

# A Racal-Vadic Modem

Model 4850PA  
User's Guide

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Equipment returned to the factory should be accompanied by the following information: the reason for return, with a comprehensive description of the malfunction; shipping instructions; and the name and telephone number of a contact in the event of problems.

Please address comments about this manual to:

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**FCC REQUIREMENTS FOR END USERS**

Connection of terminal equipment to the public switched-telephone network is regulated by the Federal Communications Commission (FCC) as defined by FCC Rules and Regulations, Part 68. These regulations require the following:

1. Connection of this equipment to party lines and coin telephone service is prohibited.
2. When trouble is experienced, disconnect this equipment from the telephone line to determine if it is malfunctioning. If this equipment is determined to be malfunctioning, discontinue use until the problem has been corrected.<sup>1</sup>
3. Where such action is reasonably required in the operation of its business, the telephone company may make changes in its communication facilities, equipment, operations, and procedures. If this occurs, you will be notified by the telephone company in writing.
4. If asked, the customer must provide the modem's FCC registration number and ringer equivalence number to the local telephone company. These numbers can be found on the modem.

FCC registration number: AJ496M-71819-DM-E

Ringer equivalence number: 0.4 B

<sup>1</sup>Should this equipment cause harm to the telephone network, the telephone company may temporarily discontinue service until the problem has been corrected.

**RADIO/TELEVISION INTERFERENCE**

Model No. 4850PA ID No. pending

This equipment generates and uses radio frequency energy and, if not installed and used properly (in strict accordance with the manufacturer's instructions), may cause interference to radio and television reception. It has been type-tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of the FCC Rules, which are designed to provide reasonable protection against interference in a residential installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment on and off, try to correct the interference by one or more of the following measures:

- o reorient the receiving antenna
- o relocate the computer with respect to the receiver
- o move the computer away from the receiver
- o plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, consult the dealer or an experienced radio/television technician for additional suggestions. You might find the following booklet prepared by the Federal Communications Commission helpful:

**"How to Identify and Resolve Radio/TV Interference Problems"**

This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No. 004-000-00345-4



## **CHAPTER 1**

### **GENERAL DESCRIPTION**

The 4850PA performs synchronous, half-duplex data communication at either 2400 or 4800 bits per second.

This modem offers three methods of dialing. First, you can use the built-in automatic dialer (compatible with IBM's HDLC, SDLC and Bisynchronous protocols). Second, you can connect the modem directly to an external dialer (Bell 801). Third, you can dial directly from the modem by using the keyboard and the liquid crystal display.

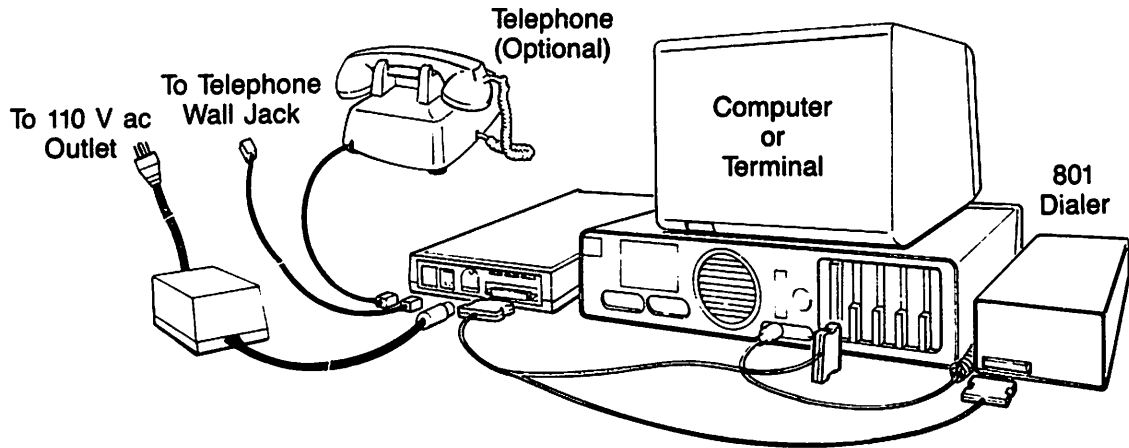
### **FEATURES**

The major features of the 4850PA are:

- o Bell 208B compatible including 2400 bps fall-back mode.
- o Automatic answer and originate modes.
- o Manual originate and answer modes.
- o Small size--modem fits under a standard desk telephones.
- o 23 functions from 12 keys on the front panel.
- o 8-character alphanumeric liquid crystal display.
- o Complete operation from the front panel: dial, set options, conduct tests, and store phone numbers.
- o Connects directly to the telephone line.
- o 2-wire leased-line compatibility.
- o Programmable, software-controlled options.
- o Standard options mode.
- o Automatic self-test in idle mode.
- o Analog loopback test.
- o End-to-end self-test.
- o Line current disconnect
- o Nonvolatile memory for options and number storage.
- o Advanced auto-dialer operates in three protocols.

The major auto-dialer features include:

- o HDLC/SDLC compatible autodialing.
- o RS-366 (801) compatible autodialing with adapter cable.
- o Complete call progress detection and reporting (HDLC/SDLC and Bisync).
- o Blind dialing in all dialing modes.
- o Number storage for up to 15 phone numbers of 60 digits each (from front panel only).
- o Dialing from the front panel keypad.
- o One-button redial.
- o Tandem dialing in all dialing modes.
- o Automatic selection of pulse or tone dialing in all dialing modes.
- o SDLC dialer optionally compatible with NRZI.
- o No telephone set required.
- o Bisync auto-dialer compatible with IBM Bisync in 2780/3780 RJE format.



**Figure 2-1. Modem Installation with Y Cable.**

**CHAPTER 2  
INSTALLATION**

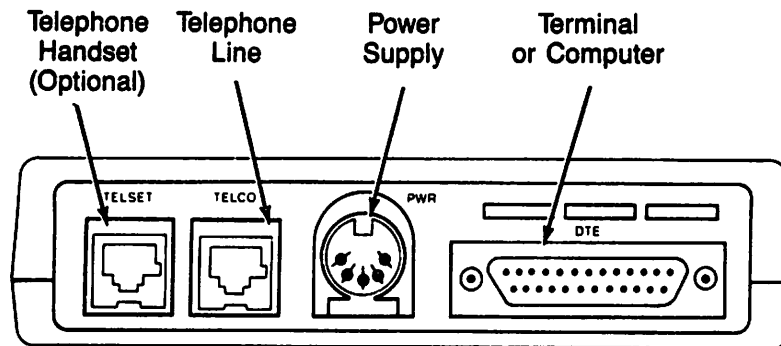
Please read this chapter completely before attempting to install your Racal-Vadic 4850PA modem. Following the installation instructions prevents possible damage to the modem and allows you to set up without problems.

**INSPECT AND INVENTORY THE MODEM**

Racal-Vadic packs four items into the modem box. Make sure you have all components.

- o modem
- o manual
- o power adapter
- o telephone cord (permissive)

Inspect the modem to make sure it has not been damaged. Look at its carton. If the carton is heavily damaged, or the modem or power supply is damaged, contact the dealer or shipping carrier.



**Figure 2-2. Modem's Rear Panel**

**INSTALL THE MODEM**

1. Install the modem close to the computer terminal. Place the modem so you can easily reach the controls on the front panel.

There must be no strain on the cables.

2. To connect to a computer terminal that has no 801 dialing port, link the modem to the computer terminal with a standard RS-232-C cable (25 pins in each connector with straight-through wiring). See Appendix B for the pin assignments.

If connecting the modem to an automatic (801) dialing port in addition to the computer terminal, use the Racal-Vadic Y cable (part number 91009-094). See Appendix B for details of the Y cable.

3. Connect the modem's TELCO jack to the phone line. Use the telephone cable included in the modem package.
4. Connect the modem to the power adapter, then plug the power adapter into a 110-volt ac, 60-hz receptacle.
5. Connect a telephone to the modem's TELSET jack. This is optional--the modem works without it.

The phone will work in the normal fashion. (The modem will answer all incoming voice calls unless auto-answer has been disabled.)

#### **PHONE SERVICE OPTIONS**

##### **Connection to a Permissive Phone Line**

The 4850PA modem is shipped from Racal-Vadic ready for connection to a permissive phone line. Simply plug the modem into the telephone wall jack, using the cable provided. The permissive connection allows a transmission level of -10 dBm.

##### **Connection to a Programmable Phone Line**

To connect the 4850PA to a programmable phone line, a special cable designed for programmable operation is required and must be ordered separately from Racal-Vadic (part number 15048-004).

Contact your local phone company for installation of a programmable phone line.

Before the 4850PA can operate over a programmable line, one jumper must be changed on its circuit board.

1. Unplug the modem from the wall. (Do not disconnect the power cord from the modem while it is powered up.)
2. Open the modem carefully. Four snap tabs hold the covers together. Carefully press these tabs with a screwdriver and gently pry the covers apart with your fingers.
3. Find the strap labeled W2. Remove the plastic jumper from the posts.
4. Reassemble the modem.

#### **Connection to a Leased Line**

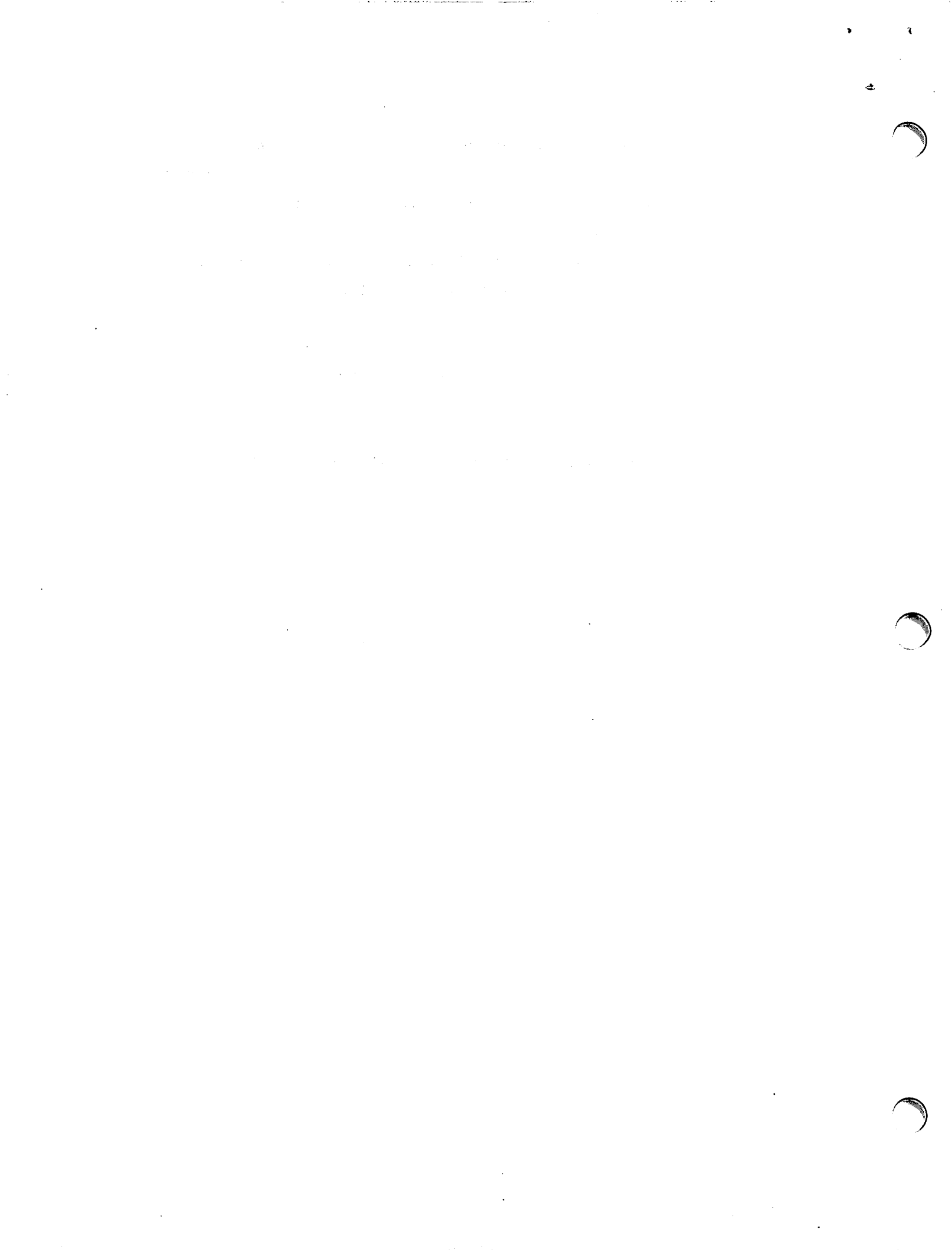
You can lease private phone lines directly from the phone company. Connect the modem to the leased line with the phone cable provided with the modem.

Adapt the 4850PA to a leased line by changing four hardware straps.

1. Unplug the modem from the wall. (Do not disconnect the power cord from the modem while it is powered up.)
2. Open the modem carefully. Four snap tabs hold the covers together. Carefully press these tabs with a screwdriver and gently pry the covers apart with your fingers.
3. Find strap W1. Set the plastic jumper so that it connects the "A" posts together. This changes the dynamic range.

4. Find the strap labeled W2. Remove the plastic jumper from the posts. Replace the jumper so that it connects posts the "B" posts together. This changes the transmission level.
5. Find strap W3. Set the plastic jumper so that it connects both posts together. This changes the line connection.
6. Find the site for strap A. Solder a jumper wire across the two holes. This bypasses the off hook relay.
7. Reassemble the modem.

**NOTE:** See Appendix B for jumper settings for phone service options.





## Chapter 3

### OPERATION

#### **MODES OF OPERATION**

The keys and display behave differently in the different operational modes. Below is a brief description of these modes:

##### Idle Mode:

When the modem is not passing data, dialing, or being manipulated from the front panel, it is in idle mode.

##### Data Mode:

Any time the modem is connected to the telephone line, not dialing, and not in test, it is in data mode.

##### HDLC/SDLC Dialing Mode:

This mode occurs whenever the DTE interacts with the modem using the HDLC/SDLC command set.

##### RS-366 Dialing Mode:

This mode occurs whenever Call Request is present on the 4850PA interface.

##### Bisync Dialing Mode:

This mode occurs whenever the DTE interacts with the modem using the Bisync command set.

##### Test Mode:

The 4850PA is in test mode any time analog loopback or end-to-end self-test is in operation.

##### Numeric Mode:

This mode occurs when the dialing, number storage, or option routines are entered from the front panel.

## **GENERAL MODEM USE**

There are four straightforward steps to successful data communication: Set the parameters, dial a phone number, establish a data link (modem handshake), and transfer data.

### **Data Link Parameters**

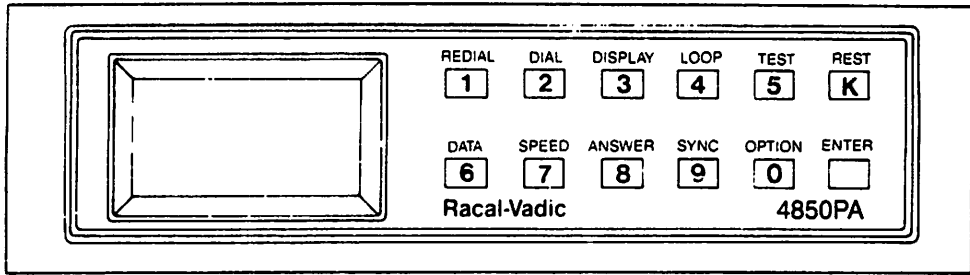
The first step in setting up a data link is to define the link parameters. You might call the remote operator (by voice) to make sure the settings are correct at both ends. Among the parameters which should be checked are data rate, modulation, automatic disconnects, and character set.

### **Dial**

The second step is to call a remote system. There are four ways to place this call. First, you could manually originate; that is, you can connect a telephone directly to the modem and dial manually, then connect the modem to the phone line when voice communications are complete. Second, you can dial directly from the computer (in HDLC, SDLC, or Bisync modes). This is called automatic dialing. Third, you can dial through a Bell 801 automatic dialing port. Fourth, you can dial directly from the modem's keyboard.

### **Connect**

After dialing--but before sending data--the local and remote modems must establish a data link (connect). Once the link is established, the front panel LCD displays "ON LINE."



**Figure 3-1. The Front Panel**

### **Data Transfer**

Once connected, the modems can send or receive data. They do this at either 4800 or 2400 bps. The modems operate in half-duplex mode. Half-duplex means that the data can flow in only one direction at a time. The modem can send or receive, but not both simultaneously.

### **MANUAL OPERATION**

#### **Summary of the Keyboard**

##### Redial/1:

When in idle mode, this key causes the 4850PA to redial the last number auto-dialed. When in numeric mode, this key enters the number "1."

##### Dial/2:

In idle mode, this key initiates the front panel keypad dialing sequence. This key enters the number "2" in numeric mode.

##### Display/3:

When the modem is in RS-366 dialing mode, this key toggles the display from operational status (RS-232-C signals), to RS-366 diagnostic indicators. When in data mode or other dialing modes, this key toggles the display between RS-232-C indicators and operational status. In numeric mode, this key enters the number "3."

Loop/4:

In idle mode, this key places the 4850PA into analog loopback. While in data mode, this key conditions the modem to act as the transmitter for the end-to-end self-test. In numeric mode, this key enters the number "4."

Test/5:

In ALB, this key initiates the self-test pattern. When online, this key conditions the 4850PA to act as the receiver for the end-to-end self-test. This key enters the number "5" in numeric mode.

Reset/K:

When in numeric mode, this key places the tandem dial pause "K" into the dialing string. In all other modes, this key resets all modem functions though it does not affect the options and numbers stored in nonvolatile memory.

Data/6:

From idle mode, this key takes the modem off-hook and sets it for originate operation. While the modem is in data mode, pressing this key will cause the modem to immediately return on hook. In numeric mode, this key enters the number "6."

Speed/7:

In idle mode, this key allows the user to read the modem speed or toggle the modem between its standard speed, 4800 bps, and fall-back mode (2400 bps). Press the SPEED key twice. This switch overrides the setting of option 13. In numeric mode, this key enters the number "7."

Answer/8:

In idle mode, this key takes the 4850PA off hook and sets it for answer operation. This key will cause the modem to go on hook if the modem is in data mode. This key enters the number "8" in numeric mode.

Store #/9:

While in idle mode, this key allows a telephone number to be stored in a specified address. This key enters the number "9" in numeric mode.

Option/0:

In idle mode, this key allows the modem configuration to be changed by placing the 4850PA in the option mode. In numeric mode this key enters the number "0."

Enter:

This key is used in the dialing, number storage, speed selection, and option modes to enter numbers and commands.

### **Summary of the Display**

The 4850PA has an 8-character alphanumeric display that provides information of two types: messages from the modem and symbols representing the interface signals (these are the RS-232-C or RS366 signals in the cable connected to the modem). You can switch the modem between these two displays. Use the DISPLAY key to select the type of display.

Along the top of the display is one row of labels representing the interface signals. When an asterisk appears below a label, the signal represented by that label is present in the cable.

### **RS-232-C Interface Signals**

TXD	Transmitting data to local computer.
RXD	Receiving data from local computer.
HS	Request to send data from modem to computer.
CTS	Clear to send data from computer to modem.
DSR	Data set (modem) is ready.
DTR	Data terminal (computer) is ready to communicate.
RI	Ring indicator. Modem detects incoming call.
CXR	Carrier is present in phone line.

The messages in Table 3-3 are displayed on the modem's LCD only.

**Table 3-3. Messages from the Modem**

<b>Message</b>	<b>Description</b>
IDLE	Modem is in the idle mode.
DIAL	Modem has been placed in the front panel dial mode.
ADDRESS:	Modem is requesting a stored number address.
DIALING	Modem is dialing.
RINGING	Modem has detected a ring or ringback signal.
ANS TONE	Modem has detected answer tone.
ON LINE	Modem is connected to the telephone line.
FAILED	Modem failed to connect.
NUMBER:	Modem requests a telephone number to be entered either to dial or to be stored.
FALLBACK	Modem has connected in fall-back mode.
OPTION:	Modem requests an option number to be examined.
ST ERROR	Modem has detected an error during one of the self-test diagnostics.
ALB	Modem is in analog loopback.
ALB ST	Modem is in analog loopback self-test.
TERMINAL	Modem is in HDLC/SDLC or Bisync mode.
RS-366	Modem is in RS-366 interactive mode.

**NOTE:** The 4850PA displays the call progress in all dialing modes.

TXD RXD HS CTS DSR DTR RI CXR

ADDRESS

#### DIALING FROM THE FRONT PANEL

##### Number Storage

The 4850PA can store 15 phone numbers in nonvolatile memory. Each number can have up to 60 digits.

1. Press STORE #.

The LCD indicates "ADDRESS"

2. Press 3 ENTER to select address 3 in which to store the number.

LCD indicates "NUMBER:"

3. Press 5 5 5 1 2 1 2 ENTER to store the number.

LCD indicates "IDLE."

The number 555 1212 is now stored in address 3.

##### Dial a Stored Number

1. Press DIAL.

LCD indicates "ADDRESS"

2. Press 3 ENTER to dial the number in address 3.

LCD indicates "555-1212" the number in location 3.

**NOTE:** The number to be dialed will scroll across the display from the right until all digits have been displayed. If the number is greater than eight digits, only the last eight will show on the LCD display after the scrolling stops.



3. Press ENTER to begin the dialing sequence.

LCD will indicate the call progress as it occurs below:

Successful call	or	Failed call
"DIALING"		"FAILED"
"RINGING"		"IDLE"
"ANS TONE"		
"ON LINE"		

If the 4850PA connects in fall-back mode, the display will be as listed below:

"DIALING"  
"RINGING"  
"ANS TONE"  
"FALLBACK"  
"ONLINE"

**Dial Entered Number:**

1. Press DIAL.

LCD indicates "ADDRESS"

2. Press ENTER.

LCD indicates "NUMBER"

3. Press 5 5 5 1 2 1 2.

LCD indicates "5551212" as the numbers are entered.

4. Press ENTER to begin the dialing sequence.

LCD will display call progress as it occurs below:

Successful call	or	Failed call
"DIALING"		"FAILED"
"RINGING"		"IDLE"
"ANS TONE"		
"ON LINE"		

**Redial Last Number**

1. Press REDIAL

The last number dialed will then scroll onto the display from the right until the last digit is displayed.

"5551212"

The LCD then displays call progress as it occurs below.

Successful call	or	Failed call
"DIALING"		"FAILED"
"RINGING"		"IDLE"
"ANS TONE"		
"ON LINE"		

After the call has been successfully completed, the display will return to monitoring the diagnostic indicators.

### Setting Options

1. Press OPTION.

LCD indicates "OPTION:"

2. Press 2 0 ENTER to access option 20.

LCD indicates "OP 20\*1" to indicate that option 20 is set to code 1.

3. Press 2 ENTER to change Option 20 to Code 2.

LCD indicates "OPTION:"

4. If no more options are to be changed press ENTER.

The LCD will indicate "IDLE".

**NOTE:** If any of the programmable options are changed to a nonstandard setting option 1, the Standard Options mode, will automatically be disabled. If option 1 is changed from code 2, disabled, to code 1, enabled, all programmable options will be returned to their factory setting.

### **Manual Originate Operation**

1. With a standard telephone plugged into the TELCO jack on the back of the 4850PA, dial up the remote modem.
2. When answer tone is heard, press the DATA key on the modem's front panel.

LCD should indicate "ON LINE"

The connection is now established and data may be transferred. The LCD will revert to displaying the diagnostic indicators approximately two seconds after "ON LINE" is issued.

### **Manual Answer Operation**

1. Establish voice communication with the operator of the remote modem.
2. Press the ANSWER key to place your modem off hook and sending Answer Tone.  
The LCD will indicate "ON LINE" as soon as answer tone is complete.

The connection is now established and data may be transferred. The LCD will revert to displaying the diagnostic indicators approximately two seconds after "ON LINE" is issued.

## **AUTOMATIC OPERATION**

### **Automatic Answer**

1. Ensure that option 4 is enabled and DTR is present to the modem.
2. When a ring is detected, the 4850PA will go off hook and transmit answer tone. If option 8 is set to code 2, the 4850PA will auto-answer on the third ring rather than the first.

The LCD indicates "ON LINE".

The connection is now established and data may be transferred.

### **HDLC/SDLC Dialing**

The 4850PA includes a synchronous auto-dial command protocol compatible with HIGH LEVEL DATA LINK CONTROL (HDLC) and IBM's Synchronous Data Link Control (SDLC). The protocol uses a nontransparent ASCII or EBCDIC code set to implement HDLC or IBM SDLC in 3270 format.

The 4850PA accepts SDLC or HDLC commands from the host computer and executes them. While dialing a telephone number, it sends call progress messages back to the host until a connection is established or the attempt is aborted.

In addition to the ability to dial automatically, the SDLC/HDLC command set allows the host computer to configure the 4850PA programmable options which are stored in nonvolatile memory.

See Appendix D for more detail.

### **Bisync Auto-dialer**

The 4850PA includes an auto-dial protocol for Bisync systems. This auto-dial protocol uses a nontransparent EBCDIC code set to implement IBM Bisync in 2780/3780 RJE format.

The Bisync auto-dialer will accept commands from a host computer and execute them. While dialing a telephone number, it will send call progress information back to the host until a connection is established or the attempt is aborted.

The command set for the Bisync dialer includes the ability to configure the 4850PA's programmable options.

See Appendix E for more detail.

### **RS-366 Dialing**

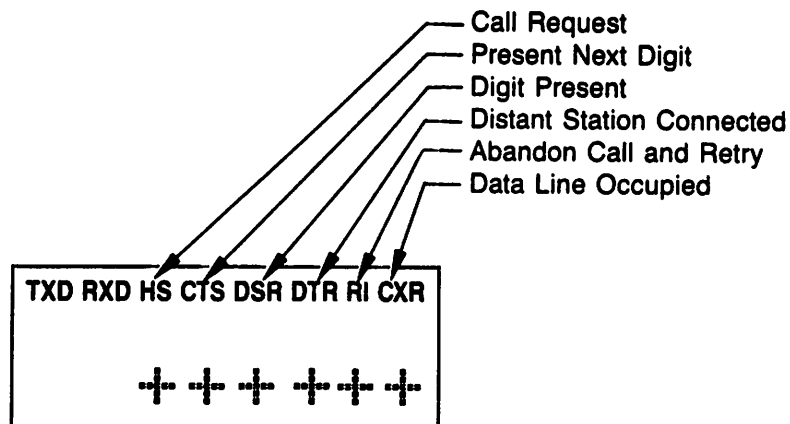
1. To initiate the RS-366 dialing sequence, the dialing port raises Call Request. The 4850PA starts the Abandon Call and Retry Timer.
2. One-half second after the 4850PA detects dial tone, it raises Present Next Digit and Data Line Occupied.
3. The dialing port sets the first digit on circuits NB1-NB8 and turns Digit Present ON. Upon seeing Digit Present, the modem dials the first digit, turns Present Next Digit OFF, and resets the Abandon Call and Retry timer.

4. The dialing port now drops Digit Present. When Digit Present drops, the 4850PA responds by raising Present Next Digit.

Steps 3 and 4 repeat until all of the digits have been dialed.

5. When all digits have been dialed, the 4850PA will again raise Present Next Digit but the dialing port will not raise Digit Present. The modem continues to wait until answer tone is detected.
6. Once answer tone is detected, the 4850PA brings up Distant Station Connected and stops the Abandon Call and Retry Timer.
7. The dialing port now drops Call Request and Present Next Digit. DLO and DSC remain on as long as the 4850PA remains OFF HOOK.

**NOTE:** If the end-of-number character is received, DSC should be immediately issued to the dialing port.



**Figure 3-2. Meaning of the RS-366 Indicators.**

**RS-366 Display**

When RS-366 diagnostic indicators are selected, the diagnostic indicators show the condition of the RS-366 signals. To identify which signal the modem is displaying:

"+" indicates an RS-366 signal.

\*\*" indicates an RS-232-C signal.

**NOTE:** The TXD and RXD segments are not used for RS-366 displays.



## CHAPTER 4

### OPTIONS

The 4850PA provides configuration options, which are stored in nonvolatile memory. Table 4-1 and 4-2 lists the available options.

**Table 4-1. Standard User Options**

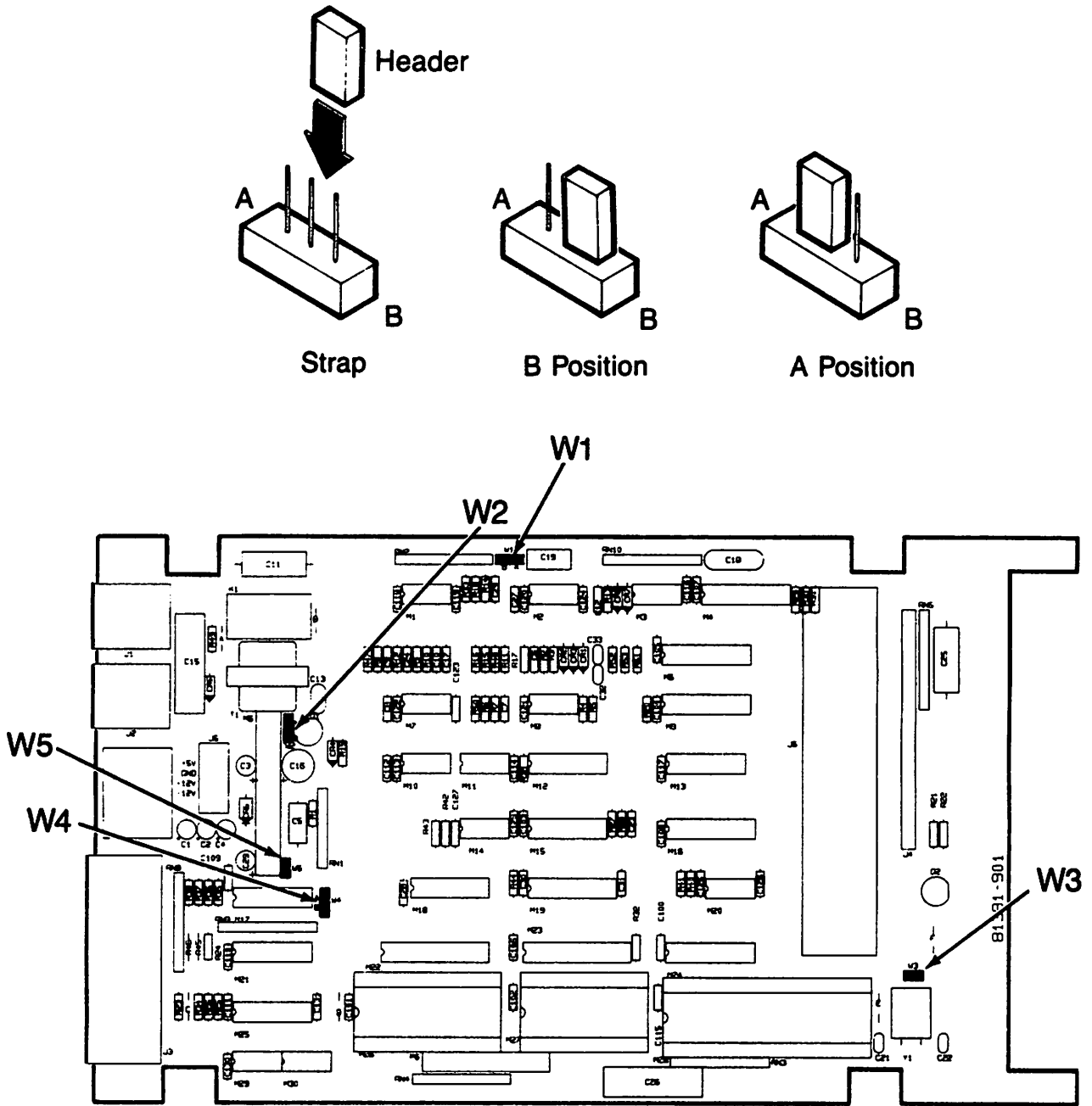
No.	Option	Status	Code
1	Standard Options	Enabled	1
2	DSR Control	CSI	1
3	Reserved		1
4	Auto Answer	Enabled	1
5	Dial Mode	Auto Selection	1
6	Blind Dial	Disabled	1
7	Reserved		1
8	Answer Delay	First Ring	1
9	Reserved		1
10	Failed Call Timer	60 seconds	1
11	Reserved		1
12	Reserved		1
13	Speed Select	4800 bps	3
14	Busy Out with DTR LOW	Disabled	1
15	NRZI	Enabled	1
16	Satellite Option	Disabled	1
17	Clear To Send Delay	50 ms	1
18	Local Copy	Disabled	1
19	Turnaround Delay	Enabled	1
20	Line Current Disconnect	Enabled	1
21	Clock Mode	Internal	1
22	Force DTR	Disabled	1
23	ACR Timer	45 seconds	3
24	ACR on Invalid Digit	Enabled	1
25	ACR on Busy Tone	Enabled	1
26	ACR on Local Modem Busy	Enabled	1
27	Interactive Character Set	EBCDIC	1
28	Modulation	Bell 208	1

**Table 4-2. Factory Options (Hard Straps)**

<b>DESCRIPTION</b>	<b>SELECTION</b>	<b>STRAP IN</b>	<b>STRAP OUT</b>
Dynamic Range	0 to -33 dBm (leased line)	W1-A	W1-B
	-10 to -43 dBm (switched network)*	W1-B	W1-A
Transmit Level	0 to -12 dBm (programmable)	-	W2
	0 dBm (leased line)	W2-B	-
	-10 dBm (permissive)*	W2-A	-
Line Connection	Switched Network*		-W3
	Leased Line	W3	-
Bypass the Off	Switched Network*	-	A
Hook Relay	Leased Line	A	-
Multiline Indication	Enabled*	B	-
	Disabled	-	B
Protective Ground to Signal Ground	Tied	C	-
	Not tied*	-	C
SCR with Carrier OFF	In Phase with SCT	E	-
	Clamped to MARK	-	E

\*Indicates the standard selection.

See the circuit board to determine which positions are A and B.  
Strap D is for manufacturing purposes only.



**Figure 4-1. Location of Straps**

## **User Options**

The asterisk (\*) indicates standard code settings.

### **1 Standard Option Settings**

When enabled, all options are set to their standard settings. (This option must be disabled if any other option is changed to a nonstandard setting.)

- 1 Enabled\*
- 2 Disabled

### **2 DSR Control**

This option controls the DSR signal to the EIA interface. When Computer System Interface is selected, DSR will pulse low for four seconds when the modem returns on hook. All other times DSR remains HIGH to allow the DTE to interact with the modem.

- 1 Computer Interface\*
- 2 DSR always ON
- 3 DSR normal

### **3 Reserved**

A one must be inserted here in the batch option string.

### **4 Auto Answer**

This option allows the modem to automatically answer a call.

- 1 Enabled\*
- 2 Disabled

## 5 Dial Mode

This option selects pulse dialing, tone dialing, or automatic selection of pulse or tone dialing. When the automatic selection option is chosen, the modem will first attempt tone dialing. However, if dial tone is still present after the first digit dialed, then the number is redialed from the first digit using pulse dialing. This option controls the dialing mode from any dialing method.

- 1 Auto\*
- 2 Tone
- 3 Pulse

## 6 Blind Dial

This option disables the dial tone detection circuitry and causes the modem to delay five seconds before dialing to allow access to telephone lines with nonstandard dial tones. This option functions in all dial modes.

- 1 Disabled\*
- 2 Enabled

## 7 Reserved

A one must be entered here in the batch option string.

## 8 Answer Delay

This option allows the modem to automatically answer an incoming call after the first or third ring.

- 1 First ring\*
- 2 Third ring

## 9 Reserved

A one must be entered here in the batch option string.

## 10 Failed Call Timer

This option selects the delay used in the failed call timer.

- 1 Delay = 60 seconds\*
- 2 Delay = 30 seconds
- 3 Timer disabled

11 Reserved

A one must be entered here in the batch option string.

12 Reserved

A one must be entered here in the batch option string.

13 Speed Select

This option selects the operating speed of the modem. (It can be temporarily overridden by pressing the front panel speed key.)

- 1 2400 bps
- 2 Not used
- 3 4800 bps\*

14 Busy Out with DTR LOW

When enabled, this option causes the modem to present a busy condition to the telephone network whenever DTR (Pin 20) is LOW.

**NOTE:** a 4-second exchange clear down delay is applied by the modem when in transition from online to busy out.

- 1 Disabled\*
- 2 Enabled

15 NRZI

This option conditions the modem to operate with systems which utilize Invert-On-Zero Coding (NRZI).

- 1 Enabled\*
- 2 Disabled

### 16 Satellite Option

When this option is enabled, RTS is inhibited within the modem for 275 ms after the end of answer tone (and after DSR comesg on). This delay, which occurs on both the originating and answering ends, allows the echo suppressors on the telephone link to be enabled. This option allows the modem to transmit data over satellite links but will not permit fast turnaround operation.

- 1 Disabled\*
- 2 Enabled

### 17 Clear To Send Delay

This option selects the delay between receipt of RTS from the DTE until CTS is raised. This delay ensures that the remote receiver is ready to accept data.

- 1 50 ms\*
- 2 150 ms

### 18 Local Copy

When enabled, this option causes the modem to reflect back to the DTE all data being transmitted.

- 1 Disabled\*
- 2 Enabled

### 19 Turnaround Delay

When enabled, this option holds CXR LOW for as much as 150 ms after RTS is turned OFF. If a loss of energy is detected during the 150 ms delay, CXR will be turned on 52 ms after energy is detected. If a loss of energy is not detected, CXR will turn on 52 ms after the delay is complete. Any changes in energy will be ignored for the first 8.5 ms. This option prevents the modem from re-ceiving the echo of its own transmitted data.

- 1 Disabled\*
- 2 Enabled

## 20 Line Current Disconnect

This option allows the modem to disconnect automatically when the remote modem disconnects. With this option enabled, the modem will detect the line current reversal, which occurs when the remote modem disconnects, and drop its local connection.

- 1 Enabled\*
- 2 Disabled

## 21 Clock Mode (This option is only accessible from the front panel.)

This option selects whether the modem will provide the transmit clock on pin 15 of the EIA (internal) or if the DTE will provide the transmit clock on EIA pin 24 (external).

- 1 Internal\*
- 2 External

## 22 Force DTR (This option is only accessible from the front panel.)

This option forces DTR internally to allow the modem to be used with terminals which do not supply DTR on pin 20.

- 1 Disabled\*
- 2 Enabled

## 23 ACR Timing (This option is only accessible from the front panel.)

This option selects the duration of the Abandon Call and Retry timer. The ACR timer determines how long the modem will wait to receive answer tone. When the timer expires, ACR is issued to the RS-366 dialing port to signal a failed call.

- 1 15 seconds
- 2 30 seconds
- 3 45 seconds\*
- 4 60 seconds



24 Issue ACR on Invalid Digit (This option is only accessible from the front panel.)

When enabled, this option requires the modem to issue the ACR signal if an invalid digit is issued in the dialing string.

- 1 Enabled\*
- 2 Disabled

25 Issue ACR on Busy Tone Detect (This option is only accessible from the front panel.)

With this option enabled, the modem will issue ACR if a busy tone is detected on the phone line.

- 1 Enabled\*
- 2 Disabled

26 Issue ACR on Local Modem Busy (This option is only accessible from the front panel.)

When this option is enabled, ACR will be issued if a call is attempted while the local modem is off hook.

- 1 Enabled\*
- 2 Disabled

27 Interactive Character Set (This option is only accessible from the front panel.)

This option selects the character set used in the HDLC/SDLC dialing mode. The EBDIC code is needed for SDLC operation and the ASCII code for HDLC operation.

- 1 EBCDIC\*
- 2 ASCII

28 Modulation (This option is only accessible from the front panel.)

This option selects between Bell 208 and CCITT V.27 modulation.

- 1 208\*
- 2 V.27

### **Batch Option Mode**

The options accessible through the HDLC/SDLC and Bisync interactive modes may be changed with a 28-digit batch option string. With the batch dialing string, no option settings may be left out. Even those option numbers which are not used must be filled in the batch option string.

Standard options string (from list of options):

1111111111113111111111311111

## **CHAPTER 5**

### **DIAGNOSTICS**

#### **OVERVIEW**

To help you pinpoint the source of a problem in a data link, the 4850PA has four built-in tests:

- o Idle mode self-test
- o Analog loopback test
- o Analog loopback self-test
- o End-to-end self-test

In this chapter, you'll find a trouble-shooting procedure and explanations of all the tests.

#### **TROUBLE-SHOOTING**

There are many parts to a data communications link, especially when you consider the number of signals in the RS-232-C and RS-366 cables. Just one missing signal or one loose connector can prevent successful communication. Furthermore, there can be numerous options in the communications software that must be set correctly before you can transfer data.

## **WHAT TO DO WHEN THE MODEM WON'T RESPOND**

If your modem doesn't respond, follow these steps:

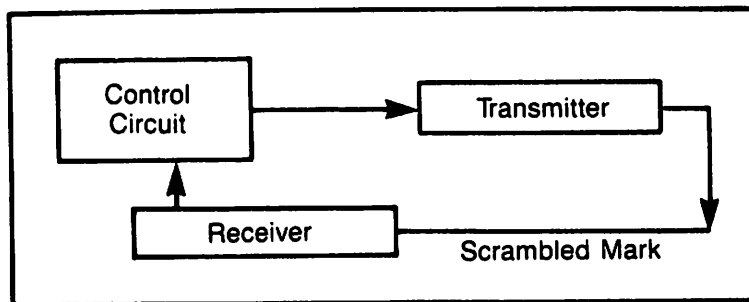
### **Check the Installation**

1. Use only cables that are wired specifically for your particular terminal (see Appendix A). All connectors must be firmly attached--use small screws to secure each connection. Make sure there is no stress or strain on the cables. If you think a wire has broken, test the cables with an ohmmeter.
2. Make sure you have connected the modem to the correct serial communications port on your computer or terminal. (Check the manual that came with your equipment.)
3. Make sure that the modem and computer or terminal are plugged into the power source. The LCD will display "IDLE" when the modem has power.

### **Check Communications Software Settings**

1. Check that your computer or terminal is running at a speed the modem can handle (4800 or 2400 bps).
2. Make sure you have selected the proper port on your computer or terminal with your communications software.
3. Make sure the modem's DSR (Data Set Ready), and DTR (Data Terminal Ready) options match the needs of your communications software or terminal.

**NOTE:** If the modem still won't respond after you have checked all of these items, call our Diagnostic Center.

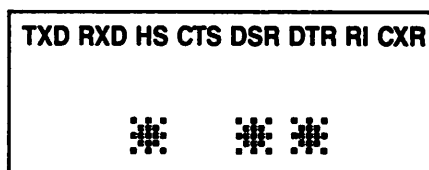


**Figure 5-1. Block Diagram of the Idle Mode Self-Test.**

Use the following convention to interpret the EIA signals:

o = ON

\* (flashing) = data being sent



**Figure 5-2. EIA Signals During the Idle Mode Self-Test.**

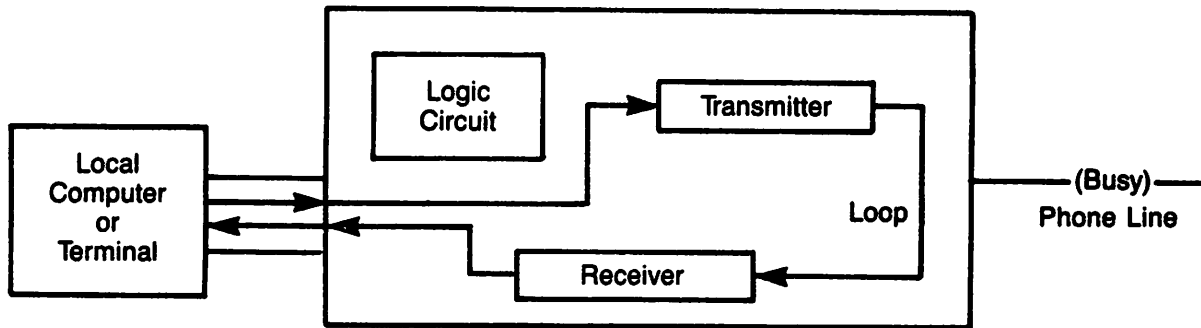
## TESTS

### Idle Mode Self-Test

The 4850PA runs this self-test continuously whenever it is in idle mode (the display indicates "IDLE"). The modem conducts the self-test automatically. The test ends when the modem leaves idle mode.

If the modem detects an error, the display shows "ST ERROR" (self-test error). After one second, the display returns to "IDLE."

If the modem detects numerous errors, the display continues to show "ST ERROR." The modem does not record the number of errors detected.



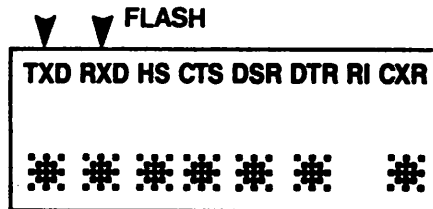
**Figure 5-3. The Analog Loopback Test.**

### **Analog Loopback**

Use the analog loopback test to check modem and the connection between the 4850PA and the computer. Basically, the idea is to send characters through the modem and compare them to what was received.

During this test the modem remains isolated from the phone line. To those who call, the phone line is busy.

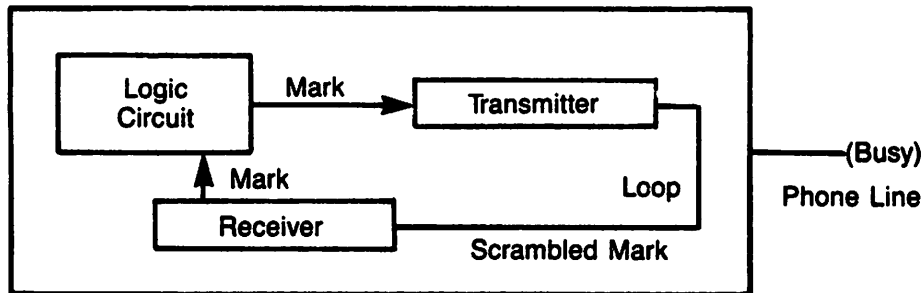
The modem transmitter loops data directly to the receiver. The modem's display indicates "ALB." (Press the DISPLAY switch to see the diagnostic indicators.)



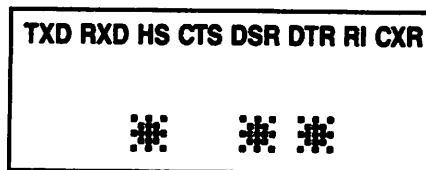
**Figure 5-4. BIA Signals During the Analog Loopback Test.**

To conduct an analog loopback test, follow these steps:

1. Make sure the modem is connected to the computer or terminal, powered up and on-hook.
2. Press the LOOP key once. This puts the modem into analog loopback, where signals sent to the modem from the computer/terminal are looped back. In this state, the modem display shows "ALB."
3. Type a block of capital Us (or any character of your choice). Watch for uninterrupted Us on your computer/terminal display. Change the modem's display with the DISPLAY key to see the characters you have typed.
4. End the test when you have finished by pressing LOOP or RESET.



**Figure 5-5. Diagram of the Analog Loopback Self-Test.**



**Figure 5-6. EIA Signals During the ALB Self-Test.**

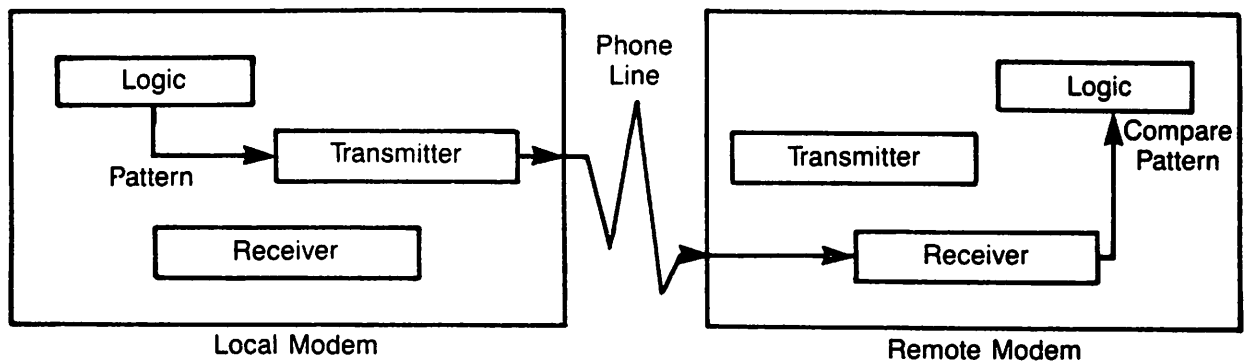
#### **Analog Loopback Self-Test**

The analog loopback self-test uses the internally generated test pattern, scrambled MARK, instead of data input from the DTE to verify the operation of the modem. If a failure is detected in the internal test pattern, the modem displays "ST ERROR" on the LCD.

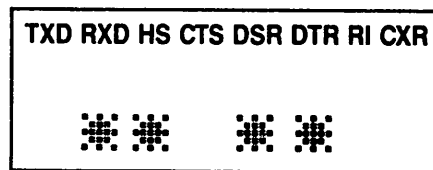
Before entering the ALB self-test, press RESET. Begin the test by pressing LOOP, then TEST. The test will continue until you press RESET (or press TEST, then LOOP).

During the test, the display shows "ALB ST" and the phone line will appear busy to incoming callers. If the modem detects an error, it displays "ST ERROR."





**Figure 5-7. Diagram of the End-to-End Self-Test.**



**Figure 5-8. EIA Signals During the End-to-End Self-Test.**

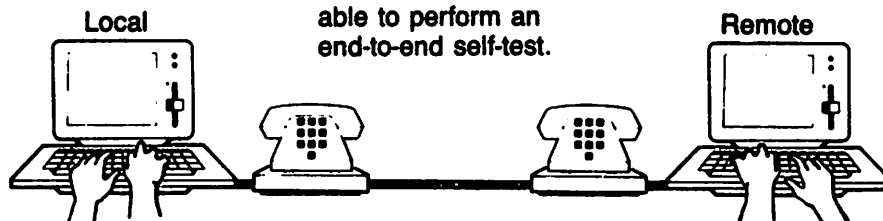
**End-to-End Self-Test**

The end-to-end self-test checks the operation of both modems in one direction only (one modem sends, the other receives) and the phone line between them. To thoroughly test both modems, conduct this test twice--once transmitting from the local modem and once transmitting from the remote modem.

One modem transmits its internal test pattern to the remote modem. The remote modem compares the received pattern to its own internal test pattern. If an error is detected, the remote modem displays "ST ERROR" until the test ends.

### End-to-end Self-test

Modems online at  
4800 bps.  
Both modems must be  
able to perform an  
end-to-end self-test.



Condition remote  
modem to receive the  
self-test pattern.

#### 1. Press LOOP

Local modem transmits  
a test pattern. Remote  
modem compares  
pattern received to  
internal pattern.

```
TXD RXD HS CTS DSR DTR RI CXR
SELFTEST
```

```
TXD RXD HS CTS DSR DTR RI CXR
SELFTEST
```

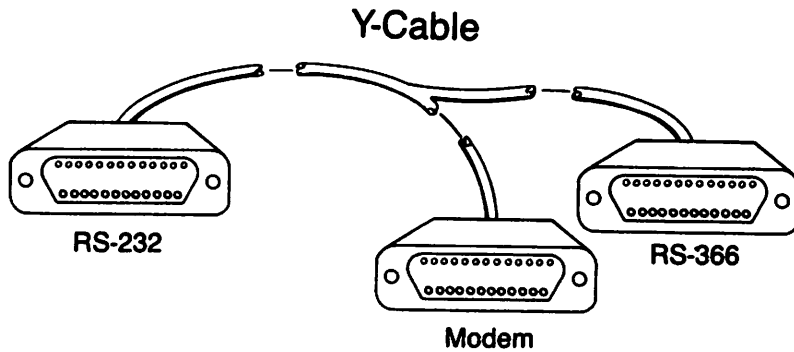
#### *Failed Test*

If the test patterns do not  
compare at the remote  
modem, that modem  
displays the error  
message.

```
TXD RXD HS CTS DSR DTR RI CXR
ST ERROR
```

#### 2. Press LOOP

Exit the test. Press  
LOOP or TEST again  
to stay online.  
If either operator  
presses RESET,  
modems will break  
the connection.



**APPENDIX A**

**DETAIL OF THE CONNECTOR CABLES**

**The Y Cable**

The modem connects to the computer (or terminal) and to an 801 dialing port through the 18-inch Y cable (Racal-Vadic part number 91009-094). The cable channels two separate sets of signals into the modem.

The cable carries RS-232-C signals between the computer terminal (DTE) and the modem, and carries RS-366 signals between an 801 dialing port and the modem. The computer terminal and dialer also share some signals through the Y cable.

The Y cable connects to the dialing port and the computer terminal with female, 25-pin, D-type connectors. The cable attaches to the modem with a male, 25-pin connector. The connectors are labeled "RS232" (computer terminal), "MODEM" and "RS366" (dialing port).

If you have trouble connecting the modem, please call us. Our service representatives will gladly answer your questions.

**Table A-1. Assignment of Pins in The Y Cable**

<b>Modem</b>	<b>Function</b>	<b>DTE</b>	<b>Dialer</b>
1	Frame Ground (FG)	1	1
2	Transmit Data (TXD)	2	
3	Receive Data (RXD)	3	
4	Request To Send (RTS)	4	
5	Clear To Send (CTS)	5	
6	Data Set Ready (DSR)	6	
7	Signal Ground (SG)	7	7
8	Carrier Detect (CXR)	8	
9	+12 Volts (PWI)*	9	6
10	-12 Volts (-V)	10	
11	Binary Digit 8 (NB8)*		17
12	Digit Present (DPR)*		2
13	Data Line Occupied (DLO)*		22
14	Present Next Digit (PND)*		5
15	Serial Transmit Clock (SCT)	15	
16	Distant Station Connected (DSC)*		13
17	Serial Receive Clock (SCR)	17	
18	Binary Digit 1 (NB1)*		14
19	Binary Digit 2 (NB2)*		15
20	Data Terminal Ready (DTR)	20	
21	Abandon Call and Retry (ACR)*		3
22	Ring Indicator (RI)	22	
23	Binary Digit 4 (NB4)*		16
24	External Serial Transmit Clock (SCTE)	24	
25	Call Request (CRQ)*		4

\* These RS-366 signals require a special cable, 91009-094, to be connected to an RS-366 dialing port.

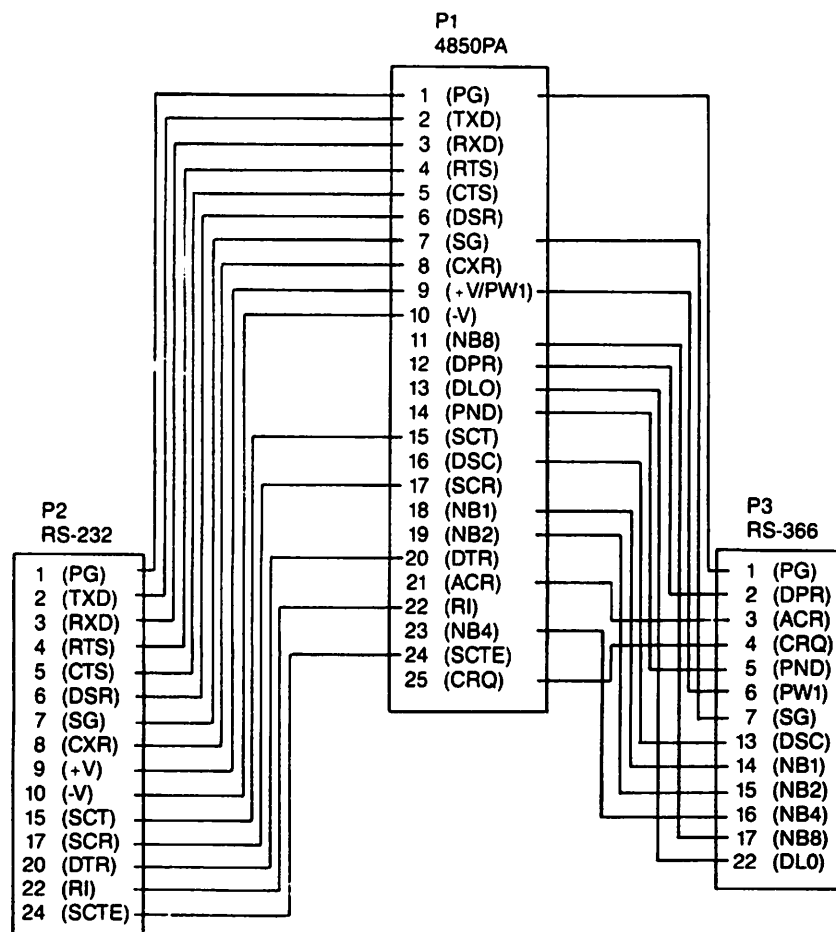


Figure A-1. Detail of the Y Cable

### The RS-232-C Cable

You can connect the 4850PA to a computer or terminal that has no RS-366 dialing port. Simply connect the modem to the computer or terminal's serial dialing port with an RS-232-C cable. The cable should have straight-through wiring (Table A-2). Purchase this cable separately.

**Table A-2. Terminal-Modem Interface Signals (RS-232-C)**

Pin Number (at each end)	Racal-Vadic	EIA/Bell	Description
1	FG	AA	Frame Ground
2	TXD	BA	Transmit Data
3	RXD	BB	Receive Data
4	RTS	CA	Request To Send
5	CTS	CB	Clear To Send
6	DSR	CC	Data Set Ready
7	SG	AB	Signal Ground
8	CXR (DCD)	CF	Carrier Detect (Data Carrier Detect)
9*	+V	+P	Test Voltage (+12.5 $\pm$ 2.5 V dc)
10*	-V	-P	Test Voltage (-12.5 $\pm$ 2.5 V dc)
15	SCT	DB	Serial Transmit Clock
17	SCR	DD	Serial Receive Clock
20	DTR	CD	Data Terminal Ready
22	RI	CE	Ring Indicator
24	SCTE	DA	External Serial Transmit Clock

\* Use pins 9 and 10 only for verifying the presence of electric power in the modem. Both voltages are supplied through 1000-ohm resistors. Never use these pins as a power source for peripheral equipment.

**APPENDIX B  
SPECIFICATIONS**

**OPERATING CHARACTERISTICS**

**Operating Modes:**

Automatic or manual originate, automatic or manual answer

**Transmit Frequencies:**

1800 Hz

**Transmit Level:**

Permissive Connection:  $-10 \text{ dBm} \pm 1.0 \text{ dB}$

Programmable Connection: 0 to  $-12 \text{ dBm}$

Leased Line:  $0 \text{ dBm} \pm \text{dBm}$

**Analog Interface**

Permissive - Telephone line connection is made through a detachable 7' cable terminated at both ends with a modular 6-position plug. The plug will mate with the following connectors:

- a. USOC RJ11C, 12C, 13C voice jack
- b. USOC RJ41S, 42S, 43S or 45S, 46S, 47S data jacks (permissive connection only).

Items a. and b. above are the "permissive" connections defined in Part 68 of the FCC Rules, and transmit level is fixed at  $-10.0 \text{ dBm} \pm 1.0 \text{ dB}$ .

Programmable - Telephone line connection is made through a detachable 7' cable terminated at both ends with a modular 8-position plug. The plug will mate with a USOC RJ41S, 42, 43, or RJ45S, 46, 47 data jack. This is defined as a "programmable" connection in FCC Rules, Part 68. Transmit level is determined by the programming resistor in the data jack (0 to  $-12 \text{ dBm}$ ).

Leased Line - The 4850PA can be optioned for leased line operation via hard straps. Transmit level for leased line is  $0 \text{ dBm} \pm 1 \text{ dBm}$ .

**Data Rate:**

4800 bps  $\pm$  .01% or 2400 bps  $\pm$  .01%

**Receive Clock:**

4800 Hz  $\pm$  .02% derived from the incoming carrier any in-phase synchronism with RXD or 2400 Hz  $\pm$  .01%.

**Carrier Frequency:**

1800 Hz  $\pm$  7 Hz

**Dynamic Range:**

Switched Network: -10 to -43 dBm

Leased Line: 0 to -33 dBm

**Carrier Detect Threshold:** (Measured when receiving all MARK)

Switched Network

Leased Line

OFF by:

-48 dBm    -38 dBm

ON by: -43 dBm

-33 dBm

Hysteresis:

2 dB minimum

**Carrier Detect Delay:**

CXR will be raised 52 ms  $\pm$  3 ms after energy is detected. CXR will drop 8 ms  $\pm$  .5 ms after energy is lost.

**Equalization:**

The receiver equalizer is automatically trained to line conditions when energy is detected and the training pattern received. A break of energy of at least 8 ms causes the receiver to look for a new training sequence.



## **ENVIRONMENTAL REQUIREMENTS**

### **Temperature**

Operating:

0° to 40° C (32° to 104° F)

Storage:

-20° to 70° C (-4° to 158° F)

### **Humidity:**

5% to 90% without condensation

## **PHYSICAL CHARACTERISTICS**

Height: 3.8 cm (1.5 in)

Width: 15.3 cm (6.0 in)

Length: 26.7 cm (10.5 in)

Weight: 1.86 kg ( 4 lb 2.5 oz)

## **POWER REQUIREMENTS:**

117 volts ac ± 10%

57 to 63 hertz

10 watts maximum

+12 V ± 5% @ 200 ma maximum

-12 V ± 5% @ 200 ma maximum

+5 V (+7% or -3%) @ 1000 ma maximum

**Table B-1. Jumper Settings For Phone Service Options**

**Jumper setting**

Permissive (standard) connection

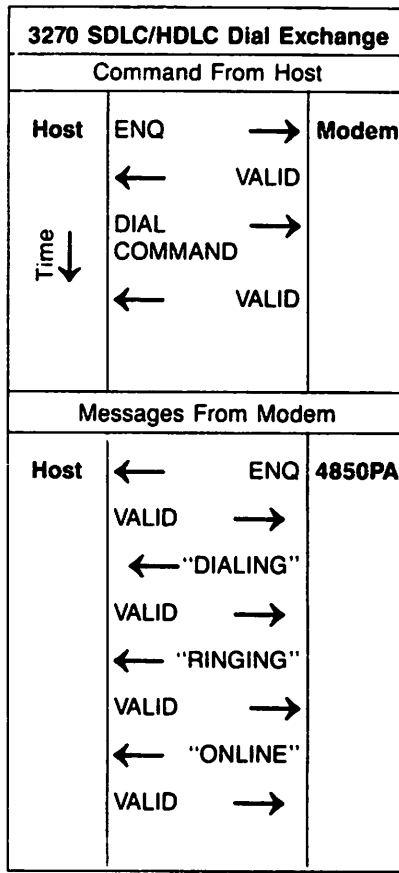
Dynamic Range	-10 to -43 dBm	W1 set to position B.
Transmit Level	-10 dBm	W2 set to position A.
Permissive Transmit Level		No jumper across W3.
Bypass the Off Hook Relay		No jumper across A.

Programmable connection

Dynamic Range	-10 to -43 dBm	W1 set to position B.
Transmit Level	0 to -12 dBm	Remove jumper W2.
Programmable Transmit Level		No jumper across W3.
Bypass the Off Hook Relay		No jumper across A.

Leased line connection

Dynamic Range	0 to -33 dBm	W1 set to position A.
Transmit Level	0 dBm	W2 set to position B.
Leased Line Transmit Level		Connect jumper across W3.
Bypass the Off Hook Relay		Solder a jumper across A.



**Figure C-1. Sample Dial Exchange**

**APPENDIX C**

**COMPUTER TERMINAL/MODEM INTERACTION IN HDLC/SDLC MODE**

**MESSAGE FORMATS**

Commands and call progress messages used in the HDLC/SDLC dialer are coded in nontransparent ASCII (HDLC) or EBCDIC (SDLC). Table D-1 lists the hex equivalent of each message or command for clarity.

**SDLC**

Flag	Flag	Address	Control	8-bit EBCDIC characters	CRC-16	Flag	Flag
------	------	---------	---------	-------------------------	--------	------	------

**HDLC**

Flag	Flag	Address	Control	7-bit ASCII, space parity	CRC-16	Flag	Flag
------	------	---------	---------	---------------------------	--------	------	------

NOTE: In Hexadecimal, Flag = 7E. Address = FF, and Control = 13.

**Figure C-2. HDLC/SDLC Data Frames**

**Table C-1. Structure of HDLC/SDLC Commands and Messages**

**Command Messages**

closing flag											
checksum											
command											
control											
address											
opening flag											
Option Command	7E	7E	7E	7E	FF	13	O (option #)	CR1	CR2	7E	7E
Dial Command	7E	7E	7E	7E	FF	13	D (phone #)	CR1	CR2	7E	7E
<b>Call Progress Messages</b>											
Dialing	7E	7E	7E	7E	FF	13	D	CR1	CR2	7E	7E
Ringing	7E	7E	7E	7E	FF	13	R	CR1	CR2	7E	7E
Answer Tone	7E	7E	7E	7E	FF	13	A	CR1	CR2	7E	7E
On Line	7E	7E	7E	7E	FF	13	L	CR1	CR2	7E	7E
Busy	7E	7E	7E	7E	FF	13	B	CR1	CR2	7E	7E
Failed Call	7E	7E	7E	7E	FF	13	F	CR1	CR2	7E	7E
No Dial Tone	7E	7E	7E	7E	FF	13	E	CR1	CR2	7E	7E
<b>Protocol Control</b>											
Inquiry	7E	7E	7E	7E	FF	13	(ENQ)	CR1	CR2	7E	7E
Valid	7E	7E	7E	7E	FF	13	V	CR1	CR2	7E	7E
Invalid	7E	7E	7E	7E	FF	13	I	CR1	CR2	7E	7E

**Table C-2. Definition of ASCII Characters**

						0	0	0	0	1	1	1	1
b7 →						0	0	0	1	1	1	1	1
b6 →						0	0	1	0	0	1	1	1
b5 →						0	1	0	1	0	1	0	1
Bits	b4	b3	b2	b1	column row ▼ ▶	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	SP	0	@	P		p
	0	0	0	1	1	SOH	DC1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC2	"	2	B	R	b	r
	0	0	1	1	3	ETX	DC3	#	3	C	S	c	s
	0	1	0	0	4	EOT	DC4	\$	4	D	T	d	t
	0	1	0	1	5	ENQ	NAK	%	5	E	U	e	u
	0	1	1	0	6	ACK	SYN	&	6	F	V	f	v
	0	1	1	1	7	BEL	ETB	'	7	G	W	g	w
	1	0	0	0	8	BS	CAN	(	8	H	X	h	x
	1	0	0	1	9	HT	EM	)	9	I	Y	i	y
	1	0	1	0	10	LF	SUB	*	:	I	Z	i	z
	1	0	1	1	11	VT	ESC	+	;	K		k	;
	1	1	0	0	12	FF	FX	,	<	L		l	!
	1	1	0	1	13	CR	GS	-	=	M		m	}
	1	1	1	0	14	SO	RS	.	>	N	>	n	-
	1	1	1	1	15	SI	US	/	?	O	-	o	DEL

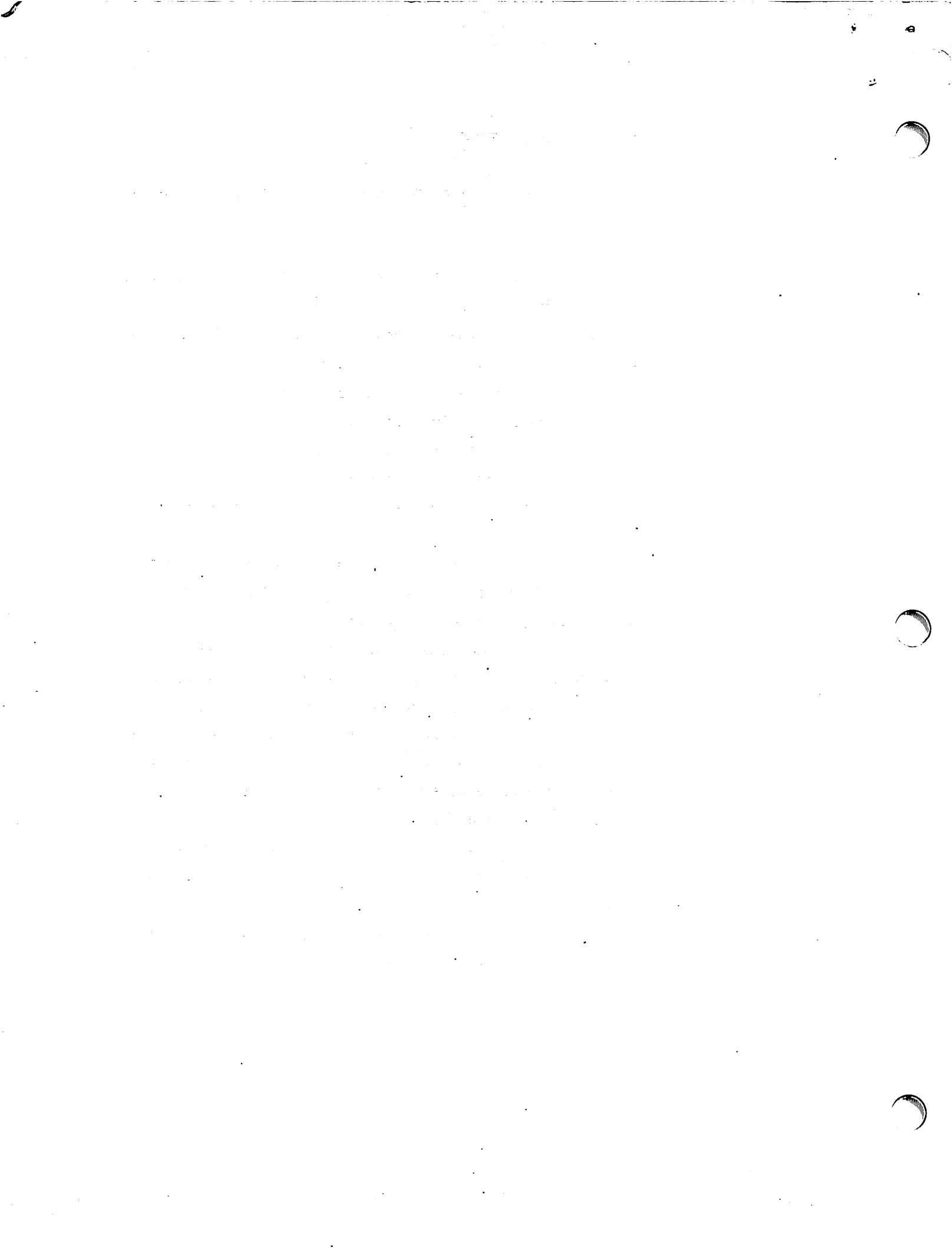
**Table C-3. Definition of EBCDIC Characters**

Bits 4567	Hex ↓	00				01				10				11				Bits 0,1
		00	01	10	11	00	01	10	11	00	01	10	11	00	01	10	11	2,3
		0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	Hex 0
0000	0	NUL	DLE			SP	&	-										0
0001	1	SOH	SBA				/		a	i			A	J			1	
0010	2	STX	EUA		SYN				b	k	s		B	K	S		2	
0011	3	ETX	IC						c	l	t		C	L	T		3	
0100	4								d	m	u		D	M	U		4	
0101	5	PT	NL						e	n	v		E	N	V		5	
0110	6			ETB					f	o	w		F	O	W		6	
0111	7			ESC	EOT				g	p	x		G	P	X		7	
1000	8								h	q	y		H	Q	Y		8	
1001	9		EM						i	r	z		I	R	Z		9	
1010	A					c	!	!	:									
1011	B					.	\$	,	#									
1100	C		DUP		RA	<	.	%	@									
1101	D		SF	ENQ	NAK	{	}	-	'									
1110	E		FM	ACK		+	;	}	=									
1111	F		ITB		SUB		_	?	"									

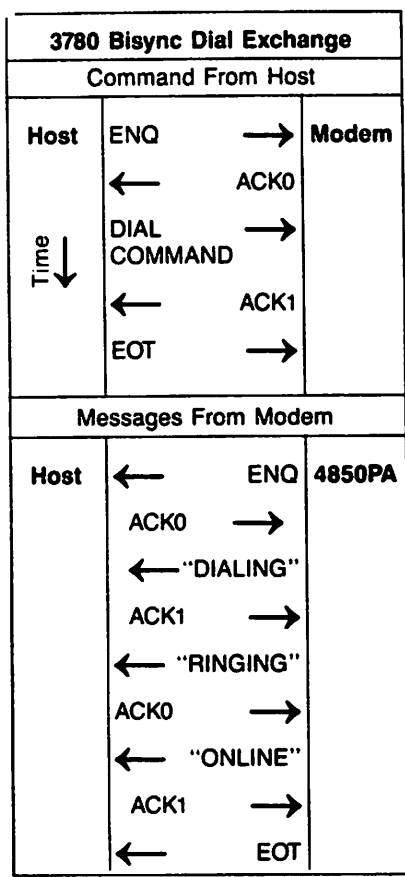
## **HDLC/SDLC PROTOCOL RULES**

The following rules govern operation of the HDLC/SDLC Auto-dial protocol:

1. Any time the computer terminal drops DTR, the modem will return to idle mode.
2. The protocol uses the broadcast address (FF) defined in HDLC/SDLC for all commands and responses.
3. The protocol uses unnumbered information frames as defined in HDLC/SDLC for all commands and responses. The control byte is fixed as 13 (hex).
4. The modem will repeat the same acknowledgment as long as it keeps receiving "INQUIRY." There is no counter or timer limit.
5. The modem will repeat the same call progress or protocol message as long as it keeps receiving "INVALID" from the host. There is no counter or timer limit.
6. Once the modem sends the "DIALING" message to the computer terminal, it will not dial the central office until it receives the correct acknowledgment (Valid).
7. The modem starts the abort timer after dialing the last digit of the telephone number. If answer tone is not received in the selected time, the modem will send a "FAILED CALL" message and go on hook.
8. The modem will send an "INVALID" command message in response to an incorrect option, dial command, or FCS error.
9. The DTE will send an "INVALID" command message to the modem in the event of receiving an unrecognized command or FCS error.







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Figure D-1. Sample Dial Exchange

**APPENDIX D**

**COMPUTER TERMINAL/MODEM INTERACTION IN BISYNC MODE**

**MESSAGE FORMATS**

Commands and call progress messages used in the Bisync dialer are coded in nontransparent EBCDIC. Table E-1 lists the hex equivalent of each message or command for clarity.

**BISYNC**

SYN	SYN	STX	8-bit EBCDIC characters	ETX	CRC-16
-----	-----	-----	-------------------------	-----	--------

**Figure D-2. Bisync Data Frame**

**Table D-1. Structure of Bisync Commands and Messages**

**Command Messages**

closing flag									
checksum									
command									
opening flag									
Option Command	SYN	SYN	SYN	SYN	STX	O (option #)	ETX	CRC16	PAD
Dial Command	SYN	SYN	SYN	SYN	STX	D (phone #)	ETX	CRC16	PAD
<b>Call Progress Messages</b>									
Dialing	SYN	SYN	SYN	SYN	STX	D	ETB	CRC16	PAD
Ringing	SYN	SYN	SYN	SYN	STX	R	ETB	CRC16	PAD
Answer Tone	SYN	SYN	SYN	SYN	STX	A	ETB	CRC16	PAD
On Line	SYN	SYN	SYN	SYN	STX	L	ETB	CRC16	PAD
Busy	SYN	SYN	SYN	SYN	STX	B	ETB	CRC16	PAD
Failed Call	SYN	SYN	SYN	SYN	STX	F	ETX	CRC16	PAD
No Dial Tone	SYN	SYN	SYN	SYN	STX	E	ETX	CRC16	PAD
Invalid	SYN	SYN	SYN	SYN	STX	C	ETX	CRC16	PAD
<b>Protocol Control</b>									
Inquiry	SYN	SYN	SYN	SYN	ENQ			—	—
End of Transmission	SYN	SYN	SYN	SYN	EOT			—	—
ACK-0	SYN	SYN	SYN	SYN	ACK0			—	—
ACK-1	SYN	SYN	SYN	SYN	ACK1			—	—