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X.25-SDLC TRAINING MANUAL FOR

INTERVIEW® 3000 and 3500

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Notice

This training manual is intended for use with Series B 3500 units and X.25-SDLC training tape TAP-895-104-1.3.

Atlantic Research Corporation reserves the right to make improvements to the manual and tape without prior notice. Further tape revisions, beyond 102-1.3, will not necessarily affect correlation with this manual.

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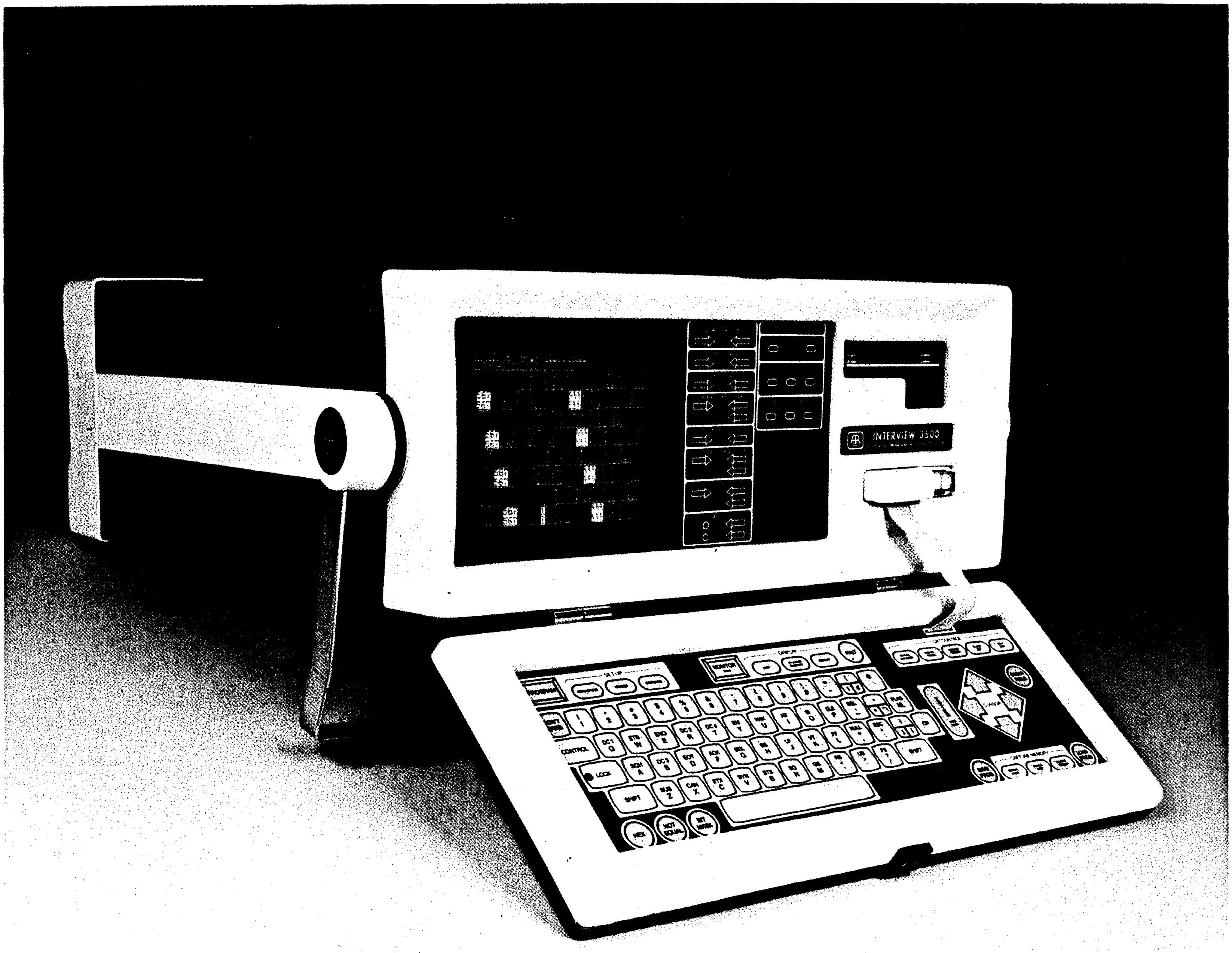

INTERVIEW 3500
CONTROL
LOCK
SHIFT

1 Introduction

The INTERVIEW 3500 is not only a powerful, fully programmable monitor, but also an independently programmable data recorder. Its tape not only accommodates 4 million bits of data, but also stores the diagnostic test—including a complete set of program parameters—in a protected area. This training manual is based on the INTERVIEW 3500's X.25-SDLC Training Tape, 104-1.2.

If you are an INTERVIEW 3000 user, the numerous CRT display reproductions will enable you to use this basic course also. You should consult Appendix A first for suggestions on adapting the manual to your needs.

1.1 SCOPE OF MANUAL

This manual, in conjunction with the X.25-SDLC Training Tape, is intended to teach you to use the INTERVIEW 3500 in a bit-oriented protocol environment, including X.25, X.75, SDLC, HDLC, and BISYNC-framed X.25.* Since a self-teaching format is used, you should proceed through the manual in the given sequence. If you are familiar with the digital data communications world and bit-oriented protocols, then, using this manual and the training tape, you should be able to accomplish the following:

10-30 minutes: operate the 3500 and display bit-oriented protocol data.

1-2 hours: enhance data and use the network performance capabilities of an existing program.

2-3 hours: modify existing programs and conduct extemporaneous program diagnostics and performance measurements.

An extremely important consideration in any training activity is retention. With 3-4 hours' training from this manual and tape you can use the INTERVIEW 3500 effectively even after a "vacation" of 2-3 weeks because the logically and functionally labeled operations follow intuitively and there is no "instruction" set to memorize or look up.

Consult the Technical Manual, ATLC-107-895-101, for specifications and details of 3500 (or 3000) operation. Use other reference documents for in-depth treatment of specific protocols and interface standards.

The remainder of Section 1 presents a general non-operating view of the INTERVIEW 3500. You will become familiar with the major operational controls and indicators.

Beginning with Section 2, you will use the instrument in various operational modes. Operator actions are printed in bold face type, which should be especially useful when you want to review a procedure.

Figures show typical CRT displays. Negative reproductions of displays have been used because they offer better definition in print than do positives. The tape block numbers may vary between the training tape and figures in this manual because of operator response time; however, the content of each figure will illustrate the point.

* Throughout this manual the term BOP (Bit-Oriented Protocol) is used to include X.25, X.75, SDLC, and HDLC. The more universal term BOP is also used in CRT menus. Although BISYNC-framed X.25 is BOP in content, it uses synchronous framing and cannot be considered BOP for 3500 programming purposes.

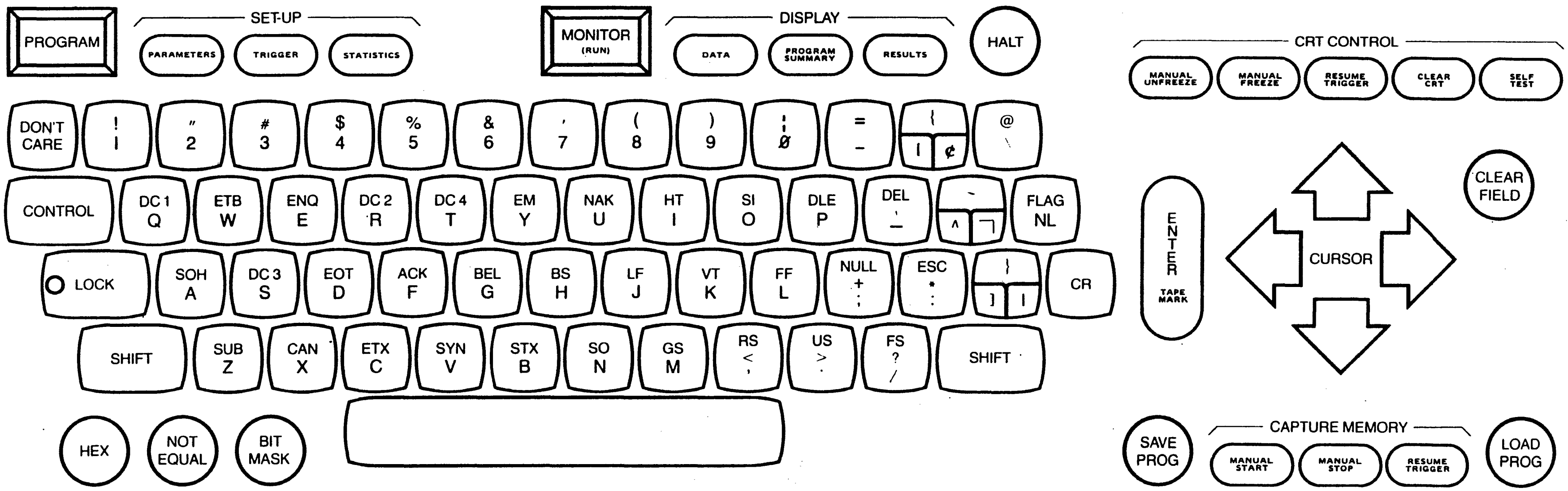

PROGRAM
SET-UP
PARAMETERS
TRIGGER
STATISTICS
MONITOR (RUN)
DISPLAY
DATA
PROGRAM SUMMARY
RESULTS
HALT
CRT CONTROL
MANUAL UNFREEZE
MANUAL FREEZE
RESUME TRIGGER
CLEAR CRT
SELF TEST
DON'T CARE
! 1
" 2
3
$ 4
% 5
& 6
' 7
(8
) 9
Ø
= –
@
CONTROL
DC 1 Q
ETB W
ENQ E
DC 2 R
DC 4 T
EM Y
NAK U
HT I
SI O
DLE P
DEL
FLAG NL
LOCK
SOH A
DC 3 S
EOT D
ACK F
BEL G
BS H
LF J
VT K
FF L
NULL +
ESC *
CR
SHIFT
SUB Z
CAN X
ETX C
SYN V
STX B
SO N
GS M
RS <
US >
FS ? /
SHIFT
HEX
NOT EQUAL
BIT MASK
ENTER
TAPE MARK
CURSOR
CLEAR FIELD
SAVE PROG
CAPTURE MEMORY
MANUAL START
MANUAL STOP
RESUME TRIGGER
LOAD PROG

Figure 1-1

1.2 HUMAN INTERFACE

You interact with the 3500 via the keyboard and the 7-inch CRT display. Each control key is clearly labeled by function.

With only a glance at the two status lines on the CRT and the status indicator zone of the front panel you will quickly understand what mode the 3500 is in, what it is doing, and why. An audible beeper confirms proper key operation and calls attention to illegal key actions.

1.3 KEYBOARD

Familiarize yourself with the color-coded, touch-sensitive keyboard (see Figure 1-1). Notice especially the following significant features:

- Full ASCII typewriter-terminal keyboard layout.
- Blue keys are those used for HEX (and the most often used protocol control characters).
- Red keys are used primarily in the Program Mode.
- Green keys are used in the Monitor Mode and are grouped in three zones for—

  Display selections,
  CRT control,
  CAPTURE MEMORY (tape) control.
- Rectangular Red and Green keys are the mode entry keys:

  PROGRAM = RED; MONITOR = GREEN.
- A special FLAG key is used for the *Flag* byte in HDLC (bit stuffing) framing. (An HDLC *Flag* cannot be entered using HEX 7 E.)

Notes:

1. Some keys repeat when held down (e.g., cursor arrows).
2. The CONTROL key must be held down while a key for a protocol control character is operated.
3. Some keys are alternate action (e.g., CRT SELF TEST and, in *Monitor* Mode, HEX).
4. Some keys are single function latch (e.g., HEX accepts the next two keys as HEX in *Program* Mode).
5. Refer to the Technical Manual for full key specifications.

1.4 INDICATOR PANEL

The right STATUS indicator zone of the front panel clearly identifies the CRT display and tape activity (Figure 1-2). A FREEZE indicator quickly verifies that the CRT display is supposed to be frozen and whether the cause is a manual request by the operator or action by a program trigger. A RECORD indicator verifies that the tape is recording at the direction of the operator *manually* or via a program *trigger*.

The left STATUS zone of the front panel provid additional functionally labeled indicators for the I 232/V.24 interface signals (Figure 1-3).

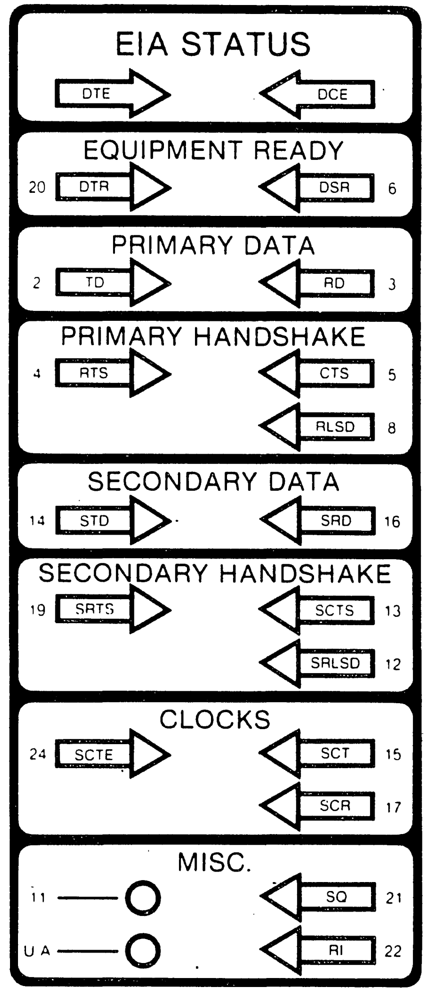


Figure 1-2

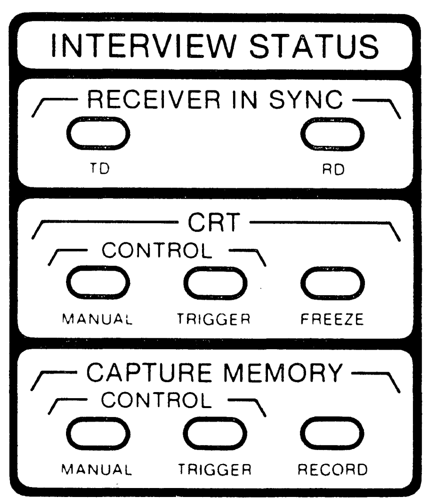


Figure 1-3

1.5 CRT DISPLAY

The top two lines of the CRT display are reserved for status information for the operator. Sixteen lines are provided for data display and program menus. Each line contains 40 characters for a total data display of 640 characters.

A buffer holds three displays of data (1920 characters). The CRT window of 640 characters can be scrolled through this buffer line by line.

1.6 PROGRAMMING CONCEPT

A unique *nonsequential* programming concept makes it unnecessary to learn programming. Terms such as addresses, steps, jumps, interrupts, conditional tests, and macro instructions are not used at all because a simpler and more powerful method is provided.

Basically, you define a situation you want to *look for* and what *action* (or actions) should then be *set*. This capability is called a *trigger*. Eight triggers are available. All eight triggers can look for independent nonrelated conditions (e.g., character strings) simultaneously and can take independent and (or) interrelated actions (counters, timers, CRT control, tape control, and so on).

You simply indicate what the 3500 is to do. No sequential program steps or flow charts are required and there is no list of instructions or commands to remember.

2 Power-up

2.1 WITHOUT TAPE INSERTED

(1) **Operate the red power switch.** The CRT will show the display of Figure 2-1. If an error is found during the power-up interactive diagnostics among the internal microprocessors, a code indicative of the defective subassembly will be displayed in the SELF TEST line. Refer to the Technical Manual for a list of the error codes.

You may now use only the PROGRAM key or the MONITOR key. Any other key will cause a KEY ERROR response on line 2 of the display and an audible signal. KEY ERROR clears after 3 seconds or when a correct key is operated.

(2) **Verify the KEY ERROR response by operating a numeric key.**

NOTE: On power-up without tape inserted, the program defaults to basic BISYNC parameters.

```
           ** INTERVIEW 3500 **

 RS-232 / V.24 INTERFACE

 TAPE: TAPE NOT INSTALLED  (01)

 SELF TEST: GOOD


 PRESS PROGRAM KEY FOR MENU PAGE

 PRESS MONITOR KEY TO START PROGRAM



                  SOFTWARE VERSION: 03.00
```

Figure 2-1

(3) **Operate the MONITOR key and observe the display** (Figure 2-2). On the top line are the mode, MONitor, signal source, LINE, and the tape BLOCK number. The second line shows that the monitor is expecting signals on BOTH the DCE and DTE circuits and that the signals should be EBCDIC and SYNChronous with synchronization characters of 32 32_{16}.

If a BISYNC signal were to be applied to the rear RS-232/V.24 connector, the data would now be displayed.

(4) **Operate the PROGRAM key and observe the display** (Figure 2-3).

NOTE: You may use the PROGRAM key at any time in any mode to provide a known basic starting point.

Notice that the Program Selections menu permits only six selections. All programming is accomplished

```
*MON LINE*        BLOCK=
BOTH/EBCDIC/SYNC/3232
```

Figure 2-2

through the Parameters, Triggers, and Statistics menus, which are thoroughly explained in this manual.

The bottom two selections permit you to *SAVE* or *LOAD* a program.

2.2 TAPE INSERTED AFTER POWER-UP

(1) **Check that the RECORD tab on the rear of the tape cartridge is not in the record position** (the tab should be toward the center of the cartridge). **Insert the X.25-SDLC training tape** with the drive wheel to the rear and the transparent window on top. **Push it gently in until you feel it lock.**

NOTE: The training tape may be supplied with the record tab removed entirely to prevent accidental erasing of its content. Nevertheless, you should develop the habit of checking the tab whenever you use any tape.

```
           ** PROGRAM SELECTIONS **

PRESS PARAMETERS THEN 1
      TO DISPLAY THE BASIC MONITOR MENU

PRESS PARAMETERS THEN 2
      TO DISPLAY THE CRT & TAPE MENU

PRESS  TRIGGER   THEN TRIGGER NUMBER 1-8
      TO DISPLAY THE TRIGGER MENU

PRESS STATISTICS
      TO DISPLAY THE COUNTER/TIMER MENU

PRESS LOAD PROG  TO READ PRGM FROM TAPE

PRESS SAVE PROG  TO STORE PRGM ON TAPE
```

Figure 2-3

(2) **Operate the PROGRAM key.**

(3) **Press the LOAD PROGram key** to the right of the CAPTURE MEMORY zone. The microprocessor that controls the tape will automatically reposition the tape to the program area, read the program, and reposition the tape to Block 000 for playback.

Observe the display (Figure 2-4). The TEST ID is X.25/SDLC TRAINING followed by an issue number. The other parameters on this menu will be discussed in later sections.

(4) **Operate the MONITOR key.** After the tape automatically positions itself, data is displayed (Figure 2-5). The top two lines indicate we are *MONitoring* the TAPE at BLOCK XXX as a source for signals on BOTH the DTE and DCE lines using ASCII code with SPACE parity in BOP (Bit-Oriented Protocol) format.

```
** PROGRAM MODE -- BASIC MONITOR **

TEST ID: X.25/SDLC training #104-1.2
SOURCE : LINE TAPE DTM TAPE/DTM EDIT/DTM
         START: BLOCK 000  CONTINUE
MONITOR: BOTH DTE DCE
CODE   : EBCDIC   ASCII   EBCD  XS-3
         IPARS  REV EBCD  BAUDOT HEX
         BITS  : 8 7
         PARITY: EVEN ODD MRK SPACE NONE
FORMAT : SYNC BOP BOP/NRZI ASYNC




         SPEED: 2400_
```

Figure 2-4

Operate the PROGRAM key to stop the tape and **then power down the 3500 with the red alternate- action power button.** Leave the tape inserted.

2.3 POWER-UP WITH TAPE INSERTED

(1) **Insert the training tape; then power up the 3500.** The tape is automatically searched for a test in its protected location after the internal self tests are complete. The test is automatically loaded and the power-up menu with the TEST ID displayed as shown in Figure 2-6.

(2) **Operate the MONITOR key.** Data from the tape is now displayed on the CRT.

(3) **Stop the tape by operating PROGRAM before you turn off the power.**

```
*MON TAPE*       BLOCK=001
BOTH/ASCII/SPACE/BOP
              A"                 @ a~
   ; - EXPECTS A BIT INDEX (7 - 0) IN 'B
                                      a
IT'   %m      !     $  &                 ;
       b    U
- EXPECTS IX OR IY IN 'IR'  %     A
                                     TURN
                   a(              j  ! i
S ON A BIT AT THE ADDRESS CALCULATED BY
                                      &
COMBINING   %4   A    N  "
       A%                              ! $  .
;   THE 3 MACRO ARGUMENTS   %      a
  a '
     ' DSDFGHJKL\[ o  b  $
```

Figure 2-5

```
** INTERVIEW 3500 **
RS-232 / V.24 INTERFACE
TAPE: X.25/SDLC training #104-1.2
SELF TEST: GOOD


PRESS PROGRAM KEY FOR MENU PAGE
PRESS MONITOR KEY TO START PROGRAM


                    SOFTWARE VERSION: 03.00
```

Figure 2-6

2.4 REVIEW

• To use a tape containing a previously saved test that has already been inserted in the 3500, only two keys are required: Power-up and MONITOR.

• To insert a saved program tape *after* power-up—

1. Insert the tape.
2. Operate the PROGRAM key.
3. Operate LOAD PROGram.
4. Operate MONITOR.

NOTE: Always stop tape motion by pressing the red PROGRAM key before you operate the Power button to power down the 3500. Never eject a tape until after tape motion has stopped.

3 Monitor Mode

3.1 INTRODUCTION

The training tape contains three types of data:

1. HDLC-framed X.25 (Blocks 000 to 070)
2. BISYNC-framed X.25 (Blocks 080 to 095)
3. SDLC-SNA (Blocks 150 to 250)

HDLC-framed X.25 will be used as a general case. BISYNC-framed X.25 and SDLC will be specifically addressed in Sections 5 and 6, respectively.

Appendix B contains a brief overview of the construction of Bit-Oriented Protocols. Appendix C lists the acronyms displayed by the 3500 for bit-oriented protocols. You may prefer to read these Appendixes before proceeding through the manual. For a thorough review, consult the applicable documentation of CCITT for X.25 and X.75 and that of IBM for SDLC-SNA.

By programming the 3500, you can perform extensive diagnostics on the data. You can save your programs on additional tapes for future *on line* use. The diagnostic applications you will be able to perform after using this manual include the following:

DISPLAY:

- Readable expansion of frame command bytes and packet definition including LCN numbers and Q, D, M bit status
- Suppress all idle Flag characters to increase the efficiency of the display
- Display only information frames
- Display only information packets
- Display only packets to a given LCN
- Force hexadecimal presentation of command bytes
- Suppress the content of information frames or packets to condense the display or maintain security
- Highlight specific types of frames or packets
- Freeze CRT to capture cause of fault
- Record only specific LCN packets

MEASUREMENTS:

- Packet size
- Protocol efficiency
- Line utilization
- Q, D, M bit activity
- Error recovery, e.g., count resets, SARM, DISC.
- FCS errors
- Elapsed call time

3.2 DATA, REAL TIME

With the tape installed, power up the 3500 and press the green rectangular MONITOR key to put the unit in Monitor Mode. This key enables all the green keys on the keyboard and also permits a number of other keys to be used for special functions available only in Monitor Mode.

As you go through this section you will be working with the data on the training tape. Remember that there are three types of data on the tape (see Section 3.1).

Since the training tape program applies only to Blocks 000-070, you will need to rewind the training tape when it reaches Block 070. When the tape plays past Block 070, no data will be displayed. When this occurs, **press PROGRAM, then MONITOR,** to automatically rewind the tape to Block 000 before playback resumes. Do this now and observe the display.

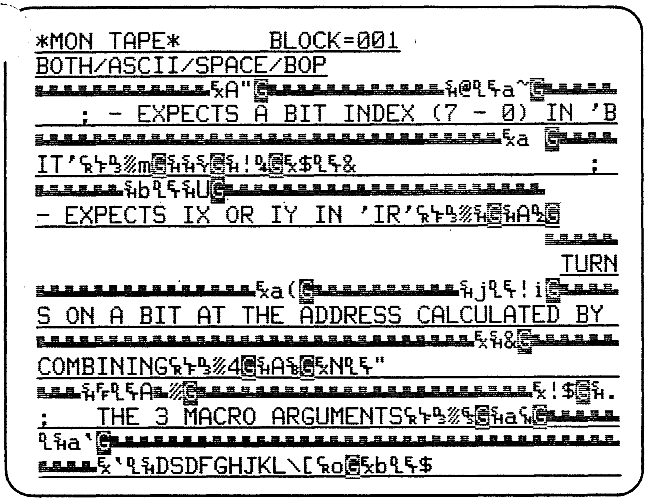


Figure 3-1

Notice that in the training tape program, the idle *Flag* bytes between frames are suppressed (Figure 3-1; compare this display with Figure 3-2). This accounts for the pauses in writing the display.

Observe that in HDLC framing the 3500 display replaces the second frame check byte (FCS 2) with an indicator letter for the frame (see Figure 3-3). These reversed letters, G for Good and B for Bad, provide clear marcation between frames as well as immediately highlighting problems. Aborted frames are identified by the reverse letter A. Since good blocks are normal, the G is low intensity, while the B and A are bright to catch your eye.

In Program Mode, up to eight other characters may be selected for blinking reverse-image display.

Notice the time-correlated, dual-line display of the full-duplex data. The first line is always DTE data; and

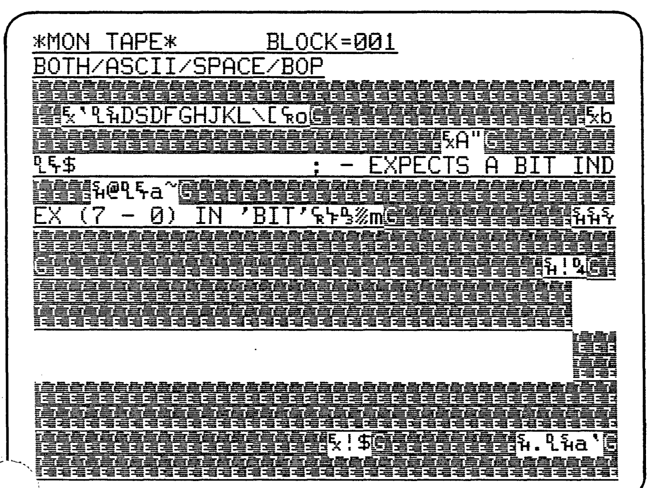


Figure 3-2

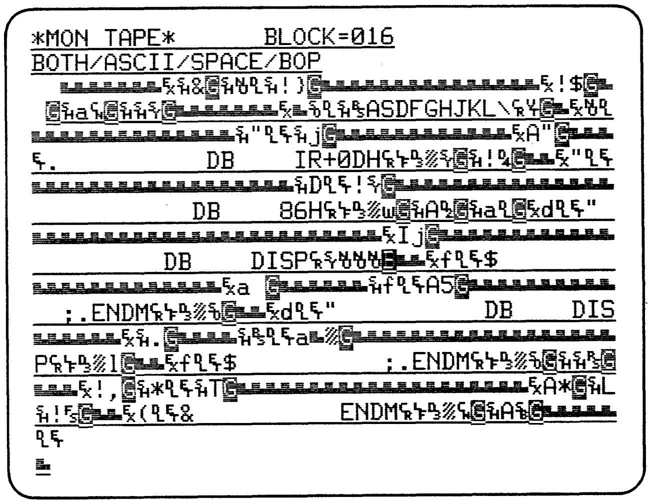


Figure 3-3

the second, DCE. The DCE data is always underlined because the DCE is usually connected to the transmission line.

Operate the HEX key and observe that the entire display (except the status lines) is now in hexadecimal, as shown in Figure 3-4.

Operate the HEX key again to restore test.

In HDLC framing, protocol characters such as STX, SOH, or ETX are not relevant. They should be displayed in hexadecimal because their true significance usually lies in their bit patterns. **Operate CONTROL plus HEX simultaneously** and observe that only ASCII control characters change to hexadecimal and the text remains (as in Figure 3-5). **Operate CONTROL plus HEX again** to restore all text. HEX and CONTROL plus HEX are alternate action operations.

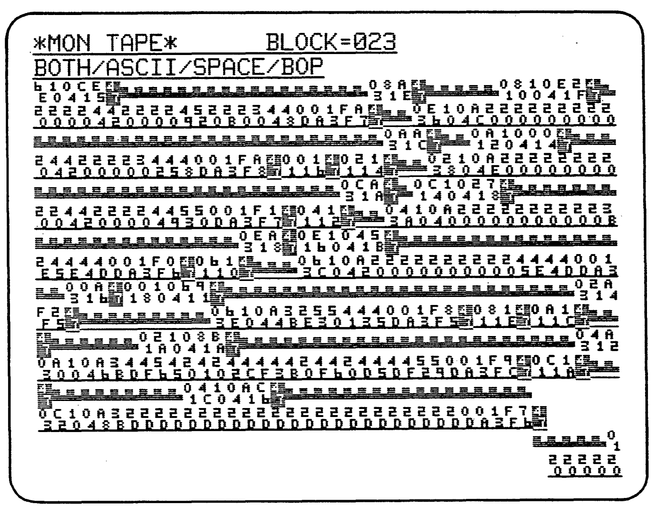


Figure 3-4

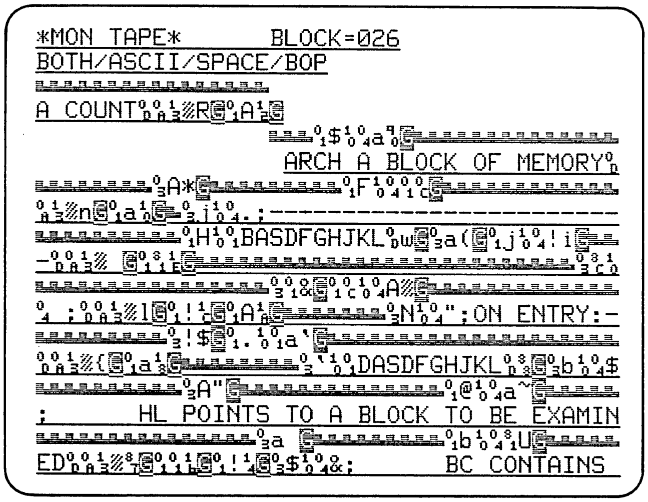


Figure 3-5

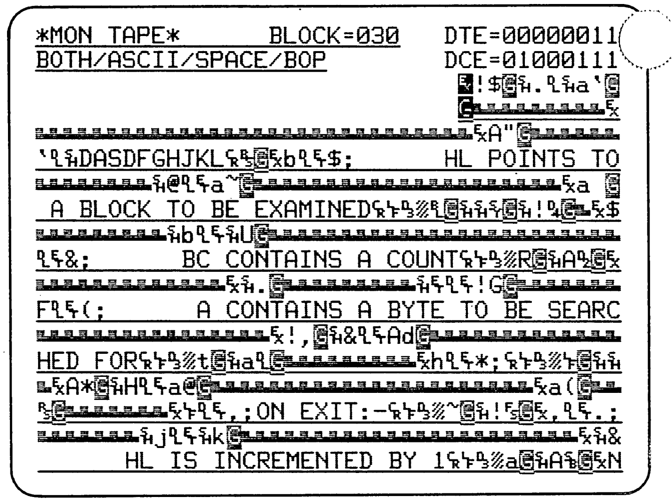


Figure 3-7

The speed of the CRT display is 2400 bps as defined by the program on the training tape. To *speed up* the display, **operate the UP cursor arrow.** In Monitor Mode, each operation of the UP cursor key doubles the playback speed to a maximum of 9.6 kbps. (The tape will record data at 19.2 kbps.) Each operation of the DOWN cursor halves the playback speed (to a minimum of about 14 bps).

3.3 DATA, MANUAL FREEZE

Operate the MANUAL FREEZE key in the CRT control zone to obtain a display similar to Figure 3-6.

Notice that the two lines that were blanked when the display was running real time have restored their data to give a full 640-character display. The blinking cursor is on the last character (or two characters in dual-line display) received.

Operate the B key to display the Beginning of the buffer (Figure 3-7 is typical) and **then the E key** for the End of the buffer (Figure 3-8 is typical). Intermediate positioning of the 640-character CRT window in the 1920-character buffer is accomplished by holding the UP or DOWN cursor key until, after the cursor reaches the top or bottom of the CRT, the next line is pulled onto the screen.

Notice that the RIGHT and LEFT cursor keys a position the cursor (blinking characters) and it *wra* around from the end (or beginning) of one dual line to the beginning (or end) of the next. This is a valuable time-saving feature.

NOTE: In some units, Manual positioning of the cursor on a data display may randomly cause a character at the cursor location to change from hexadecimal to text or vice versa. The character will revert to its original display form when the cursor is moved away.

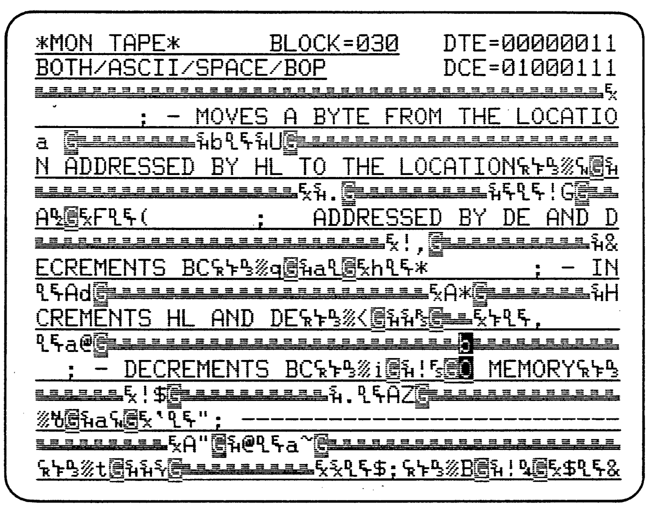


Figure 3-6

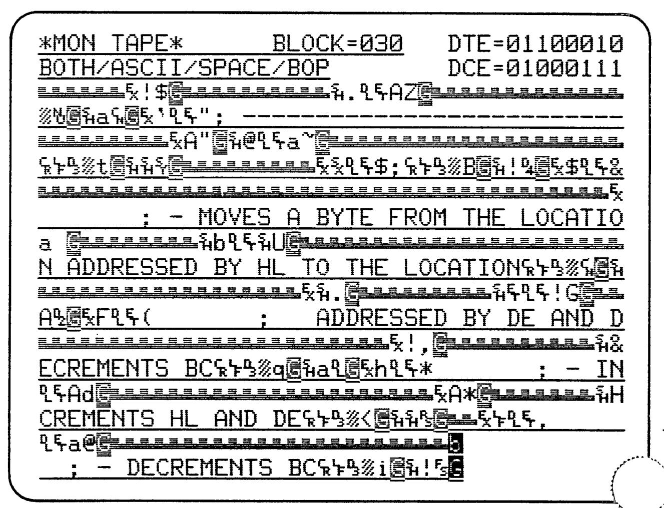


Figure 3-8

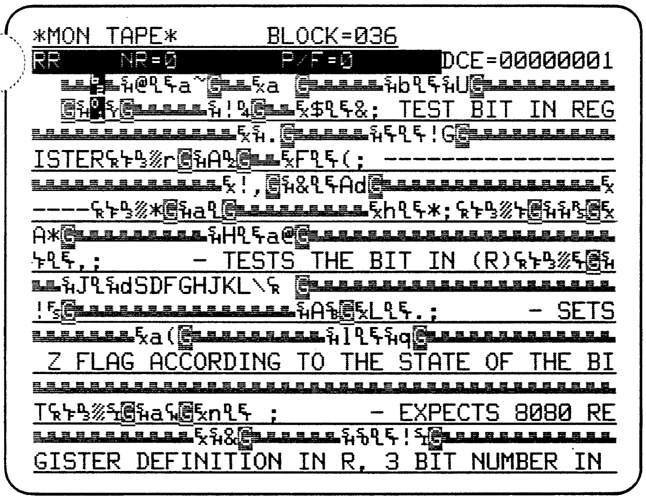


Figure 3-9

At the right side of the top two lines are displayed DCE and DTE with 1-0 patterns representing the binary patterns of the characters at the cursor position. *Bit 1, the low-order bit and first bit in the serial stream, is the rightmost bit on the screen.* This permits you to read the haxadecimal equivalent directly from the bit pattern.

NOTE: We have observed this convention throughout the 3500 display and documentation. This is an important point, as there is much inconsistency in the order in which bit patterns are printed in the industry's literature.

The MANUAL and FREEZE LEDs on the indicator panel are ON.

Also notice that the block number of the tape remains displayed. In playback mode only, the tape stops when MANUAL FREEZE of the CRT is operated. MANUAL STOP of the CAPTURE MEMORY also stops the tape and thus freezes the display in the same manner.

HEX and CONTROL plus HEX also work in freeze.

Operate CLEAR CRT in the CRT CONTROL zone to clear the display of old data.

Operate MANUAL UNFREEZE to again display real-time data.

3.4 ACRONYM EXPANSION: FRAME and PACKET

The cursor can be "tabbed" through the display to automatically locate each frame control byte or packet-type byte. When the cursor comes to rest on one of these bytes a bit analysis is performed on it and the CRT displays the acronyms and other associated protocol information. The frame-control and packet-type byte expansions available in the 3500 are given in Appendix C.

To obtain expansions of frame control bytes:

(1) **Operate FREEZE, then the "B" key** to position the cursor at the beginning of the display buffer.

(2) To make interpretation easier, **use CONTROL plus HEX to display all control bytes in hexadecimal.**

(3) **Operate the "F" key** to locate the first frame control byte on the display after the cursor. Figure 3-9 is typical.

(4) Observe that line 2 contains the expansion of the frame-control byte.

(5) **Continue to operate the F key** to tab through the display. When the cursor is at the bottom of the CRT the next line(s) will be scrolled onto the CRT from the display buffer. When the cursor reaches the end of the buffer, NO CONTROL BYTE FOUND will be displayed.

To display expansions of packet-type octets:

(1) **Operate the B key.**

(2) **Operate the P key** to locate the first packet-type octet. Figure 3-10 is typical.

(3) Line 2 contains the expansion of Octets 1 and 2 as well as the packet-type octet (Octet 3). The logical channel number is displayed as a decimal number, and if the Q, D, and M bits are 1, the appropriate characters are displayed.

(4) If you continue using the P key to the end of the buffer, NO CONTROL BYTE FOUND will be displayed.

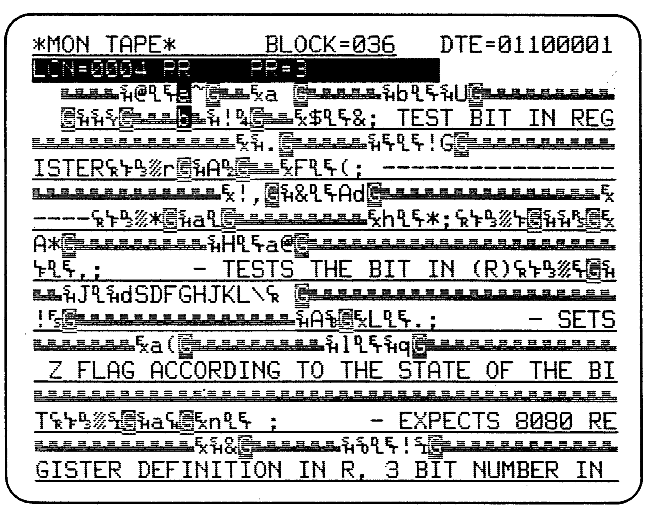


Figure 3-10

Alternate use of the F and P keys will move the cursor back and forth between the frame-control byte and packet-type octet of one frame until one of the two keys is operated twice in succession.

Notice that although the cursor points to both a DTE and a DCE character simultaneously, you can identify which character the F or P key has expanded by which binary breakdown appears at the upper right-hand corner of the screen.

You may obtain a mnemonic expansion for any character on the screen by positioning the cursor at the desired byte and pressing CONTROL plus F or CONTROL plus P. Thus, you may move the cursor *back* to expand any control byte in which you are interested. *Remember, though, that in this case the logic cannot distinguish between a genuine frame-control byte or packet-type octet and the numerous invalid possibilities.*

3.5 RESULTS, REAL TIME

Operate PROGRAM, then MONITOR, to rewind the tape to Block 000. While data is being displayed, **operate the RESULTS key in the DISPLAY zone** to obtain the display of Figure 3-11. The two status lines at the top remain and the tape block number is still incrementing.

Observe that the four counters and two timers are clearly named to show their functions in the training tape program. The counters will be counting almost continuously, depending on what data is read from the current block of the tape.

Press the DATA key and notice that data is still being monitored.

Return to RESULTS.

Notice the value of the Not Pak Frms counter; **operate the C and then the 4 key to reset Counter 4 to zero.** Any counter can be reset with C followed by its number or any timer by T followed by its number. The R key resets all counters and timers. **Operate MANUAL FREEZE** and observe that the counter accumulations stop, because the tape playback stops. **Press RESUME TRIGGER** and observe that the counters and timers resume counting, without resetting.

Results can be easily modified while a test is running to enable you to look for several criteria at the same time without going back into the Program Mode.

```
*MON TAPE*        BLOCK=002
BOTH/ASCII/SPACE/BOP
 COUNTERS:

   #1  Data Pakets        15

   #2  NotData Pak        15

   #3  Pak #chars.       604

   #4  NotPak Frms        15

 TIMERS:    MSEC SEC

   #1  Call length         0

   #2  Idle time..         8
```

Figure 3-11

With Results displayed, operate the MONITOR key and notice that all counters and timers reset. MONITOR, used when the unit is already in Monitor Mode, restarts the entire test, without initializing the tape.

Both timers increment in milliseconds or seconds as indicated on the display.

Maximum count is 65,535 for counters and timers. Overflow is indicated by a message to the right of the counter or timer.

NOTE: All data received by the 3500 is presented to the counters and timers whether or not the data or portions of it are displayed on the CRT or recorded onto tape.

3.6 PROGRAM SUMMARY

While you are viewing data and results, you may wish to review the program. The 3500 allows you to see the program without leaving Monitor Mode. It presents a Program Summary in an easy-to-understand format that requires no complex instruction listings or flow charts.

3.6.1 Perhaps you would like to know how Counter on the Results display has been programmed to count Data Packets. Data packets are defined by the fifth byte (Octet 3) having Bit 1 = 0.

Operate the PROGRAM SUMMARY key in the display zone. The program will be displayed as in Figure 3-12. Find CTR 1 in the Trigger #1 area. The summary shows that Trigger #1 looks at the DCE line for a sequence of *Flag* (shown as hexadecimal reverse-image 7E), any byte not equal to *Flag* (reverse-image 7E with a bar through it), three Don't Care bytes (reverse-image DC), and a bit mask (reverse-image M). The byte not equal to *Flag* represents the address byte and defines the preceding *Flag* as the opening *Flag*; the three Don't Care bytes are the frame-control byte and the first two packet octets; and the bit mask represents the unique bit pattern of a packet-type octet (Octet 3). In Program Mode, the Trigger #1 menu would show the specific pattern of the bit mask to be XXXX XXX0.

CRT1I means that Counter 1 is set to Increment upon receipt of the above string.

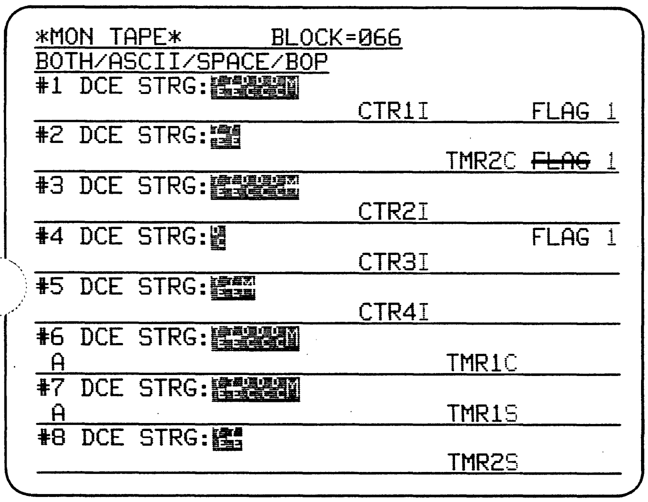


Figure 3-12

3.6.2 **Operate the RESULTS key.** Notice that Timer 2 is actively increasing. It indicates elapsed idle time for comparison with Call time.

Display the Program Summary again. Notice the entry under Trigger #2. A DCE string consisting of a byte Not Equal to *Flag* followed by *Flag* identifies the ending *Flag*. TMR2C means that Timer 2 Continues when the ending *Flag* is detected by Trigger #2.

Under Trigger #8 you can see that Timer 2 stops when the leading flag is detected. The leading flag is specified by the DCE sequence *Flag*, Not Equal *Flag*.

Once you have read the sections on programming, you will find the Program Summary easy to interpret and a valuable timesaver.

3.6.3 **Return to Results.** The counters, timers, and block numbers will have changed because the program has been running while the Program Summary has been displayed.

3.6.4 **Press PROGRAM to stop the tape; then press the red power button to power down the 3500.**

3.7 MONITOR REVIEW

In Monitor Mode, without stopping the test or interrupting the recording of data onto tape, you may review the Program Summary or Results, reset the counters or timers or both, and manually freeze or unfreeze the display and return the CRT to trigger control. This capability substantially increases efficiency, especially in time-critical situations.

4 Program Mode: X.25 Applications

Pressing the red rectangular PROGRAM key enables all the red Program Mode keys and allows full use of the typewriter keyboard. The PROGRAM key also initializes all circuits, counters, and timers, and stops tape motion.

4.1 PACKET DIAGNOSTIC DISPLAY

In a packet network, many of the transmissions on a communications link are only for the purpose of network supervision or communication error control. One link may carry many packet channels.

Often the first task in analyzing a problem is to visually display the information that is specifically of interest. This section will lead you step by step to a clear display of all information packets on a specific logical channel without supervisory or error control material.

4.1.1 Basic Monitor Mode Menu. To give you experience in programming the 3500, we will not use the training tape program here, but you will need the tape as the data source.

(1) **Power-up the 3500 without the tape** (as in Section 2.1).

(2) **Press PROGRAM** to place the unit in Program Mode.

(3) **Operate the red PARAMETERS key and then the numeral 1.**

The Basic Monitor menu shown in Figure 4-1 will be displayed.

The bright reverse-image blinking cursor is in the TEST ID field. Here you may enter a program title of up to 27 alphanumeric or control characters (spaces count). We have titled the first program PACKET DIAGNOSTIC DISPLAY. **Use the LOCK to lock in SHIFT; then type in the title. Press SHIFT to release the LOCK.**

To move the cursor to the SOURCE field, **press ENTER.** The cursor will move to the default selection, LINE. **Press the right cursor arrow to move the cursor to TAPE.** This not only selects TAPE as the data SOURCE, but also automatically displays a START field on the next line and a SPEED selection field on the last line.

Notice that if you try to use the RIGHT cursor arrow to leave the SOURCE field, the selection will change. To be sure that you do not alter your selection, always use the ENTER key to move the cursor directly to the next field. If you move the cursor too far down, you may move it back up with the UP cursor arrow.

```
** PROGRAM MODE -- BASIC MONITOR **

TEST ID: _
SOURCE : LINE TAPE DTM TAPE/DTM EDIT/DTM

MONITOR: BOTH DTE DCE
CODE   : EBCDIC   ASCII   EBCD  XS-3
         IPARS  REV EBCD  BAUDOT HEX

FORMAT : SYNC BOP BOP/NRZI ASYNC
         SYNC CHARS:
         OUT SYNC   : OFF ON CHAR:  #:
         AUTOSYNC   : OFF ON
CLOCK  : EXT INT
```

Figure 4-1

Use ENTER to position the cursor at BLOCK 000 the START field. Since the X.25 data on the training tape runs from Block 000 through 070, this default selection is the one we want.

Notice that the default selection for MONITOR is BOTH DTE and DCE. Since this is the selection we want, we can **tab directly to the CODE line by using the ENTER key twice.** The ENTER key never alters a selection.

The training tape data that we intend to monitor is ASCII with seven information bits. **Use a cursor arrow to select ASCII.** Two new fields now appear, BITS and PARITY. (Compare Figure 4-2 with Figure 4-1.)

```
** PROGRAM MODE -- BASIC MONITOR **

TEST ID: PACKET DIAGNOSTIC DISPLAY
SOURCE : LINE TAPE DTM TAPE/DTM EDIT/DTM
         START: BLOCK 000  CONTINUE
MONITOR: BOTH DTE DCE
CODE   : EBCDIC   ASCII   EBCD  XS-3
         IPARS  REV EBCD  BAUDOT HEX
         BITS  : 8 7
         PARITY: EVEN ODD MRK SPACE NONE
FORMAT : SYNC BOP BOP/NRZI ASYNC
         SYNC CHARS: 
         OUT SYNC  : OFF ON  CHAR:  #:
         AUTOSYNC  : OFF ON

         SPEED: 2400
```

Figure 4-2

The default selection in the BITS field is 7, so you can **use ENTER to tab directly to the PARITY field.** In the training tape data, the eighth bit (parity bit) is space rather than parity. (This is the case with most DEC equipment, for example.) **In the PARITY field, select SPACE.**

Now go to the FORMAT field. The default format selection is SYNC. **Move the cursor to the right to select BOP** and notice that all the options under FORMAT disappear because they are not applicable to monitoring Bit-Oriented Protocols.

The last line is the value for SPEED, which was automatically entered when you selected TAPE. The default value is 2400.

Your Basic Monitor menu should now appear as in Figure 4-3. You have now selected all the parameters necessary to monitor data from the training tape.

1.2 CRT Control. **Insert the X.25-SDLC training tape. Press MONITOR.** The microprocessor that controls the tape will automatically reposition the tape to

```
** PROGRAM MODE -- BASIC MONITOR **

TEST ID: PACKET DIAGNOSTIC DISPLAY
SOURCE : LINE TAPE DTM TAPE/DTM EDIT/DTM
         START: BLOCK 000  CONTINUE
MONITOR: BOTH DTE DCE
CODE   : EBCDIC   ASCII   EBCD  XS-3
         IPARS  REV EBCD  BAUDOT HEX
         BITS  : 8 7
         PARITY: EVEN ODD MRK SPACE NONE
FORMAT : SYNC BOP BOP/NRZI ASYNC



         SPEED: 2400
```

Figure 4-3

Block 000, as you have specified on the Basic Monitor menu, and begin playback. As Figure 4-4 shows, the display is single-line, with DCE data distinguished by the underline. No data is suppressed: all the idle *Flags* (low-intensity reverse 7E) are displayed. There are no other highlights because none have been programmed.

Press PROGRAM; then PARAMETERS and 2, to display the menu shown in Figure 4-5. We shall be concerned with the CRT CONTROL portion of the menu.

Move the cursor from SINGLE LINE (the default selection) **to DUAL LINE. Press MONITOR.** Again the tape playback will begin from Block 000. The data will now appear in time-correlated dual-line display as shown in Figure 4-6.

Since the idle *Flags* take up most of the display space, we shall suppress them, as was done on the Training Tape Program.

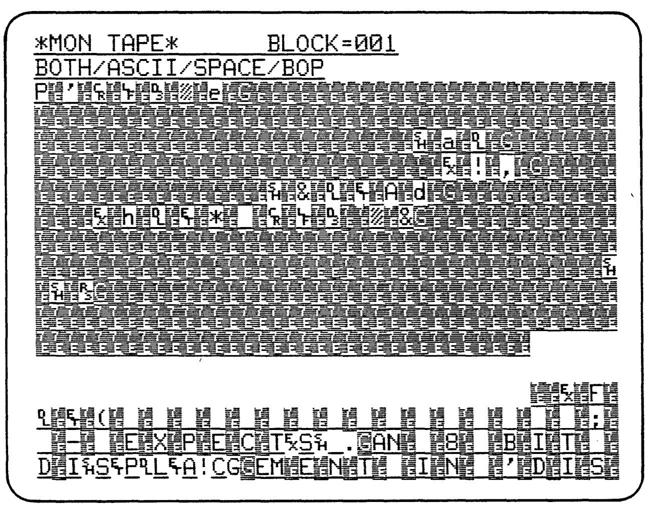


Figure 4-4

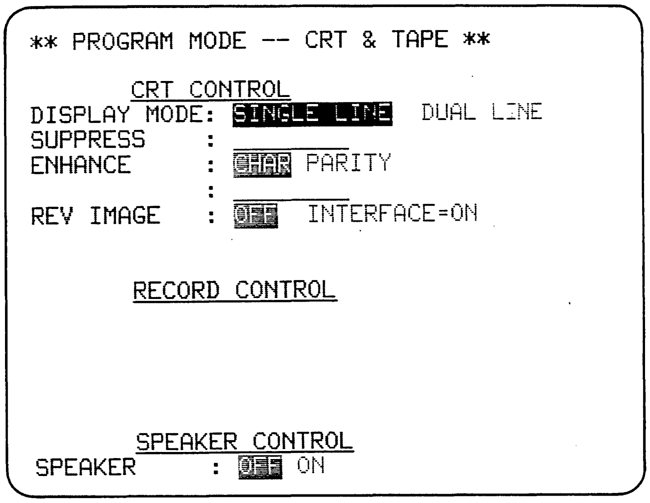


Figure 4-5

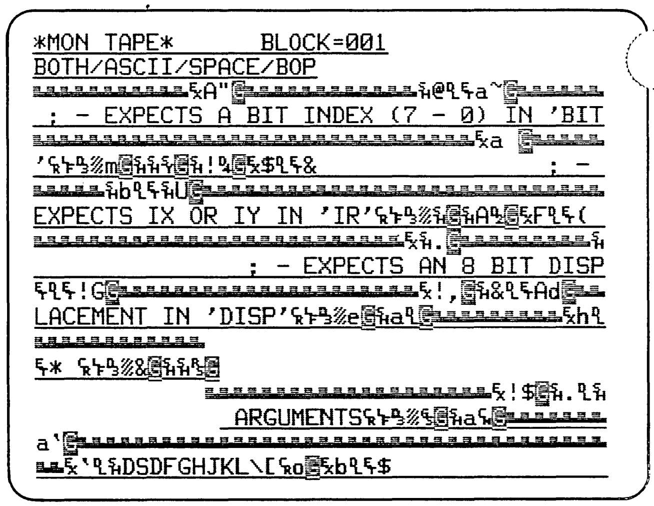


Figure 4-7

Return to the CRT CONTROL menu (PROGRAM, PARAMETERS, 2). The cursor is in the DISPLAY MODE field. **Move the cursor to the SUPPRESS field.**

The SUPPRESS field is a data entry field; that is, you may choose up to eight characters to be suppressed and enter them directly from the keyboard. To suppress idle *Flags*, **press CONTROL plus the FLAG key simultaneously.** A low-intensity 7E appears.

NOTE: A low-intensity entry in a data entry field always signifies that the symbol represents something other than itself. In this case, it means that a *Flag* is intended, and the logic will treat it as a *Flag*, rather than a data $7E_{16}$.

If you make an error in a data field, you may write over it. You may clear the remainder of a field starting with the cursor position by pressing SHIFT plus CLEAR FIELD. CLEAR FIELD clears an entire field. CONTROL plus CLEAR FIELD clears an entire menu to default condition and thus should be used cautiously.

MONITOR the taped data and notice how much more compact the display is (Figure 4-7) with the idle *Flags* suppressed. Frames still can be distinguished by the good (G), bad (B), and abort (A) symbols.

You may wish to verify that if you enter HEX, 7, E in the SUPPRESS field, *Flags* will not be suppressed.

4.1.3 Triggers. Using the triggers, the CRT can be unfrozen and refrozen so that only data of interest is added to the display.

Operate PROGRAM; then TRIGGER. Notice that the display (Figure 4-8) is similar to that given by the PROGRAM SUMMARY key in Monitor Mode (Figure 3-12). There are eight triggers.

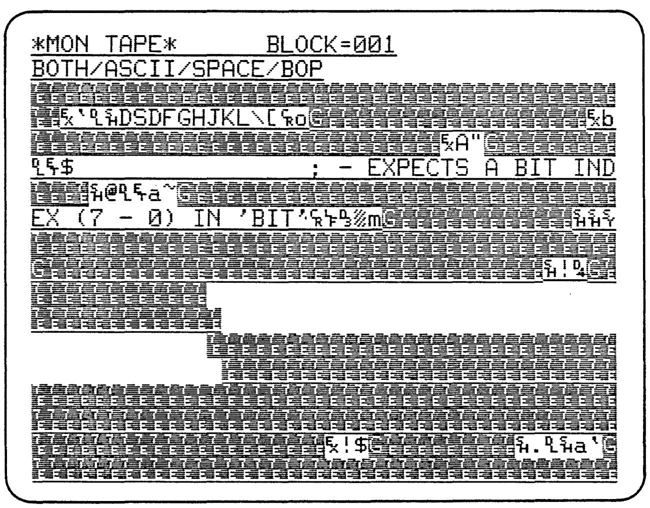


Figure 4-6

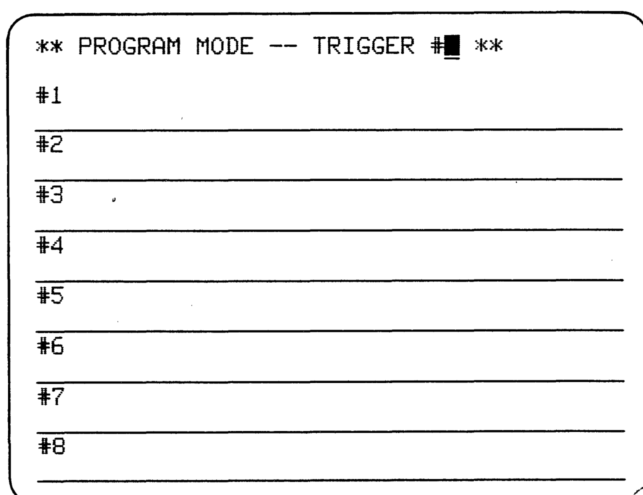


Figure 4-8

Press the numeral 1. This displays the menu for Trigger 1 (Figure 4-9). A horizontal line divides the top MONitor characteristics that the trigger will LOOK FOR from the bottom SET actions that it will take. If you compare this with Figure 3-12, you will see the significance of the upper and lower lines for each trigger on the Program Summary.

There are three monitor conditions that the triggers will look for: (1) data characters; (2) interface lead status; and (3) internal flags. When all of the selected conditions are true, the trigger will take as many of the following actions as have been selected: (1) set CRT; (2) set tape; (3) set flag; (4) set timer; (5) set counter; (6) set alarm; and (7) set OUTSYNC.

4.1.4 Selective Display of Information Frames. Since we want the trigger to look for information frames, we are only interested in looking for certain

```
** PROGRAM MODE -- TRIGGER #1 **

MON DATA ON   : NEITHER DTE DCE

MON I/F LEADS: NO YES

MON FLAG      : NO YES
-----------------------------------------
SET CRT   : NO YES


SET FLAG : NO YES
SET TIMER: NO YES
SET CNTR : NO YES
SET ALARM: NO YES    SET OUTSYNC: NO YES
```

Figure 4-9

data characters, and only those from the DCE. The bright reverse blinking cursor is on the default selection NEITHER in the first data selection field of the trigger menu. **Use the cursor to select DCE.**

A second line now appears, offering four selections; STRinG, 1 OF, GOOD FCS, and FCS ERROR (Figure 4-10). To find an information frame we shall need to find a certain string of characters. Therefore, **operate the ENTER key to move to the LOOK FOR field.** The cursor will go to STRG because it is the default selection.

Under STRG, there is an underlined space, which indicates a data entry field. **Press ENTER, and the cursor will go to the first position of the data entry field.**

An information frame is defined by the 0 in the Bit 1 position of the second byte after an opening *Flag*. So,

```
** PROGRAM MODE -- TRIGGER #1 **

MON DATA ON   : NEITHER DTE DCE
    LOOK FOR  : STRG  1 OF   GOOD FCS ERR

MON I/F LEADS: NO YES

MON FLAG      : NO YES
-----------------------------------------
SET CRT   : NO YES


SET FLAG : NO YES
SET TIMER: NO YES
SET CNTR : NO YES
SET ALARM: NO YES    SET OUTSYNC: NO YES
```

Figure 4-10

we want to look for a string composed of three bytes: a *Flag*, a byte not equal to a *Flag* (the address byte), and a byte having Bit 1 equal to zero (the control byte for an information frame).

(1) On the data entry line for STRG, **enter a *Flag*.** Remember that you must use CONTROL plus the FLAG key.

(2) To allow any byte except a *Flag* in the second byte position, press NOT EQUAL followed by CONTROL plus FLAG. Notice the horizontal "Not Equal" bar through the character.

(3) In the third position we need any byte with Bit 1 = 0. **Press BIT MASK.** A low-intensity reverse M will appear, indicating that something other than a data character M is meant. To the right is the 8-position bit mask entry field, and the cursor is at Bit 8. (See Figure 4-11.) The X's indicate Don't Care bits. Since we are only interested in Bit 1, we can immediately **move the cursor to the bit 1 position on the far right, using the**

```
** PROGRAM MODE -- TRIGGER #1 **

MON DATA ON   : NEITHER DTE DCE
    LOOK FOR  : STRG  1 OF   GOOD FCS ERR
              M                  XXXXXXXX
MON I/F LEADS: NO YES

MON FLAG      : NO YES
-----------------------------------------
SET CRT   : NO YES


SET FLAG : NO YES
SET TIMER: NO YES
SET CNTR : NO YES
SET ALARM: NO YES    SET OUTSYNC: NO YES
```

Figure 4-11

```
** PROGRAM MODE -- TRIGGER #1 **

MON DATA ON  : NEITHER DTE DCE
    LOOK FOR : STRG  1 OF   GOOD FCS ERR
                                 XXXXXXX0
MON I/F LEADS: NO YES

MON FLAG      : NO YES

SET CRT  : NO YES       0=OFF 1=ON X=NO CH
    X  0   X   X   X   X   X
    CLR FRZ HEX LO  UND BLI REV

SET FLAG : NO YES
SET TIMER: NO YES
SET CNTR : NO YES
SET ALARM: NO YES   SET OUTSYNC: NO YES
```

Figure 4-12

RIGHT cursor arrow. Enter the numeral 0 here. The low-intensity M in the third character position of the string now signifies a byte with Bit 1 = 0. Its meaning could easily be changed at any time by changing the bit pattern in the bit mask field. **Press ENTER to return to the string.** If other bytes were needed, you could now enter them.

If you should wish to alter the Bit Mask, reposition the cursor on the low-intensity M and press BIT MASK. The cursor will return to the bit mask field without altering the string.

Since we want information fields to be displayed, we want the character string to turn the CRT freeze OFF. **Using ENTER, tab the cursor down to the SET CRT field. Select YES,** and observe that another selection field appears. **Tab to the selection field and select FRZ; then enter a numeral 0 for OFF.**

```
** PROGRAM MODE -- TRIGGER #2 **

MON DATA ON  : NEITHER DTE DCE
    LOOK FOR : STRG  1 OF   GOOD FCS ERR

MON I/F LEADS: NO YES

MON FLAG      : NO YES

SET CRT  : NO YES       0=OFF 1=ON X=NO CH
    X  1   X   X   X   X   X
    CLR FRZ HEX LO  UND BLI REV

SET FLAG : NO YES
SET TIMER: NO YES
SET CNTR : NO YES
SET ALARM: NO YES   SET OUTSYNC: NO YES
```

Figure 4-13

```
** PROGRAM MODE -- TRIGGER #  **

#1 DCE STRG:
       CRT:X0XXXXX
#2 DCE STRG:
       CRT:X1XXXXX
#3

#4

#5

#6

#7

#8
```

Figure 4-14

The Trigger 1 menu should now look like Figure 4-12.

We need to turn the CRT FREEZE ON again at the end of the information frame while Trigger 1 waits for the next information frame. The next *Flag* after the freeze is turned off, i.e., after the control frame, is always the closing *Flag*.

Select the Trigger #2 menu. Select DCE. Enter NOT EQUAL FLAG, FLAG in the LOOK FOR data entry field, and set the CRT FRZ to turn ON. (See Figure 4-13.)

Now **view the Trigger Summary** (simply press TRIGGER) and notice how your entries on the individual trigger menus are summarized (Figure 4-14). The Trigger Summary is the same as the Program Summary.

MONITOR the data to see that only information packets and FCS bytes are now displayed as in Figure 4-15.

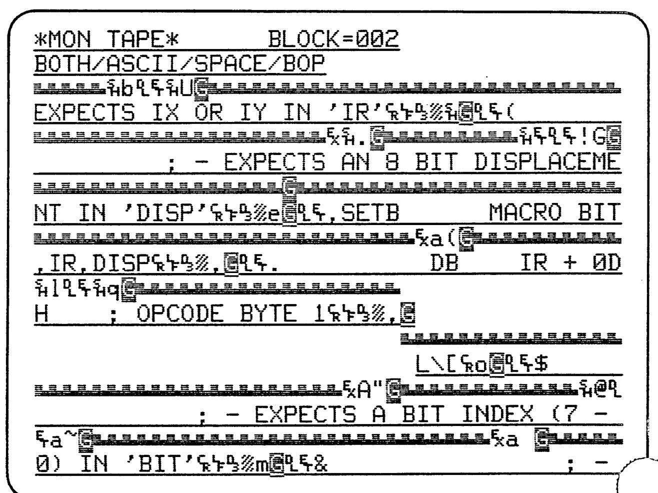


Figure 4-15

Although the dual-line display is much more compact with the *Flags* and protocol material suppressed, it is apparent that there is little simultaneous transmission recorded on the training tape. It will be more efficient for analysis, therefore, to display the data in single-line mode. **To do this, return to Program Mode; select the CRT Control menu (PARAMETERS 2), and select SINGLE LINE** instead of DUAL LINE. The display will now appear as in Figure 4-16. **(Use CONTROL plus HEX to help distinguish the LCNs from the packet-type octets.)**

Because the first two bytes of each frame have not been received in the display buffer, the P key cannot be used to find the packet-type octets automatically. However, you may still obtain packet-type expansions by positioning the cursor manually on the packet-type octet, that is, the third character in any packet. **Operate CONTROL plus P to obtain the correct acronym expansion,** as in Figure 4-17 (in the figure, the cursor is near the center of the display). Note that CONTROL *must* be used with the P key in this case.

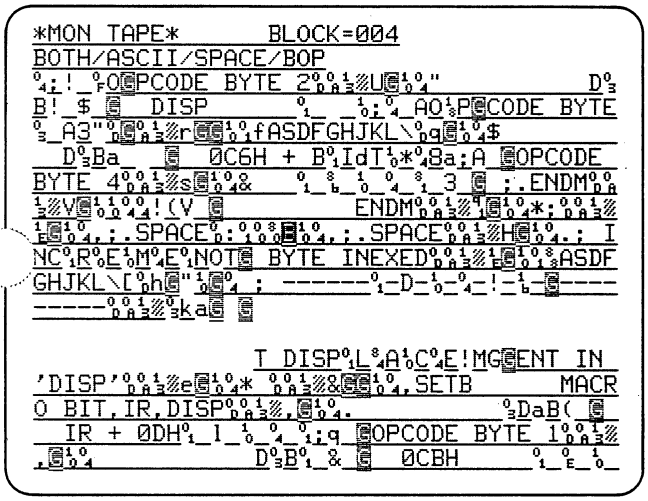


Figure 4-16

Remember that when CONTROL plus P is used, the logic cannot identify your mistakes: it will display an expansion of whatever byte is at the cursor location, whether valid or not.

4.1.5 Selective Display of Traffic on One Logical Channel. We can modify the program already in the unit (Section 4.1.4) to display only the data on a specific logical channel. To do this, we program the triggers to look into the first two packet bytes for the LCN. We shall illustrate this by displaying only transmissions on LCN 0004, whether information, supervisory, or nonsequenced.

(1) **Select the Trigger #1 menu, and use the ENTER key to position the cursor in the LOOK FOR STRG data entry field. Move the cursor to the low-intensity M. Clear the Bit Mask with SHIFT plus CLEAR FIELD.** The cursor will remain at the third position in the string.

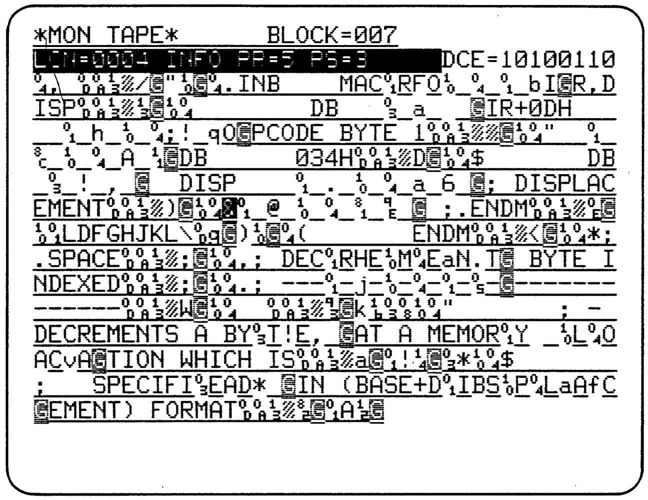


Figure 4-17

(2) **Operate the DON'T CARE key** to indicate that any bit combination in that position in the string is valid for the control byte.

(3) **Next enter the logical channel number information for the first two packet octets,** 10 04_{16}. The HEX key is a two-character latch, so to enter the LCN use the key sequence HEX, 1, 0; HEX, 0, 4.

(4) You have now programmed Trigger #1 to unfreeze the CRT upon receipt of any frame on LCN 0004. (See Figure 4-18.)

(5) Trigger #2 has already been set to freeze the data after the closing *Flag* (Figure 4-14).

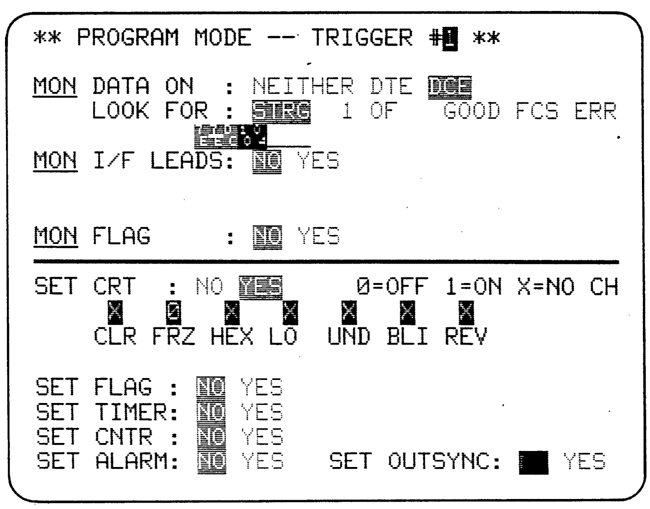


Figure 4-18

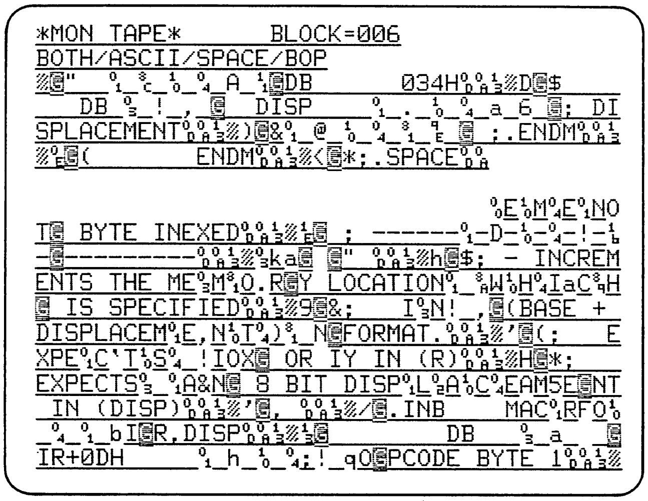


Figure 4-19

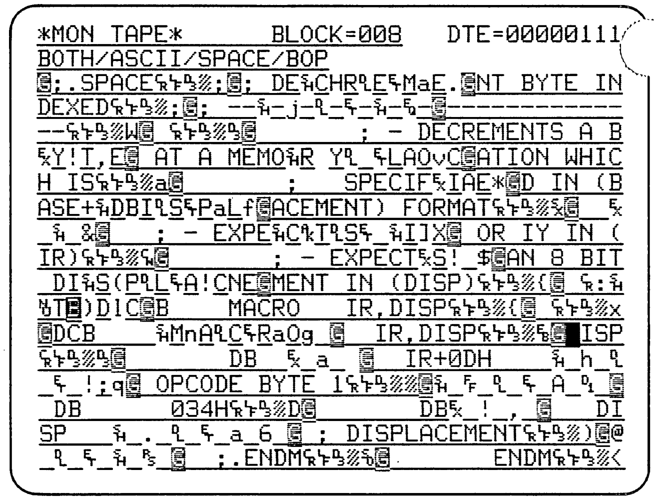


Figure 4-21

Go to Monitor Mode. All frames on Logical Channel 0004 are displayed, whether information, supervisory, or nonsequenced (Figure 4-19).

By including the packet-type octet (Octet 3) in the unfreeze string for Trigger #1, we can limit the display of frames on LCN 0004 to a specific packet type. **To display only information packets add a Bit Mask to the string and enter zero in the Bit 1 position** (Figure 4-20).

Now the display consists solely of information packets on LCN 0004 and the data can be read almost as straight text (Figure 4-21).

Observe that each packet terminates with CR LF followed by a few other characters that are not useful in understanding the information content of the packet. To suppress these assorted characters, **change Trigger #2 to turn CRT freeze ON after the string CR LF is received** instead of waiting for the closing *Flag* byte. (See Figure 4-22 and 4-23.) Since CR and LF are control character mnemonics, enter them using the CONTROL key plus the CR or LF key.

The three characters CR, LF, and ; appear throughout the display and detract from its readability. **Suppress them by adding them to the SUPPRESS list on the CRT CONTROL (Parameters 2) menu.** Now observe the display. As in Figure 4-24, it is a clear, readable presentation of only the information on Logical Channel 0004 and can easily be compared with the input (or output) of that terminal.

NOTE: In some instances, CR or LF or any suppressed character may be of significance to the user, e.g., it may be part of the message content. It will nevertheless be suppressed whenever it appears.

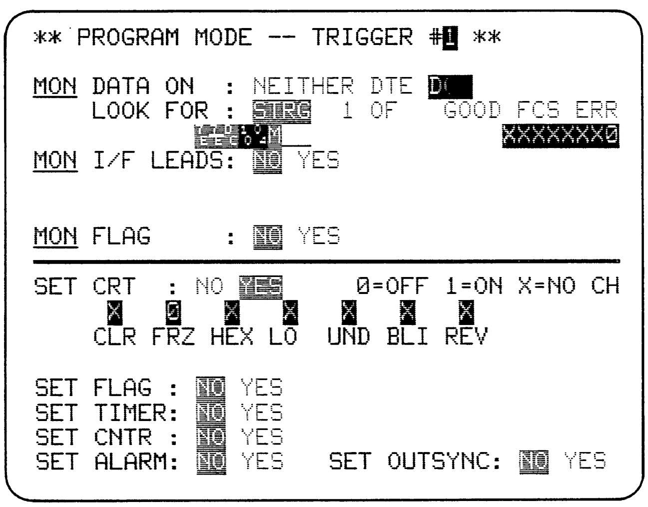


Figure 4-20

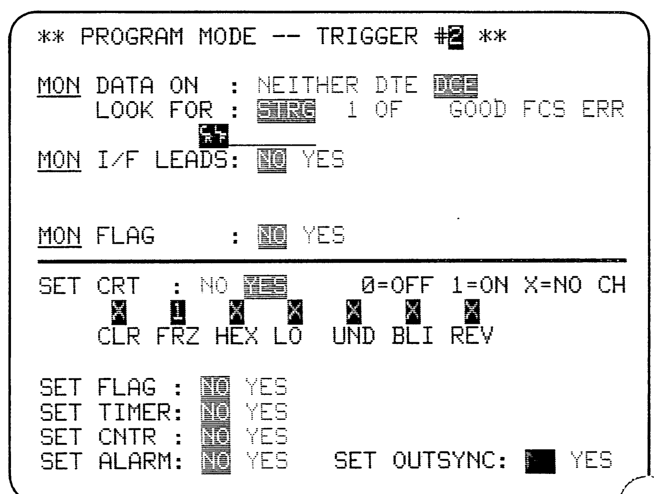


Figure 4-22

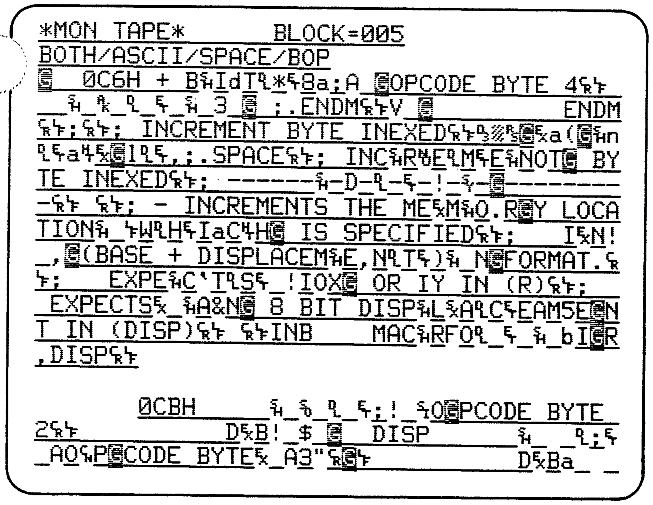


Figure 4-23

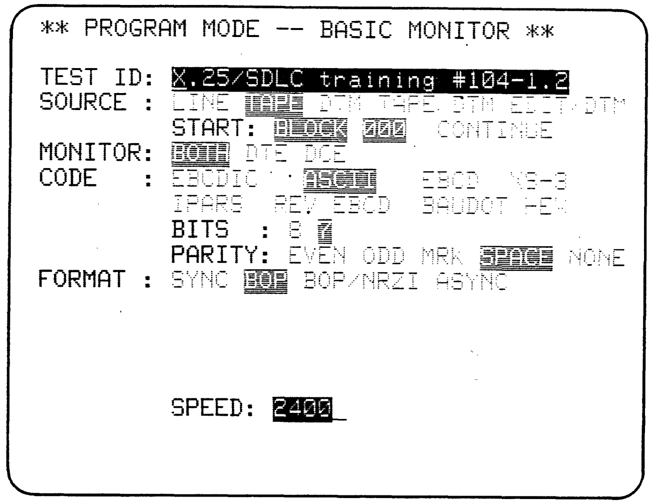


Figure 4-25

NOTE: If a circuit is very busy, it may be advantageous, for example, to select only DCE on the Parameters 1 menu in order to eliminate spurious characters from the DTE.

4.2 THE TRAINING TAPE PROGRAM

The program on the training tape is designed specifically for monitoring ASCII data in X.25 format. The basic parameters of the program are shown in Figures 4-25 and 4-26. The Parameters 1 setup is the same one that you entered in Section 4.1. The display is dual line and *Flags* are suppressed. Figure 4-27 is the Trigger Summary and Figure 4-28 is the statistics menu.

4.2.1 Frame and Packet Efficiency. Network utilization can be determined easily with the training tape program. The program analyzes traffic from the DCE or NODE but it can be edited easily to look at traffic originating at the DTE.

Packet Efficiency is the percentage of data packets to all packets. Counter 1 counts data packets and Counter 2 counts all other packets, using the Bit Mask XXXX XXX0 to define the packet-type octet for an information packet. Inspection of Figure 4-29 (which was not made from the training tape data) shows that 50% of the packets are for supervisory or control purposes; the packet efficiency is therefore 50%.

Average packet size is another valuable parameter. It is relevant for node throughput and memory allocation analysis. It also reveals whether messages are being combined to minimize the packet count. Since many administrations charge on a packet basis, whether or not the packets are full, this information can be important. On Trigger 4, Counter 3 is set to increment for every

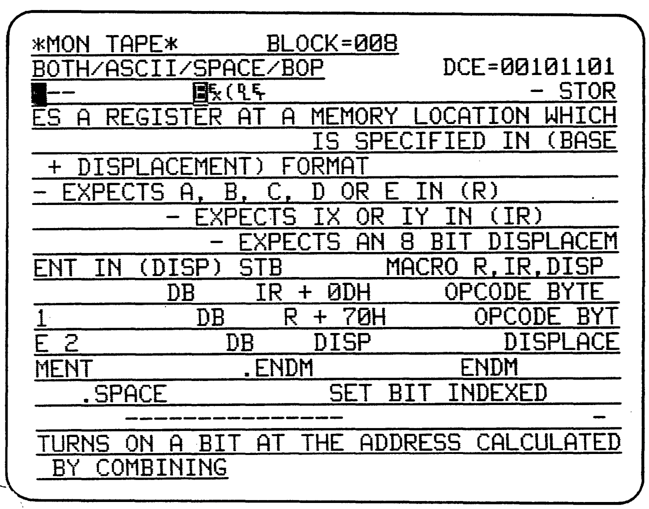


Figure 4-24

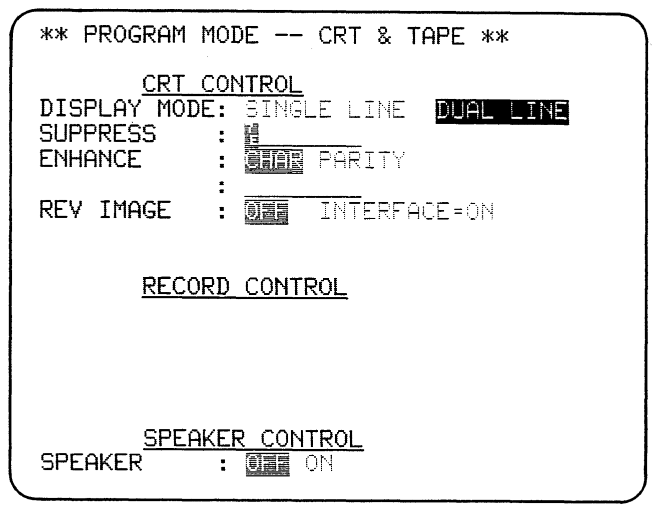


Figure 4-26

```
** PROGRAM MODE -- TRIGGER #█ **
#1 DCE STRG:
                       CTR1I          FLAG 1
#2 DCE STRG:
                             TMR2C  FLAG 1
#3 DCE STRG:
                       CTR2I
#4 DCE STRG:                          FLAG 1
                       CTR3I
#5 DCE STRG:
                       CTR4I
#6 DCE STRG:
 A                           TMR1C
#7 DCE STRG:
 A                           TMR1S
#8 DCE STRG:
                             TMR2S
```

Figure 4-27

```
*MON TAPE*        BLOCK=072
BOTH/ASCII/SPACE/BOP
COUNTERS:
   #1  Data Pakets    392
   #2  NotData Pak    387
   #3  Pak #chars.  11722
   #4  NotPak Frms    385
TIMERS:   MSEC SEC
   #1  Call length    292
   #2  Idle time..    237
```

Figure 4-29

byte received while Flag 1 is ON, that is, every byte received between the packet-type octet defined by the string on Trigger 1 and the end of the packet defined by the string on Trigger 2. Using the data of Figure 4-29, we see that division of Counter 1 (number of data packets) into Counter 3 (cumulative number of data packet bytes) gives approximately 30 bytes per packet. This amounts to only 25 percent utilization on a network that provides 128-byte packets.

Frame efficiency is the ratio of packets (or information frames) to supervisory or control frames. Counter 4 counts all frames other than packet frames (all noninformation frames). The total of Counter 1 (data packets) and Counter 2 (nondata packets) in Figure 4-29 gives the number of packets, which is the number of information frames. There are two packet frames for every nonpacket frame, so the frame efficiency of the circuit is approximately 2:3 or 67 percent.

4.2.2 Call/Circuit Utilization. Timer 1 is ON between the CALL ACCEPT packet, Trigger 6, and the CLEAR packet, Trigger 7 (see Figures 4-30 and 4-31). This timer displays the duration of the call. Since the X.25 section of the training tape does not contain a CALL ACCEPT packet, this timer will remain at 00 when the training tape is being monitored.

Timer 2 accumulates the time between frames, that is, from the string on Trigger 2 to the string of Trigger 8, which is idle circuit time.

In the data of Figure 4-32 only 12 out of 74 seconds were utilized for sending frames. This could indicate that personnel making manual entries need further training. Use of a batch-type terminal to store the data on tape before transmission might improve efficiency.

```
** PROGRAM MODE -- STATISTICS **
 COUNTERS:
   #1  Data Pakets
   #2  NotData Pak
   #3  Pak #chars.
   #4  NotPak Frms
 TIMERS:   MSEC SEC
   #1  Call length
   #2  Idle time..
```

Figure 4-28

```
** PROGRAM MODE -- TRIGGER #6 **
MON DATA ON  : NEITHER DTE DCE
    LOOK FOR : STRG  1 OF   GOOD FCS ERR
                                00001111
MON I/F LEADS: NO YES

MON FLAG     : NO YES

SET CRT  : NO YES


SET FLAG : NO YES
SET TIMER: NO YES #1 2   RSTRT CONT STOP
SET CNTR : NO YES
SET ALARM: NO YES   SET OUTSYNC: NO YES
```

Figure 4-30

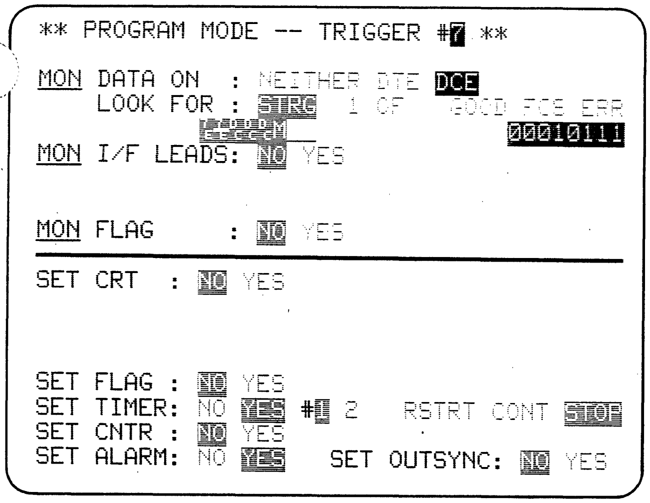


Figure 4-31

NOTE: As shown in Figure 4-32, the timer is set to count in seconds. When the periods being counted are less than seconds, the count will vary by at least + or − 1 second. To minimize this effect of a 1-second resolution on periods that may be shorter than 1 second, the seconds timer should be allowed to accumulate well into the hundreds. For total periods of less than 60 seconds, the millisecond range is recommended for accuracy.

NOTE: With HDLC framing, you should remember that the characters have had extra zero bits "destuffed." Therefore when you correlate character counts to time measurements you will find that there are more bits of time on the circuit than will be accounted for by adding up character times. However, the display will always show when eight bit times have been accumulated by inserting the L-shaped fill symbol on the faster data path (in dual-line display). See Section 6 (SDLC) for further details.

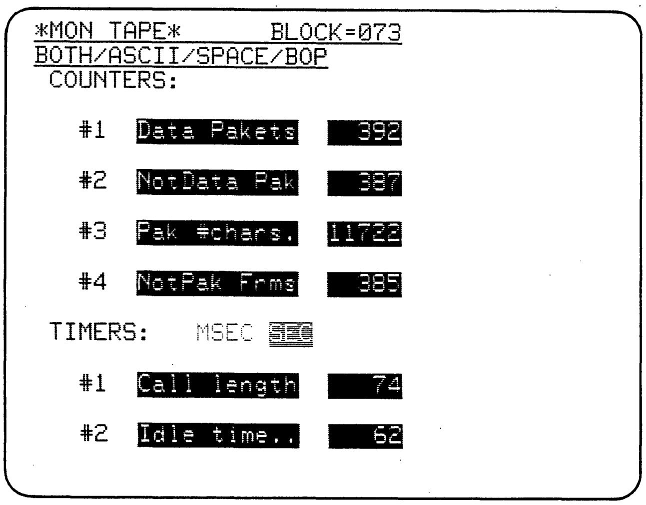


Figure 4-32

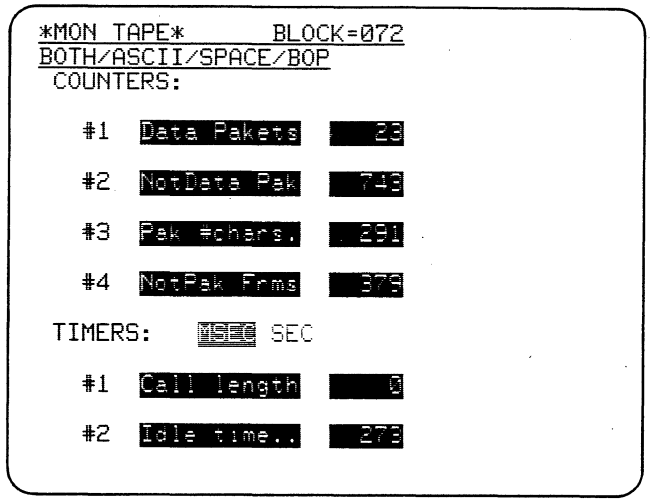


Figure 4-33

4.2.3 DTE Analysis. On the training tape program, all triggers are assigned to the DCE. You can easily make the same measurements on the DTE path. Since the CALL/CALL ACCEPT does not appear until Block 68, the CALL duration will not accumulate.

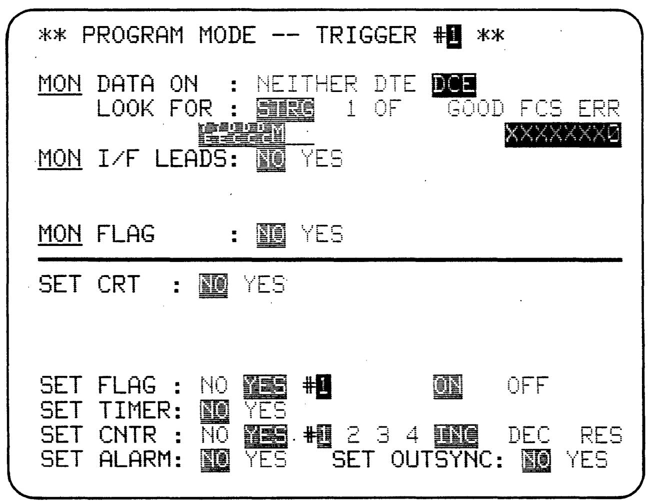


Figure 4-34

Load the training tape program. In succession, select each trigger menu and change the LOOK FOR selection to DTE. Operate MONITOR and observe the Results display around Block 073 (see Figure 4-33). Notice that there are only 23 data packets with a total of 291 characters. Obviously the DTE is generating very little traffic, and packet overhead is 743 out of a total packet count of 766. The Node servicing the terminal may be rather busy with packet handling, but moving little actual data.

4.2.4 Specific LCN Analysis. The training tape program uses DON'T CARE for the LCN octets (as in Figure 4-34). You can easily modify the strings in Triggers 1, 3, 6, and 7 to specify an LCN of interest or to exclude a specific LCN. Replace the second and third Don't Care bytes with hexadecimal values for the desired LCN bytes (see Figure 4-35, for example).

```
** PROGRAM MODE -- TRIGGER #1 **

MON DATA ON   : NEITHER DTE DCE
    LOOK FOR  : STRG  1 OF   GOOD FCS ERR
             [illegible]            XXXXXXX0
MON I/F LEADS: NO YES


MON FLAG      : NO YES
------------------------------------------
SET CRT  : NO YES



SET FLAG : NO YES #1        ON   OFF
SET TIMER: NO YES
SET CNTR : NO YES #1 2 3 4 INC  DEC  RES
SET ALARM: NO YES   SET OUTSYNC: NO YES
```

Figure 4-35

5 BISYNC-Framed X.25

5.1 GENERAL

X.25 can be framed with transparent BISYNC instead of HDLC (or bit stuffing). In this case, select SYNChronous FORMAT rather than BOP on the Parameters 1 menu since entering BOP in the 3500 enables bit stuffing.

Two types of transparent BISYNC framing are in general use: EBCDIC with SYN = 32_{16} and ASCII with SYN = 16_{16}. ASCII with SYN = 96_{16} is seldom found. The EBCDIC or ASCII framing does not necessarily define the data code: the codes are often mixed. EBCDIC data may be framed with ASCII; or ASCII data may be framed with EBCDIC.

5.2 TRAINING TAPE DATA

The data on Blocks 080 to 095 of the training tape is BISYNC-framed X.25 with ASCII data, 7 information bits, space parity, and SYN = 16_{16}.

5.2.1 Parameters Setup. **Power up the 3500 without a tape, and display the Parameters 1 menu. Make the following selections:**

SOURCE:	**TAPE**
START AT:	**BLOCK 080**
MONITOR:	**BOTH**
CODE:	**ASCII**
BITS:	**7**
PARITY:	**SPACE**

The display should appear as in Figure 5-1. For transparent BISYNC framing, we want SYNChronous FORMAT, which is the default selection, rather than BOP. The synchronization characters default to the values for space-parity ASCII, 16 16_{16}, so there is no need to make further selections on this menu.

On the Parameters 2 menu, select SINGLE LINE DISPLAY. Position the cursor on the data entry line below ENHANCE and, holding down the CONTROL

```
** PROGRAM MODE -- BASIC MONITOR **

TEST ID: SET UP FOR BSC X.25 @ 080
SOURCE : LINE TAPE DTM TAPE/DTM EDIT/DTM
         START: BLOCK 080  CONTINUE
MONITOR: BOTH DTE DCE
CODE   : EBCDIC   ASCII   EBCD  XS-3
         IPARS  REV EBCD  BAUDOT HEX
         BITS   : 8 7
         PARITY: EVEN ODD MRK SPACE NONE
FORMAT : SYNC BOP BOP/NRZI ASYNC
         SYNC CHARS: SY
         OUT SYNC   : OFF ON  CHAR:  #:1
         AUTOSYNC   : OFF ON

         SPEED: 2400
```

Figure 5-1

key, type in STX, ETX, and DLE (see Figure 5-2). In Monitor Mode the enhanced control characters will be displayed in blinking bright reverse image (see Figure 5-3).

5.2.2 Display of Transparent Data. **Operate MONITOR.** The tape control logic will position the tape at Block 080 before playback starts. Allow the tape to run to Block 095 to fill the display buffer; **then press MANUAL FREEZE.** (Note: there is a pause in the data between Blocks 081 and 084.) The BISYNC framing can be clearly discerned because the framing characters are enhanced. Each transmission (that is, each frame) begins with DLE STX and ends with DLE ETX CRC1 CRC2.

Operate the HEX key. Notice that the enhanced DLEs are all 10's in hexadecimal, but the DLEs in normal video are 90_{16}. The 90_{16} DLEs have the bit pattern

```
** PROGRAM MODE -- CRT & TAPE **

        CRT CONTROL
DISPLAY MODE: SINGLE LINE  DUAL LINE
SUPPRESS    :
ENHANCE     : CHAR PARITY
            :
REV IMAGE   : OFF  INTERFACE=ON

        RECORD CONTROL
INITIAL COND: NOT RECORD      RECORD
START AT    : CONTINUE        BLOCK 000
STOP AT     : ENDLESS LOOP    END
INTERFACE   : NO YES

        SPEAKER CONTROL
SPEAKER     : OFF ON
```

Figure 5-2

1001 0000 but are displayed as DLEs because the CRT logic reads only 7 bits when a 7-bit code has been selected. The Parameters 2 logic, however, sees the mark parity bit and enhances only characters with the bit pattern 0001 0000.

Since DLE (10_{16}) is used as an indicator prior to STX and ETX, it must be distinguished from 10_{16} in the data. The BISYNC rules require another 10_{16} to be inserted before any data 10_{16}. The extra DLE is thrown away upon receipt, but of course you will see it when you are monitoring the line. Octet 1 is usually 10_{16} for LCNs below 256; therefore the dual DLE (10 10_{16}) occurs with some frequency in this display.

NOTE: When you are counting to find a particular octet, remember to disregard one of every two consecutive 10_{16} DLEs.

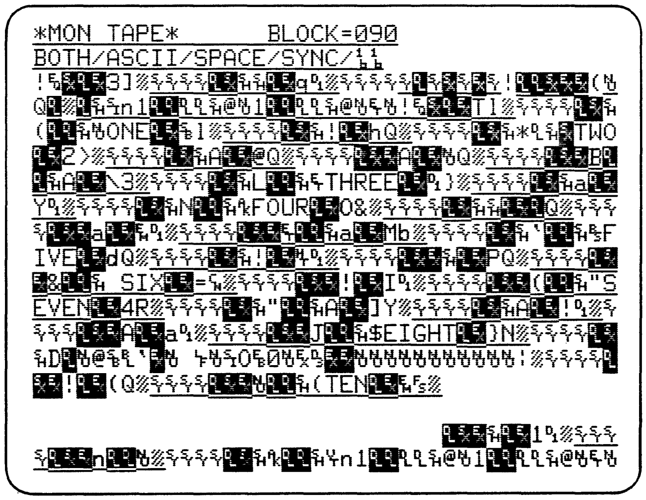


Figure 5-3

Return the data display to clear text using the HEX key. Operate CONTROL plus HEX. This will display not only the control characters in hexadecimal but also those text data characters having the same mnemonics. This problem arises frequently because the X.25 control bytes frequently fall in the same range of hexadecimal values as the BISYNC control values. The 90_{16} DLEs are examples. You will find that using CONTROL plus HEX on transparent data displays is a very useful device for distinguishing the real control characters. (See Figure 5-4.)

NOTE: In transparent BISYNC-framed X.25, DLEs are frequently inserted near the LCN. The automatic packet locator activated by the P key is programmed to ignore the extra DLE when it counts character locations. When you are observing the display or

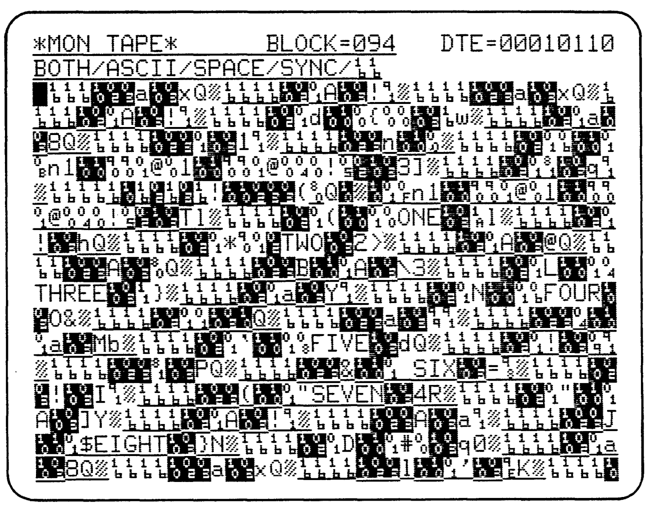


Figure 5-4

manually selecting the bytes to be expanded using CONTROL plus P, be sure to consider the rules for transparency.

5.2.3 Packet Call Sequence. The BISYNC-framed X.25 portion of the training tape contains a packet call setup, an interrupt, and a call clear. It is instructive to observe the call sequence.

When you are making frequent use of the cursor, the large number of enhanced characters on the screen may make it difficult to identify the cursor. **Select the Parameters 2 menu, place the cursor in the ENHANCE data entry field, and operate CLEAR FIELD.** This cancels ENHANCE. **Return to the Monitor Mode and freeze the display at Block 95.**

Operate the B key to scroll to the beginning of the display buffer. There is a limited amount of BISYNC-framed data on the tape, so the first character in the buffer will be the first character of the taped data.

Press the P key to automatically tab the cursor through the sequence of packet-type octets and display the mnemonic expansion for each packet. Table 5-1 summarizes the packet traffic on the tape. The third packet (Table 5-1B) is a CALL packet (see also Figure 5-5). The table clearly shows the sequence of all packets in the call through CLEAR.

In Table 5-1B, notice the packet DCE RR P(R) = 3 following DTE INFO P(S) = 3 and preceding DTE INFO P(S) = 4. You might infer that the RR should have been P(R) = 4 since the next P(S) is a 4. However, timing delay in the Node may permit a "skew" of one count. A similar condition may arise when window rotations are used to control the traffic flow.

Operate the B key to return to the beginning of the buffer. Use the F key to obtain the sequence of frame control expansions of Table 5-1A.

5.2.4 Packet Highlight. You can use triggers to highlight only data packet content. The simplest approach is to set a trigger to look for a specific LCN and the data packet-type octet (Octet 3).

(1) **Check the Trigger Summary** to be sure that the triggers are at default condition, that is, no entries show on the Program or Trigger Summary.

(2) **On the Trigger 1 menu, select**
MON DATA ON: DTE
LOOK FOR: STRG

Enter the two LCN bytes using the key sequence HEX, 1, 0; HEX, 0, 1. Represent the data packet-type octet by a Bit Mask, XXXX XXX0 (see Section 4.1.3 to review instructions regarding the Bit Mask).

(3) **Under SET CRT, select REV and enter a one (1) to turn REVerse image ON.**

(4) **Set Trigger 2 to look for the end-of-text sequence, DLE ETX, and to turn REVerse CRT OFF (0). Then set Triggers 3 and 4 in the same way to highlight data packets *on the DCE*.**

The Trigger Summary should appear as in Figure 5-6.

In Monitor Mode, freeze the display manually at Block 095; then operate the B key to obtain the display of Figure 5-7. Obtain the display of Figure 5-8 using CONTROL plus HEX.

5.2.5 The Q Bit. Notice that in Figure 5-7 the data packet containing TWO was not highlighted. Why didn't the trigger catch this packet?

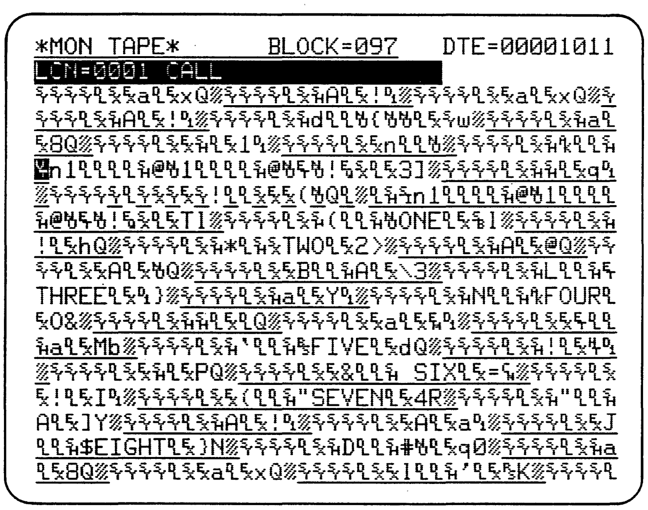


Figure 5-5

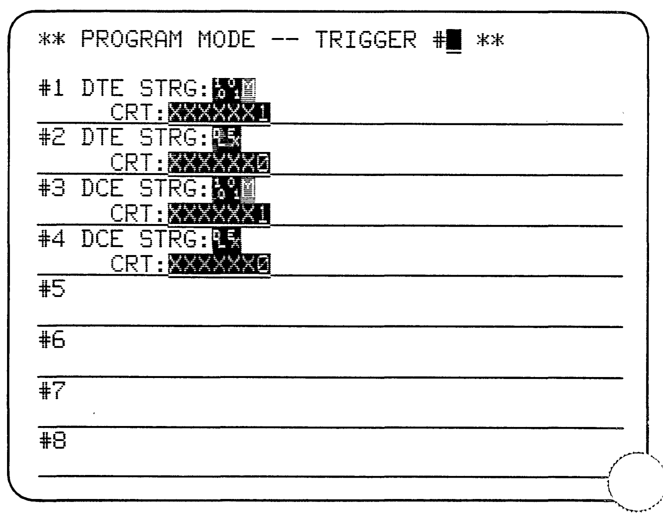


Figure 5-6

Table 5-1

Table 5-1A

		Frame		
	Type	NR	NS	P/F
DTE	RR	7		0
DCE	RR	2		0
DTE	RR	7		0
DCE	RR	2		0
DTE	RR	7		0
DCE	RR	2		0
DTE	INFO	7	2	0
DCE	RR	3		0
DCE	INFO	3	7	0
DTE	RR	0		0
DTE	INFO	0	3	0
DCE	RR	4		0
DCE	INFO	4	0	
DTE	RR	1		0
DTE	INFO	1	4	0
DCE	RR	5		0
DTE	INFO	1	5	0
DCE	RR	6		0
DCE	INFO	6	1	0
DTE	RR	2		0
DTE	INFO	2	6	0
DCE	RR	7		0
DTE	INFO	2	7	0
DCE	RR	0		0
DCE	INFO	0	2	0
DTE	RR	3		0
DTE	INFO	3	0	0
DCE	RR	1		
DCE	INFO	1	3	0
DTE	RR	4		
DCE	INFO	1	4	0
DTE	RR	5		0
DTE	INFO	5	1	0
DCE	RR	2		0
DCE	INFO	2	5	0
DTE	RR	6		0
DTE	INFO	6	2	0
DCE	RR	3		0
DCE	INFO	3	6	0
DTE	RR	7		0
DCE	INFO	3	7	0
DTE	RR	0		0
DTE	INFO	0	3	0
DCE	RR	4	0	0
DCE	INFO	4	0	0
DTE	RR	1		0
DTE	INFO	1	4	0
DCE	RR	5	0	0
DCE	INFO	5	1	0
DTE	RR	2		0
DTE	RR	2		
DCE	RR	5		
DTE	RR	2		
DCE	RR	5		

Table 5-1B

			Packet			
	LCN	Type	P(R)	P(S)	(Q)	Text
DTE	0000	Restart				
DCE	0000	Restart confirm				
DTE	0001	Call				
DCE	0001	Call accept				
DTE	1	INFO	0	0		One
DTE	1	INFO	0	1	Q	Two
DCE	1	RR	2			
DTE	1	INFO	0	2		Three
DTE	1	INFO	0	3		Four
DCE	1	RR	3			
DTE	1	INFO	0	4		Five
DCE	1	INFO	5	0		Six
DCE	1	INFO	5	1		Seven
DTE	1	RR	2			
DCE	1	INFO	5	2		Eight
DTE	1	Interrupt				
DCE	1	Interrupt confirm				
DCE	1	INFO	5	3		
DTE	1	RR	3			
DCE	1	INFO	5	4		
DTE	1	Clear				
DCE	1	Confirm				

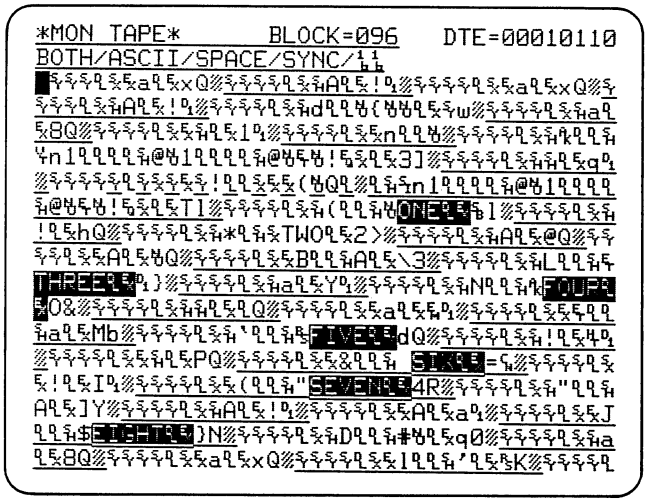


Figure 5-7

Use the P key to tab to the packet-type octet for that frame. Notice that the Q bit is set (see Figure 5-9). The Q bit is the first bit in Octet 1. **Move the cursor to the left to Octet 1 (90_{16}).** Notice from the bit expansion that Bit 8, which is the Q bit, is 1. But the trigger is programmed to look for a byte with Bit 8 = 0 (10_{16}).

Although ASCII defines only seven information bits, the status of the eighth bit can always be examined by using the cursor to show the bit expansion.

5.2.6 Enhance Parity. You may find it useful to be able to see at a glance what bytes have Bit 8 = 1 (Mark parity bit). **On the Parameters 2 menu, in the ENHANCE field, select PARITY. Return to Monitor Mode.**

Each byte having Mark parity bit is now displayed with a horizontal bar through it (Figure 5-10). Control characters with mark parity (specifically the frame and

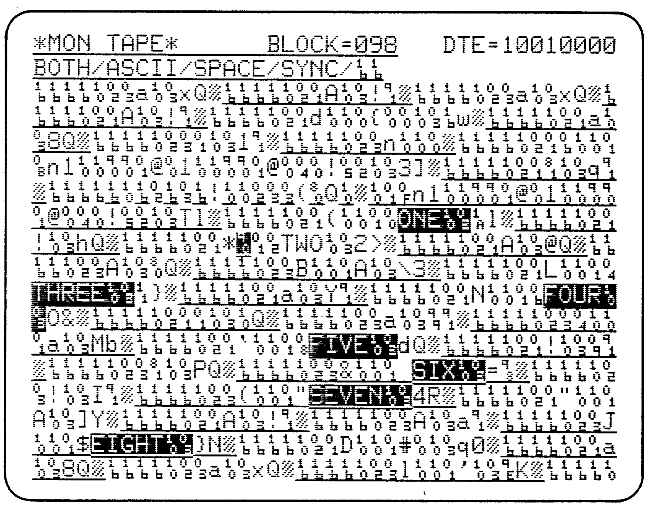


Figure 5-8

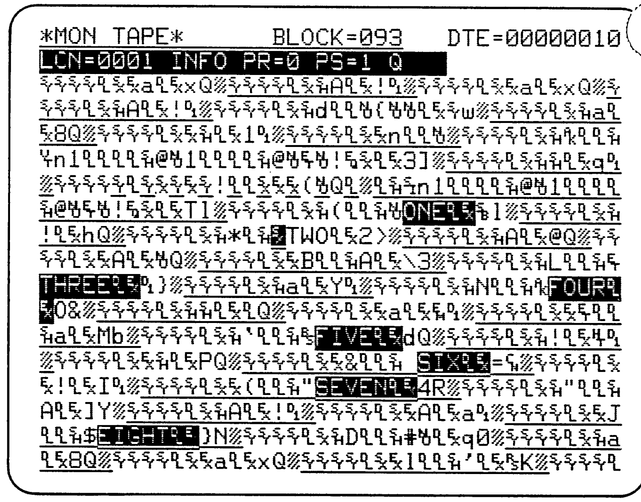


Figure 5-9

packet control and supervisory octets) are legal because parity applies only to the data (INFO) fields.

Display the Program Summary and notice the entries under Triggers 7 and 8 (Figure 5-11). When you select ENHANCE PARITY, these two triggers are automatically programmed to count parity errors. If you need Triggers 7 and 8 (or Counters 3 and 4) for other purposes, you can clear each of them with CONTROL plus CLEAR FIELD. This makes the two triggers a the two counters available, but it does not clear the ENHANCE PARITY selection on the CRT display.

5.3 OTHER BISYNC-FRAMED DATA.

5.3.1 Same Code for Framing and Data. When both framing and data are EBCDIC or ASCII, select EBCDIC or ASCII for the CODE on the Parameters 1 (Basic Monitor) menu. The synchronization characters will be

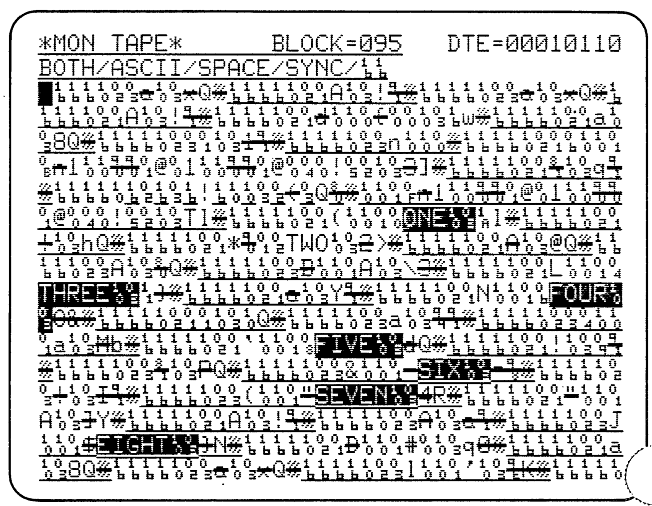


Figure 5-10

automatically determined: the system will look up the SY character in the selected code chart and enter it—including appropriate adjustments for parity.

5.3.2 Different Code for Framing and Data. In this case, the synchronization characters must be entered in hexadecimal to override the default selection for the selected code. Select the data CODE (usually EBCDIC or ASCII), then the correct number of bits and parity as applicable.

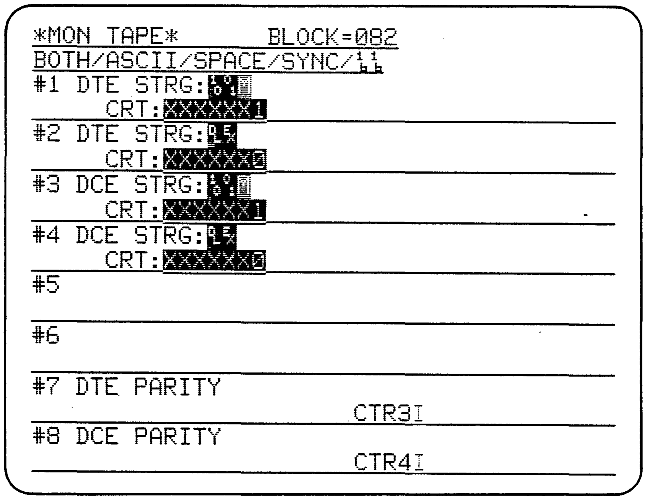


Figure 5-11

Enter each synchronization character using the HEX key followed by two digits. The usual selections are as follows:

EBCDIC = $32\ 32_{16}$
ASCII odd, space, or no parity = $16\ 16_{16}$
ASCII even parity (rarely used) = $96\ 96_{16}$

An example of the set up for EBCDIC-framed ASCII is shown in Figure 5-12.

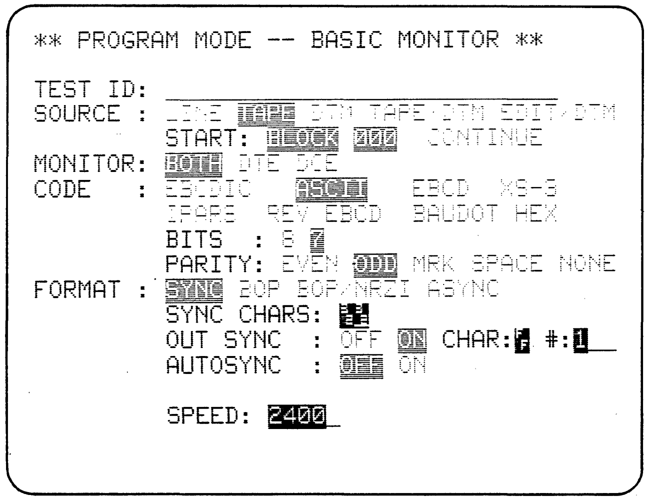


Figure 5-12

6 SDLC Data

6.1 GENERAL

SDLC may be implemented in several ways depending on the application. The data on Blocks 150 to 250 of the training tape represents traffic with a 3276 terminal on a multi-drop circuit.

6.2 PARAMETERS SETUP

The SDLC data on the training tape runs from Block 150 to 250.

On the Parameters 1 menu, program the 3500 to START at BLOCK 150. The data CODE is EBCDIC, and the FORMAT is BOP, since SDLC uses HDLC (bit stuffing) framing. Figure 6-1 shows the Parameters 1 setup.

On the Parameters 2 menu, select DUAL LINE since we may anticipate simultaneous transmission by the DCE and DTE (Figure 6-2).

6.3 DISPLAY

Operate MONITOR. Playback will begin BLOCK 150. **When the display looks similar to Figure 6-3 (Block 151 of the tape), FREEZE the CRT and operate the B key.**

6.3.1 Idle Line. **Use the F key to tab to the UA/NSA frame** (Figure 6-4). Figure 6-4 shows that on the DTE line idle mark is represented by the L-shaped fill symbol. Each DTE frame begins and ends with at least one *Flag* (7E).

The DCE line (underlined) idles with *Flags*.

```
** PROGRAM MODE -- BASIC MONITOR **

TEST ID: SET UP for SDLC @ 150
SOURCE : LINE TAPE DTM TAPE/DTM EDIT/DTM
         START: BLOCK 150  CONTINUE
MONITOR: BOTH DTE DCE
CODE   : EBCDIC   ASCII   EBCD  XS-3
         IPARS  REV EBCD  BAUDOT HEX


FORMAT : SYNC BOP BOP/NRZI ASYNC




         SPEED: 2400
```

Figure 6-1

```
** PROGRAM MODE -- CRT & TAPE **

        CRT CONTROL
DISPLAY MODE: SINGLE LINE  DUAL LINE
SUPPRESS     :
ENHANCE      : CHAR PARITY
             :
REV IMAGE    : OFF  INTERFACE=ON


        RECORD CONTROL




        SPEAKER CONTROL
SPEAKER      : OFF ON
```

Figure 6-2

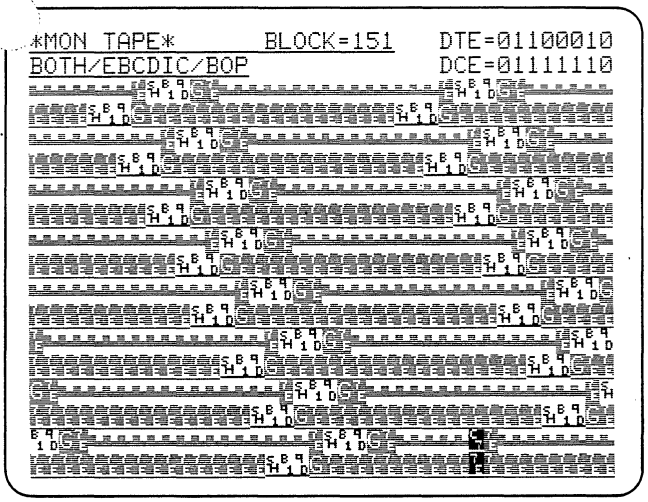


Figure 6-3

6.3.2 Hexadecimal Display. Figure 6-4 shows that the 3500 displays many bytes as mnemonics. **Operate CONTROL plus HEX** to display these characters in hexadecimal as shown in Figure 6-5.

6.4 ZERO INSERTION

With the F key, tab to the next XID frame (Figure). The training tape contains sequences in which the idle 7E *Flags* have been accidentally stuffed with zeros. Figure 6-6 shows two blocks containing = = = = = and ending in B for Bad block. The bit expansion for the DCE cursor character is 0111 1110, indicating that the = symbol represents the $7E_{16}$ *Flag*.

Operate MANUAL UNFREEZE and let the tape run until about Block 190, where messages containing many of the numeral 7 will appear (see Figure 6-7). **FREEZE the CRT.**

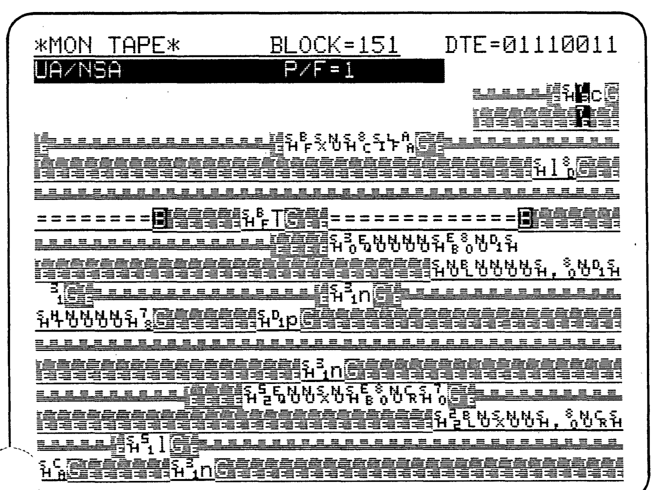


Figure 6-4

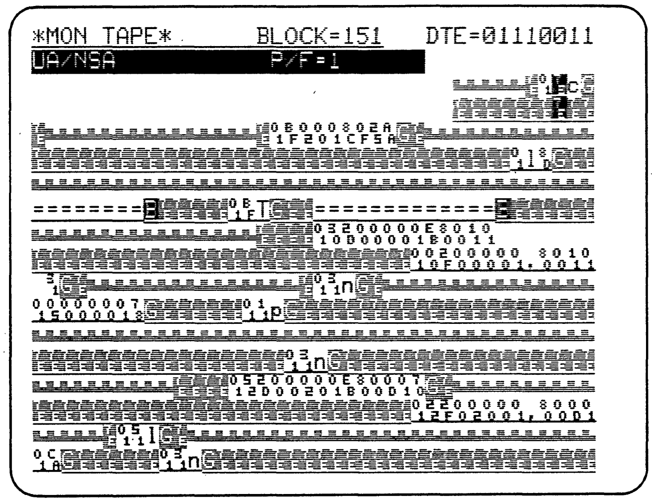


Figure 6-5

6.4.1 Fill Characters: Display of (De)stuffed Zeros. An EBCDIC 7 is $F7_{16}$, bit pattern 1111 0111 (notice the breakdown in Figure 6-7). Two consecutive 7's contain seven consecutive 1's. Therefore, one zero is inserted for every 7, and a sequence of eight 7's on the DTE gains eight bits or one byte over the DCE. This gain is represented by an L-shaped fill symbol following every eighth 7 on the DTE in order to maintain time correlation with the DCE.

No fill characters have been inserted in the DCE string of 7's near the bottom of Figure 6-7 because the DTE side idles with mark and time correlation is not relevant.

In dual-line BOP display on the 3500, you will see the L-shaped fill symbol inserted in the data whenever eight bits have been inserted and time correlation must be maintained.

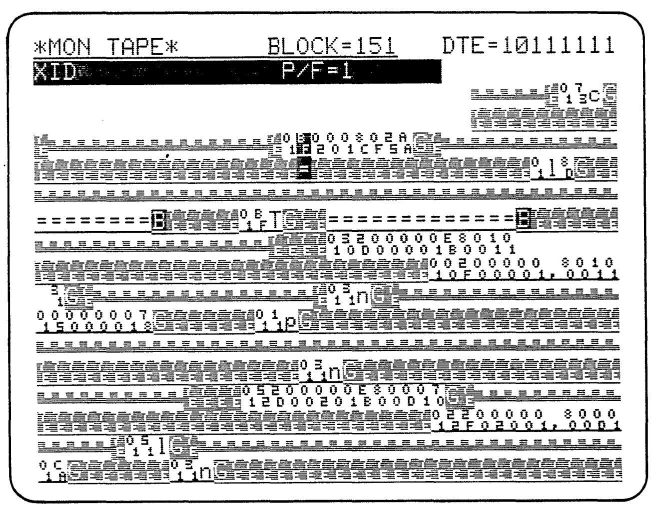


Figure 6-6

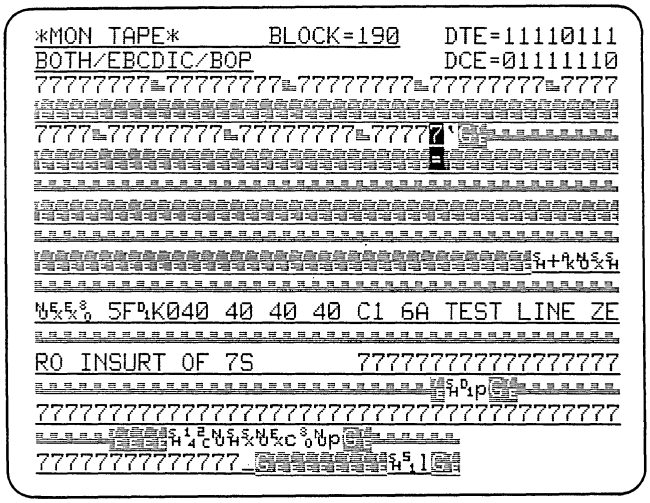


Figure 6-7

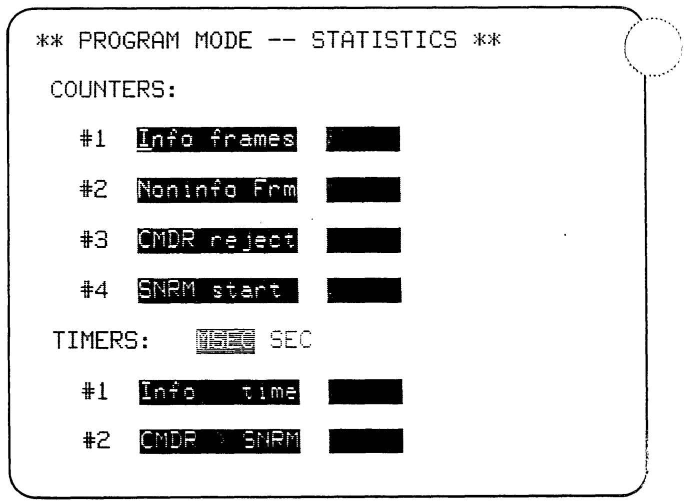


Figure 6-9

NOTE: The fill symbols will not necessarily appear in the same place each time data is replayed because the accumulation up to eight is a continuous process.

6.4.2 Suppress Idle. So far, the SDLC data has been displayed with a large number of idle *Flags.* It has been instructive to see them, but it will be more efficient to suppress them. **On the Parameters 2 menu, enter a *Flag* (CONTROL plus FLAG) on the SUPPRESS data entry line and again MONITOR the data.** Figure 6-8 shows the compact data display around Block 153 with the EBCDIC control character mnemonics converted to hexadecimal (using CONTROL plus HEX).

6.5 NETWORK MEASUREMENTS

We shall program triggers to make the measurements listed in Figure 6-9. **First, select the Statistics menu and name the counters and timers as shown on the figure.** Frame efficiency can be measured by counting information and noninformation frames. **Press TRIGGER to view the Trigger Summary** and be sure the triggers are in default condition; i.e., the summary is clear.

Display the Trigger 1 menu. Select DTE and enter a string to define information frames; namely, *Flag*, Not Equal *Flag*, Bit Mask with Bit 1 = 0. Set Counter 1 to increment and thus count information frames (see Figure 6-10).

Set up Trigger 2 to count noninformation frames on Counter 2 (as in Figure 6-11).

To use Trigger 3 to count Command Reject (CMDR) frames on Counter 3, enter a DTE string to identify the CMDR frame: *Flag*; Not Equal *Flag*; HEX, 9, 7. (See Appendix C.1 for the bit patterns of SDLC commands.)

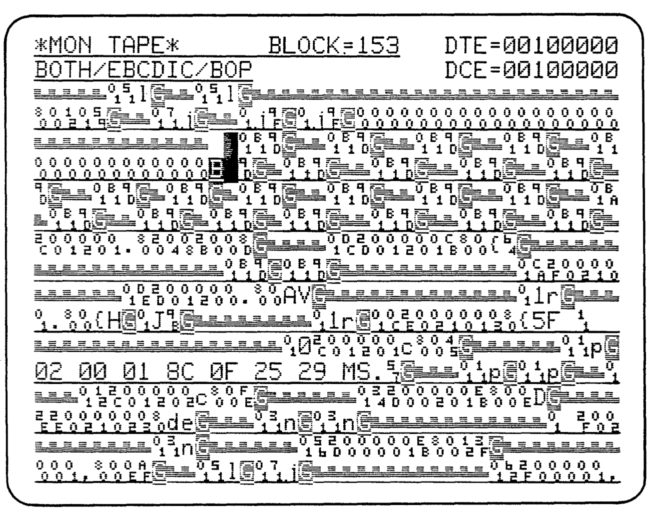


Figure 6-8

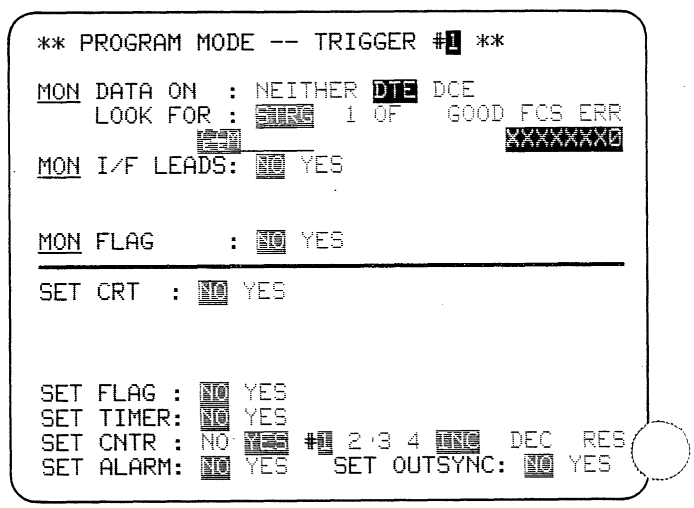


Figure 6-10

```
** PROGRAM MODE -- TRIGGER #2 **

MON DATA ON  : NEITHER DTE DCE
    LOOK FOR : STRG  1 OF   GOOD FCS ERR
                                XXXXXXX0
MON I/F LEADS: NO YES

MON FLAG     : NO YES
SET CRT  : NO YES

SET FLAG : NO YES
SET TIMER: NO YES
SET CNTR : NO YES #1 2 3 4 INC DEC RES
SET ALARM: NO YES   SET OUTSYNC: NO YES
```

Figure 6-11

Set Normal Response Mode (SNRM) frames appear on the DCE line. **To count them on Trigger 4, set Counter 4 to increment when the DCE string *Flag*, Not Equal *Flag*, 93_{16}** is received.

The Program Summary should now look like Figure 6-12.

To measure the total line time actually used for transmitting information you can set a timer to run from receipt of the information control frame byte through the closing *Flag*. The string already entered on Trigger 1 can be used to start Timer 1. **Select CONT to permit the timer to accumulate the total information frame time.**

None of the triggers includes a string to define the end of a frame, so **select the Trigger 5 menu. Enter a DTE string of Not Equal *Flag*, *Flag* and set Timer 1 to STOP.**

```
** PROGRAM MODE -- TRIGGER # **

#1 DTE STRG:
                        CTR1I
#2 DTE STRG:
                        CTR2I
#3 DTE STRG:
                        CTR3I
#4 DCE STRG:
                        CTR4I
#5

#6

#7

#8

```

Figure 6-12

```
** PROGRAM MODE -- TRIGGER # **

#1 DTE STRG:
                        CTR1I TMR1C
#2 DTE STRG:
                        CTR2I
#3 DTE STRG:
                        CTR3I TMR2C
#4 DCE STRG:
                        CTR4I TMR2S
#5 DTE STRG:
                              TMR1S
#6

#7

#8

```

Figure 6-13

The strings needed to measure the total time between Command Reject and Set Normal Response Mode have already been entered on Triggers 3 and 4, so you can use these triggers to set a timer. **On Trigger 3, set Timer 2 to CONTinue, and on Trigger 4, set Timer 2 to STOP.**

The Trigger Summary should now appear as in Figure 6-13.

From Figure 6-14, we can compute the frame efficiency on the test circuit as 249/(3321 + 249) = 7%.

SNA uses headers on information frames for equipment control, configuration, initialization, and other purposes. Triggers can be used to look for specific headers, to locate the user data, and to measure it. These details are application dependent and the operator must be quite familiar with the system under test.

```
*MON TAPE*      BLOCK=236
BOTH/EBCDIC/BOP
 COUNTERS:

   #1  Info frames     249

   #2  Noninfo Frm    3321

   #3  CMDR reject       4

   #4  SNRM start        9

 TIMERS:   MSEC SEC

   #1  Info    time  14758

   #2  CMDR > SNRM     410
```

Figure 6-14

7 Recording

CAUTION: Do not use the training tape to save a program or record data. (On some of the training tapes, the record tab has been removed to help avoid this error.)

7.1 PREFORMATTING TAPES

New tapes should be preformatted before use to retension them and provide block numbers. (See the Technical Manual for detailed instructions.)

7.2 SAVING A PROGRAM

CAUTION: Always verify a tape as blank (or as having a program that is no longer of interest) before you SAVE a program on it. You should do this *before* the new program has been developed to avoid the possibility of writing over it with whatever may be on the tape.

(1) **Insert the tape and press LOAD PROGram:** the name of any resident program or "NO PROGRAM FOUND" will be displayed.

(2) **Remove the cartridge and position the RECORD tab toward the outside of the case** (this is the record position).

(3) **Develop the desired program in the 3500.**

(4) **Insert the new tape (with the record tab ON). Press the SAVE PROGram key** and the Program CRT menu will appear.

(5) **Always operate the LOAD PROG key** to verify that the program has transferred to the tape. You should review each of the four menus—

Parameters 1, Basic Monitor;
Parameters 2, CRT and Tape;
Trigger Summary;
Statistics, Counters and Timers.

(6) **Remove the tape and move the RECORD ta[b] to the center of the case to protect the tape.**

(7) **Fill out a label with the program menu and attach it to the case.**

7.3 RECORDING DATA

7.3.1 Manual Recording. Only one operation is required for manual recording:

(1) **Position the RECORD tab of the tape toward the outside edge of the case.**

(2) **In the MONITOR mode, press the MANUAL START key in the CAPTURE MEMORY zone of the keyboard.** The RECORD LED on the panel will go ON and the BLOCK number will increment for each 2400 characters received.

(3) **To stop recording, press MANUAL STOP.**

7.3.2 Program Control. When LINE has been selected as data source, triggers can be used to start and (or) stop data recording. The RECORD and TRIGGER LEDs on the panel will indicate whether the tape is recording.

7.3.3 Override. When the tape is under program trigger control, you may use the MANUAL START and MANUAL STOP keys to override the triggers in the same way that you can override the CRT display freeze. Use RESUME TRIGGER to restore program control.

APPENDIX A
Using This Manual with the INTERVIEW 3000

This training manual can be used with the INTERVIEW 3000 (which does not have a tape). The following considerations are important.

(1) Obtain a source of HDLC-framed signals, preferably X.25 as that is what has been used for the basic part of the manual. Connect the signals to be monitored to the RS-232/V.24 connector on the rear of the instrument.

(2) Since you have no taped program, you will need to program the Parameters 1 menu before you can monitor data. You should, therefore, read Section 4, through Section 4.1.1, Basic Monitor Menu, before you read Section 3 in detail.

(3) The Parameters 1 menu should show SOURCE: LINE for all tests. Select BOP for FORMAT and enter synchronization characters to match the framing of the data to be monitored.

(4) Throughout, study the figures in the man before you apply the text to your own data.

(5) You can skip Sections 2.2, 2.3, 2.4, and 7, which pertain only to the INTERVIEW 3500.

An INTERVIEW 3000 may be field-upgraded to a 3500 by adding a Tape Upgrade Kit, OPT-895-01-2. Please specify serial number and software version (see power-up display of your unit) when you order.

APPENDIX B
Introduction to Bit-Oriented Protocols

ADCCP (Advanced Data Communication Control Procedures) is the most general of the bit-oriented protocols. Most of those in use are subsets of ADCCP. Because its provisions for extended addressing and extended control fields have not been generally implemented, they will not be discussed here.

B.1 OVERVIEW

A bit-oriented protocol can be viewed as three essentially separate parts:

1. The BASIC FRAME, needed to coordinate transmissions.
2. PACKETS, the content or information to be sent, for example.
3. The FRAMING around each transmission, essential for synchronization.

Most Bit-Oriented Protocols (BOP) have the following general characteristics:

- Because specific bits within a control byte have individual significance, each bit is accessible for analysis.
- Messages need not be individually acknowledged: a specific number of messages may be outstanding without acknowledgment.
- Each transmission consists of a frame with a minimum of four 8-bit bytes: one address, one control, and two frame check (FCS) bytes.
- Transmission by the DTE and the DCE is simultaneous, which increases throughput.
- Data messages can be sent in any binary format (memory dumps, for example), because the information content is "transparent" to the framing.
- *All* bytes used for control purposes are eight information bits. Information characters may be 8 bits or less, depending on what protocol is used for the information field.

Particular BOP implementations may exclude some of these or include other characteristics.

B.2 BASIC FRAME

The basic (that is, minimum) frame structure four 8-bit bytes.

Byte 1	Byte 2	Byte 3	Byte 4
ADDRESS	CONTROL	FCS_1	FCS_2

The address and control bytes are defined by their positions.

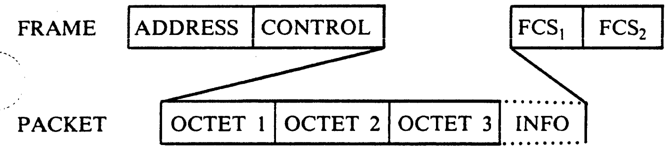
If a frame contains a message or data (information frame), additional bytes are inserted. Certain control frames also require more bytes. Additional bytes of either type always follow the control byte and their presence is signaled in the control byte.

ADDRESS	CONTROL	....	FCS_1	FCS_2
		INFORMATION		

Bit patterns and command acronyms used in X.25 and SDLC frame-control bytes are listed in Appendix C.

B.3 PACKET

In X.25 and X.75 protocols, an information frar is by definition a Packet. A packet always contains least three octets (octet is the CCITT term for byte):



The INTERVIEW 3500 analyzes the first three octets of the packet.

Octet 1			Octet 2	Octet 3			
1 1	0 1	XXXX	X X X X X X X X	X X X	X	X X X	0
Q D	Mod 8	12-Bit Logical Channel (LCN)		P(R)	M	P(S)	

Packets usually contain up to 128 bytes of information. If the block to be sent is larger and requires several packets, the M bit (More data bit) within the packet-type octet (Octet 3) is set to 1. This serves the same function as an ITB in BISYNC. The last packet of a contiguous block has the M bit set to 0.

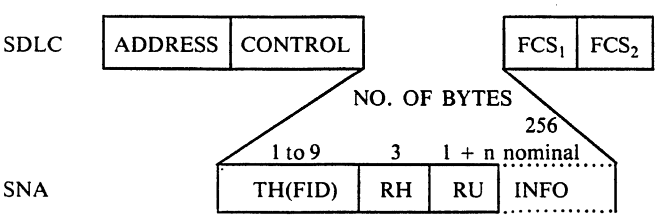
The 3500 displays the LCN, P(R), and P(S), as well as Q, D, or M if any of these three bits is set to 1.

If the modulus is 128 (bits 6 and 5 of Octet 1 set to 10), the 3500 displays only the LCN and MOD 128.

B.4 SDLC-SNA

SDLC-SNA is a protocol that includes numerous application-dependent variables. It accommodates control of terminals and other hardware-software devices as well as various host application programs. It is not a general-purpose network protocol such as X.25, although the basic principles are the same.

SDLC can be considered equivalent to frame level and SNA roughly equivalent to packet level:



Since SDLC may address multiple stations (controllers), the address byte can have many values. The ultimate destination or origin (device) address is contained within the FID field.

The 3500 displays all control command acronyms for the SDLC control byte.

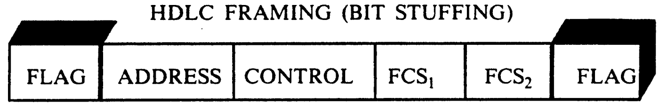
For in-depth treatment of SDLC-SNA, see IBM Technical Bulletin G 320-6024, "SNA Architecture Reference Summary."

B.5 FRAMING

Framing characters (or signals) precede and follow each frame (four or more 8-bit bytes) to synchronize the characters of the frame.

B.5.1 HDLC Framing. At least one *Flag* (0111 1110, $7E_{16}$) must precede and end each frame.

HDLC FRAMING (BIT STUFFING)



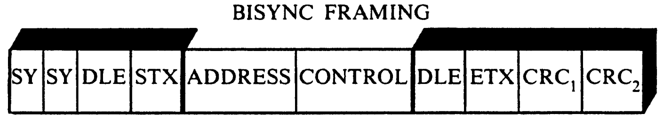
A technique called "zero bit stuffing" is used to prevent having more than five consecutive 1 bits on the line except when the *Flag* is sent.

A special detector monitors the line for the *Flag* signal. The first non-*Flag* byte is the address byte and the next *Flag* signals that the frame has terminated.

In the INTERVIEW 3500, the term BOP is reserved for HDLC framing.

B.5.2 Transparent BISYNC Framing. The BISYNC protocol includes provisions for sending transparent binary data. Many networks have implemented bit-oriented protocols using transparent BISYNC framing because the communication hardware for HDLC was not available.

BISYNC FRAMING



Either EBCDIC (SYN = 32) or ASCII (SYN = 16) framing may be used. Whichever framing is used, synchronization is absolutely independent of the information code. EBCDIC, ASCII, or any other code may be used for the information code.

The rules for sending transparent data in any BISYNC protocol are followed. If DLE occurs in the data stream a second DLE is inserted to qualify it as a valid 10_{16}. Buried synchronization characters may also be present (e.g. DLE, SYN) and must be ignored when message content is reviewed.

Frame check bytes (FCS) are replaced by the CRC characters used with BISYNC.

In the INTERVIEW 3500, SYNChronous FORMAT must be selected to monitor transparent BISYNC-framed data.

B.6 NOTES

B.6.1 Bit Order and Numbering. Lack of consistency between and even within documents has made misunderstandings about bit order and numbering a common problem.

- In INTERVIEW 3500 literature and display, the first serial bit is consistently the rightmost bit and is designated as Bit 1.
- Most documents specify Bit 1 as the first serial bit in a byte and Bit 8 as the last serial bit.
- In IBM literature, Bit 7 is usually the first serial bit and Bit 0 is the last bit.
- In some documents the first serial bit is the leftmost bit and in some cases the first serial bit is the rightmost bit.
- Bytes are often represented hexadecimally. In this case, the rightmost bit is the lowest-order bit and also usually the first serial bit.
- CCITT X.25 transposes the order of the bits on the printed tables for frame and packet. Bit 1 is on the right for all packet tables and is always the first serial bit. Conversion to hexadecimal from these tables is obviously an opportunity for confusion.
- The best guide to bit order in any table is to identify an INFO command or INFO Packet; then establish the bit having a defined value of 0 as the first serial bit.
- A series of bytes (or fields or characters) is usually presented with the first sequential byte in the leftmost position.

	Bit Designation							
Documentation	**Last bit sent**							**First sent**
CCITT	8	7	6	5	4	3	2	1
Most IBM documentation	0	1	2	3	4	5	6	7
INTERVIEW 3500	8	7	6	5	4	3	2	1

The following control frame is an example of the convention used in 3500 documentation:

Bit pattern	1	0	1	0	0	1	1	0
Acronyms	N (R)			P/F	N (S)			INFO
Hexadecimal	A				6			

The hexadecimal representation of this byte on the 3500 screen would be A6. The first bit transmitted is a zero, indicating that this is an information frame and an information field will follow this byte.

B.6.2 Protocol Characteristics.

(1) X.25 and X.75 specify basically a point-to-point, DTE-to-NODE(DCE) connection. Supervision, acknowledgment, and so on are generally best understood in these terms rather than with regard to end-to-end use. At packet level, the recently introduced D bit can indicate end-to-end delivery significance. (D = 0 for local significance.)

(2) X.25 idles with *Flags* ($7E_{16}$) on both paths.

(3) SDLC permits multiple stations on a network. The return path idles with mark between frames from different stations. Each frame is preceded and followed by one *Flag*. The outbound path idles with *Flags*.

(4) SDLC NRZI is used with or without modem clock. The circuit should be tested in whichever manner it is actually used.

APPENDIX **C**

Frame and Packet Expansions

C.1 FRAME

The 3500 will display acronyms for X.25 (including LAP B), X.75, and SDLC. Therefore up to three different acronyms may appear for one control byte when the P key is used.

C.2 PACKET

The 3500 displays acronym expansions for X.25 and X.75 for modulo 8. Modulo 128 is so indicated without further explanation.

Table C-1
X.25/X.75/SDLC Frame Control Byte Expansion

Bit Pattern 8 7 6	5	4 3 2 1	Display*			
N(R)	P	N(S) 0	INFO	NR = X	NS = X	P/F = X
N(R)	P/F	0 0 0 1	RR	NR = X		P/F = X
N(R)	P/F	0 1 0 1	RNR	NR = X		P/F = X
N(R)	P/F	1 0 0 1	REJ	NR = X		P/F = X
N(R)	P/F	1 1 0 1	SREJ†			P/F = X
0 0 0	P/F	0 0 1 1	NSI†			P/F = X
0 0 0	P/F	0 1 1 1	SIM†/RQI†			P/F = X
0 0 0	F	1 1 1 1	SARM/DM/ROL†			P/F = X
0 0 1	P/F	0 0 1 1	NSP†			P/F = X
0 0 1	P	1 1 1 1	SABM			P/F = X
0 1 0	P	0 0 1 1	DISC†/RQD			P/F = X
0 1 0	P/F	0 1 1 1	RGA†			P/F = X
0 1 1	F	0 0 1 1	UA/NSA†			P/F = X
1 0 0	F	0 1 1 1	FRMR/CMDR†			P/F = X
1 0 0	P	0 0 1 1	SNRM†			P/F = X
1 0 1	P/F	1 1 1 1	XID†			P/F = X
1 1 0	P/F	0 1 1 1	CFGR†			P/F = X
1 1 1	P/F	0 0 1 1	LINKTEST†			P/F = X
1 1 1	F	1 1 1 1	BCN†			P/F = X
All other patterns			UNKNOWN			

*All acronyms for X.25 and X.75 frame and packet level as well as all SDLC frame-control byte commands are included. Where one bit pattern is used several ways all acronyms are displayed by the INTERVIEW.

†Frames used only by IBM.

Table C-2
X.25/X.75 Packet-Type Expansion

	Octet 3 8 7 6 5 4 3 2 1		Display (XXXX = Decimal 0000-4096)
1	0 0 0 0 1 0 1 1	LCN = XXXX	CALL
2	0 0 0 0 1 1 1 1	LCN = XXXX	CALL ACCEPT
3	0 0 0 1 0 0 1 1	LCN = XXXX	CLEAR
4	0 0 0 1 0 1 1 1	LCN = XXXX	CONFIRM
5	P(R) M P(S) 0	LCN = XXXX	INFO PR = X PS = X QDM
6	0 0 1 0 0 0 1 1	LCN = XXXX	INTERRUPT
7	0 0 1 0 0 1 1 1	LCN = XXXX	INTERRUPT CONFIRM
8	P(R) 0 0 0 0 1	LCN = XXXX	RR PR = X
9	P(R) 0 0 1 0 1	LCN = XXXX	RNR PR = X
10	P(R) 0 1 0 0 1	LCN = XXXX	REJ PR = X
11	0 0 0 1 1 0 1 1	LCN = XXXX	RESET
12	0 0 0 1 1 1 1 1	LCN = XXXX	RESET CONFIRM
13	1 1 1 1 1 0 1 1	LCN = XXXX	RESTART
14	1 1 1 1 1 1 1 1	LCN = XXXX	RESTART CONFIRM
15	All other		UNKNOWN