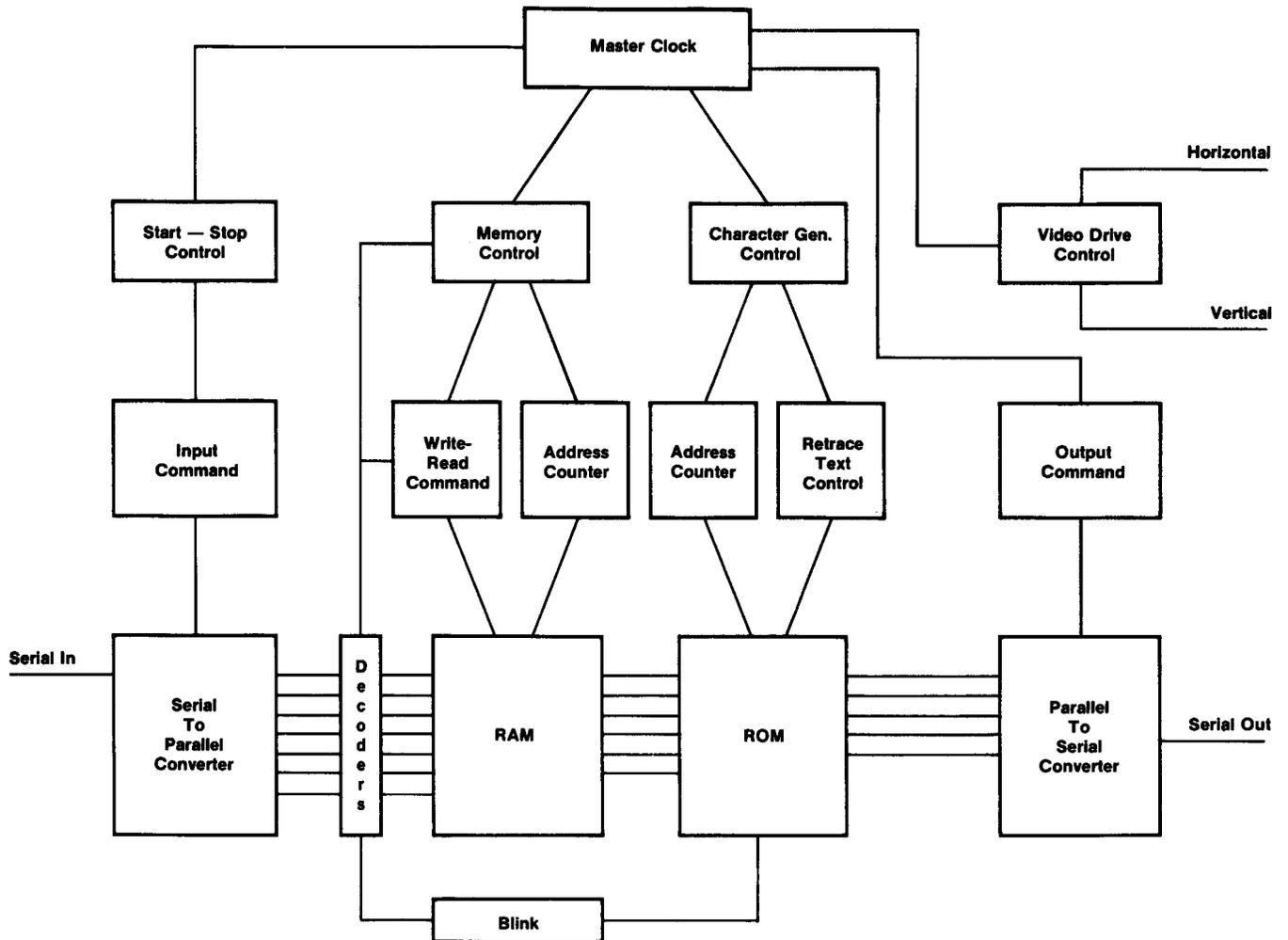
Figure 11, Data Converter Command and Control Diagram

b) The read address counter runs whenever write is not operating.

c) Write command is issued on receipt of a printable character.

d) Read for each character in the memory, even when write is operating.

3.25 *Character Generator Control.* Essentially, this is the blink control, text separation, CRT horizontal retrace time and address counter.

3.26 *Parallel-to-Serial Converter.* The dots are output from the ROM in parallel to the parallel-to-serial converter. Then under control of the clock, the parallel-to-serial converter outputs a stream of dots to the video line.

3.27 *Horizontal and Vertical Drive Clocks.* The horizontal drive provides the horizontal sweep frequency and the vertical drive provides the vertical sweep frequency.

CRT Display

3.28 The CRT display assembly consists of the deflection circuits PC board, the flyback transformer, the high voltage rectifier, the yoke, the CRT and its pin socket.

3.29 The VuSet terminal does not use composite video signals as does a standard television receiver. Each of the three signals, video, horizontal and vertical are independent, controlled by the master clock eliminating the necessity of external controls as horizontal and vertical hold. The brightness control remains, but as an internal adjustment.

Regulator Board Circuit Description

3.30 The regulator board receives ac voltages from three separate secondary windings on the power transformer. The ac voltages are rectified and fed to three separate voltage regulators which provide regulated voltages of +5 Vdc, +12 Vdc, —12 Vdc. The regulator board also supplies unregulated +21V to power the display assembly.

Reusable Collar (A)

Partition (A)

Terminal Operators Instruction Card
and Installation, Operation and
Maintenance Practice

Reusable Foam Inserts

(A) Collar and Partition provide space for
packing and transporting telephone set.
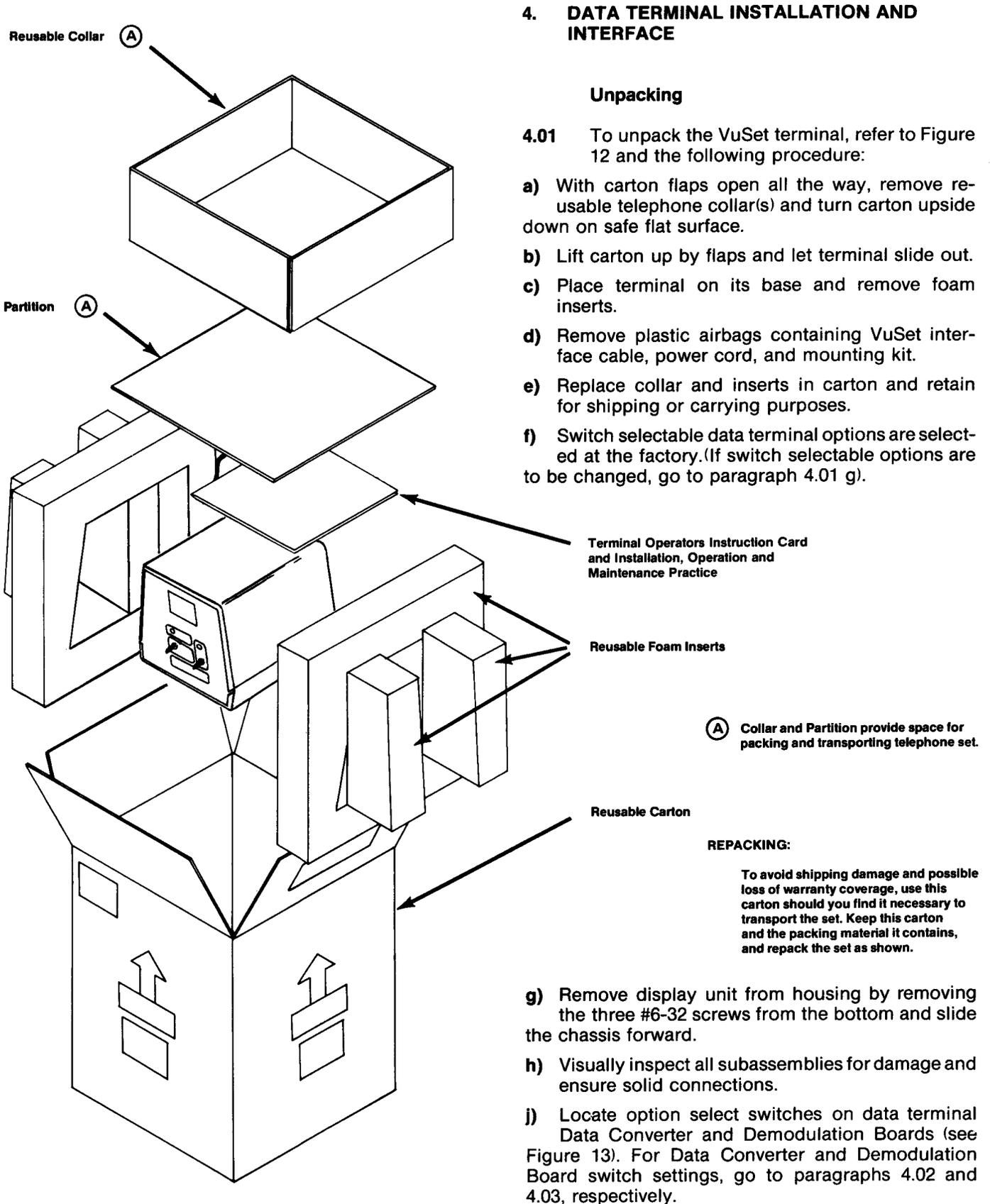
Reusable Carton

4. DATA TERMINAL INSTALLATION AND INTERFACE

Unpacking

4.01 To unpack the VuSet terminal, refer to Figure 12 and the following procedure:

a) With carton flaps open all the way, remove reusable telephone collar(s) and turn carton upside down on safe flat surface.

b) Lift carton up by flaps and let terminal slide out.

c) Place terminal on its base and remove foam inserts.

d) Remove plastic airbags containing VuSet interface cable, power cord, and mounting kit.

e) Replace collar and inserts in carton and retain for shipping or carrying purposes.

f) Switch selectable data terminal options are selected at the factory.(If switch selectable options are to be changed, go to paragraph 4.01 g).

REPACKING:

To avoid shipping damage and possible
loss of warranty coverage, use this
carton should you find it necessary to
transport the set. Keep this carton
and the packing material it contains,
and repack the set as shown.

g) Remove display unit from housing by removing the three #6-32 screws from the bottom and slide the chassis forward.

h) Visually inspect all subassemblies for damage and ensure solid connections.

j) Locate option select switches on data terminal Data Converter and Demodulation Boards (see Figure 13). For Data Converter and Demodulation Board switch settings, go to paragraphs 4.02 and 4.03, respectively.

Figure 12, Data Terminal Packing

Data Converter Board Setting

4.02 The seven segments of switch S1 (1-7) on the Data Converter Board (see Figure 13) should be set for required options as listed in Table B.

CAUTION: *Data rates must be the same for terminal and data set.*

TABLE B
Data Converter Board Option Select

S1 on Data Converter Board							
1	2	3	4	5	6	7	Option Selected
OFF	OFF	ON	OFF	—	—	—	110 Baud Rate
OFF	OFF	ON	ON	—	—	—	150 Baud Rate
OFF	ON	OFF	ON	—	—	—	300 Baud Rate*
—	—	—	—	ON	—	—	64 Character Display
—	—	—	—	OFF	—	—	128 Character Display*
—	—	—	—	—	ON	—	CR Decode Enable
—	—	—	—	—	OFF	—	STX, CR, LF Decode Enable*
—	—	—	—	—	—	ON	DC-1 Blink Enable
—	—	—	—	—	—	OFF	DC-2 Blink Enable*

*Factory set position

Demodulator Board Setting

4.03 The seven segments of switch S1 (1-7) on the Demodulator Board (see Figure 13) should be set for required options as listed in Table C.

TABLE C
Demodulator Board Option Select

S1 on Demodulator Board							
1	2	3	4	5	6	7	Option Selected
ON	OFF	—	ON	OFF	OFF	—	Alphanumeric*
OFF	ON	—	OFF	OFF	ON	—	Numeric
—	—	—	—	—	—	ON	Local Copy
—	—	—	—	—	—	OFF	Echoplex*

*Factory set position
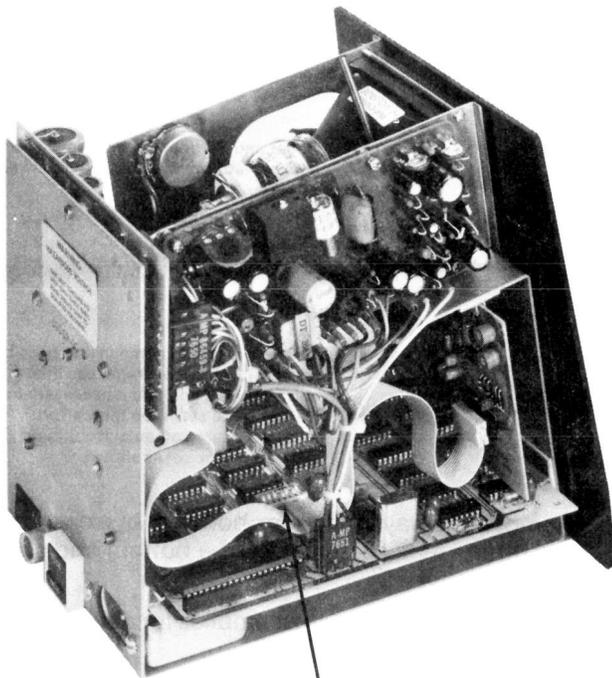
S1 on Data Converter Board
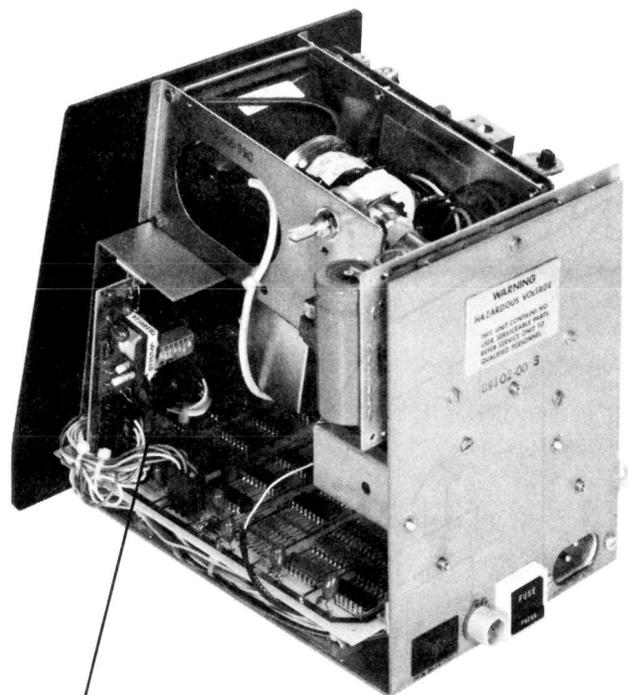
S1 on Demodulator Board

Figure 13, Data Terminal Switch Locations

Interface Cable Connection

CAUTION: *Do not apply power to terminal or connect telephone to line before making connections per this section.*

4.04 Connect the interface cable to the telephone set as follows:

a) Route interface cable to standard telelphone sets per Figure 15 and Table E as necessary.

b) Route interface cable to TOUCH-A-MATIC® telephones per Figure 16 and Table F.

c) Connect interface cable spade lugs per Table D.

d) Connect interface cable to receptacle at rear of terminal, see Figure 14. Note that the cable connector is of the push-on, pull-off type and should **not** be turned or twisted to attach or remove.

e) Connect power supply cord to receptacle at rear of terminal.
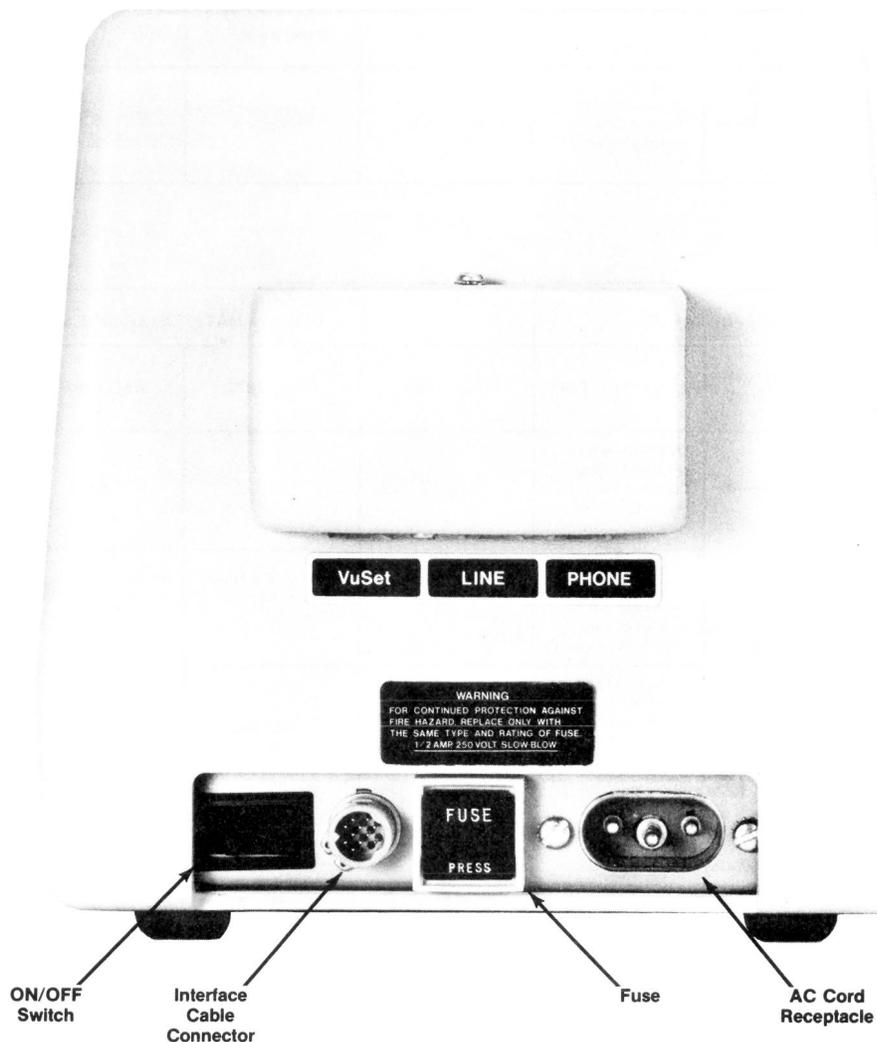
Figure 14, Interface Connections to VuSet Terminal

TABLE D
Telephone Set Interface Connections

TELEPHONE SET CIRCUIT	INTERFACE CABLE			TELEPHONE SET			
	LEAD COLOR	SWITCH CIRCUIT	LEAD FUNCTION	WECO 2500 D, 2564, 2565, 2566, 2567	WECO 500D, 564, 565, 566, 567, WITH 1035C3A DIAL		
	Red		Add (Red) to positive transmitter lead on telephone network.	Network T	Splice to previously spliced (Red) transmitter lead and (S-W) 4 lead of 1035 dial.		
	Green		Remove negative transmitter lead from normal network termination and splice to (Grn).	Remove (Blk) handset wire from Network B and splice.	Remove (Blk) handset wire from Network B and splice.		
	Black		Add (Blk) to normal network termination for negative transmitter lead.	Network B	Network B		

TELEPHONE SET CIRCUIT	INTERFACE CABLE			TOUCH-A-MATIC TELEPHONE SETS			
	LEAD COLOR	SWITCH CIRCUIT	LEAD FUNCTION	WECO 2960	WECO 2872	WECO 2870	
	Red		Add (Red) to Positive Transmitter Lead on telephone network.	PSB-20	TB2-12	TB-15	
	Green		Remove Negative transmitter lead from normal network termination and splice to (Grn).	Remove (Blk) handset wire from PSB-21 and splice	Remove (Blk) handset wire from TB2-8 and splice	Remove (Blk) handset wire from TB-13 and splice	
	Black		Add (Blk) to normal network termination for negative transmitter lead.	PSB-21	TB2-8	TB-13	

PROCEDURE	(SEE NOTE 1)
1.	Remove telephone housing from base plate.
2.	Remove paper backing from adhesive side of cable-tie clamp.
3.	Install cable-tie clamp to base place, under DTMF pad. See Note 2.
4.	Fasten interface cable to clamp with cable-tie.
5.	Make interface cable connections as stated in Tables D and E as appropriate. Use plastic snap-on insulator provided in mounting kit for wire splice.
6.	Replace telephone housing, ensuring interface cable is not trapped or stressed by housing or base and that cradle switch operation is free.

NOTES: 1 Disconnect telephone from line using standard plant practices before performing this procedure.

   2 For other type telephones, cable-tie clamp may be cut to shape and/or clamped on any reasonable interior surface.

Figure 15, Interface Connections to Standard Desk Set Telephones

TABLE E
Connections for Western Electric 500D & 565HK
Telephone Sets with 1035 Dial and 185A Network
BSP 502-501-101 (500D), 501-164-1035 (C3A)

LINE	HOOK-SWITCH	NETWORK	NOTE 3	HANDSET	DIAL	1035C3A TERMINAL BOARD NOTE 4	VuSet WIRES NOTE 2

(wiring schematic diagram)

	PROCEDURE (SEE NOTE 1)
1.	Insulate separately and store 1035 dial leads as follows: 6, 7, 9, and 11. Modify 500D, add 185A network and add 1035 C3 dial, as follows:
2.	Remove (W) line switch lead from F of network and splice to (W-BL) S lead of 1035 dial.
3.	Remove (Y) and (S) line switch leads from L2 of network and store.
4.	Remove (BL) dial pulse lead from F of network and connect to L2 of network. Connect one wire of 185A network to C of network.
5.	Remove (BL or G) dial pulse lead from RR of network and connect to (BL-W) 1 lead of 1035 dial and one wire of 185A network.
6.	Connect (V-G) 12 lead of 1035 dial to RR of network.
7.	Remove (W) handset lead and (R) line switch lead from GN of network and splice to (O-W) 2 of 1035 dial.
8.	Connect (BR-W) 3 of 1035 dial to GN of network.
9.	Remove (R) handset lead from R of network and splice to (S-W) 4 lead of 1035 dial.
10.	Connect (W-S) 10 lead of 1035 dial to R of network.
11.	Connect (S-V) 5 lead of 1035 dial to B of network.
12.	Connect (V-S) 14 lead of 1035 dial to C of network.
13.	Remove (BR) line switch lead from C of network and store.
14.	Add connections as shown in Table D.

NOTES:
1. Disconnect telephone from line using standard plant practices before performing this procedure.
2. If the 500D telephone is a model which does **not** have color coded wires and has soldered lugs on the network, replace the telephone with a later model having spade lugs on the network.
3. Connect After 1035C3A Connections.
4. Splice or Spare Unused Terminals As Appropriate.
5. Wires 6, 7, 8, 9, 11, 13 and T Not Used.
6. NO WIRES REMAIN ON TERMINAL "F" OF NETWORK.

Cable Routed
Through Opening
in PSB to
Terminals

Cable Clamp
Under PSB
Mounting Screw

Figure 16, TOUCH-A-MATIC Telephone Interface Cable Routing

TABLE F
Connections for Western Electric TOUCH-A-MATIC®
Telephones, Models 2870, 2872 and 2960

Model 2870   BSP 503-300-101   Model 2960   BSP 503-301-101
Model 2872   503-603-101

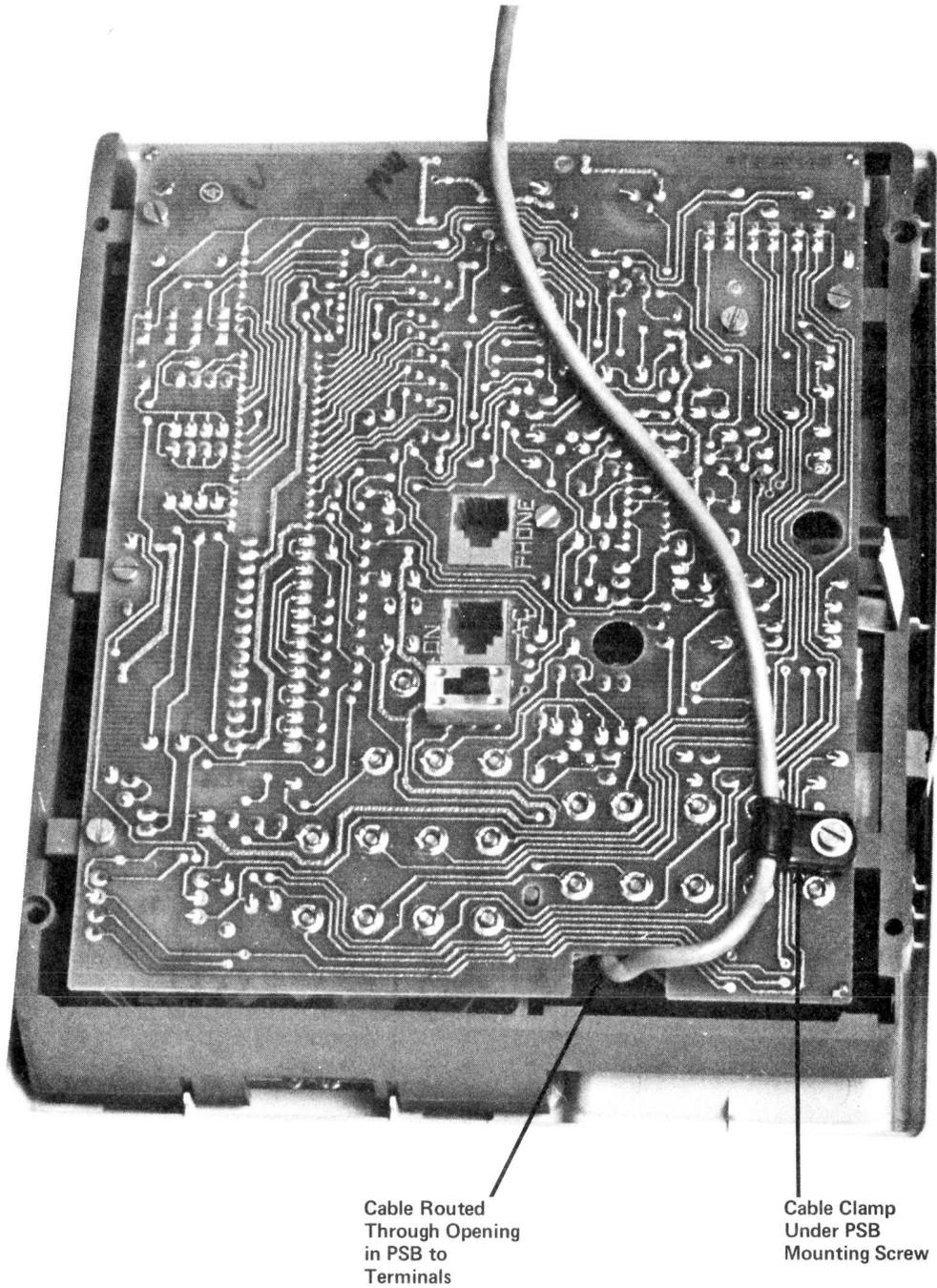| PROCEDURE |
|---|
| 1. | Disconnect power cord and tip and ring mounting cord from phone. |
| 2. | Remove faceplate and handset cradle. |
| 3. | Remove backing paper from adhesive side of cable tie clamp. Install clamp to rear surface of housing 1/2" from the bottom and 1/2" from the left-hand edge. |
| 4. | Remove the captive memory screws (4), lift memory to the right and rest it on the DTMF pad. |
| 5. | Route the spaded end of the interface cable through the rear cable mounting hole and to the left around the terminal board and the switchboard assembly. |
| 6. | Make the necessary interface cable connections as stated in Table D. Use the snap-on insulator provided in the mounting kit for the wire splice. |
| 7. | Secure interface cable to cable-tie clamp with the cable tie. |
| 8. | Replace the memory, handset cradle and faceplate, ensuring the interface cable is not trapped or stressed by the housing and switch-hook operation is free. |

PROCEDURE
1.	Disconnect power cord and tip and ring mounting cord from phone.
2.	Remove lower housing (4 screws).
3.	Remove upper housing. (3 screws under faceplate on the right and 1 screw under number plate.)
4.	Route interface cable (spade lug end in first) through rear mounting cord knockout in lower housing. Route cable through opening in power supply board as shown in Figure 16.
5.	Remove battery from battery compartment.
6.	Make the connections as defined in Table D. The splice is to be made using the snap-on insulator provided under the power supply board. The cable is then to be secured using the cable clamp provided as shown in Figure 16.
7.	Replace the lower housing.
8.	Replace the battery into the compartment and replace the upper housing. Verify that the hook-switch operation is free and the interface cable is not trapped or stressed.
9.	Replace the power cord and the tip and ring mounting cord.

Operation and Test Procedure

4.05 This procedure verifies operation of the VuSet terminal.

a) Connect telephone set to telephone line using standard plant practices.

b) Plug in VuSet power cord.

c) Set POWER switch in ON position.

d) Scattered characters may appear on the screen after 30 seconds; this is normal. Clear screen by depressing CLEAR switch and release.

e) Ensure that the DATA/TALK switch on display unit is in TALK position.

f) Pick up telephone handset and ensure dial tone is present.

g) Place call to VuSet test station.

h) On receipt of answerback tone, set terminal DATA/TALK switch to DATA position and leave handset off-hook.

j) Verify that DATA indicator lights steady.

k) Enter data via pushbutton pad according to the appropriate system procedures. Response will appear on CRT display.

l) Upon completion of call, replace handset onto the switch-hook. DATA indicator should now be extinguished.

NOTE: The DATA/TALK switch must be in the DATA position for communications with the computer. In the event you wish to use the telephone for voice communications, place the DATA/TALK switch in the TALK position.

VuSet Automatic Test Station (ATS)

4.06 A dial-up automatic test station for VuSet customers is available. It permits installers or repairmen to exercise a VuSet Terminal from a customer site or test bench. The automatic test station consists of a DS151A Data Station, a data set with echoplex character recognition system and a DTE simulator board.

4.07 The ATS data set is equipped with an echoplex feature which will permit a character recognition and return of all other TOUCH-TONE entries, which do not interact with the DTE simulator as the control characters # and * do. This permits selected manual testing of TOUCH-TONE inputs of characters 0 through 9 and their returned ASCII equivalents.

Figure 17, DTE Simulator Test Block Diagram

DTE Simulator

4.08 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.

4.09 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 from the DTE connector of the simulator channel location to the DTE connector of the data set to be tested. Figure 17 is a functional block diagram of the simulator test set-up.

4.10 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.

4.11 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 Figure 13 and Table B).

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 seize 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 character #. 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 18. 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 character *. A pattern of 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.
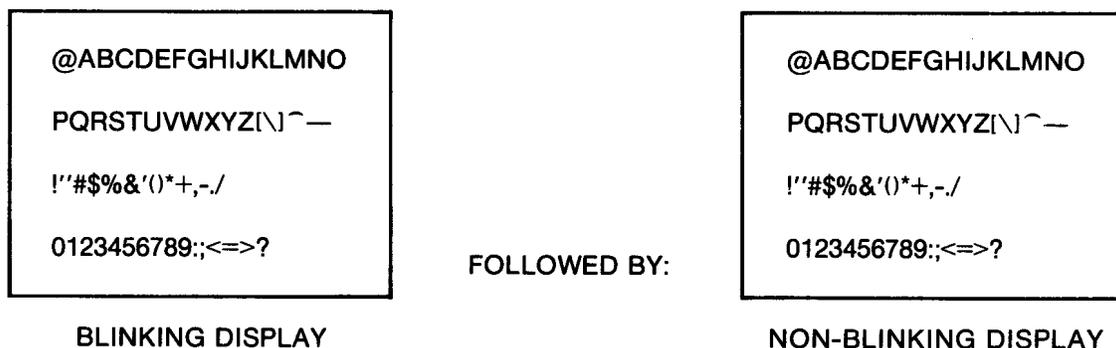

BLINKING DISPLAY FOLLOWED BY: NON-BLINKING DISPLAY

Figure 18, DTE Simulator and Automatic Test Station Test Message

Other Tests

4.12 Additonal testing of terminal, TOUCH-TONE pad and data set functions may be tested by setting the data set switch (S2) into DLB (digital loop back) mode. This disables the data set interface with the DTE or DTE Simulator.

Site Requirements, Customer Responsibilities

4.13 The following facilities are required at the user site:

a) Telephone line with a dual-tone multifrequency capability; or an auxiliary 12-button TOUCH-TONE pad must be attached to telephone set before attachment of interface cable. (See paragraphs 4.04)

b) Three-wire, single phase, grounded, 117V, 60-Hz power receptacle within reach of 8-foot power cord on display unit. Reference: National Electrical Code 1971, Chapter 8, Article 800—Communications Circuits.

c) Desk, table, or platform capable of supporting VuSet terminal and telephone set. Maximum separation between these units is four feet.

Site Requirements, TELCO Responsibilities

4.14 The DS150C and the DS151A are designed to operate on telecommunication lines that meet normal talking and ringing requirements.

TABLE G
Troubleshooting Guide

Initial Installation

Symptom	Cause	Action
1. Power Lamp off	1. Unit unplugged	1. Plug A.C. Power Cord into rear of VuSet and into 115AC receptacle.
	2. Power Switch off	2. Turn Power Switch on.
	3. Loose Fuse	3. Reseat Fuse Holder.
	4. Open Fuse	4. Replace Fuse
	5. Defective VuSet	5. Replace VuSet.
2. Alpha-numeric characters scattered across screen	1. Normal	1. Press Clear Switch.
3. Clear Switch will not clear Screen	1. Defective VuSet	1. Replace VuSet.

Operational

Symptom	Cause	Action
1. Tone heard in Handset Receiver but no Data Light	1. Data/Talk Switch in Talk Position	1. Put Switch in Data Position.
	2. Interface Cable unplugged	2. Push (do not twist) Interface Cable into receptacle in rear of VuSet.
	3. Interface Cable wired improperly	3. Verify connection per Installation Instruction para. 4.04.
	4. Defective VuSet	4. Replace VuSet.
2. No tone heard in Receiver	1. Incorrect phone number dialed	1. Verify phone number.
	2. System at other end down	2. Verify system operation.
	3. Defective Network	3. Replace Telephone.
3. DTMF pad does not operate after connection to Data Set has been established	1. Polarity reversal	1. Install Polarity Guard per plant practices.
	2. Defective dual-tone pad	2. Replace Telephone.
4. No data on Screen while data is being transmitted from the DTE (Listen to the Handset Receiver)	1. Loose Circuit Connectors in VuSet	1. Remove Housing, check Connections.
	2. Brightness Adjustment or Contrast Adjustment turned down	2. Adjust Brightness or Contrast Control.
	3. VuSet data rate setting different from Data Set and/or DTE	3. Set VuSet to correct data rate (see para. 4.02).
	4. Interface Cable problem	4. Check Interface Cable and telephone set connections for opens, shorts and proper terminals (see Table D).
	5. Defective VuSet	5. Replace VuSet.
5. Wrong message or characters on the Screen	1. Noisy telephone line	1. Hang up and redial the DTE or test facility.
	2. Intermittent Interface Cable	2. Inspect and replace Interface Cable as necessary.
	3. VuSet data rate setting different from Data Set and/or DTE	3. Set VuSet to correct data rate (see para. 4.02).
	4. VuSet improperly grounded	4. Ground the AC Power Connection (see para. 4.13).
	5. Defective VuSet	5. Replace VuSet.
6. Telephone will not operate for voice communications (Transmitter inoperative)	1. Data/Talk Switch in Data Position.	1. Place Data/Talk Switch in Talk Position.
	2. Interface Cable not connected to the rear of the VuSet	2. Connect Interface Cable to rear of VuSet (see para. 4.04).
	3. Defective Interface Cable	3. Replace Interface Cable.

5. ON-SITE TROUBLESHOOTING

General

5.01 Table G provides guidelines for analysis and correction of troubles that may occur in the VuSet terminal. This is intended solely for the purpose of correcting troubles that do not require field change-out of any parts. If suggested action does not correct the deficiency, remove and return the VuSet terminal for servicing. Additional trouble-shooting and maintenance instructions are available in the DS150C Data Terminal Maintenance Practice 11001-00.

5.02 The video display and indicator lamps are the key to quick and efficient trouble-shooting in the VuSet terminal to help identify a particular problem. Table G lists the trouble indications and the suggested action to correct or identify the problem.

Removal/Replacement

5.03 Before disassembly of equipment, set POWER switch on rear of the terminal to OFF position and disconnect power supply cord from 117-Vac main.

5.04 Proceed as follows if the entire VuSet terminal, including the interface cable is to be removed:

a) Following standard plant practices, disconnect the telephone from the line.

b) Follow, in reverse the installation procedure given in paragraph 4.04.

c) Following standard plant practices, re-connect the telephone to the line.

5.05 An alternative to the above procedure is to remove and replace entire units, including the telephone, by proceeding as follows:

a) Turn off power switch at rear of display unit.

b) Disconnect power supply cord from 117-Vac main.

c) Using standard plant practices, disconnect telephone being replaced from line and connect replacement telephone to the line.

d) Disconnect interface cable and power supply cord from rear of the terminal. See Figure 14.

5.06 If only the data terminal is to be replaced, proceed as follows:

a) Disconnect power supply cord from 117-Vac main.

b) Disconnect the interface cable from the rear of the terminal being replaced and set aside.

c) Connect interface cable to receptacle at rear of new terminal.

d) Connect power supply cord to receptacle at rear of new terminal.

e) Test new terminal per paragraph 4.05.

Transportation to Factory from User Site

5.07 Pack the equipment for transportation as follows noting that the telephone set might not be included. In any case, be sure to place the collar on top of the display unit to provide a tight fit in the packing container. (See Figure 12)

a) Set POWER switch in OFF position.

b) Disconnect power supply cord from main supply.

c) Disconnect power supply from display unit.

d) Using standard plant practices, disconnect telephone instrument from test line.

e) Disconnect interface cable from rear of display unit.

f) Place display unit between foam inserts in carton.

g) Place power supply cord in space provided alongside display unit.

h) Replace collar on top of display unit in carton.

j) Place telephone set with interface cable attached in collar zone of carton.

k) Tape carton closed.

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