"VUSET*" DUAL TONE MULTI-FREQUENCY (DTMF) SYSTEM DESCRIPTION AND OPERATION COMMUNICATION DISPLAY TERMINALS

1. GENERAL

1.01 This section covers the VUSET System method of communicating, over telephone lines, between a remote terminal and a local data station. This communication is by dual tone multi-frequency (DTMF) signalling entered through a TOUCH-TONE† telephone or an accessory pad. The data station and the computer communicate in character-serial ASC11 code.

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†Trademark of AT&T.

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

1.03 Descriptive information and operating procedures are contained in the attached reprint of the practice prepared by Plantronics, Inc.

PLANTRONICS
Santa Cruz

System Description and
Operation Practice
09069-01 March, 1979

VuSet® DTMF SYSTEM DESCRIPTION

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VuSet® DTMF SYSTEM DESCRIPTION

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 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.

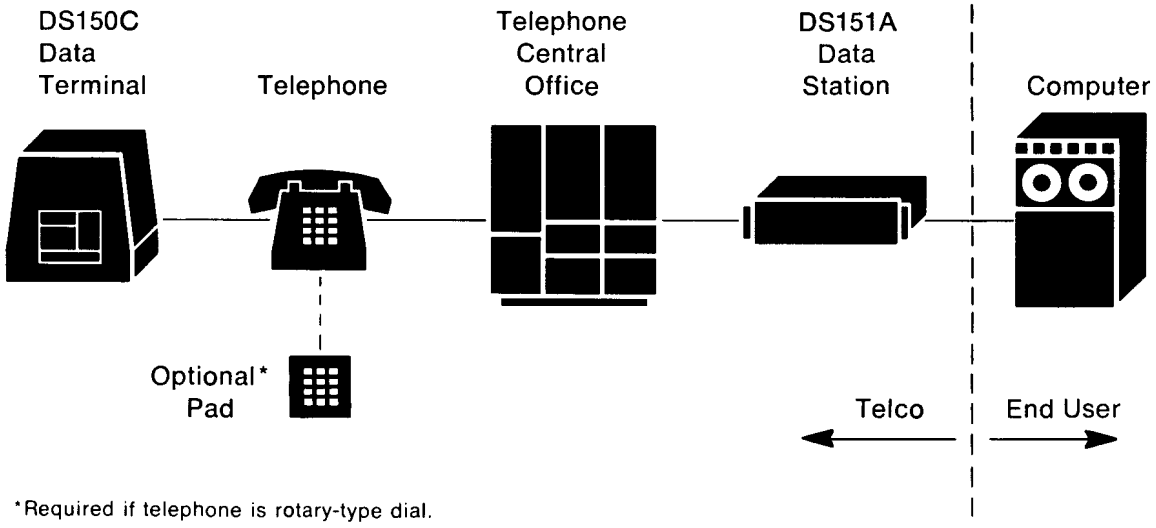
1.07 The interface between the data station and the computer conforms to EIA Standard RS-232-C.

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.



*Required if telephone is rotary-type dial.

Figure 1, Simplified VuSet System

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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 DATA/TALK switch in TALK 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.

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 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 ## 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

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 which is option switch selectable into 64 character format (four lines of 16 characters) or 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 (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 (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 @( ) />_ ! "#$%&'() *+,—./: ;<>=? SPACE	← FSK ← ASCII	A-Z 0-9 @( ) />! "#%&'() *+,—./: ;<>=? 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 switch selected CR or STX function character) from the computer.

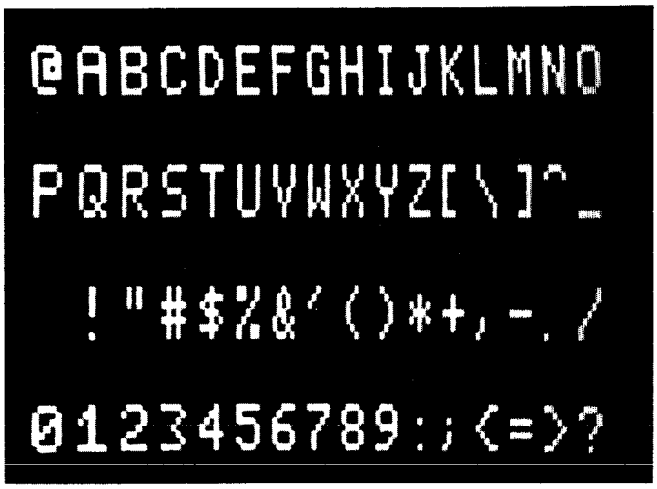

Figure 4, Display Repertoire

Data Terminal Specifications

2.14 *Data Specifications.*

Display Format:	5 x 7 Character dot matrix 64 characters (4 lines of 16 characters) or 128 characters (8 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 character/second) selectable at installation. Asynchronous operation.
Receive Level Sensitivity:	0 to -40 dBm (referenced to telephone line)

2.15 *Power Requirements*

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

2.16 *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)

2.17 *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)

3. DATA STATION DESCRIPTION

Station Description

3.01 The VuSet Data Station consists of the following principal assemblies. (See Fig. 5 & 6).

	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

3.02 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.

3.03 The Data Mounting measures 19 inches wide by 5-1/4 inches high by 23-1/2 inches deep and weighs approximately twenty pounds when all board locations are filled. It can be placed on a desk or shelf or rack mounted in either 19" or 23" racks.

3.04 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.

3.05 The rear panel (Figure 6) provides receptacles for connections to the computer and the telephone lines.

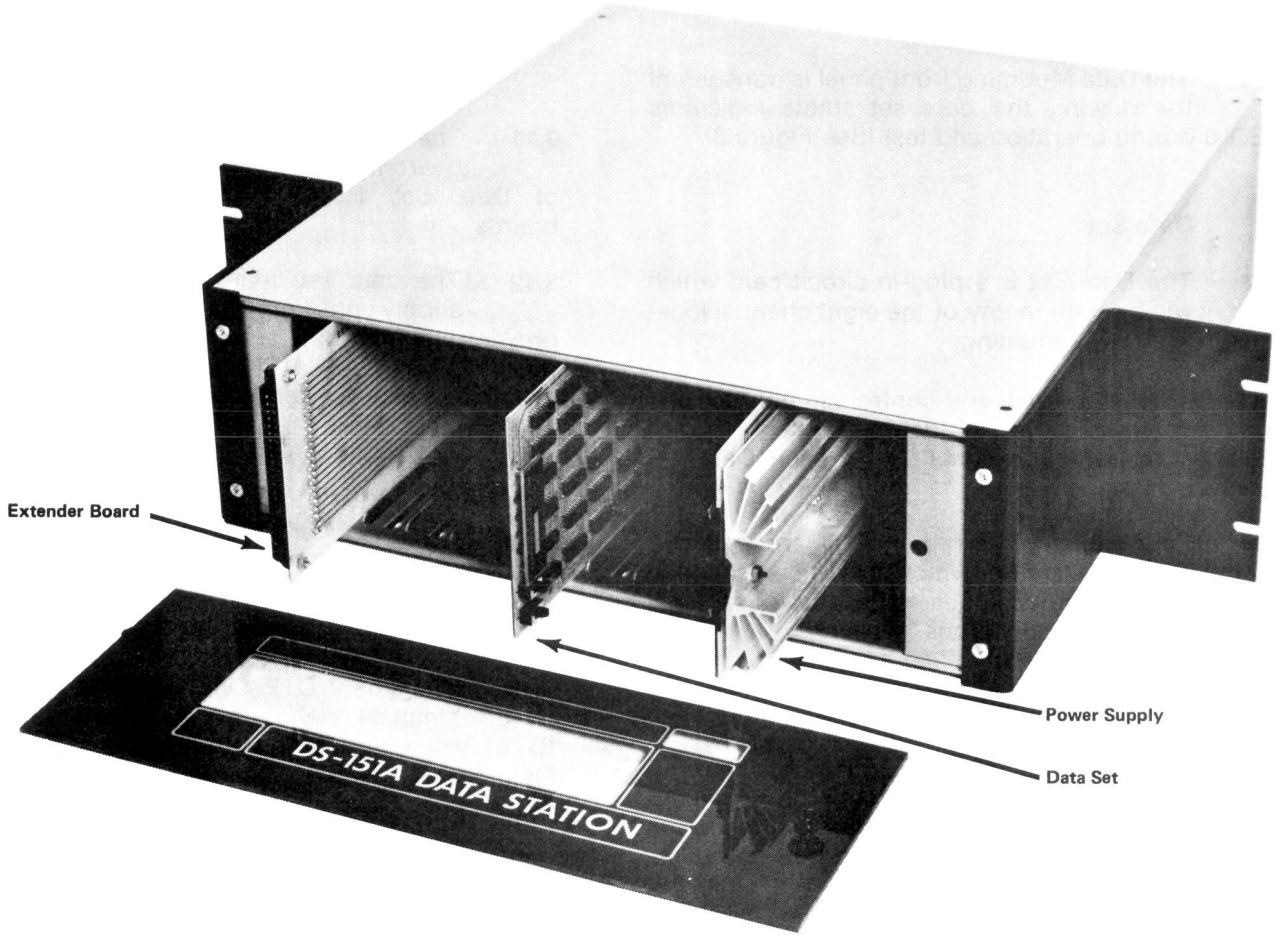

Figure 5, DS151A Data Station (One Channel Installation Shown)

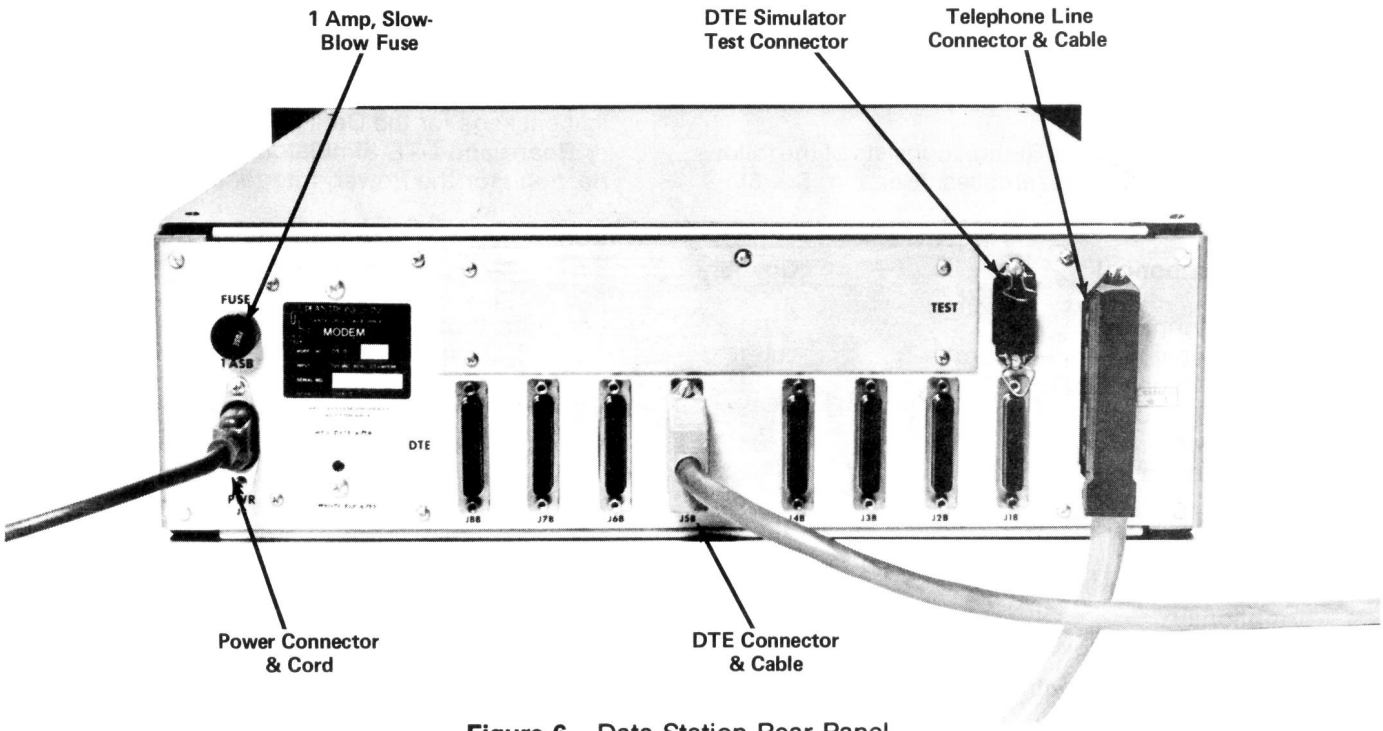

Figure 6, Data Station Rear Panel

3.06 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

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

3.08 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.

3.09 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

3.10 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

3.11 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.

3.12 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

3.13 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.

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

Status Indicators

3.15 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.

3.16 *Power Indicator.* This LED on the power supply board 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.

3.17 *Channel Indicators.* The four LED's on each data set board 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).

Data Station Specifications

3.18 *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: 900Ω ± 10%, ac coupled

f) DC loop resistance: 82Ω 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

3.19 *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: 900Ω ± 10%, ac coupled

f) DC loop resistance: 82Ω 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.

3.20 *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.

3.21 *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 delay: Character output to DTE 17 to 25 ms. after DTMF "OFF".

3.22 *Power Requirements*

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

3.23 *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.

3.24 *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)

3.25 *Data Station Options*

See Table B

TABLE B
Data Station Options

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

4. OPERATOR'S INSTRUCTIONS

System Connection

4.01 To connect the system to the computer, proceed as follows:

a) Set terminal POWER switch to ON position.

b) Verify that terminal POWER lamp lights.

c) Scattered characters may appear on the screen after 30 seconds; this is normal. Depress terminal CLEAR switch to clear the screen.

d) Set terminal DATA/TALK switch to TALK position.

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

f) Place call to required number.

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

h) Verify that terminal DATA lamp lights steady.

j) Use the TOUCH-TONE dial/pad to enter data as locally directed.

System Disconnect

4.02 To disconnect the system from the computer, proceed as follows:

a) Set terminal DATA/TALK switch to TALK position.

b) Place telephone handset on switchhook (hang up).

c) Depress terminal CLEAR switch to clear the display screen if desired.

d) The telephone can now be used for normal voice communications.

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