INSTRUCTION MANUAL

DATASCOPE

MODEL D-501

SPECTRON CORPORATION
CHURCH ROAD & ROLAND AVENUE • MOUNT LAUREL, NEW JERSEY 08057
TWX:710-897-1369
609-234-5700

DATASCOPE - D-501

GETTING STARTED

Inspect for obvious shipping damage. If in doubt, remove dust cover (screws along bottom of each side) and reseat all plug-in boards. Look for visible internal damage. Replace cover.

Turn on power -- fan runs, power lite on

Set switches as follows for 8-bit data:

SPEED -- MODEM for synchronous data

-- INTERNAL for asynchronous, thumbwheel as follows:

A - 50	E - 150	I - 1200	M - 3600
B - 74.2	F - 300	J - 1800	N - 4800
C - 110	G - 600	K - 2000	O - 7200
D - 134.5	H - 1050	L - 2400	P - 9600

FRAMING PATTERN	--	NORM	ASCII - 16 16
			EBCDIC - 32 32
SYNC RESET	--	ON	ASCII - 04
			EBCDIC - 37
1-8/8-1 Send Rcv Both	--	All Down	
Send/Rcv	--	FDX	
Framing	--	SYNC-8 or ASYNC-8	
Code	--	ASCII - A EBCDIC - B	
Marker	--	OFF	
Suppress	--	OFF	
Display	--	RUN	
Program	--	IDLE	

Observe display:

ASCII -- all deletes (^{D}T)
EBCDIC -- all quotes (")
Alternate lines underscored
Display Dim

Connect EIA interfaces at rear. Business Machine to lower connector, Modem to upper.

Observe data, freeze display by moving Display switch to STOP, scroll through the last 2000 characters using scroll buttons, display in hexadecimal by moving Code switch to HX.

PLEASE READ YOUR INSTRUCTION MANUAL FOR FURTHER INFORMATION

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1.0 General Description

The Spectron DATASCOPE Model D-501 is a portable and programmable test instrument for troubleshooting and monitoring data communications channels. It provides a CRT display of all traffic at the business machine (EIA RS-232) interface of any standard modem. It is compatible with most forms of data transmissions, whether synchronous or asynchronous, and it operates at any speed up to 64 KBPS. It may be connected to the data link directly or through a Remote Connection Unit which bridges the interface and provides electrical isolation and signal level conversion without adding cable length or increasing electrical loading. The Block Diagram, Figure 1, shows internal DATASCOPE components.

During on-line operation data flows through separate hardware synchronizers, one for send, one for receive, and is multiplexed for delivery to the display. (See Figure 1.) Switches control the sync logic and the display format as in the 600 series Datascopes. The processor is bridged to the multiplexed data bus at the display input in such a way that either the line or the processor can drive the display. When the line drives the display, the processor monitors the data stream and stores the last 2000 characters in a buffer for future playback. At the same time, a stored program analyzes the stored data and recognizes complex patterns to either freeze the display or count or time events of interest. When the Datascope is "stopped" (i.e. not operating on-line) the processor delivers stored data to the display in such a way that the user can scroll back and forth through the last 2000 characters that arrived from the line. Stopping may be done manually as in the 600 series Datascopes, or under program control.

Either Send-Data, Receive-Data or both may be selected for display and programmed analysis, with characters from the receive leg identified by an underline in the display. Framing for 5, 6, 7, or 8 bit characters can be selected. The display operates at low intensity when the DATASCOPE is searching for character framing and at full brightness when the unit is in sync. A negative-image flag for character parity, incoming carrier, Request-to-Send, or the event marker can be selected for simultaneous display with the data. When the selected signal is present (true) the data character image is made black-on-white instead of the normal white-on-black.

Either an English Language (ASCII, EBCDIC, etc.) or a hexadecimal display can be selected. For ASCII, upper case, lower case, numerals and punctuation are displayed as normal graphics. Non-printing characters use the two-character alphanumeric form of the Proposed American National Standard Graphic Representation of ASCII Control Characters. For hex, incoming characters are left-justified and, for codes shorter than eight bits, low order bits are filled with zeroes to produce uniform 8-bit characters. Parity bits are included in the hexadecimal representation. (See 2.03). The screen contains a maximum of 375 data characters (either normal graphics, control pairs, or hex pairs) arranged in 15 lines of 25 characters each. Characters are formed on a dot matrix in an 11 x 15 field. Control pairs and hex pairs use side-by-side 4 x 9 matrices within the character field. Incoming data ripples from left to right and top to bottom with one full blank line for demarcation between old and new data. However, when the display is stopped, the most recently received data jumps to the bottom of the screen.

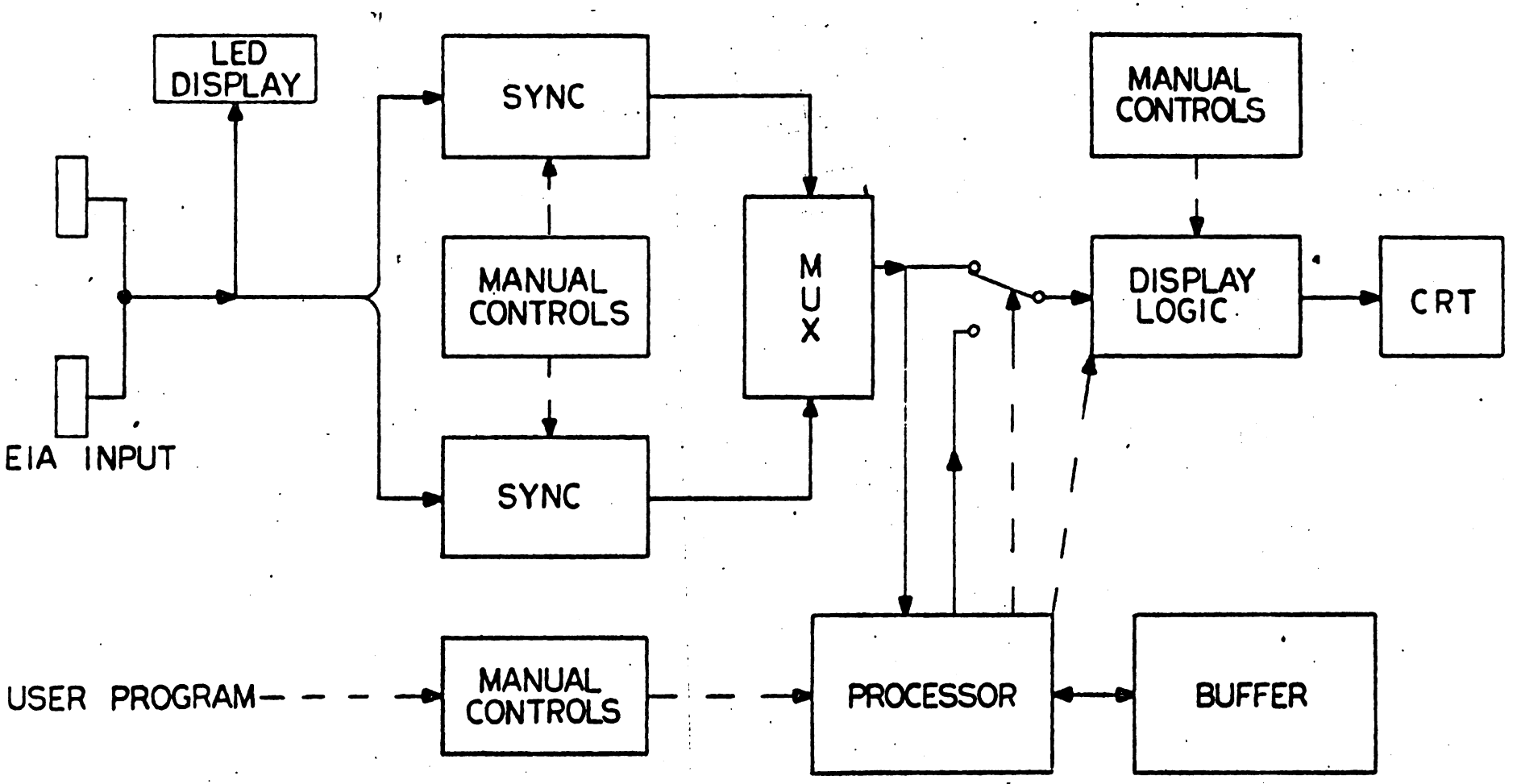

LED DISPLAY
SYNC
MANUAL CONTROLS
MANUAL CONTROLS
MUX
DISPLAY LOGIC
CRT
EIA INPUT
SYNC
USER PROGRAM
MANUAL CONTROLS
PROCESSOR
BUFFER

FIGURE 1

2.0 Controls and Indicators

2.01 SEND/RCV

--SEND: Displays Send Data signal only.

--RCV: Displays Receive Data signal only.

--HDX-4: Displays both Send and Receive data signals in time sequence as they appear. If both are present simultaneously, Display is garbled. Useful on 4-wire half duplex circuits. (Essentially a logical OR for SPACE signals.)

--HDX-2: Displays Send Data signal when Request-to-Send is present (high) and Receive Data signal when Request-to-Send is absent (low). Useful on 2-wire half-duplex circuits.

--FDX: With the switch in this position both sides of the communication channel appear simultaneously on alternate lines of the display. Send data is above Receive data and the latter is underscored as in the standard unit. Time relationships between the two data streams are fully visible. When the marker switch is placed in the FDX position, receive data characters are highlighted when carrier is present and send data characters are highlighted with Request-to-Send.

NOTE: For all positions of the SEND/RCV switch, an underline appears beneath each character from the receive side of the line to distinguish received data from transmitted data.

2.02 FRAMING

--ASYNC: Selects 5, 6, 7, or 8 data bits for START/STOP character framing. Each character must be preceded by a start bit of "space" polarity and followed by one or more stop bits of "mark" polarity.

--SYNC: Selects 5, 6, 7, or 8 bit synchronous character framing. Two consecutive framing characters as selected by Framing Pattern switches are required to acquire sync.

--SDLC: (DIR;NRZ) Interprets the incoming Send and Receive Data streams according to the "Synchronous Data Link Control" discipline with DIR(ect) or NRZ(I) decoding, superfluous zero suppression and 0111 1110 as the framing pattern ("Flag") preceding and following each transmission.

--OFF: Disables all automatic synchronization to facilitate reconstruction of the binary data stream.

2.03 DISPLAY

--HEX: Selects hexadecimal display as follows:

b8 b7 b6 b5	b4 b3 b2 b1
1st hex digit	2nd hex digit

--A,B,C,D: Used to select codes of customer choice. ASCII occupies position "A", EBCDIC - position "B", other optional codes - positions "C" and "D".

NOTE: Data is always delivered to the display in 8-bit bytes. For less-than-eight bit codes, the lowest numbered bits are forced to ZERO. This fact must be taken into account when interpreting 5, 6 & 7 bit codes in the hexadecimal representation.

2.04 MARKER

--OFF: Disables marker flag in the display. All characters are displayed as white symbols on a black background.

--ODD: Causes characters with odd parity to be displayed as black symbols on a white background.

--EVEN: PAR: Causes characters with even parity to be displayed black-on-white.

--CD: Causes all characters that arrived while Carrier Detect (EIA Pin 8) was present (high) to be displayed black-on-white regardless of SEND/RCV switch setting.

--FDX: When the SEND/RCV switch is not set to FDX, this Marker switch position is identical to the RTS position described below. In full duplex operation, this position of the Marker switch causes receive characters to be displayed black-on-white when Carrier Detect is high and send characters to be black-on-white when Request-to-Send is high. (Useful for simultaneous display of CD and RTS.)

--RTS: Causes all characters that arrived while Request-to-Send (EIA Pin 4) was present (high) to be displayed black-on-white - regardless of SEND/RCV switch setting.

--EXT: Causes characters that arrived while an external signal was present to be displayed black-on-white.

.05 IDLE SUPPRESSION — A rotary selector switch permits deletion of all idle characters after the first four and resumes display four characters before the idle period ends. The rotary switch turns the feature on and off and selects mark, space or synchronous idle. The synchronous idle pattern is the same as the framing pattern. (This feature does not function when data is displayed from the Datascope's internal buffer memory.)

.06 SPEED

--INTERNAL/MODEM: Selects serial clock signals from modem (EIA Pins 15 & 17) or from internal clock recovery circuits. In the modem position, input bit rate is determined solely by the modem; in the internal position, input bit rate is determined by the associated thumb-wheel switch.

--THUMB-WHEEL: Selects internal speeds from 50 - 9600 BPS in 16 steps, A through P as follows:

A - 50	E - 150	I - 1200	M - 3600
B - 74.2	F - 300	J - 1800	N - 4800
C - 110	G - 600	K - 2000	O - 7200
D - 134.5	H - 1050	L - 2400	P - 9600

2.07 FRAMING PATTERN Four thumb-wheel switches select the character pattern to be used for framing in the synchronous mode; and a toggle switch selects normal or two-character sync. In the normal position, two consecutive repetitions of the character selected by the left hand pair of thumb-wheel switches are necessary to acquire sync (the right hand pair of thumb-wheels have no meaning.) In the 2-CHAR position a single occurrence of the two characters represented by all four thumb-wheel switches is required.

2.08 SYNC RESET Two thumb-wheel switches select a character to initiate a search for new sync in the synchronous mode; ON/OFF switch disables this function and a pushbutton permits manual sync reset.

Once the DATASCOPE has acquired sync, it becomes insensitive to further occurrences of the framing pattern until a line turn-around occurs or until 32 bits of constant mark (idle) have been received or until the operator pushes the MANUAL button or moves the Framing switch. The sync Reset feature permits, in addition, the selection of a specific character to initiate a search for new sync. (Note that "old sync" is never disturbed until new sync is actually acquired.)

NOTE: Both Framing Pattern and Sync Reset Thumb-wheels represent characters in hexadecimal form.

2.09 INVERSION SWITCHES (SEND, RECEIVE & BOTH)

2.09.1 SEND or RCV - reverse the electrical polarity of signals delivered to the Sync Logic (see Figure 1.)
Down = normal polarity.

At the EIA interface, negative levels are normally considered ONE's or MARK's and positive levels, ZERO's or SPACE's. These switches invert that interpretation for send and receive data respectively. (These switches do affect Framing Pattern and Sync Reset settings.)

2.09.2 BOTH - reverses the electrical polarity of all signals at the output of the refresh memory in the Display Logic. Thus this switch will invert both Send and Receive polarity even while the screen is frozen. Down = normal. (Does not affect Framing Pattern or Sync Reset switches.)

2.10 1-8/8-1 - reverses bit order at the output of the refresh memory. Normal is 8-1 with bit 1 arriving first on the line; 1-8 places bit 8 first. Operates even when display is frozen. (Does not affect Framing Pattern or New Sync switches.)

2.11 DISPLAY - Two-position switch controls operation of display. STOP freezes display and allows scrolling; RUN clears display and reconnects to line. SCROLL buttons move display back and forth within the interal buffer memory.

2.12 PROGRAM - Three position switch controls program execution and listing. LIST position displays program; IDLE position allows normal Datascope operation; EXC causes program to run. CURSOR buttons function only when the program switch is in the LIST position and move the program cursor up and down the list.

NOTE: Further detail on the DISPLAY and PROGRAM switches is provided in paragraphs 4.02, Program Running and 5.04, Manual Program Controls.

2.13 CLEAR - A momentary toggle switch that clears the program memory to permit entry of new program(s).

2.14 HEX KEYBOARD - This group of 16 push buttons is used for program entry. Each button serves the dual function of entering either an instruction or a numeric digit; hexadecimal or decimal. Its use is more fully described in Section 4.01, Program Entry.

NOTE: The three unlabled buttons below the Hex Keyboard to the left of the Clear Switch are spares and perform no function.

2.15 LAMP DISPLAY - 21 LED's display all leads in the RS-232 interface except pins 1, 7, 9 and 10. Light ON indicates signal is positive.

2.16 POWER - switch controls AC power to DATASCOPE; light indicates when power is on.

3.0 Inputs and Outputs

3.01 EIA BRIDGING CONNECTIONS - Two 25-pin female connectors (DB-25S) wired in tandem pin-for-pin (except pins 9 and 10) for routing the business machine-to-modem connection through the DATASCOPE. A high impedance bridging tap is connected to each lead of the interface (except pins 1, 7, 9 and 10) for monitoring without adding electrical loading.

Pin 7 is used as a signal ground reference and is connected to pin 1 and to the DATASCOPE frame. Pins 9 and 10 have no connection on one of the tandem connectors (marked MODEM). On the other connector (marked BUS MACH/RCU) they are connected respectively to + 12 volts from within the DATA-SCOPE. This connector is also used for input from a Remote Connection Unit (RCU) and provides the power necessary for RCU operation.

NOTE: Although operation without an RCU is possible, it requires that the cable from business machine to modem be routed through the DATASCOPE. An RCU avoids this necessity and make use of the DATASCOPE more convenient.

3.02 TEST JACKS - 24 test jacks on the rear panel allow direct oscilloscope monitoring of all interface signals except Pin 1.

3.03 EXTERNAL CONTROL PACKAGE - 7 jacks on the rear panel accept external EIA signals to display Event Marks, reset sync or stop the display on either rising (+) or falling (-) edge of the external signal. In addition, an EIA output provides an external control pulse (high) whenever an external or a programmed Stop occurs. (This output is useful for coupling to a T-611 Tape Unit.)

4.0 ENTERING AND RUNNING PROGRAMS

4.01 PROGRAM ENTRY - A 16-key keyboard on the front panel is used for program entry. The CRT display lists the program. User instructions are of two types. Data Instructions are those that act on data in the buffer; Test and Control Instructions test, time or count events of interest and control Datascope operation. Instructions may have several formats made up of the following components:

Operator -- the part of an instruction that identifies the function to be performed. e.g. "SKIP", "FIND", "REPEAT", or "MATCH", etc.

Index -- a single decimal digit in an instruction that specifies the particular counter or timer to which the instruction relates. e.g. CNT "c", TIME "t"

Branch -- a two-digit decimal number in an instruction that specifies the program step to which the program is to branch if the required conditions are met. e.g. GOTO "uv", MATCH OR "uv"

Criterion-- that part of an instruction against which the data stream or a counter or timer is tested to establish the required conditions for a program branch. For Data Instructions the Criterion is always a 2 digit hexadecimal number (displayed in the program listing as its ASCII graphic equivalent). For Test and Control Instructions the Criterion is a 4 or 5 digit decimal number.e.g. RPT "x", CNT c THEN uv IF "mnpr"

Instructions are always entered and listed with their component parts in the same order -- operator first; then, if required, the index, branch, and criterion.

Entry of an operator causes the operator's mnemonic and a blank format to appear on the next display line, with a cursor (underscore) to show the next digit to be entered. Dots indicate empty positions in the format that must be filled by manual entry. Step numbers are automatically and continuously displayed on every line ascending from 1 to 36 (only 11 visible). The user is coached by cues displayed at the top of the screen as to what must be entered next: e.g. Enter New Instruction; Enter Number: 1 thru 4; Enter First Step Digit; Enter First Hex Digit; Enter Count: Four Digits; Enter Time: <60.000 secs; etc.

A manual cursor control moves the cursor up and down from line to line, but not within a line. Use of the cursor control terminates any instruction entry that may be in progress and repositions the cursor to the beginning of the line above or below. Lines thus selected for correction must be re-entered in their entirety. Program lines may be added by patching -- i.e. an unconditional branch to the steps to be added. Step numbers for branches are displayed black-on-white to distinguish them from Indices and Criterea.

When the PROGRAM switch is in the "List" position all on-line functions are disabled and the program listing is displayed. CURSOR buttons move both the cursor and the listing up and down to show all 36 program steps. The step at which the cursor is left when leaving the "List" state is the one at which the program will start and to which the program will return during operation. This permits a number of short programs to be stored and executed at will by simply repositioning the cursor. On re-entry into the "List" state after program execution, this starting step with the cursor marking it will appear at the top of the screen followed by the next 10 steps in the list. Lower numbered steps will be invisible "above" the screen, accessible for viewing by moving the cursor.

The "CLR" switch clears the entire program, repositioning the cursor to the top of the listing, and leaving only step numbers showing in the display.

4.02 PROGRAM RUNNING - The program runs only when the PROGRAM switch is in the "EXC" (Execute) position and the DISPLAY switch is set to "RUN". Either switch may be used to initiate program execution and the program always starts with the step where the cursor was last positioned. Moving the DISPLAY switch to STOP stops the display and also the program if it was running. Moving the PROGRAM switch from EXC to IDLE stops only the program. A programmed stop, stops both the display and the program and either switch may be used to restart by momentarily switching to STOP or IDLE and then back to RUN or EXC.

Timers are stopped but not reset whenever the program stops and reset to zero whenever the program starts. Event counters, however, are not reset by a stop of any kind. This can only be done by a programmed reset or manual operation of the RSCT button when the display is stopped. Also, whenever the display is stopped, the RDCT button causes the value of all current counts and times to be displayed instead of stored data, as long as the button is held. Data display is restored when

the button is released. None of the other program controls and indicators function unless the PROGRAM switch is in the "LIST" position.

5.0 DESCRIPTION OF INSTRUCTIONS AND MANUAL PROGRAM CONTROLS

The following discussion is intended to make clear the details of each instruction's function. To do this precisely, the descriptions may include reference to operating program and hardware details (pointers, registers, etc.). These details are included for clarity only and need be of no concern to the user once the function of the instruction is understood. Indeed, the actual implementation of user instructions may be quite different from that implied by these descriptions, but the function of each instruction is nevertheless accruately described.

5.01 BASIC FACTS

1. The user program that analyzes the stored data stream is actually a background program that runs only when no interrupt is present. However, interrupts result only from the arrival of a new character to be stored or a manual stop, so the user program runs most of the time.

2. Incoming characters from the line are loaded into the buffer by program interrupt at the location specified by a load pointer.

3. The load pointer progresses sequentially thru the buffer and wraps around continuously.

4. The user program takes characters from the buffer location specified by a read pointer.

5. The read pointer progresses sequentially thru the buffer always remaining behind (or abreast of) the load pointer. It is always subject to waiting, if necessary, for the load pointer to advance first if the two pointers are abreast.

6. Because some instructions take longer to execute than others, the read pointer may sometimes fall behind the load pointer. This is especially true at high data rates where loading the buffer occupies a large part of the available processor time. If the read pointer ever falls so far behind as to be overtaken by the load pointer, program execution stops automatically and an alarm message is displayed. This condition can sometimes be improved by reprogramming to eliminate the more time consuming instructions. Relative execution time numbers are therefore shown in circles beside each instruction.

7. The program operates on only one side of the line at any time.

5.02 Data Instructions are those that act on the data in the buffer. Each instruction receives a data character passed down to it from the preceeding instruction in the program. It may pass on that character to the next instruction or it may discard it and fetch one or more new characters from the buffer, incrementing the read pointer with each character fetched until the current instruction is complete and the proper character is passed to the next instruction in the program. An awareness of this character-passing is essential to the effective use of the D-501.

TSND -- Establishes the send leg of the line as the one upon which subsequent instructions will operate.

Examines the character passed down to it by the previous instruction. If that character was from the send leg, it is passed on at once to the next instruction. If not, succeeding characters are fetched from the buffer until a send character is found and passed on.

TRCV -- Causes subsequent instructions to operate on the receive leg of the line.

Operation is the same as TSND except a receive character is required.

SKIP -- Ignores one character and passes on the next.

Discards the character passed to it by the previous instruction and fetches the next character from the buffer. If that character was from the same side of the line as the one just discarded, it is passed at once to the next instruction. If not, succeeding characters are fetched from the buffer until a character from the "right" side of the line is found and passed on.

FIND X -- Ignores all characters until X is found; passes on the first character that matches with X.

Compares the character passed down to it by the previous instruction with "X", and passes it on to the next instruction if they match. If not, that charcter is discarded and the next character is fetched from the buffer. If the new character was from the same side of the line as the one just discarded, it too is tested for a match with "X". If it is from the

"wrong" side of the line or if it does not match with "X", it too is discarded and the process repeats until a character from the "right" side of the line is found that matches with "X". That character is then passed on to the next instruction.

RPT X -- Finds first non-X character and passes it on

Compares the character passed to it by the previous instruction with "X", and passes it on to the next instruction only if they do not match. If they do match, that character is discarded and the next character is fetched from the buffer. If the new character was from the same side of the line as the one just discarded, it too is tested for a match with "X". If it is from the "wrong" side of the line or if it matches with "X", it too is discarded and the process repeats until a character from the "right" side of the line is found that does not match with "X". That character is then passed on to the next instruction.

MATCH OR uv: X, Y, Z, ... -- Matches the string X, Y, Z, ... or jumps to program step uv on a mismatch

Compares the character passed to it by the previous instruction with "X". If they do not match the program jumps to step "uv" and the same character is passed on to the next instruction. If they do match then the next character (from the "right" side of the line) is fetched from the buffer and compared with "Y". Again, a mismatch produces a jump and the character passed on is the one that failed to match. If the characters did match then the process is repeated with "Z" and all succeeding characters in the Criterion. The process continues until either a jump occurs or the last character of the Criterion is matched. When this happens, the next character from the "right" side of the line is fetched and passed on to the next instruction. Thus, a mismatch passes on the first character that does not match while a complete match passes on the character just after the last one in the matching string.

Note: The sequence to be matched may be up to 10 characters long, but MATCH instructions may be stacked without (practical) limit. Match instructions may also be "chained" thru jumps. Here a limit is imposed by timing considerations, depending on the speed of the data.

5.03 Test and Control Instructions are those used to test time or count events of interest, to reset counters and timers and to exert absolute (unconditional) control over the system operation and machine status. While these

instructions may examine data they never fetch new characters from the buffer. They always pass on to the next instruction the same character they receive from the previous instruction.

MRKR uv -- Jumps to Program Step "uv" when marker occurs:

Examines the marker bit of the character passed to it by the previous instruction. If the marker bit is a "1", the program jumps to step "uv". If the marker bit is a "0", the program proceeds to the next step. (As with all test and control instructions the same character is passed on to the next instruction.)

CNT c: uv IF mnpr --

Increments counter "c"; then tests count. If count "C" = "mnpr", program jumps to step "uv". If count "c" ≠ "mnpr", program proceeds to next step. Count stops at 9999 -- does not recycle.

RSCT c -- Resets counter "c"

(Counters are not automatically reset when program starts or stops. Counters may be reset individually only by this instruction, or collectively by the RSCT button when the display is stopped.)

TIME t: uv IF mn.prs --

Tests timer "t", then starts it if it is not already running. If time "t" > "mn.prs" (seconds), program jumps to step "uv". If time "t" < "mn.prs", program proceeds to next step. Timers repeat at 65.535.

STPT t -- Stops timer "t" without resetting it

(Timers are all stopped without resetting when the program stops.)

RSTM t -- Resets timer "t" and stops it if it was running

(Timers are all reset when the program starts.)

Note: Counters are 4-digit decimal with a range of 0000 to 9999. There are four counters, numbered 1 through 4; and four timers, also 1 through 4. Timers have a resolution of 1 ms. and a range of 00.000 to 65.535 seconds (decimal). After 65.535 seconds timers are automatically reset to zero and begin again. Therefore, if intervals greater than one minute are to be timed, a TIME instruction must be executed at least once every 5 seconds to be sure that the timer is tested before it recycles to zero. For this reason timers are referred to elsewhere as having a range of only 60 seconds.

STIM - Stop Immediate:

Terminates user program and buffer loading at once.

STDL - Stop Delayed:

Terminates user program at once. Buffer loading continues until Load Pointer is 1024 characters ahead of Read Pointer, and then stops.

GOTO uv -- Unconditional jump:

Causes program to jump to step uv.

Note: Empty steps in the program listing will be skipped. A "STIM" will be executed automatically after step 36.

5.04 Manual Program Controls are not stored instructions at all, but switches and buttons that control machine operation, program entry and manual starting and stopping.

RSCT - Reset Counters:

Resets all counters at once when the display is stopped, (except in the Program List mode.) This is a triple purpose button, used during program entry to enter the "RSCT c" instruction or a hexadecimal digit, and in other operating modes as described for collective counter reset.

RDCT - Read count & time:

Operates only when the display is stopped, (list mode or not.) Causes the current values of all counters and timers to be displayed instead of data or Program as long as button is held. Data or Program display is restored when button is released.

CURSOR UP/DOWN -- Operates only in the Program List mode under the following conditions:

- Instruction entry begun but format incomplete: terminates entry, erases partially entered instruction, and repositions cursor to the beginning of the line just erased.

- Match instruction to be terminated with Criterion of less than 10 characters: terminates entry and repositions cursor to beginning of line above or below.

- Waiting between instruction entries or just after switching to program entry mode: moves cursor to beginning of line above or below.

PROGRAM EXC/IDLE/LIST --

LIST: - All on-line functions disabled; program listing is displayed; program entry keyboard and cursor control are enabled; CURSOR buttons move listing up and down to show all program steps. Program, display and buffer loading are all stopped.

IDLE: - Program stopped and reset to step where cursor was left during program entry. Otherwise same as Exc.

EXC: - On-line functions enabled; program entry functions disabled; display shows data; program and display are controlled by Display switch; Program runs only if Display switch is set to "Run".

DISPLAY/RUN/STOP-Operates only when Program Switch is in "Idle" or "Exc" position.

STOP: - Display, program and buffer loading all stopped; scrolling enabled; Program reset to step where cursor was left during Program entry.

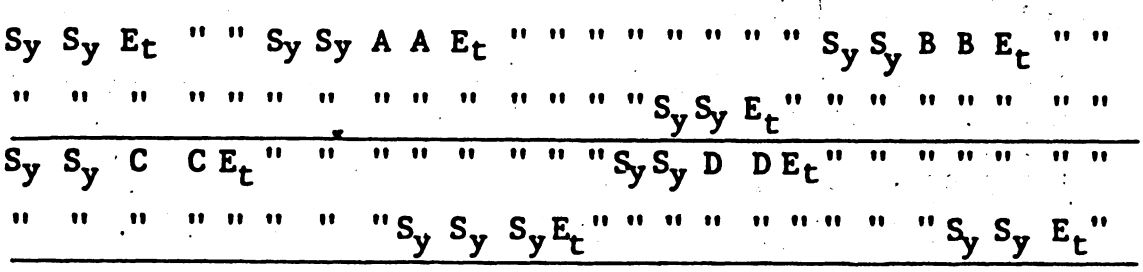
RUN: - Display runs and buffer loads; Program runs only if Program Switch is in Exc position.

PROGRAMMED STOPS -- Program Switch in "Exc"; Display Switch in "Run".

If program produces a stop: display, buffer loading and program all stop, and scrolling is enabled. DISPLAY switch must be moved to "Stop" position and then back to "Run" to restart display, buffer loading and program; or, Program switch may be moved to "Idle" to restart display only, and then back to "Exc" to restart program.

EXTERNAL STOPS -- Same as Programmed Stops.

5.05 D-501 Sample Program



Typical FDX Display on Datascope

Stop on "Nk" from Terminal "CC"		Stop on data from Terminal CC		Stop on any response from CC	
01	TSND (Test Send)		SAME		SAME
02	FIND S_y (Find Sync)		"		"
03	RPT S_y (Repeat Sync)		"		"
04	Match or 01:C,C,E_t (Look for C,C,E_t)		"		"
05	TRCV (Test Rcv)		"		"
06	FIND S_y		"		"
07	RPT S_y		"		"
08	MATCH or 01:N_k	08	MATCH or 01:S_h	08	MATCH or 10:E_t
09	STIM (Stop immediate)	09	STDL(Stop after Delay)	09	GOTO 01
				10	STIM

The Program first looks at the send leg and, using sync characters to identify the beginning of each poll, tries to find a poll to terminal CC. For polls to other terminals, the match instruction (step 04) fails and the program returns to step 01. When CC is polled the program switches to look at the receive leg and waits for terminal CC's response.

The response is analized according to different criterea in each of the three programs. The first looks for a "NAK" and stops whenever one occurs. The second looks for "SOH" to signal the presence of data and then delays the stop to capture the entire message. The third looks for any response other than EOT and jumps to step 10 to stop whenever the match on EOT fails.

6.0 Display Image Modifiers

Image modifiers (underline, bright/dim, white background) are applied to displayed characters to indicate various conditions in the data stream. In some cases, the signals which produce these image modifiers are used to perform other functions like switching between send and receive or dropping sync. An understanding of the various inter-relationships among these signals and image modifiers is important to properly interpret the display. The brief summary below describes the image modifiers, their meaning, their timing, and the signals which produce them. (References to "tape replay" in the following discussion refers to the use of a separate T-611 High Speed Tape Unit.)

6.01 Send/Rcv -- Underline indicates receive.

6.1.1 Send Mode -- Underline never present.

6.1.2 Receive Mode -- Underline always present.

6.1.3 HDX-4 Mode -- Underline appears under the first receive character which contains a ZERO or SPACE.

-- Disappears under the first send character which contains a ZERO or SPACE.

-- Thus, during idle periods, the side of the line on which a ZERO most recently appeared will be displayed.

6.1.4 HDX-2 Mode -- Underline first appears under the character during whose arrival Request-to-Send went low (off).

-- Disappears under the character during whose arrival Request-to-Send went high.

-- A timing tolerance of ± 1 character applies when the display is replayed from tape. (See 7.4.)

6.1.5 FDX -- Underline continuously present on alternate lines of display.

6.02 In Sync -- Bright image indicates "in sync".

-- Image is bright at all times in asynchronous (start-stop) operation except for "delete" (FF) characters which are dim beginning with the fourth consecutive delete code.

-- Image is dim at all times when FRAMING switch is in the "off" (step) position.

-- In synchronous operation, bright image begins with the first sync character (provided a consecutive pair is present), or the "flag" in SDLC.

-- Image goes dim (in synchronous operation) on the first of the following:

. On the character selected by the Sync Reset switches if that feature is "on".

. On the fourth consecutive "delete" (FF) character.

. On the first character after a "line turn-around", as defined by the Send/Rcv switch. (e.g. in Both-2, a line turn-around is defined as a change in the Request-to-Send signal; in Both-4, the occurrance of a ZERO on the "other" side of the line.)

. Whenever the Step button is depressed or the Send/Rcv switch is moved.

. On the first character after an external Sync Reset signal (if equipped).

6.03 White background -- indicates that the signal or condition to which the Marker switch is set is high, on or true.

6.3.1 Parity -- background always applies to the character with which it appears.

6.3.2 Carrier Detect, Request-to-Send & Event Marker

-- First appears with the character during whose arrival the selected signal went high (on).

-- Disappears with the character during whose arrival the selected signal went low (off).

-- A timing tolerance of ± 1 character applies when the display is replayed from tape. (See 6.4.)

-- An additional tolerance of ± 2 characters applies at all times to the Event Mark only.

6.04 General Timing Considerations

Whenever an image modifier is derived from the data stream itself (e.g. parity, sync and send/rcv in HDX-4) its appearance in the display will always coincide exactly with the data to which it corresponds. However, where image modifiers are derived from status signals, separate from the data (e.g. Request-to-Send, Carrier Detect and Event Mark), the necessarily lower sampling rate (once every 8 data bits) for such signals gives rise to timing tolerances during tape replay. Thus, any function which depends on Request-to-Send will assume the ± 1 character timing tolerance which applies to that signal during replay. Hence, the beginning of traffic must clear changes in the Request-to-Send signal by at least one character time for satisfactory replay in the HDX -2 operating mode. During on-line operation this tolerance does not apply.

A similar consideration can cause the send and receive data streams to vary in time with respect to each other by ± 1 bit during replay. Consequently half duplex send and receive traffic must be separated by at least one bit of "idle" time if an apparent overlap is to be avoided during replay in the Both-4 operating mode.

Both the ± 1 character tolerance on status signals and the ± 1 bit tolerance on data are very substantially lower than any conditions encountered in actual practice. Nevertheless, an awareness of these considerations may help in interpreting the display under unusual circumstances.

6.04 General Timing (Cont'd)

In full duplex operation, the send and receive data streams are usually derived from two different clock sources. The send clock is usually local while the source of receive clock is normally at the distant station. More important, the two clocks are usually not locked in either frequency or phase and in fact actually operate at two slightly different frequencies. Since the display must move in response to the faster of these two rates, provision is made for periodic insertion of "dummy" characters in the slow side to prevent the faster data stream from getting ahead. These dummies take the form of a single dot in the center of the character space and have the effect of restoring time correlation between send and receive which, at the time of each dot, have drifted apart by one character interval. This ability to absorb differences in character rate by filling empty time with dummy characters permits operation of the full duplex display at widely different send and receive rates. (Note however, that the tape system cannot absorb such widely different rates - only the display. For tape recording, the inevitable minor differences in rate are absorbed by "elastic buffering", but such differences are limited to approximately ±5%.)