PLANTRONICS DS151A
*ComSet** MODEM
MAINTENANCE

1. GENERAL

1.01 This section is a cover sheet for the Plantronics/*ComSet* Modem DS151A Maintenance Manual 09072-00.

1.02 The *ComSet* DS151A-1M-1C Modem is a multiple mounting equipped with a cover. It may be placed on a table or shelf, or mounted in a 19-inch rack or cabinet. It comes equipped with a power supply board and one modem channel board. Slots will accept seven more modem channel boards (a total of eight channel boards per mounting).

Note: Space is also provided to store an extender board.

1.03 Each modern channel board connects one telephone line with one computer port through an E1A interface. The channel board provides unattended answering. It accepts "*Touch-Tone*®" signals from the line and converts them to 300 baud frequency shift keyed (FSK) ASCII signals. These are presented to the computer port and, when desired, can be transmitted back on the line to the visual data terminal. This echoplexing can be done either by the modem channel board or by the customer's computer. As transmission is half-duplex, the operator cannot send another character until the echoplexed character is received by the visual data terminal.

2. USOC CODE/CUSTOMER OPTIONS

ComSet Modem (USOC DM8++)

A. 1. Echoplex
   2. No Echoplex

B. 3. 300 Baud
   4. 150 Baud/110 Baud (See Note 1.)

C. 5. Even Parity
   6. Odd Parity

D. 7. EOT (##) Not transmitted to computer (immediate disconnects)
   8. EOT (##) Transmitted to computer

E. 9. CB lead is true "Clear to Send"
   10. CB lead goes on when both CC and CD leads are on (See Note 2.)

F. 11. Auto time-out set at 10 seconds
   12. Auto time-out variable 8 to 50 seconds (See Note 3.)

Notes:

1. 110 or 150 baud is entered in remarks.

2. Modem functions as RS-232-C but gives appearance of CB=CC to accommodate some computers.

3. Desired variable automatic time-out from 8 to 50 seconds is entered in remarks.

3. ORDERING–SERVICE/RETURNS

3.01 Factory repair service is provided by Plantronics on a repair and return basis.

3.02 All purchasing and returns is handled by Western Electric (WE).

3.03 Order Wording

(Qty) Modem, ComSet, Plantronics, DS151A-1M-1C

Maintenance Spares

(Qty) Board, Channel, Modem, Plantronics, 09092-00

(Qty) Assembly, Supply, Power, Modem, Plantronics, 09093-00

Tool

(Qty) Board, Extender, Plantronics, 09094-00

*Registered trademark of Plantronics, Incorporated

Attachment:
Plantronics/ComSet Modem DS151A Maintenance Manual 09072-00

PLANTRONICS

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REV A
APRIL 1975

PLANTRONICS/ComSet™ MODEM DS151A

MAINTENANCE MANUAL

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FIGURES

TABLES

1. GENERAL

Scope

1.01 This manual includes instructions for installation, operation and maintenance of Plantronics/ComSet DS151A Modem units. Section 1 provides a general description, information for equipment identification, and specifications. Section 2 contains installation instructions. Modem operation is outlined in Section 3. The principles of operation are discussed with block diagrams in Section 4 for the system and Section 5 for the circuit boards. Information for troubleshooting is provided in Section 6 which describes procedures for fault isolation to the replaceable subassembly level.

1.02 The DS151A is a part of the Plantronics/ComSet system for on-line data entry and inquiry/response between a central processor and remote terminals; e.g., DS150/DS150A series terminals. The system utilizes DTMF signaling from a pushbutton telephone at the remote terminal installation for inputs, and frequency-shift keying (FSK) for answerback from the modem to the terminal. Communication between the modem and the processor is in accordance with EIA Standard RS-232-C (reference 1). For a more detailed system description refer to Plantronics/ComSet System Description and Interface Specification (09069-00). Basic installation and operation instructions for the modem are provided in the Plantronics/ComSet Modem Installation and Operation Manual (09073-00).

Modem Description

1.03 The DS151A Modem is designed as the interface between the communications network and the data terminal equipment (DTE) in a data communications system using dial-up facilities (primarily), and may also be used on private line networks. It consists of a mechanical shelf assembly which houses and provides interconnection between communications lines, up to eight modem channel boards, and common power and timing circuitry.

Figure 1-1 shows a one-channel modem unit with the front panel removed. The power supply board provides the regulated power and reference oscillator frequency to all the channel boards in a modem shelf. All of the signal and control circuitry for one communications link is contained in each channel board assembly. Also shown is the optional extender board.

1.04 Communications connections are made with three types of connectors that plug into receptacles mounted on the rear panel (figure 1-2). Each channel installation requires a channel board, a connection to the DTE, and a connection to the network via either the telephone tip/ring (T/R) or a data access arrangement (DAA) type CBS. Eight sets of DAA and DTE receptacles are aligned in two rows, with each vertical pair corresponding to one of the eight channel positions. The incoming telephone T/R pairs are interfaced through the telephone line connector. Details of these interface connectors are given in 1.12.

1.05 The wiring between the board and the receptacles is performed by an interconnect assembly within the unit. The power and reference frequency drives from the power supply board are bussed to the channel baord connectors; the connectors (DAA, T/R, DTE) are directly wired to the corresponding channel board connector location. No wiring is required for installation or operation. Switch settings on each channel board allow for selection of functions. For a discussion of setup and alignment, see Section 2.

System Operation

1.06 The system employs dual-tone multifrequency (DTMF) signals from a pushbutton telephone at the remote terminal, frequency-shift keying (FSK) answerback signals to the remote terminals and EIA Standard RS-232-C (reference 1) signaling and data transfer between the modem and the DTE. (See Plantronics/ComSet System Description and Interface Specification 09069-00 for explanation of the EIA circuit functions and operations.) The modem communicates

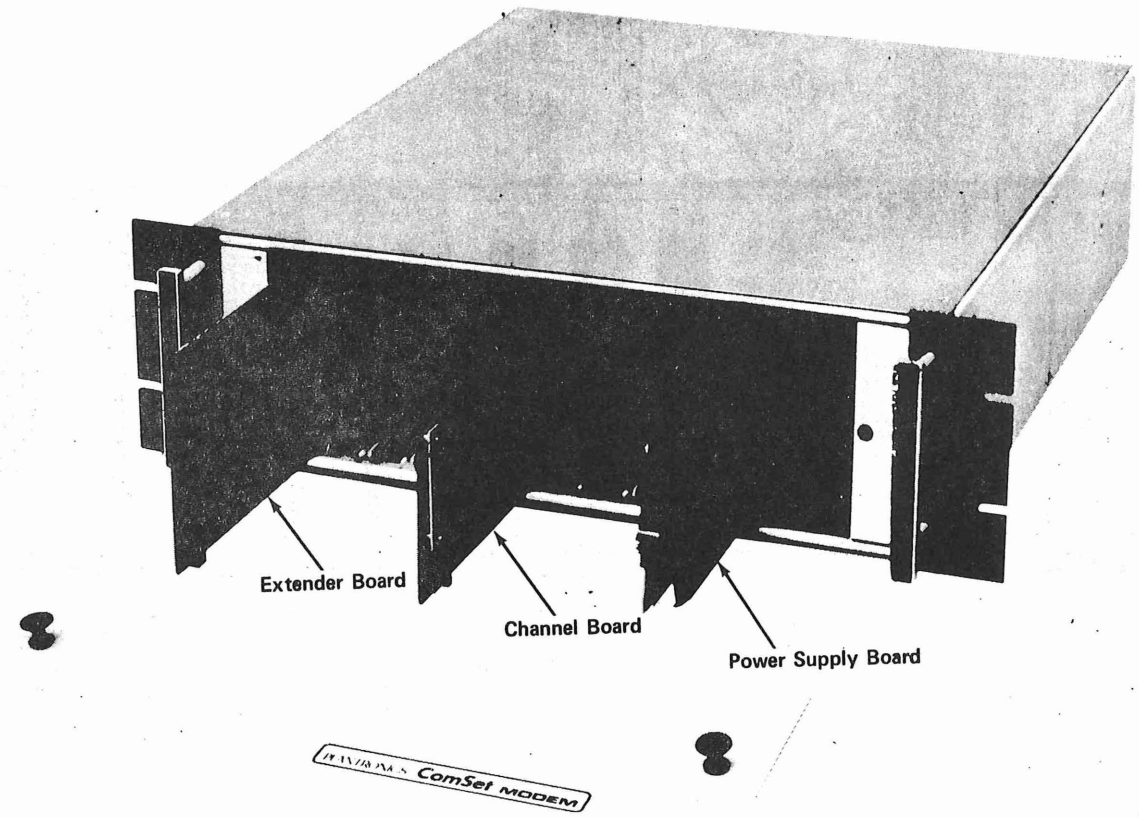


Figure 1-1. DS151A Modem (One Channel Unit)

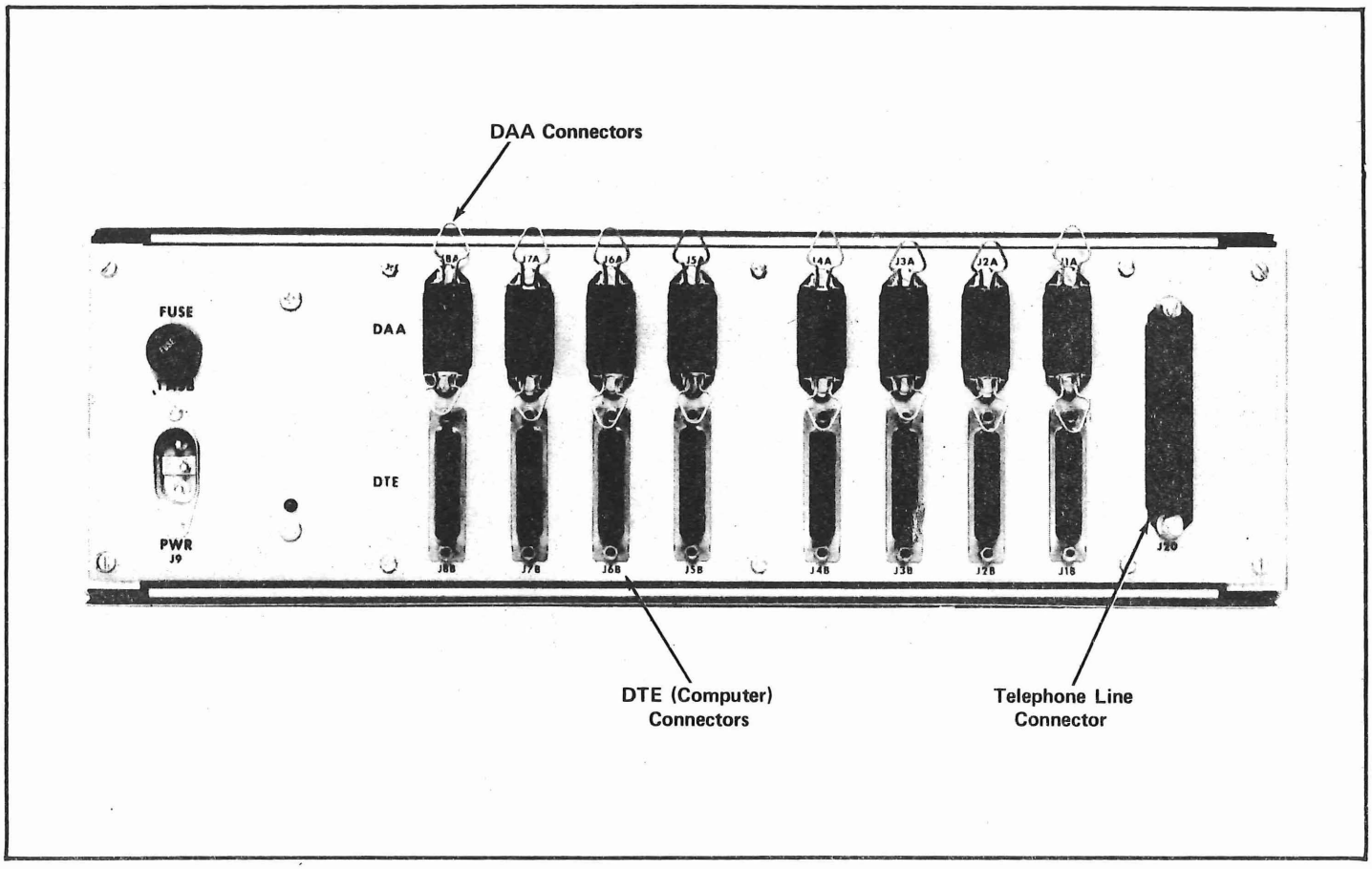


Figure 1-2. Modem Rear Panel

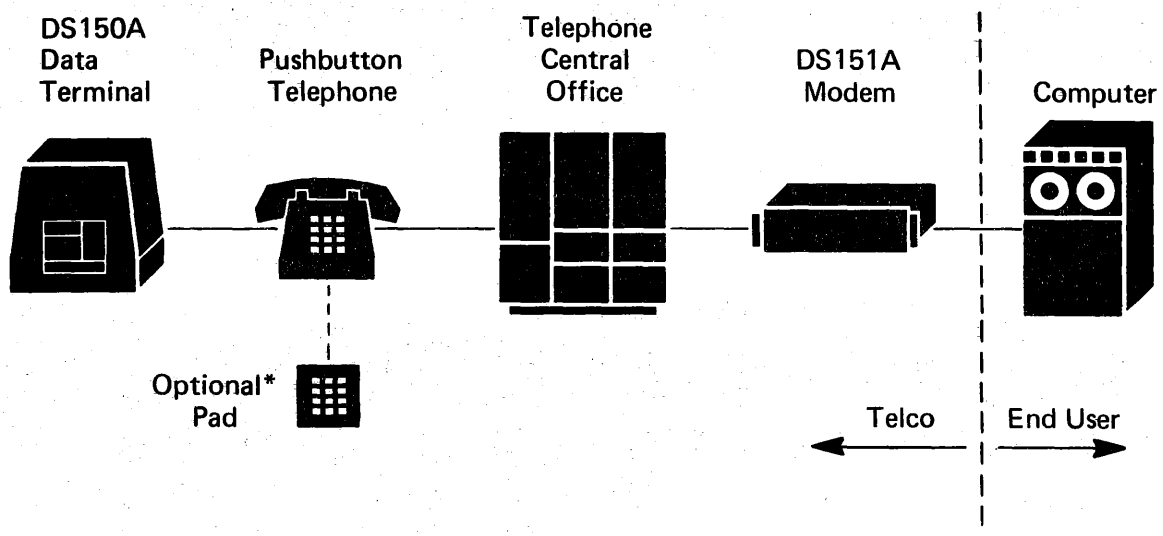
with the terminal through the phone lines accessed by either direct termination of T/R leads, or through CBS type DAA connections (conforming with specifications in Bell System Technical Reference PUB 41802). Figures 1-3 (a and b) are diagrams of typical installations. The line seize channel establishment and line disconnect procedures for the direct T/R and DAA interfaces are discussed separately.

1.07 Direct T/R Connection

(a) Line Seize. The modem seizes the line to answer incoming telephone calls by internal sensing of ringing on T/R. The DTE (computer) must provide CD (Data Terminal Ready) ON for the circuits to function. The line seize circuits may also be operated by setting a switch (S1) on the channel board. This is an overriding control to "Busy Out" that line, or to hold the line permanently seized.

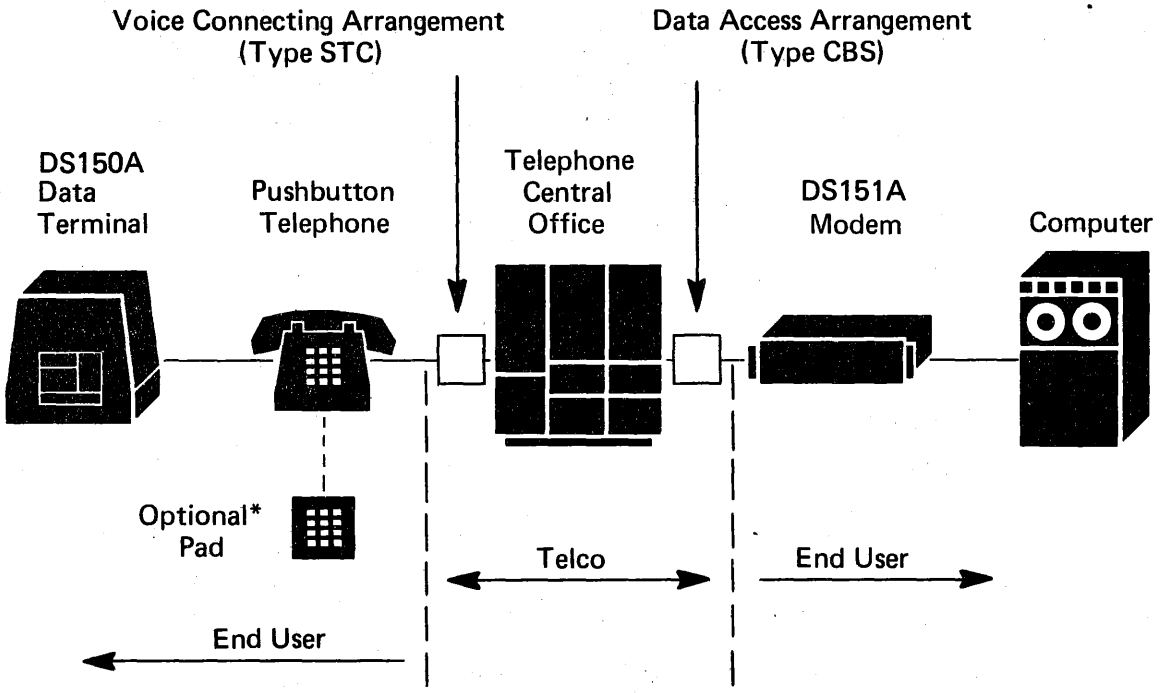
(b) Channel Establishment. After line seize the modem delays 2 seconds and then sets CC (Data Set Ready) and CF (Carrier Detect) ON. The remote terminal is then signaled by a continuous MARK tone (2225 Hz) to indicate that channel establishment has occured and data transmission may begin. At the DTE (computer) side, the CC and CF obtained above indicate that the channel is set up. The DTE may respond with CA to indicate that it is ready to transmit data as available.

(c) Line Disconnect. The modem channel (unless set to "Busy Out") is disconnected from the line by any one of three conditions: CD turned "OFF" (by DTE), or optionally two consecutive "#" entries from the remote terminal (see Section 2), or finally, automatic time-out (no signals from either side for a preset interval).



*Required if telephone is rotary-type dial.

Figure 1-3(a). Simplified System Diagram (Telephone Company Provided)



*Required if telephone is rotary-type dial.

Figure 1-3(b). Simplified System Diagram (End User Provided)

1.08 DAA Connection

(a) Line Seize. Upon receipt of RI (Ring Indicator) from the DAA, the modem responds with OH (Off Hook) allowing the DAA to seize the line. The DTE must provide CD (Data Terminal Ready) ON for the circuits to function. The line seize circuits may also be operated by setting a switch (S1) on the channel board. This is an overriding control to "Busy Out" that line, or to hold the line permanently seized.

(b) Channel Establishment. The DAA sets CCT (Coupler Cut Through) ON after seizing the line. The modem delays two seconds and generates CC and CF ON to the DTE and 2225-Hz MARK tone to the remote terminal. The DTE may then respond with CA to indicate that it is ready to transmit data as available.

(c) Line Disconnect. The modem channel (unless set to "Busy Out") is disconnected from the line by any one of three conditions: CD turned "OFF" (by DTE), or optionally two consecutive "#" entries from the remote terminal (see Section 2), or finally, automatic time-out (no signals from either side for a preset interval).

Channel Functions

1.09 Each channel board of the DS151A modem provides all the signaling functions for two-way half duplex communications between remote terminals over phone lines, and interfaced central processors. Figure 1-4 is a functional block diagram of a modem channel. The line and supervisory control circuits manage the mentioned 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. The hybrid is required for

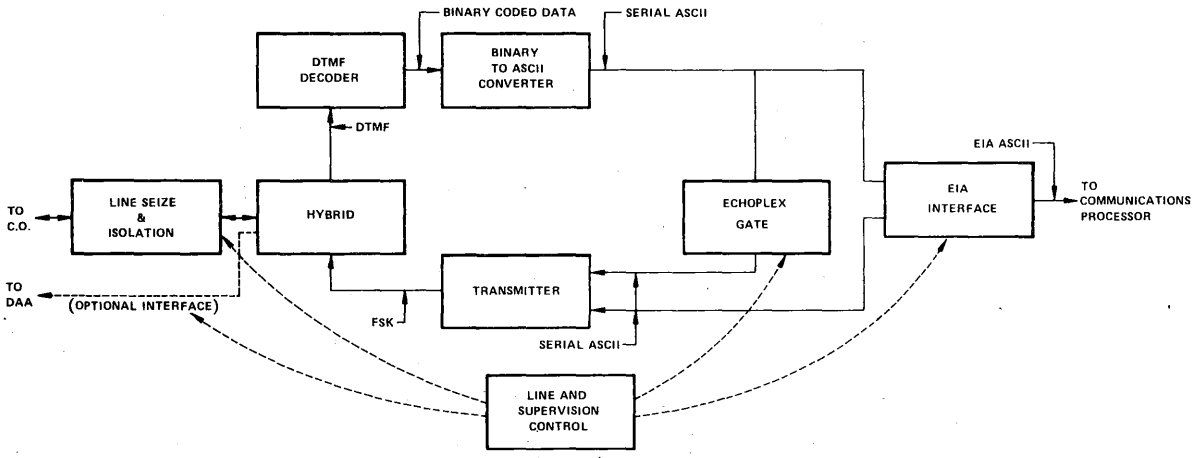


Figure 1-4. Functional Block Diagram of Modem Channel

separating the FSK and DTMF signal paths for two-way communications between terminal and modem. The receiver consists of DTMF decoder and ASCII converter stages; data obtained is sent to the DTE via the EIA interface. If the EPX switch is ON, the data is also enabled to key the transmitter, thereby generating FSK signals for repeating (echoing) the input character back to the remote terminal. Serial ASCII from the DTE is accepted by the EIA interface to key the transmitter. The FSK signals generated are coupled to the phone line via the balanced hybrid, which also contains a line matching resistor.

Status Indicators

1.10 System status is indicated by LEDs mounted at the front edge of each board, visible when the front panel is removed.

(a) Power Indicator. This LED on the power supply board when ON indicates the validity of both (+12 Vdc) power and reference oscillator outputs.

(b) Channel Indicators. The four LEDs on each channel board represent the following:

A Detection of A group DTMF tones
B Detection of B group DTMF tones
CD Data Terminal Ready Signal from the DTE
CC Data Set Ready to the DTE

Interface Connections

1.11 Connection of the computer and the telephone line to the modem is provided for by receptacles mounted on the rear panel. There is one shared receptacle for up to eight pairs of telephone line connections, one receptacle per channel for the computer connector, and one receptacle per channel for an optional DAA connection. These are as follows:

(a) Computer Connector. The computer receptacle is a Cinch DB-19604-433 or equivalent. The cable from the 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 be less than 50 feet in length.

(b) Telephone Line Connector. This connector is a 25-pair AMP Champ 229974-1 or equivalent. The cable from the telephone lines should terminate with an AMP Champ 2-552001-1 or equivalent (not supplied by Plantronics).

(c) DAA Connector. The DAA receptacle is an Amphenol type 57-40140 or equivalent. The cable from the DAA should terminate with an Amphenol type 57-30140 or equivalent. An optional 25-foot DAA cable is available from Plantronics.

Specifications

1.12 Input Signal From Remote Terminal

(a) Format: DTMF (2 of 7 A,B tones; 12 combinations)

(b) Allowable input levels: -40 dBm to 0 dBm

(c) Repetition rate: 10 characters/second maximum at 300 baud (one character/100 milliseconds)

(d) Input impedance: 900 ohms ±10%, ac coupled

(e) Dc loop resistance: 82 ohms at 120 mA maximum

(f) Character recognition time: 12 to 18 milliseconds

(g) Frequency (A or B) recognition bandwidth: ±2% nominal; ±3% maximum

(h) Allowable input amplitude difference: F_A-F_B=6 dB (nominal); F_A-F_B=12 dB (maximum)

1.13 Output Signal to Remote Terminal

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

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

(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 ohms ±10%, ac coupled

(f) Dc loop resistance: 82 ohms at 120 mA maximum

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

(h) Echoplex data rate: 110, 150, or 300 baud (switch selectable)

(i) Disconnect Time-out: 8 to 50 seconds (continuously adjustable)

1.14 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

(c) Signal to in-band (2125 Hz ±400 Hz) non-coherent noise immunity: 6 dB (minimum)

(d) Signal to out-of-band (300 - 1740 Hz; 2600 Hz and up) noise immunity: -20 dB (minimum)

1.15 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 30 to 40 ms after DTMF "OFF".

1.16 Power Requirements: 117 Vac ±10%, 60 Hz, 10 watts maximum

1.17 Physical Characteristics

(a) Shelf dimensions: 19 inches wide
5-1/4 inches high
20-3/4 inches deep

(b) Shelf weight: approximately 20 pounds fully loaded

(c) Shelf capacity: up to eight individual modem channels, one extender board, one power supply board

1.18 Operating Environment

(a) Temperature: $0^{o}C$ to $50^{o}C$ (operating)
$-10^{o}C$ to $65^{o}C$ (storage)

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

(c) Altitude: 10,000 feet maximum

2. INSTALLATION

2.01 This section covers shipping and receiving, rack mounting and preparation for operation.

Unpacking and Inspection

2.02 Damage occurring 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 Warranty and Service Policy see Section 8.

Storage and Shipment

2.03 To protect the equipment during storage or shipment, use the best packaging methods available. A recommended method is described below.

(a) Cover the equipment with a protective wrapping.

(b) 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.

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

Site Requirements

2.04 The following facilities are required where the modem is to be installed:

(a) Access to the communications network (DAA or T/R)--25 feet maximum distance to the DAA.

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

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

(d) Three-wire 117V, 60-Hz power receptacle within reach of the 8-foot power cord supplied with the modem.

Mounting

2.05 Before installation, equipment should be checked to verify that it includes the required circuit cards and options (mounting positions of the circuit cards in the unit are shown in figure 1-1). Remove the snap-on front panel of the shelf and verify receipt of:

(a) One modem channel board, 09092-00, (figure 2-1) for each communications channel up to a maximum of eight.

(b) One power supply board, 09093-00, (figure 2-2).

(c) One optional extender board, 09094-00, used for test purposes.

(d) Optional 25-foot DAA cables (included in shipping container, if ordered).

2.06 The DS151A modem occupies three vertical mounting spaces on a standard 19-inch rack or cabinet. Overall dimensions are 19 inches wide by 5-1/4 inches high by 20-3/4 inches deep; maximum weight is about 20 pounds. The shelf can also be installed on a table, shelf, or other horizontal surface. For a stand-alone type installation, an optional cover kit, 09095-00, is available. Power and signal connections are made on the rear panel.

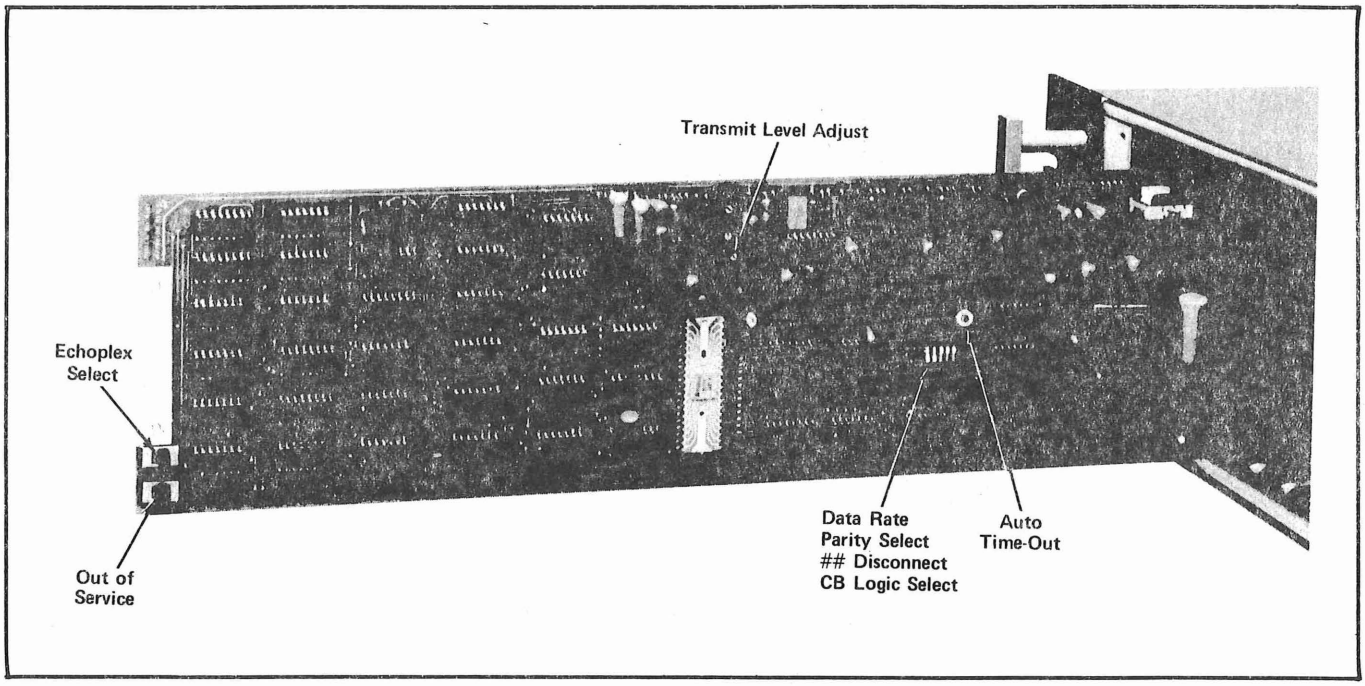


Figure 2-1. Modem Channel Board (Shown Mounted on the Extender Board) (See Table 2-4 for explanation of selectable functions.)

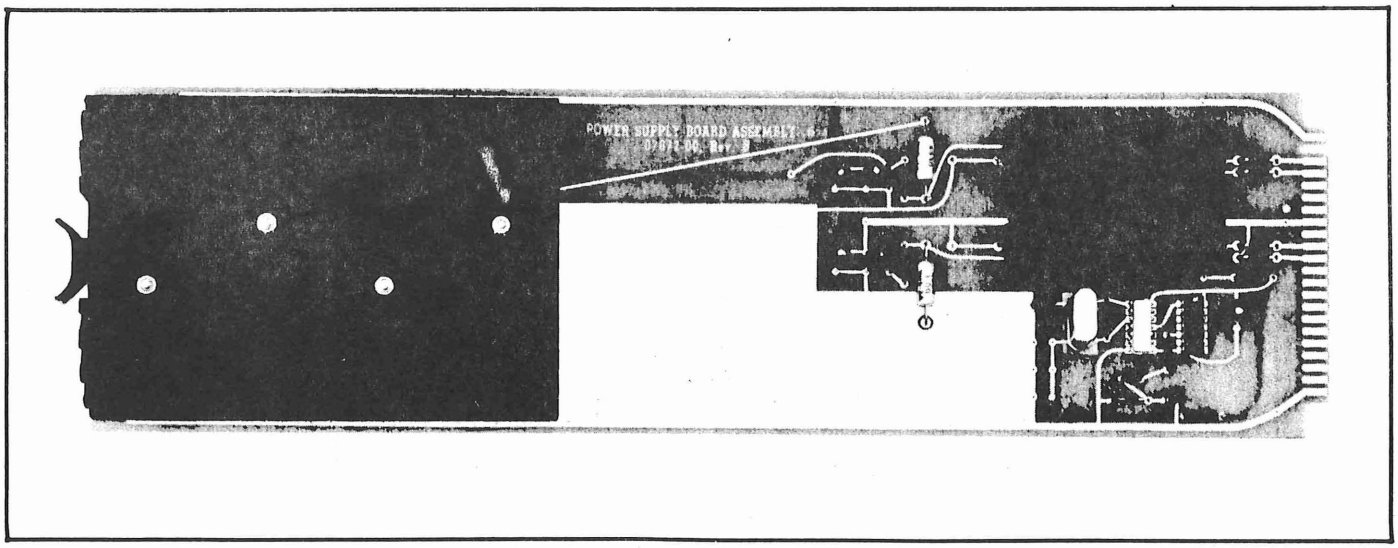
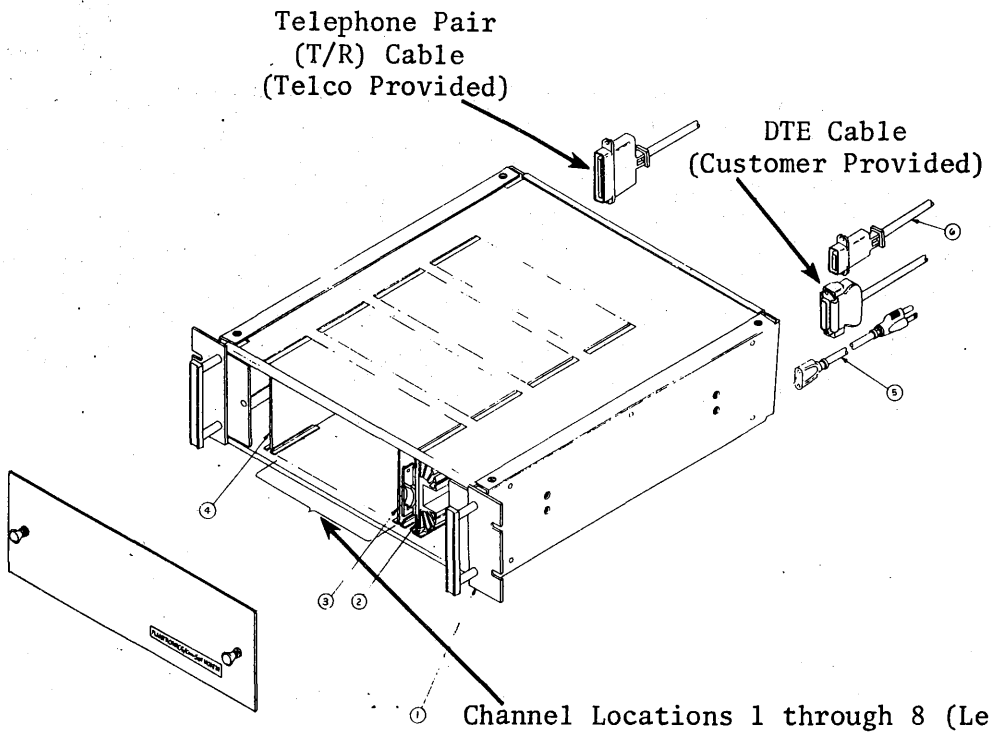


Figure 2-2. Power Supply Board



COMSET MODEM DS151A SPARE PARTS LIST			
No.	Description	Manufacturer Part Number	Order Spare As:
1	Modem Shelf Assembly	07750-00	07750-00
2	Power Supply Board	07872-00	09093-00
3	Channel Board	07748-00	09092-00
4	Extender Board (optional)	07839-00	09094-00
5	Power Cord	07779-00	07779-00
6	DAA Cable (optional)	07769-00	07769-00
7	Fuse (1 amp, slow blow)		

Figure 2-3. Typical (one-channel) Modem Installation

Installation

2.07 Figure 2-3 shows a typical one-channel modem installation; the procedure described here is applicable for all installations. Select one of the eight channel positions available and make a note of that number (N). The channel connections are given in table 2-1.

2.08 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 shelf closest to the power transformer (mounted on the inside rear panel) with the heatsink facing that side. The channel boards plug into the next eight slots, and the last connector is a dummy position to store an extender board. Make sure that the channel board is in the correct position for the selected channel position (N).

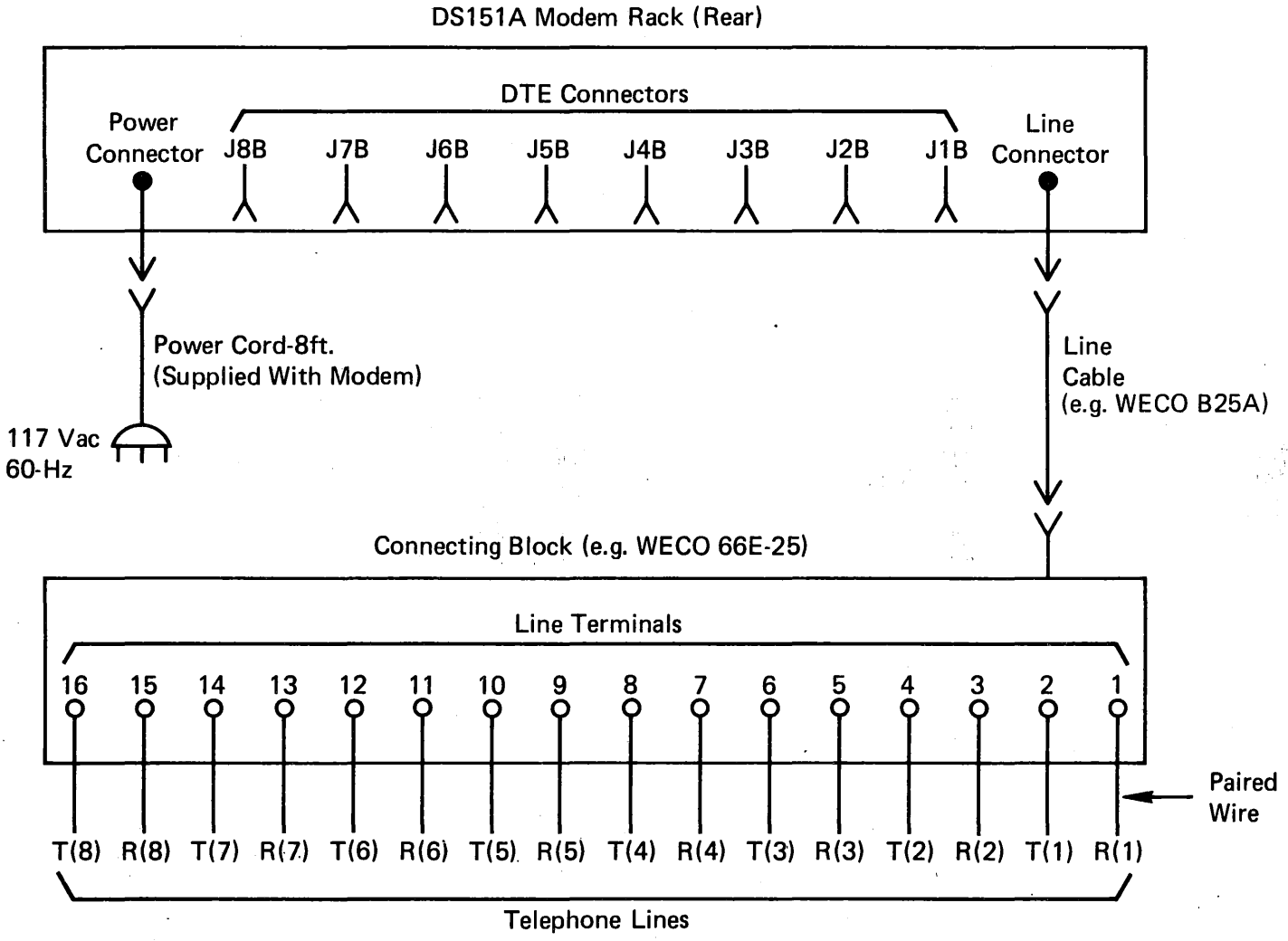
2.09 On the rear panel (figure 1-2) install the power cord (DO NOT CONNECT TO MAINS). Check the fuse (1A slow blow).

2.10 Connect the computer cable to the DTE receptacle with the selected number J "N" B.

2.11 Determine the access arrangement to be used for connection to the telephone network. (Section 1.11 specifies connector mating types).

(a) If direct T/R termination is to be used, connect cable (not provided by Plantronics) from connector block to J20 using pin assignments given in table 2-1.

Table 2-1. DS151A Modem Interconnect Diagram.



Modem Line Connector Pair Assignments:

Modem Channel Number*		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

*Channel Number (Or Position) 8 Is The One Nearest The Power Supply Board.

NOTE: DAA connectors on the modem rear panel (not shown here) are J1A through J8A for channels 1 through 8 respectively. See table 2-2 for DAA connector pin assignment and table 2-3 for the DTE pin assignment.

Table 2-2. DAA Connector Signals and Pin Assignment

DS151A Modem Connector Pins	DAA CBS Terminal	I/O[1]	Function
9	DT	I/O	Data Tip
10	DR	I/O	Data Ring
7	OH	O	Off-Hook
5	DA	O	Data Access
8	RI	I	Ring Indicator
4	SG	---	Signal Ground
6	CCT	I	Coupler Cut Through

[1] Input or output with respect to the modem.

Table 2-3. DTE Connectors: Signals and 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
18	EPX[3]	I	Echoplex
20	CD	I	Data Terminal Ready
22	CE	O	Ring Indicator
25	LTV	---	Loop Test Voltage (+12V)

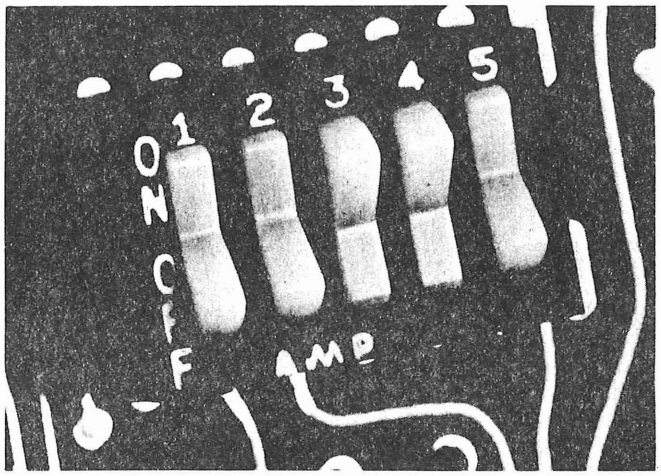
[1] Input or output with respect to the modem.

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

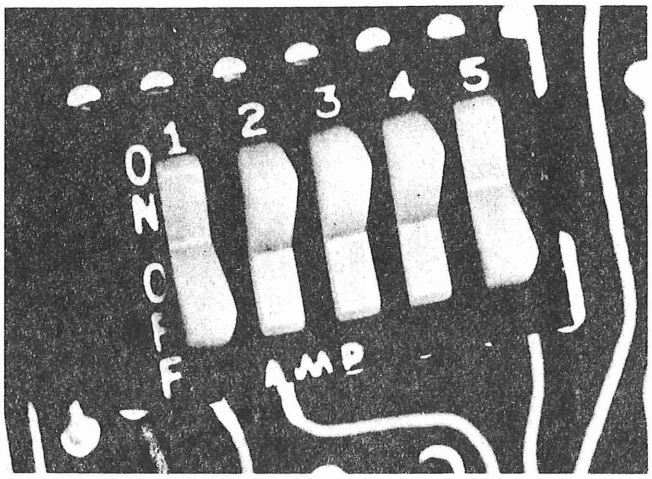
[3] See Selectable Functions.

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

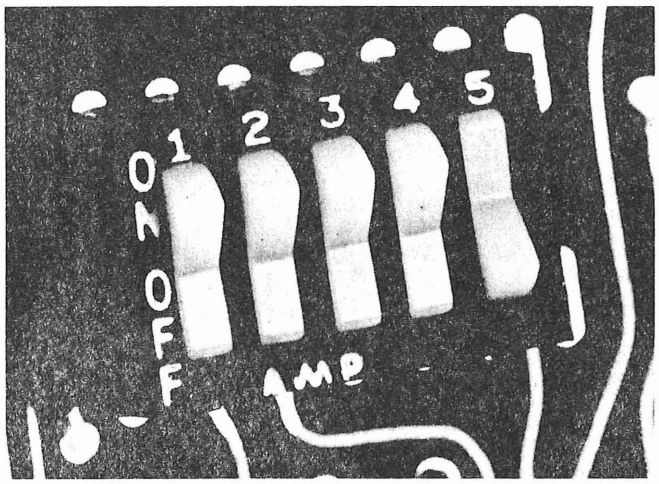
* Signals will be recognized as "1", "Mark", or "OFF" when the voltage is more negative than -3.0V. Signals will be recognized as "0", "Space", or "ON" when the voltage is more positive than +3.0V. Signals in the transition region between -3.0V and +3.0V are not uniquely defined. All voltages are measured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



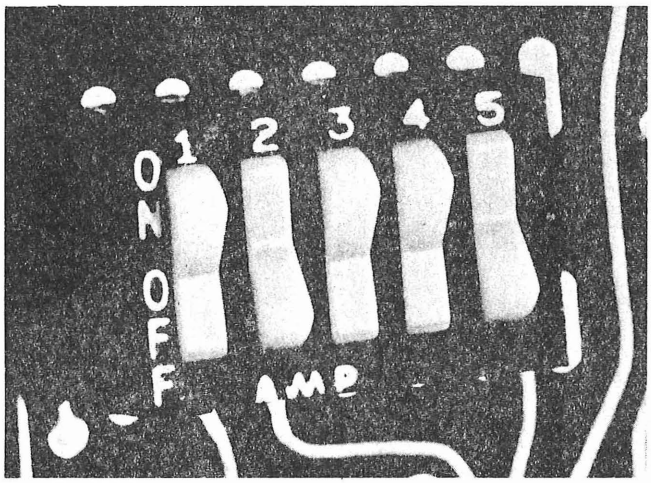
300 Baud



150 Baud



110 Baud



150 Baud

Figure 2-4. Data Rate Selection

Table 2-4. Channel Board Selectable Functions. (See System Description and Interface Specification (09069-00) and Section 6 of this manual for detailed description of options.)

FUNCTION	SWITCH NUMBER	SWITCH POSITION	RESULTING CONDITION	COMMENT
Out of Service	S1	Dot Showing No Dot	Auto Answer	-Direct Connection or through DAA. -Appears Busy to Dial-up Line. Permanently ON to Private Line Circuit. (No Time-out in Effect)
Echoplex (EPX) Select	S2	Dot Showing No Dot	Auto Echoplex External Control	---------- -EIA Interchange Circuit EPX (Pin 18) can be used to control Echoplex. EPX "ON" - gives Echoplex. EPX "OFF" - No Echoplex
Data Rate	S3-1 and S3-2	Both ON One ON, One OFF Both OFF	300 Baud 150 Baud 110 Baud	-Factory Set Position. ---------- ----------
Parity Select	S3-3	OFF ON	Even Parity Odd Parity	-Factory Set Position. ----------
##Disconnect	S3-4	OFF ON	No Disconnect By Modem Immediate Disconnect	-EOT Transmitted to DTE. -No EOT Transmitted to DTE.
CB Logic Select	S3-5	ON OFF	CB=True "Clear to Send" CB Goes ON When Both CC & CD Are ON	-Per EIA RS-232-C. -Modem functions as RS-232-C but gives appearance of CB=CC to accommodate some computers.
Auto Time-Out	R56	Screw Adjustment	Continuously variable from 8 sec to 50 sec.	-Factory set at 10 sec (nominal). Clockwise rotation increases time-out delay. Approximately 10 sec per rotation. 4 turns maximum.
Transmit Level Adjust	R139	Screw Adjustment	Continuously variable -28 dBm to +5 dBm	-Factory set at -3 dBm nominal. Clockwise rotation increases gain.

(b) If the DAA is to be used, connect the DAA cable to the receptacle J "N" A for the channel to be used (i.e., channel "N"). Also, an 1800-ohm resistor should be strapped across the DT and DR terminals of the DAA. The optional Plantronics DAA cable includes this matching resistor.

Setup and Alignment

2.12 There are two adjustment controls and six switch settings on each channel board. Factory settings and their functions are given in table 2-4. Data rate selection is shown in figure 2-4. If any adjustments are required to be made at the time of installation, refer to Section 6 for additional (maintenance) information.

2.13 Verify that the channel board with required setup is installed on the proper location (2.08) and that the communication connectors are properly made (2.10 and 2.11).

2.14 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.

2.15 Replace the snap-on front panel. Mounting the unit in the rack completes the installation of the DS151A modem.

3. OPERATION

3.01 The DS151A modem unit is designed for unattended operation, and has no operating controls. In operation, system status is indicated by LEDs mounted at the front edge of each board, visible when the front panel is removed. With the modem unit installed as in Section 2 and the system connected as in figure 1-3 (see Plantronics manual 09069-00 for details) the indicators display system status as described below.

3.02 Power Indicator. This LED on the power supply board works from the +12V regulated supply and is driven by the 120-kHz reference. Thus, when ON it indicates the validity of both (+12 Vdc) power and reference oscillator outputs.

3.03 Channel Indicators. These four LEDs on each channel board work as follows:

(a) A - represents detection of A group DTMF tones

(b) B - represents detection of B group DTMF tones

(c) CD - represents the Data Terminal Ready Signal from the DTE (computer). This must be ON for the channel to operate.

(d) 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).

4. MODEM SHELF OPERATION

4.01 This section outlines the functional operation of the DS151A modem shelf, with primary emphasis on the system interconnections. Details of the installation are given in Section 2 and circuit board functions are given in Section 5.

Internal Connection

4.02 The DS151A modem provides all the signaling functions for up to eight channels of two-way (half duplex) communications between remote terminals over phone lines, and interfaced central processors. The design is modular; i.e., the circuitry for a complete channel is contained in one plug-in channel board. The shelf assembly provides housing and interconnection, and is also used to mount the power transformer. The secondary ac power is converted to regulated dc power for

all eight channels by circuitry on the plug-in power supply board, which also includes the reference oscillator. Figure 4-1 shows a simplified block diagram of the boards and the interconnection provided by the shelf.

External Connections

4.03 The modem communicates with remote terminals over telephone lines accessed by direct termination of T/R leads or optionally via a CBS type DAA. For modularity, receptacles for both ports are provided for each channel, although only one would be used at a given installation, (as per Section 2). The modem communicates with the computer interface directly through the DTE connectors.

Operating Sequences

4.04 Phone Answering and Line Seize

The modem seizes the line for any one of three conditions:

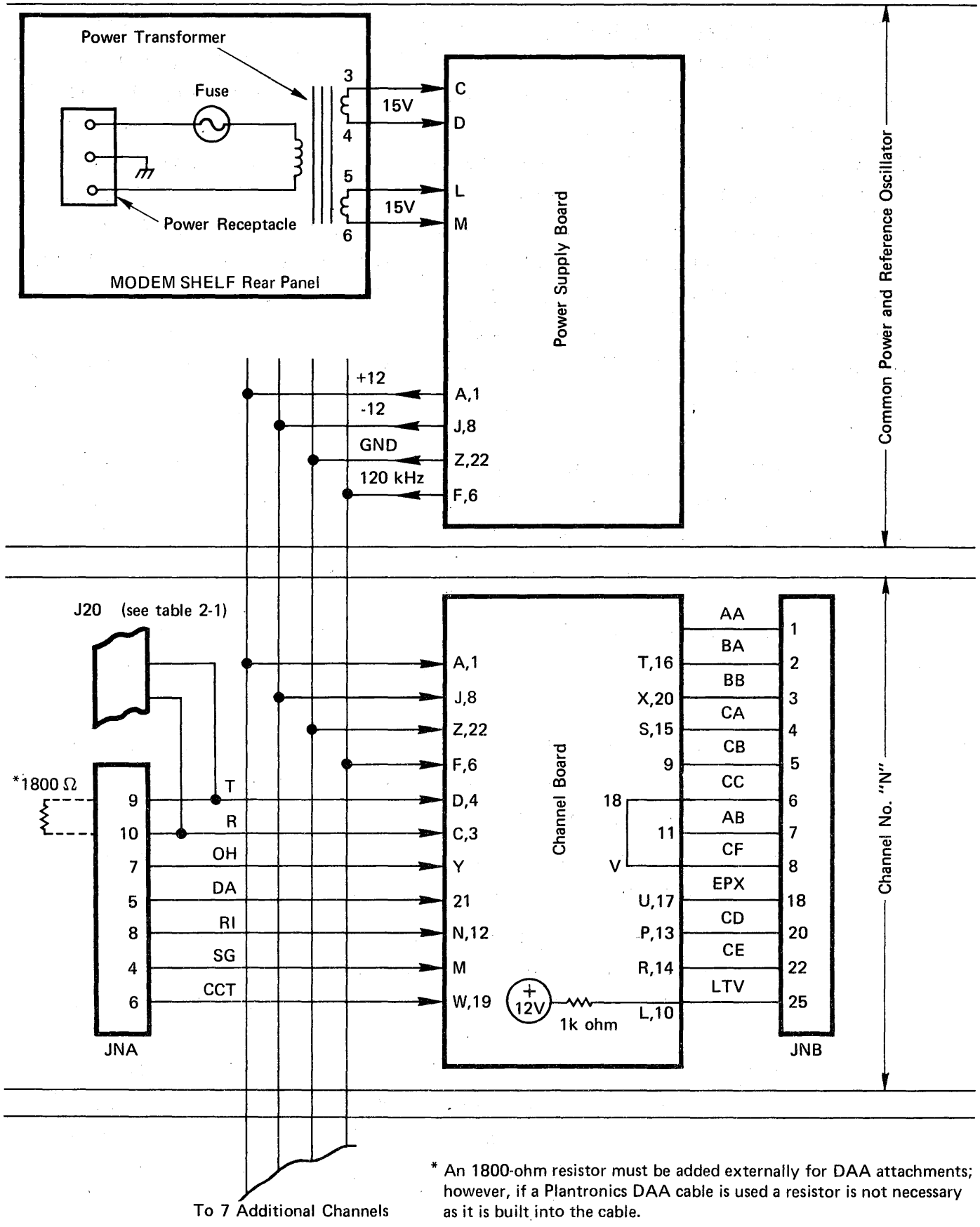
(a) Sensing of ringing on T/R for direct termination port (J20).

(b) Receipt of RI from external DAA for DAA ports (J1A through J1B).

(c) Overriding "Busy Out" setting of S1.

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

The modem generates CE (Ring Indicator) when either ringing on T/R of a direct line is sensed or RI from DAA connection is received. The CE generated follows the applied ringing cycle. This triggers line seize by the modem, as does the setting of S1 to ON.



* An 1800-ohm resistor must be added externally for DAA attachments; however, if a Plantronics DAA cable is used a resistor is not necessary as it is built into the cable.

Figure 4-1. DS151A Modem Shelf Interconnection Diagram

4.05 Channel Establishment. A two-second delay is provided after line seize before OH (Off-Hook) and DA (Data Access) are generated. The DAA provides CCT (Coupler Cut Through) with this delay; alternatively, on direct T/R termination, internal OH is delayed by two seconds. In either case, the circuit generates CC (Data Set Ready); CC is strapped directly to CF (Carrier Detect). The remote terminal is then signaled by a continuous MARK tone (2225 Hz) to indicate that channel establishment has occurred and data transmission may begin. To the DTE (computer) the CC and CF indicate that the channel is established to exchange data. The DTE may respond with CA to indicate that it is ready to transmit data as available.

4.06 Terminal Communications to Computer. The sequences for terminal data inputs and modem responds are as follows: (See Figure 5-3 and paragraphs 5.08 and 5.09 for modem timing and processing details)

(a) DTMF pushbutton is actuated, generates DTMF on telephone lines and is received by the modem (5.08).

(b) When the pushbutton is released, DTMF is removed from the lines. The modem delays data transmission approximately 40 ms (5.09).

(c) After this delay the ASCII equivalent character is transmitted to the computer.

(d) If the Echoplex (EPX) switch, S-2, is ON, the input character is also repeated back simultaneously in FSK over the line to the remote terminal.

NOTE: The reason for the 40-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 80 to 100 ms per character (including approximately a 12 to 18 ms DTMF recognition time, the 40-ms transmission delay and a 33-ms character transmission time at 300 baud and a small DTMF stabilizing and settling time). Transmissions at 110 baud lengthens the character transmission time to roughly 100 ms which increases this minimum input time.

4.07 Computer Communications to Terminal. This follows the EIA Standard RS-232-C criteria for the interface to the modem. 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).

4.08 Line Disconnect and Hangup. The modem channel is disconnected from the line (unless S1 is ON) by any one of the following conditions:

(a) Computer Disconnect. Computer turns CD (Data Terminal Ready) "OFF" for at least 50 milliseconds. The modem turns CB "OFF" to the computer and disconnects from the telephone line. (If a DAA is in use, the modem turns "OFF" DA and OH to the DAA. The DAA responds by turning "OFF" circuit CCT, indicating the communications line is released.) The modem then turns CC and CF "OFF" to the computer.

(b) Modem Time-Out. Time-out is included in the modem to provide a disconnect command after a selectable interval. This disconnect command occurs after a nominal 10-second period (as set by R56) after cessation of DTMF reception or ASCII data activity in either the transmit or receive directions. The modem disconnects from the telephone line. (If connected to the DAA, it turns "OFF" OH and DA. The DAA responds by turning "OFF" CCT when the call is dropped.) The modem also turns "OFF" CC, CF and CB (if not "OFF" already) to the computer. The

computer may respond by turning "OFF" CD.

(c) Modem ## Disconnect. By switch option (S3-4) the modem will initiate immediate disconnect, using the sequence described in the modem time-out, upon receipt of two consecutive DTMF's. In this mode of operation EOT is not transmitted to the computer (see Selectable Functions).

(d) DAA Disconnect (if used). As a result of a lost communications line the DAA turns circuit CCT "OFF". In response the modem will turn circuits CC, CF and CB (if not "OFF" already) "OFF" to the computer and circuits DA and OH "OFF" to the DAA. The computer may respond by turning "OFF" circuit CD.

After disconnect by any of the above three methods, the modem returns to the IDLE condition to await another call from the remote terminal.

5. FUNCTIONAL CIRCUIT OPERATION

5.01 This section covers the theory of operation for the two circuit boards used in the modem unit. The power supply board provides regulated +12 Vdc, -12 Vdc, and reference frequency drives common to the unit. Each channel board contains all the circuitry required for one link providing a two-way half duplex communications interface between the telephone network and a central processor (DTE).

Power Supply Board

5.02 Figure 5-1 shows 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 shelf 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

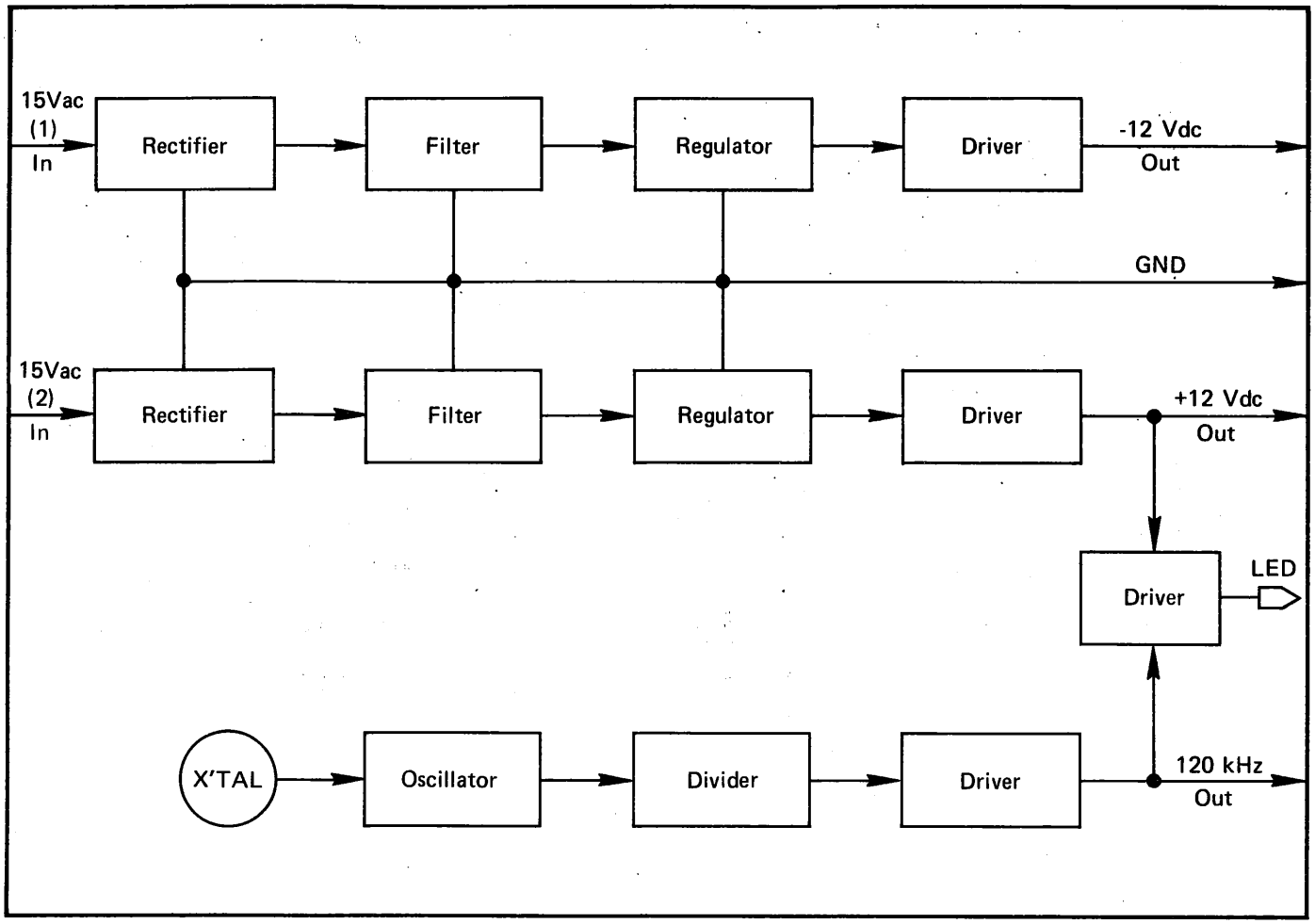


Figure 5-1. Power Supply Board Block Diagram

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.

Channel Board

5.03 Figure 5-2 shows a block diagram of the channel board identifying the user accessible controls shown in figure 2-1. This board provides all the signaling functions for two-way (half duplex) communication between remote terminals over phone lines, and interfaced central processors. DTMF tone inputs from the terminals are received, converted to ASCII characters and transmitted to the processor. A switch setting also permits the characters to be repeated back to the terminals in FSK form. Serial ASCII data from the computer is received by the modem via the DTE interface; the data is transmitted to the remote terminal (via the phone lines) using FSK modulation. The channel establishment and handshaking routines performed conform with EIA Standard RS-232-C for the DTE side, and a type 103 modem for the phone line side. The character conversion code from the DTMF digits entered is given in table 5-1. Further explanations of the operation of the blocks shown in figure 5-2 are given below.

Line Connectors

5.04 The modem communicates with remote terminals through the phone lines; connection to the telephone network can be made via one of two ports:

(a) T/R - Direct termination of phone lines (J20).
(b) DAA - CBS type DAA connections (J1A through J8A).

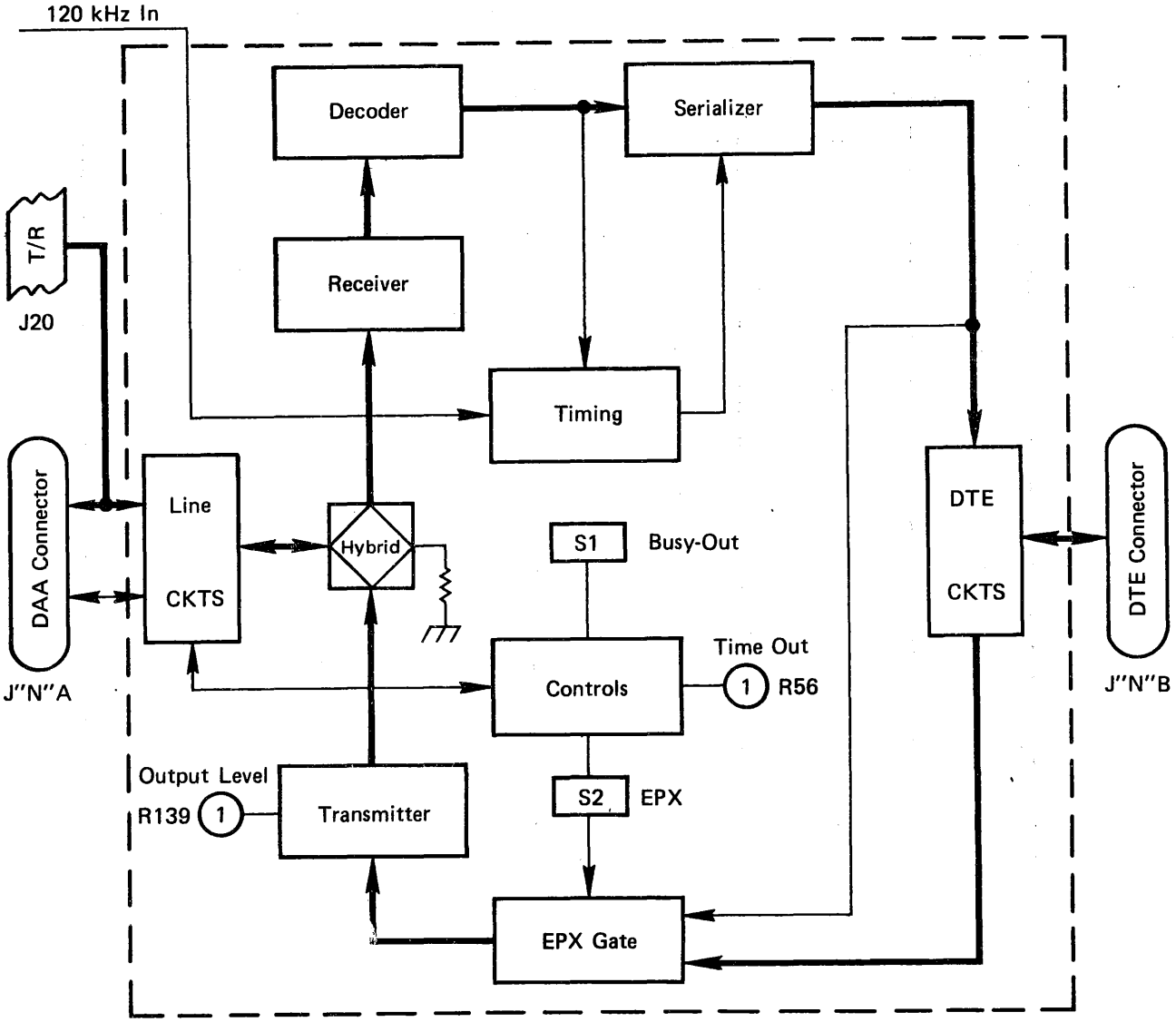


Figure 5-2. Channel Board Block Diagram

Table 5-1. DTMF/ASCII Character Conversion

DTMF DIGIT	ASCII CHARACTER	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_8 (1)
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)	0	0	0	1	1	0	0	0
#	CR	1	0	1	1	0	0	0	1
##	EOT	0	0	1	0	0	0	0	1

(1) Bit 8 is parity bit, shown in even parity.

Line Circuits

5.05 The line circuits consist of a line seize relay, a 1:1 isolating transformer, circuits for ring detection with a high impedance optically coupled network across the T/R leads, and DAA interface circuits. DAA circuits and signal conform with specifications in Bell System Technical Reference PUB 41802, as follows:

(a) Circuit OH - Off-Hook, From Modem to DAA.
This circuit provides control of off-hook and on-hook signals to the telephone line. Operating this lead will operate a circuit in the DAA which will complete a dc path to the serving central office and trip an incoming ringing signal. This lead may also be used to make the line appear busy to incoming calls when it is used in multiple line configurations employing line hunting or similar arrangements.

(b) Circuit DA - Data Access, From Modem to DAA.
This circuit is used to request that the data transmission path be cut through to the local telephone channel.

(c) Circuit RI - Ring Indicator, From DAA to Modem.
This circuit indicates that the station is being rung. The "ON" condition appears coincident with the "ON" segment of the ringing cycle. The "OFF" condition shall be maintained during the "OFF" segment of the ringing cycle and at all other times when ringing is not being received. Circuit CE (Computer Connector) follows circuit RI.

(d) Circuit CCT - Coupler Cut Through, From DAA to Modem.
This lead indicates when the transmission path is connected through the coupler to the local telephone line.

(e) Circuit SG - Signal Ground.
This lead is the common reference for all interface control signals.

The DTMF signals received on circuits DT and DR are transformer coupled through a line seize relay to the balanced hybrid circuit.

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 AGC amplifier during reception. When transmitting, the FSK is applied to the isolating transformer through the other half of the hybrid which contains the line matching resistor (900 ohm).

NOTE: When a DAA interface is used an 1800-ohm resistor should be placed in parallel with the modem inputs on the DT and DR terminals of the DAA to match the DAA 600-ohm impedance (included in Modem DAA Cable Assembly 07769-00).

Receiver

5.07 This consists of an AGC amplifier, band pass filters, and limiters. Automatic gain control is obtained from a two-stage amplifier with an input attenuator controlled by dc voltage feedback derived from peak detection of the amplified input signal. The dynamic control range is in excess of 40 dB. The signal from the AGC amplifier is coupled to the A group and B group band pass filter circuits. Each circuit consists of 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

5.08 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:

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

(b) 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 input 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.

Timing

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

(a) 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 (see table 2-4 and figure 2-4).

(b) 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. 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) disappears from the line, PAIR drops and the modem waits 40 ms before resetting STROBE. This starts the outpulsing of the data as shown by DATA OUT. (See figure 5-3 for timing chart).

Serializer

5.10 The latched decoder outputs (5.08 above) are first connected to their duo-decimal (i.e., 1 of 12) equivalents. Two devices with fixed code programming, then convert these to ASCII data. An LSI device utilizes the timing signals (5.09 above) to generate serial ASCII to the DTE and EPX circuits.

DTE Connectors

5.11 Each of the eight channels can be connected to DTE (computer) equipment via the DTE receptacles (J1A through J8A) on the modem rear panel as described in Section 2 of this manual. (The pin assignments are given in table 2-3.)

DTE Circuits

5.12 These circuits provide the interface for signaling between the modem and the computer, conforming with EIA Standard RS-232-C. The circuits and their functions are as follows:

(a) Circuit AA - Protective Ground.
This conductor is electrically bonded to the DS151A frame.

(b) Circuit AB - Signal Ground.
This circuit establishes the common ground for EIA interface circuits. Within the modem the circuit is connected to protective ground by means of a wire strap.

(c) Circuit BA - Transmitted Data, From Computer to Modem.
This conductor is used by the computer to present the data to be FSK modulated by the modem and transmitted onto the communications network. An open circuit is defined as Mark by the modem.

(d) Circuit BB - Received Data, From Modem to Computer.
This circuit delivers the data received over the communications network to the computer after being translated into 10-unit serial binary data.

(e) Circuit CA - Request to Send, From Computer to Modem.
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).

(f) Circuit CB - Clear to Send, From Modem to Computer.
This circuit is a response to "ON" condition of circuit CA (Request to Send). "ON" condition of circuit CB indicates that the modem is ready to transmit data generated by the computer. "OFF" condition indicates pushbutton signals are being received and assembled by the modem or the modem is in the echoplex mode. Receipt of DTMF signals takes priority over CPU generated data.

(g) Circuit CC - Data Set Ready, From Modem to Computer.
An "ON" indication on this circuit shows that the modem is connected to the communications line. An "OFF" condition will appear at all other times and is an indication that the computer is to disregard signals appearing on any other circuits 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 modem will then set circuit CC "OFF". The computer should interpret this as a lost or aborted call.

(h) Circuit CD - Data Terminal Ready, From Computer to Modem.
The computer must place this lead in the "ON" state to prepare the modem to be connected to the communication line and to maintain the connection

to the line once it is established. The modem is equipped for automatic answer of received calls, thus, the "ON" state of circuit CD allows the ComSet modem to be connected to the line in response to incoming ringing. An open circuit is defined as "OFF" by modem.

An "OFF" state on the CD lead will cause the modem to be removed from the communications channel following 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 modem.

(i) Circuit CE - Ring Indicator, From Modem 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" segment of the ringing cycle and at all other times when ringing is not being received.

(j) Circuit CF - Carrier Detector, From Modem 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 modem, CF is internally connected to circuit CC (Data Set Ready) so as to carry simultaneous signals and thereby simulate carrier detection to the computer.

(k) Circuit EPX - Echoplex, From Computer to Modem. See table 2-4. An open circuit is defined as "OFF" by modem.

(1) 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. (See Testing Section of Modem Installation and Operation Manual 09073-00.)

EPX Gate

5.13 This circuit accepts input ASCII data from the serializer (5.10) and signals from the control circuits (5.14). It generates levels to key the transmitter (5.13) with data in two modes:

(a) Data from the DTE circuits (i.e., computer inputs) is directly sent through to the transmitter.

(b) Data from the serializer is gated by the EPX switch (S-2); when ON, the data from the serializer is allowed to key the transmitter, thereby repeating the input DTMF character back to the remote terminal.

Controls

5.14 These 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:

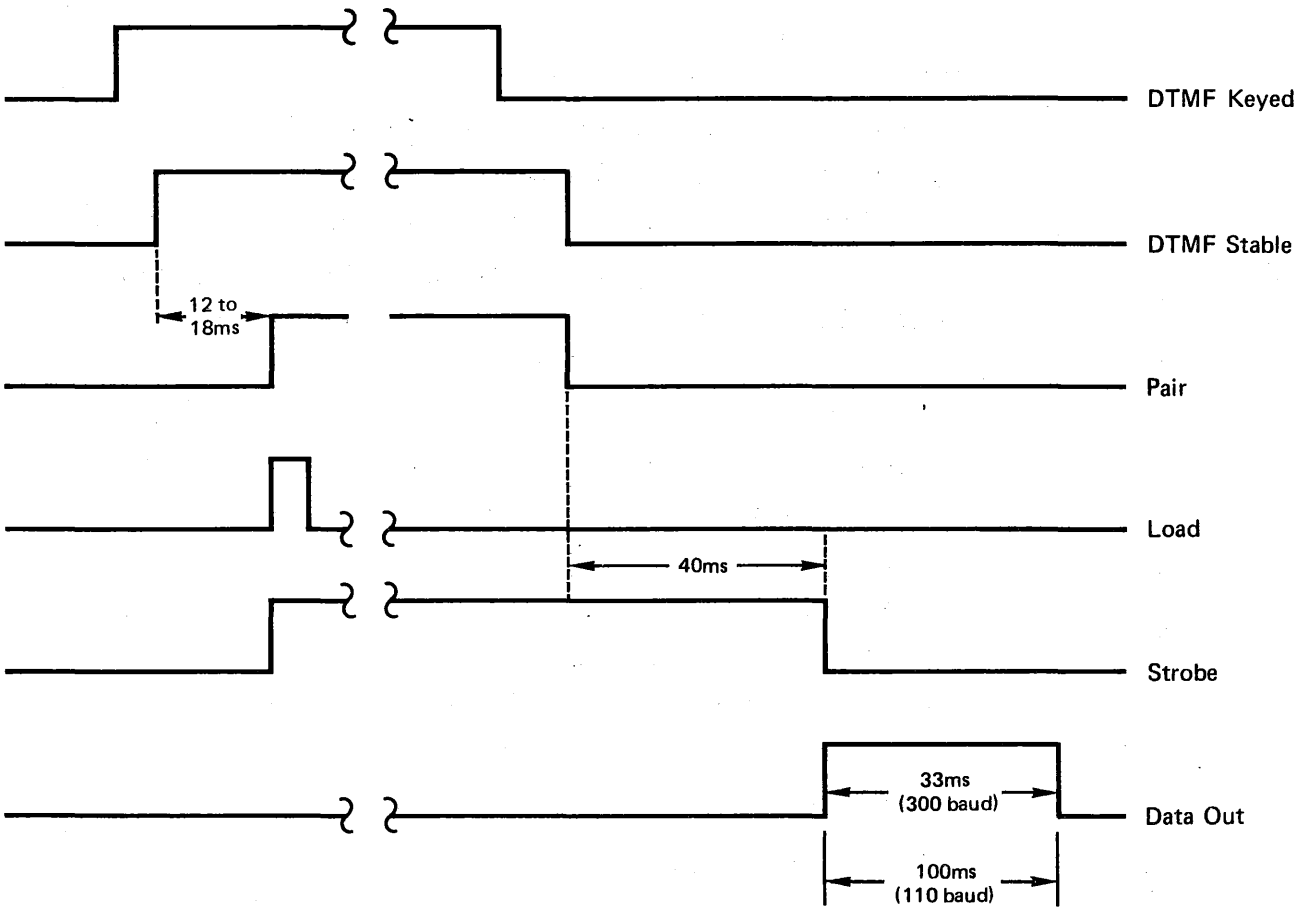


Figure 5-3. Timing Diagram (DTMF Reception through ASCII Data Transmission)

(a) 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. Either this signal or RI from the DAA 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.

(b) 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.

(c) Included is circuitry for detection of special character entry, i.e., two consecutive "#" entries, for that optional disconnect feature.

(d) Additionally, there is logic circuitry provided for the CB option (S3-4) described in table 2-4.

Transmitter

5.15 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 two stages of low pass filtering for a sinewave output. 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.

The transmitter is keyed with data from both computer (DTE) input via EIA circuits, and input from the EPX gate (see 5.13).

6. MAINTENANCE

6.01 This section covers maintenance procedures for the DS151A Modem unit. The modular design (i.e., a complete channel per board) enables system malfunction causes to be traced to one of three areas: system hookup, channel board and 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, thereby saving a trip to the installation site. The procedure described in this section should be helpful in answering "trouble calls" as well as for modem maintenance. Three tests for identifying problem areas are outlined in 6.06, 6.07, 6.08; refer to Plantronics Product Information Bulletin No. 24-004 for Automatic Test Station information.

Initial Setup

6.02 Remove the front panel and check: (see figure 2-1)

(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 channel boards are inserted in any intermediate position EXCEPT the last one away from the transformer. (This is a dummy position for storage of extender board, if required.)

(c) The location of the channel under test.

6.03 On the rear panel check: (see figure 1-2)

(a) The specified fuse (1A slow blow) is installed in the fuseholder.

(b) The telephone cable connector is plugged in. If a DAA interface is employed make sure the DAA tab connector is plugged into the proper receptacle corresponding to the channel under test.

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

"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. The power indicator lamp at the front of the power supply board should be lit (ON).

False Alarms

6.05 With the boards and connectors installed correctly, the status indicators should operate as described in 1.10. Some false alarms that may be reported are described below:

(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 modem filter circuits. However, unless there is excessive in-band noise at frequencies corresponding to DTMF tone pairs, no erroneous responses will result.

(c) Erroneous display. Contact bounce on DTMF pad and excessive noise on the lines may reduce maximum input rates (10 char/sec) or cause multiple character printing. When this occurs, hang up and recall, using another telephone terminal installation to identify the cause of the problem.

Loopback Test

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

(a) Disconnect DTE interface cable.

(b) At the DTE connector install a jumper from pin 25 (LTV) to pin 20 (CD), or optionally pins 10 and 13 on the extender board if used. A 914B Data Test Set may be used to make these connections.

(c) Set channel board EPX switch S2 in automatic echoplex position.

(d) At the remote terminal, set up a connection to the modem; if dial-up service is used, dial the applicable number.

(e) From the remote terminal, transmit a DTMF signal and observe the returned FSK signal to confirm that it coincides with the proper DTMF/ASCII conversion, (see table 5-1).

Modem Transmission and Interface Test

6.07 To test both the EIA interface and transmit branch of the modem, use a Western Electric 914B Data Transmission Test Set, or equivalent, and the procedures specified by the test equipment manufacturer.

System Test

6.08 The complete data system, including the DTE interface, can be tested by attempting to perform normal system operating procedures. As an alternative, the system can be tested by inserting a Pulsecom model 505-2 Data Interface Test Set, or equivalent, between the modem and the DTE and performing the procedures outlined by the test equipment manufacturer.

Fault Isolation Procedure

6.09 To assist in the routine maintenance of returned units, as well as for answering trouble calls from the field, a detailed step-by-step procedure is developed here. Table 6-1 is a summary, with items listed in terms of problems that may be reported, and references to locate the applicable sections in the procedure. Starting with a check of the instal-

lation, the procedure continues through a checkout of the modem unit. When specific problems have been encountered, either as reports from the field, or as determined by tests such as described in 6.05 through 6.08, the procedure may be started directly at the relevant stage, as indicated by the entries in table 6-1.

Table 6-1. Summary of Fault Isolation Procedure

Item	Report/Description	Possible Causes	Start At Section
1	General; problem unspecified	Connections, Fuse	6.10
2	No power indication	Fuse, Mains	6.11
3	Channel does not answer	Above; S1	6.14
4	No echoplex	S2	6.25
5	Erroneous outputs	S3-1,2,3	6.28
6	Parity errors	S3-3	6.33
7	Channel does not hangup	S1, S3-4	6.35
8	"Busy Out" not working	S1	6.39
9	CB Option not working	S3-5	6.40
10	Automatic timeout adjustment	R56	6.41
11	Transmit level adjust	R139	6.42

General

6.10 Check fuse, board and cable installations as described in Section 2 of this manual. To assist in verification of channel board problems, it may be useful to try another location in the modem shelf. Is installation complete?

Yes - Go to 6.11.

No - Complete installation (see 6.02, 6.03) repeat 6.09.

Power Indication

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

Yes - Go to 6.13.

No - Replace power supply board. If problem persists, go to 6.12.

6.12 Check the output of the power transformer secondaries. Measure at power supply board connector pins C-D, L-M (see figure 4-1). Is 15 Vac power received?

Yes - Replace power supply board. Go to 6.11.

No - Return modem shelf for repairs. The circuit boards may be reclaimed.

Problem Identification

6.13 For a general checkout, continue through the steps described here. If a unit has been returned as a failure, but no specific items are recorded, tests such as 6.06 through 6.08 may be performed to ascertain a specific item. If a specific failure has been reported, refer to table 6-1 for related sections of the procedure. Dial the telephone number for the channel under test. The channel should trip, ringing within two ring cycles. Is ringing tripped?

Yes - Go to 6.15.

No - Continue.

Channel Does Not Answer

6.14 The channel may be busied out. Check S1 on the board (see table 2-4). Is S1 OFF?

Yes - Go to 6.15.

No - Turn S1 OFF and repeat 6.13.

6.15 Is CD lamp on?

Yes - Go to 6.18.

No - Continue.

6.16 Check DTE connection (see table 2-1). Is DTE connected to the proper receptacle?

Yes - Go to 6.17.

No - Connect DTE as per table 2-1, and repeat 6.15.

6.17 The DTE must provide CD ON. Check with user and verify

that CD ON level corresponds to table 2-3. Is CD ON level provided?

Yes - Replace channel board, return for repair if 6.13 still negative.

No - Notify user; computer interface (DTE) must conform to table 2-3.

6.18 Is CC lamp ON?

Yes - Go to 6.21 if troubleshooting. If checking out, go to 6.24.

No - Continue.

6.19 Determine the line access arrangement (T/R or DAA) used to connect to the phone lines. Refer to tables 2-1 and 2-2 for connectors and pin arrangements. Is the line connected?

Yes - Go to 6.20.

No - Connect as per table 2-1, repeat 6.18.

6.20 Is the line connected to the channel functioning?

Yes - Go to 6.21.

No - Connect a functioning line, repeat 6.18.

6.21 Turn power OFF for 5 seconds to reset the channel board circuitry. Repeat the call. Does CC lamp turn ON?

Yes - Go to 6.24.

No - Continue.

6.22 Replace channel board and return for repair. Repeat 6.13. Does CC lamp turn ON?

Yes - Go to 6.24.

No - Continue.

6.23 Install the replacement (working) channel board in another location within the shelf (if available). Reconnect as per Section 2 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 shelf may be utilized as now connected. However, if all the channel locations are required to be operating, reclaim the circuit boards, replace the shelf, and return for repairs.

No - Replace shelf and circuit boards; return for repair.

6.24 With a complete Plantronics/ComSet System connected as indicated in Section 1 (see Plantronics manual 09069-00 for details), 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 6.27.

No - Continue.

No Echoplex

6.25 Is S2 (EPX) switch ON (see table 2-4)?

Yes - Go to 6.26.

No - Turn S2 ON, repeat 6.24. If there is still no echoplex, go to 6.28.

6.26 Is transmit level adequate? (See specifications, Section 1.)

Yes - Go to 6.27.

No - Adjust R-139 (see table 2-4 and paragraph 6.43), repeat 6.24. If echoplex problem persists go to 6.28.

6.27 Is data echoplexed correctly?

Yes - Go to 6.29.

No - Continue.

Erroneous Output

6.28 Is baud rate setting correct (per table 2-4)?

Yes - Go to 6.29.

No - Set S3-1 and S3-2 correctly, repeat 6.24.
If still an echoplex problem persists, continue.

6.29 Observe A and B group lamps on the channel board. Do both stay ON for as long as DTMF key is activated?
Yes - Go to 6.31.
No - Continue.

6.30 Is received signal level within specifications?
Yes - Go to 6.31.
No -- Select line with adequate level.

6.31 Observe A and B group lamp on the channel board. Do both stay OFF when no key is activated?
Yes - Go to 6.33.
No - Continue.

6.32 Check line condition; is noise within specification?
Yes - Replace channel board, return for repairs.
No - Select line within noise specification.

Parity Errors

6.33 Is parity switch (S3-3) set correctly (table 2-4)?
Yes - Replace channel board, return for repair, if troubleshooting. If checking out, go to 6.34.
No - Set S3-3 as required, repeat 6.24. If there is still no echoplex or erroneous output, replace channel board and return for repair.

NOTE: See paragraph 6.05 (False Alarms) to verify that the channel board is indeed faulty.

6.34 Stop data transfer, from both terminal and the computer. After the time-out interval (8-50 seconds) as set by R56 (see paragraph 6.42), the line should be released. Does the

channel hang up on auto time-out?

Yes - Refer to table 6-1 if other problems exist; continue to 6.35 if checking out.

No - Continue.

Channel Does Not Hangup

6.35 Is S1 OFF?

Yes - Replace channel board if troubleshooting; if checking out, continue 6.36.

No - Turn S1 OFF and repeat 6.34.

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

Yes - Refer to table 6-1 if other problems exist; if checking out, go to 6.39.

No - Continue.

6.37 Is S3-4 ON?

Yes - Go to 6.38.

No - Turn S3-4 ON, hangup and repeat test at 6.36.

6.38 With S3-4 ON the channel board accepts the two consecutive "#" entries and immediately releases the line for direct T/R connection or by turning OH OFF to the DAA. Verify that the modem also drops CC and CF to the OFF condition when the line is released or when CCT is turned OFF by the DAA. Is the line released for ## input?

Yes - Go to 6.39.

No - Replace channel board, return for repair.

6.39 Does removal of CD for 50 ms (minimum) by DTE cause channel board to release the line?

Yes - Refer to table 6-7 if other problems exist; if checking out, continue to 6.40.

No - Replace channel board, return for repair.

Busy_Out_Not_Working_

6.40 With the modem connected as described in Section 2, dial the channel as in 6.13. When the channel answers automatically turn S1 ON (see table 2-4). The line should be permanently seized. (No modem time-out in effect.) Does S1 operate as described?

Yes - Refer to table 6-1 if other problems exist; if checking out, go to 6.41.

No - Replace channel board, return for repair.

CB_Option Not Working

6.41 If the CB option described in table 2-4 is to be checked out, verify that the DTE provides the required signals. With the system connected, dial the channel as in 6.13. Test the working of the CB option (S3-5). Is CB option obtained as specified?

Yes - Go to 6.43.

No - Replace channel board, return for repair.

Auto_Time-Out Adjustment_

6.42 The auto time-out interval can be adjusted within the approximate range of 8 to 50 seconds by screwdriver adjustment of R56 (see figure 2-1 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, rotate four turns one way (to ensure arrival at one end of the range), and then work back to required setting.

Transmit Level Adjustment

6.43 Establish a connection to the channel under test. Set S1 ON to permanently hold the line. Measure the ac voltage output across tip and ring with the channel board transmitting steady MARK tone. The output signal can be adjusted by operating R139 (see table 2-4) over the following range:

Voltage	Line Impedance	Corresponding Power
38 mV RMS	900 ohm	-28 dBm
1.7V RMS		+5 dBm
30 mV RMS	600 ohm	-28 dBm
1.35V RMS		+5 dBm

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

7. REFERENCES

7.01 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".

7.02 DAA. All data and control signals between the modem and the data coupler CBS conform to the specifications as stated in the Bell System Technical Reference PUB 41802, "Data Couplers CBS and CBT for Automatic Terminals".

7.03 Other Related Plantronics Documents

- 09069-00 Plantronics/ComSet System Description and Interface Specification
- 09073-00 Plantronics/ComSet Modem Installation and Operation Manual
- 09135-00 Plantronics/ComSet Data Terminal Operation Manual
- 09134-00 Plantronics/ComSet Data Terminal Maintenance Manual

8. PLANTRONICS WARRANTY AND SERVICE POLICY

8.01 Warranty. Plantronics/ComSet products are guaranteed free from defects in workmanship and materials for a period of one (1) year 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 all external decorative finishes.

Products returned for repair during the warranty period will be repaired at no charge, provided that the products have not, in the judgement of Plantronics, Inc., been subjected to improper installation, breakage, abuse, neglect or unauthorized repair attempt or alteration. Plantronics will prepay the return transportation by the most appropriate means of delivery.

Products returned during the warranty period shall be subject to a handling charge if replacement of damaged items is necessary.

8.02 Factory Service. Factory repair service is provided by Plantronics for products that are out of warranty. This service is operated on a repair and return basis. Charges are based upon labor, material and transportation costs. Equipment returned for repair will be inspected to determine the extent of damage and the cause of failure. This information will be compared with that provided by the customer for each returned item. Unless otherwise directed by the customer, Plantronics will then complete the repair and reconcile all discrepancies to the actual quantity and condition of the equipment received. Shipments to Plantronics shall be prepaid. Cost of return transportation will be included with the repair billing. Plantronics will select the most appropriate means of return shipment unless otherwise designated by the customer.

8.03 Plantronics will accept returned products, transportation prepaid to:

Plantronics, Inc.
Customer Service Department
345 Encinal Street
Santa Cruz, California 95060

8.04 The following information should be included with the returned units:

(a) Bill-to address

(b) Ship-to address

(c) Purchase order/control number

(d) Reason for return and serial number