INSTRUCTION MANUAL

DATASCOPE

MODEL D 502

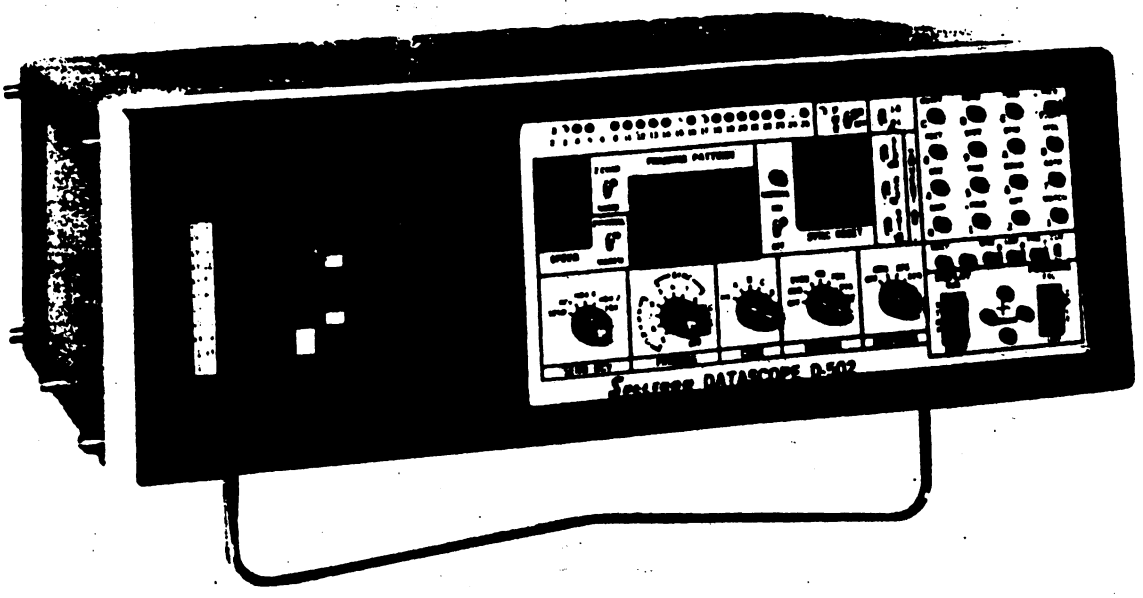

Figure 1. DATASCOPE Model D-502

1.0 GENERAL DESCRIPTION

The Spectron DATASCOPE Model D-502 (Figure 1) is a versatile, microprocessor-based test instrument for interactive troubleshooting and monitoring of data communications channels. It is similar to the D-501, but with an output buffer and an output instruction added to permit interactive operation and transfer of programs. 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 transmission, whether synchronous or asynchronous, and it operates at any speed up to 72 KBPS. It may be connected to the data link directly or, for monitoring only, 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 2) shows internal DATASCOPE components.

During on-line operation, data flows through separate hardware synchronizers (one for send and one for receive) and is multiplexed for delivery to the display. Front panel switches control the sync logic and the display format. 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 2,000 characters in a buffer for future playback. At the same time, a stored

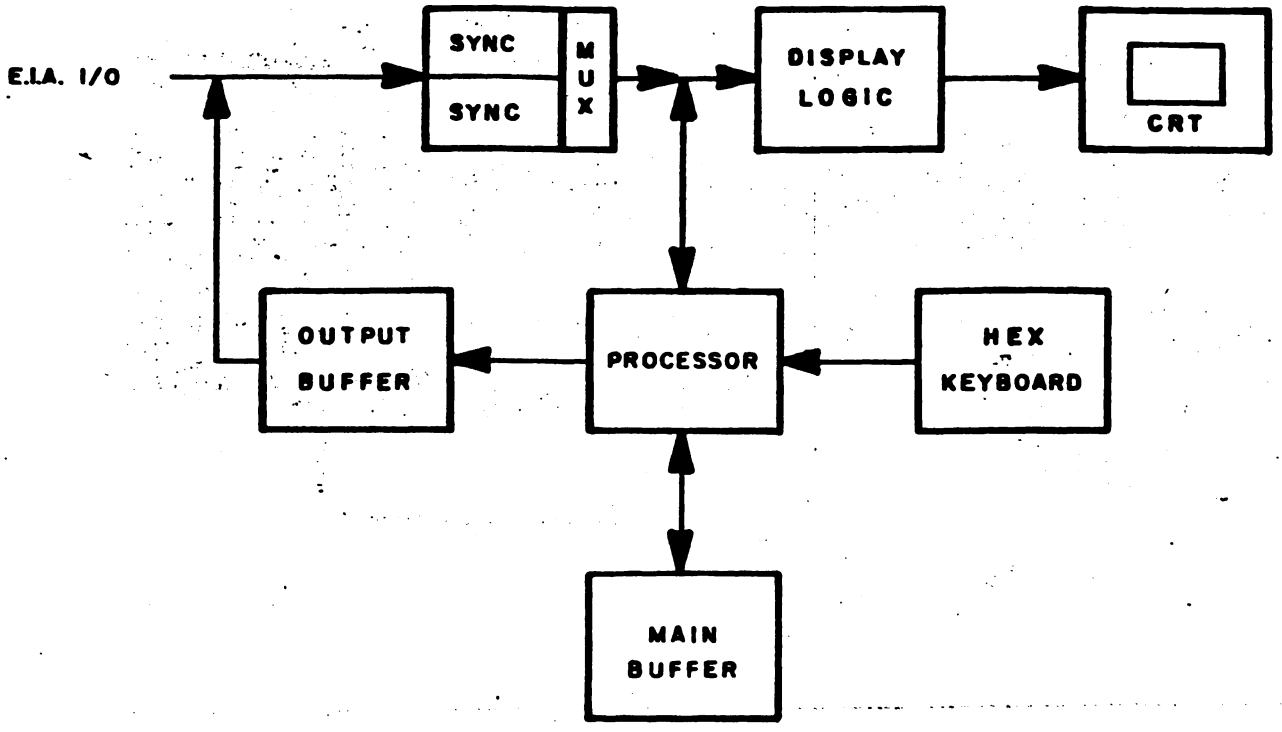

Figure 2. Block Diagram

program analyzes the stored data and recognizes complex patterns to either freeze the display or count or time events of interest. Stopping may be done manually or under program control. 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 2,000 characters that arrived from the line.

Either the output buffer, an output instruction, or both may be used as a source of output data. Up to 9 different messages of any length, with an aggregate total of not more than 300 characters, may be stored in the output buffer and referenced by output instructions. The output buffer is loaded by the processor from either the hex keyboard or the main buffer. Whenever an output instruction is executed, output data is delivered through the same EIA interface as is used for normal monitoring operations. The D-502 monitors and displays its own output just as if it were data received on-line from an external source.

A 16-key keyboard on the front panel is used for program entry, and the CRT display lists the program. Entry of an instruction causes its 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 39 (only 10 visible). The user is coached by cues at the top of the screen as to what must be entered next. Buttons move both the cursor and the listing up and down to show all 39 program steps. The step at which the cursor is left is the one at which the program will start, thus permitting a number of short programs to be stored and executed at will by simply repositioning the cursor. The D-502 may be operated with or without the program, and both the display and the program may be started and stopped at will.

Either Send-Data, Receive-Data or both may be selected for display, output, 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 for both display and output. For output of less than 8-bit characters, data is handled internally in the form of 8-bit bytes, but less significant bits are dropped before transmission.

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 a human language (ASCII, EBCDIC, etc.) or a hexadecimal display can be selected. For ASCII and EBCDIC, upper case, lower case, numerals and punctuation are displayed as normal graphics. Nonprinting characters use the two-character alpha-numeric form of the Proposed American National Standard Graphic Representation of ASCII Control Characters. For hexadecimal display incoming characters are left-justified, and for codes shorter than eight bits, low-order bits are filled with zeros to produce uniform 8-bit characters. Parity bits are included in the hexadecimal representation (see paragraph 2.03).

The screen contains a maximum of 375 data characters arranged in 15 lines of 25 characters each. Characters are formed on a dot matrix in an 11 x 15 field. Control and hex characters 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.

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-Data 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. Time relationships between the two data streams are fully visible. With the MARKER switch placed in the FDX position, Receive-Data characters are highlighted when carrier is present and Send-Data characters are highlighted with Request-to-Send.

NOTES:

1. 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. The SEND/RCV switch has no effect on output data, except that moving the switch to the FDX position while output is in progress may cause termination of the output.

3. The SEND/RCV switch determines what data is delivered to the processor and thus has a substantial impact on program execution. The FDX position is suggested for most situations and is especially suited to interactive operation where the output capability of the D-502 is used.

2.02 FRAMING

--ASYNC:

Display:

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.

Output:

Selects 5-, 6-, 7-, or 8-bit output format, with each character preceded by a start bit and followed by stop bits as described above. Less significant bits are dropped for less-than-8-bit codes.

--SYNC:

Display:

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.

Output:

Selects 5-, 6-, 7-, or 8-bit characters without start or stop bits. As before, less significant bits are dropped for less-than-8-bit codes.

--SDLC:
(DIR:NRZ)

Display:

Interprets the incoming Send-Data 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.

Output:

Selects SDLC output format with or without NRZ(I) encoding, with automatic zero insertion and with framing pattern generation before and after each transmission.

--OFF: Display:

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

Output:

Defaults to 8-bit synchronous.

2.03 CODE

--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".

NOTES: 1. Data is always delivered to the display in 8-bit bytes. For less-than-8-bit codes, the lower numbered bits are forced to zero. This fact must be taken into account when interpreting 5-, 6-, and 7-bit codes in the hexadecimal representation.

2. This switch has no effect on output data and may be operated freely at all times without interfering with output transmissions.

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: 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 external signal was present to be displayed black-on-white.

NOTE: This switch has no effect on output data and may be operated freely at all times without interfering with output transmissions.

2.05 SUPPRESS This 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 MRK (mark), SPC (space), SYN (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.) This switch has no effect on output data.

2.06 SPEED

--INTERNAL/MODEM: Selects serial clock signals from modem or internal clock for incoming data and determines the bit rate and clock for incoming data and for output data. Details are dependent on the interface configuration established by the D-502 program. (See Table 1.)

--THUMB-WHEEL: Selects internal speeds from 60 - 9600 BPS in 16 steps, A through P as follows:

--THUMB-WHEEL: (cont'd)	A - 50	E - 150	I - 1200	M - 3600
	B - 74.2	F - 300	J - 1800	N - 4800
	C -100	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 NORM 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 two consecutive characters as 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 MANUAL pushbutton permits manual sync reset.

Once the DATASCOPE has acquired sync, it becomes insensitive to further occurrences of the framing pattern until a line turnaround occurs, until 32 bits of constant mark (idle) have been received, or until the operator pushes the MANUAL button or moves the rotary 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.)

NOTES:

1. Both Framing Pattern and Sync Reset Thumb-Wheels represent characters in hexadecimal form.

2. Neither the Framing Pattern nor the Sync Reset Thumb-Wheels have any effect on output data.

2.09 INVERT (SEND, RCV AND BOTH)

--SEND OR RCV: These switches reverse the electrical polarity of signals delivered to the sync logic (see Figure 2). Down=normal polarity.

At the EIA interface, negative levels are normally considered ones or marks and positive levels, zeros or spaces. These switches invert that interpretation for Send-Data and Receive-Data respectively. (These switches do affect Framing Pattern and Sync Reset settings.)

--BOTH This switch reverses the electric 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. (This switch does not affect Framing Pattern or Sync Reset switches.)

NOTE: These switches have no effect on output data.

2.10 1-8/8-1 This switch 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. This switch operates even when display is frozen. (It does not affect output data.)

2.11 DISPLAY This three-position switch controls operation of display. OUTBUF displays the contents of the output buffer; STOP freezes display and allows scrolling; RUN clears display and reconnects to line. This switch also starts and stops program execution when the program switch is in the EXC position. The display switch will not function if the program switch is set to LIST.

2.12 CURSOR Four pushbuttons arranged in a diamond pattern are used to move the cursor horizontally and vertically across the screen.

In the main buffer the cursor is an underline for Send Data and the absence of an underline for Receive Data. The cursor appears in the main buffer only when no half-duplex data is present. This avoids confusion with respect to the underline and also prevents loading the output buffer with half-duplex data.

In the output buffer, the cursor is always an underline. (Note that data in the output buffer has no send/receive identity.)

In both the main buffer and the output buffer the cursor may be moved horizontally and vertically by the four cursor control buttons. In both buffers, the cursor is confined to the area of the display. Attempts to move the cursor beyond the display area in the output buffer will produce no response at all. Similar attempts to move the cursor beyond the display area in the main buffer will cause the display to scroll. (When the main buffer contains half-duplex data and no cursor is present, the horizontal buttons have no effect, and the vertical buttons produce immediate scrolling.)

When the program listing is displayed, cursor buttons move the cursor horizontally and vertically as more fully described in Paragraph 12.0, Manual Program Controls.

2.13 PROGRAM This three-position switch controls program execution and listing. LIST position displays program; IDLE position allows normal DATASCOPE monitoring operation; EXC causes the program to run. If the program switch is moved from IDLE to EXC while the display switch is in STOP the program will be executed on the present contents of the main buffer. When the program switch is moved from LIST to IDLE an interface configuration is established dependent upon the position of the cursor in the program listing. (For further details see Paragraph 5.0, Running Programs.)

2.14 PROG CLR A momentary toggle switch that clears the program to permit entry of new program(s).

2.15 PROG TRN This pushbutton initiates program transfers to and from tape or line. (See Paragraph 10.0 for further details.)

2.16 OUTBUF CLR A momentary toggle switch that clears the contents of the output buffer to all ONE's (FF's). This switch operates only when the output buffer is displayed. That is, with the display switch in OUTBUF and the program switch in IDLE or EXC.

2.17 OUTBUF MRK A pushbutton that inserts or removes a marker in the output buffer at the location of the cursor when the output buffer is displayed. These markers are used to identify the beginning and end of messages stored in the output buffer. (See Paragraph 7.01 for further details.)

2.18 OUTBUF LOD A pushbutton used for loading the output buffer from the main buffer. (For further details on the function of this switch see Paragraph 7.02.)

2.19 RDCT A pushbutton used to display the current values of all counters and timers when program is stopped either manually or by program control. (For further information see Paragraph 6.0.)

2.20 HEX KEYBOARD This group of 16 pushbuttons 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 Paragraphs 11.02 through 11.04.

2.21 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.

2.22 PWR This toggle switch controls AC power to DATASCOPE; light indicates when power is on.

DDCMP FORMATS

DATA	-- SOH	CC1	CC2	ACK#	MSG#	ADDR	BCC1	BCC2	DATA	BCC1	BCC2	||	NAK RSN codes:
ACK	-- ENQ	<001>	A0	ACK#	A0	ADDR	BCC1	BCC2				||	1=Header BCC 2=Data BCC
NAK	-- ENQ	<002>	RSN	ACK#	A0	ADDR	BCC1	BCC2				||	3=REP response 8=No room
REP	-- ENQ	<003>	A0	A0	NLST	ADDR	BCC1	BCC2				||	9=Rcv overrunn 16=Message too long
START	-- ENQ	<006>	3	A0	A0	ADDR	BCC1	BCC2				||	17=Header err
STACK	-- ENQ	<007>	3	A0	A0	ADDR	BCC1	BCC2				||	
BOOT	-- DLE	CC1	CC2	A0	A0	ADDR	BCC1	BCC2	BOOTDATA	BCC1	BCC2	||	

NCL MESSAGE FORMATS

UNNUMBERED CTRL:	'NCT	'DNA	'SNA	NCA	NCN	'OPD	
NUMBERED CTRL:	'NCT	'DNA	'SNA	NCA	NCN	<0>	CM
DATA:	'NCT	'DNA	'SNA	NDA	NCN	'DLA	DAP

<NCT> FIELD FORMAT

BITS	USE
0-2	TYPE
3	DNA/SNA PRESENT
4	TRACE MODE MESSAGE
5	INTERRUPT MESSAGE
6	NON-SEQUENTIAL MODE
7	<EXTENSIBLE BIT>

UN-NUMBERED CONTROL MESSAGE TYPES

NCT	TYPE	OPD		
1	ACK	<000>		
2	NAK	<000>		
3	REP	<000>		
4	START	'<NODNUM>	'<NODNAM>	'<SOFTID>
5	STACK	'<NODNUM>	'<NODNAM>	'<SOFTID>
6	NODE-ID	'<NODNUM>	'<NODNAM>	'<SOFTID>

NUMBERED CONTROL MESSAGE TYPES

(NCT TYPE = 0, DLA = 0)

CONNECT	CNT <001>	'DLA 'SLA 'DPN SPN MML FEA
DISCONNECT	CNT <002>	'DLA 'SLA RSN
NEIGHBORS	CNT <003>	(NNM LVL)
REQ CONFIG	CNT <004>	
CONFIGURATION	CNT <005>	(OBJ NDV 'PID)
DATA REQUEST	CNT <006>	'DLA DRQ
STATION ID	CNT <007>	STC

DAP (DEV CONTROL) FORMATS
(NCT TYPE = 0, DLA <> 0)

DATA	- CNT <001> (DATA)
DATA WITH EOR	- CNT <002> (DATA)
DATA REQUEST	- CNT <003> DRQ
STATUS	- CNT <004> STC STD
CONTROL	- CNT <005> DCT CDT
*USER ID	- CNT <006> PPN PSW UNAM ACCT GROUP
*FILE SPEC	- CNT <007> FST FEQ FDES

(*=NOT IMPLEMENTED)

CHARACTER TRANSLATIONS

ASCII	OCTAL	HEX	502B
<SOH>	<001>	<01>	<SH>
<STX>	<002>	<02>	<SX>
<ETX>	<003>	<03>	<EX>
<EOT>	<004>	<04>	<ET>
<ENQ>	<005>	<05>	<EQ>
<ACK>	<006>	<06>	<AK>
<BEL>	<007>	<07>	<BL>
<DLE>	<020>	<10>	<DL>
<NUL>	<000>	<00>	<NU>