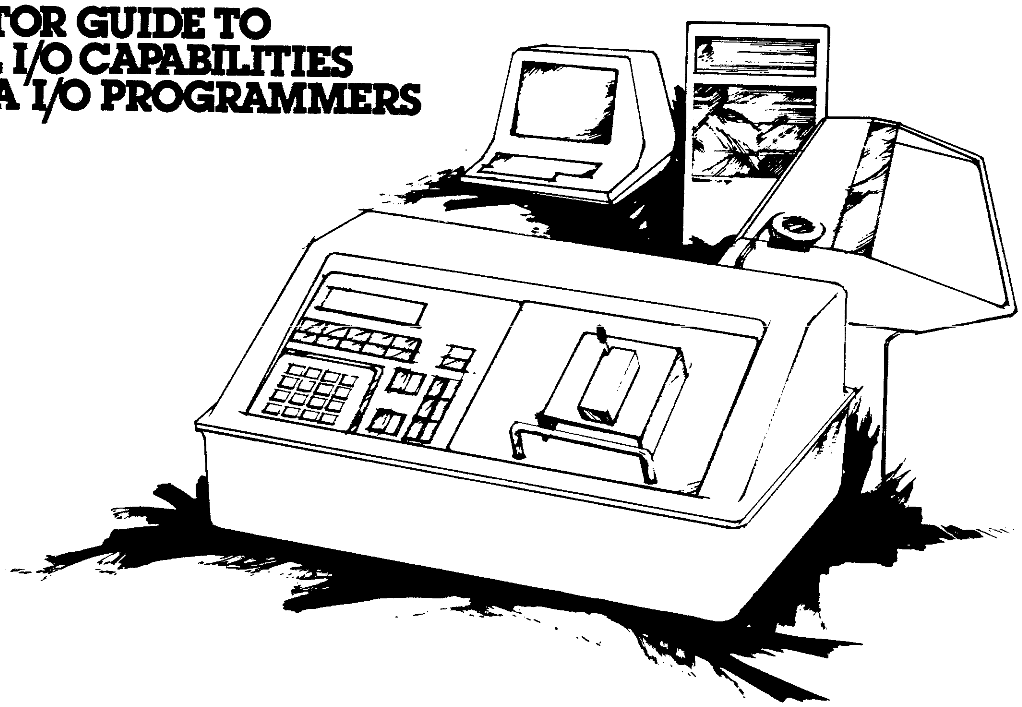
OPERATOR GUIDE TO SERIAL I/O CAPABILITIES OF DATA I/O PROGRAMMERS



COMPUTER REMOTE CONTROL 055-1902

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SECTION 1
INTRODUCTION

The Computer Remote Control option is designed to allow complete control of the System 19 by a computer. Linked directly to the programmer, the computer generates and sends commands to the programmer, determines variables for setting programming parameters (where needed) and reacts to information returned to it from the programmer.

While these commands may be sent by an operator at a terminal, the commands and syntax described in this manual were designed for ease of incorporation into a computer program. A Terminal Remote Control option is available from Data I/O, custom designed for those applications primarily involving control from a terminal.

SECTION 2
INSTALLATION

The System 19 with Computer Remote Control is connected to the computer according to standard RS232C or 20mA current-loop specifications.

The function of each serial-port connector pin on the programmer is described in the table of connector-pin assignments (Section 2, System 19 Operation and Maintenance Manual). Refer to this table to determine the necessary connector pins for serial data transfers, or to the adjoining cabling diagrams for specific applications.

The programmer's baud-rate, parity and stop-bit settings are also detailed in Section 2 of the System 19 O & M Manual.

SECTION 3
OPERATION

3.1 INTRODUCTION

Section 3 describes the set of commands available for data transfer, editing or review and for programming devices via computer remote control of the System 19.

Remote-control commands are written into the computer's operating software, allowing it to control the System 19 in much the same way as it would control any other peripheral device, such as a printer or disc drive.

Data transferred between the computer and the programmer is generally in ASCII notation and encoded in the selected translation format, although straight binary transfer is also possible.

Figure 3-1 illustrates the basic components of the System 19 under remote control.

Commands are generated by the computer according to the computer's software or in response to keyboard entries made by an operator. The computer sends these commands to the System 19, which executes the command (or tries to) and then sends an appropriate response back to the computer.

Table 3-1 summarizes the commands which the System 19 will execute, and also explains the responses it will generate.

3.2 COMMAND GROUPS

The commands available in remote control are grouped according to their functions.

CONTROL COMMANDS.

These are used to execute or suspend a command, or to display the last command executed. See paragraph 3.5.1.

DEVICE COMMANDS.

This group of commands executes the operations used in device programming: Load, Program, Verify and related operations. See paragraph 3.5.2.

UTILITY COMMANDS.

These commands set or check various operating parameters related to many operations. See paragraph 3.5.3.

I/O COMMANDS.

This group of commands sets up the programmer to transmit or receive data through the serial port. This includes inputting or outputting data, selecting a translation format, setting parity, setting address controls and other considerations incidental to I/O data transfers. See paragraph 3.5.4.

EDITING COMMANDS.

This group of commands manipulates RAM data. See paragraph 3.5.5.

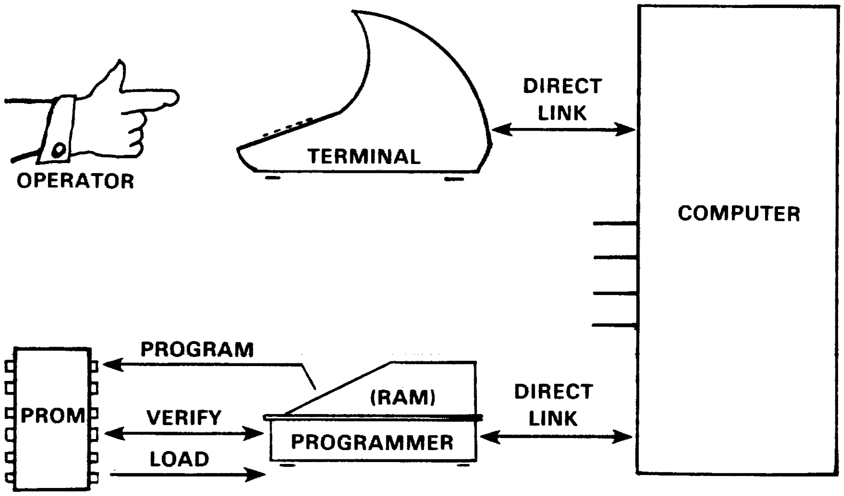


Figure 3-1. Programmer and Computer in Direct Link for Remote Control

Table 3-1. Command and Response Summary

COMMAND	NAME	DESCRIPTION
CONTROL COMMANDS		
RETURN		Execute a command.
ESC		Abort a command.
BREAK		Abort a command.
UTILITY COMMANDS		
G	Software-Configuration Number	This command sends a 4-digit hex number representing the software configuration in the programmer.
(HHHH) <	Set Begin RAM	BLOCK LIMIT L1. Defines first RAM address to be used for data transfers. Also functions as the RAM Source Address in RAM-RAM Block Move. Default Value — Ø.
(HHHH) ;	Set Block Size	BLOCK LIMIT L2. Sets number of bytes to be transferred. Default Value — programming module word limit, for device-related operations; RAM limit less L1 for I/O operations; no default for RAM-RAM block move.
(HHHH) :	Set Begin Device	BLOCK LIMIT L3. Sets the first device address to be used in data transfers. Also functions as the RAM- destination address in RAM-RAM Block Move. Default Value — Ø.
(HH)]	Select External Function	This command accesses Select Codes (HH) carried in extended software on some programming modules.
S	Sum-check Command.	Causes programmer to calculate the sum-check of RAM data up to word limit of the installed programming electronics and output it to the computer.
F	Error-Status Inquiry.	Programmer returns a 32-bit word that codes errors accumulated. Error-status word resets to zeros after interrogation. (Error-status word is shown in Figure 3-2.)
X	Error-Code Inquiry	Programmer outputs Error Codes stored in scratch-RAM and then clears them from memory.
H	No Operation	This is a null command and always returns a prompt character (>).
Z	Escape Remote Control	Return control to the programmer.
DEVICE COMMANDS		
T	Illegal-Bit Test	Test for illegal bit in device.
B	Blank Check	Check that no bits are programmed in device.
[	Family and Pinout Inquiry	UniPak. Programmer sends a 4-digit number (FFPP) where FF is the Family Code and PP is the Pinout Code in effect.
(FFPP) @	Select Family and Pinout	UniPak. A 2-digit Family Code (FF) and a 2-digit Pinout Code ((PP) set up the UniPak for programming a particular device.
R	Respond.	Programmer indicates status determined by programming module and socket adapter and outputs AAA/B/C or AAAA/B/C, where AAA or AAAA = device word limit, B = byte size and C = VOL/VOH status (1 = VOL; 0 = VOH).
L	Load	Load device data into RAM.
P	Program	Program RAM data into device.
V	Verify	Verify device against RAM.

Table 3-1. Continued

I/O COMMANDS

D	Select Odd Parity.	Sets odd parity for input and output data. Default Value — programmer's parity-switch setting.
E	Select Even Parity.	Sets even parity for input and output data. Default Value — programmer's parity-switch setting.
N	Select No Parity.	Sets no parity for input and output data. Default Value — programmer's parity-switch setting.
J	Set 1 Stop Bit.	Sets 1 stop bit for input and output data. Default Value — programmer's stop-bit switch.
K	Set 2 Stop Bits.	Sets 2 stop bits for input and output data. Default Value — programmer's stop-bit switch.
(FC) **A**	Select Translation Format.	Two characters (FC) before **A** define the translation format for I/O data transfer. Default Value — MOS Technology Format, #81.
(HH) **M**	Select Record Size.	Two hex characters before **M** define output record size. Default Value — 16 bytes per record (8 bytes per record in Fairchild Fairbug).
(HH) **U**	Set Nulls.	Two hex characters before **U** set the number of nulls output after carriage returns and enables line feeds. Default Value — no nulls and no line feeds.
(HHHH) **W**	Set Address Offset.	Four hex characters before **W** define the offset added on output and subtracted on input. Default Value — Ø.
=	Disable Timeout.	Disables the 25-second I/O timeout. Restored only at power-ON.
I	Input	Input data from computer to RAM.
O	Output	Output data from RAM to computer.
C	Compare	Compare RAM data with data in computer.
Y	Parity-Error Inquiry.	Responds with the hex number of parity errors since last **Y** command, since power-ON, or since last parity command (**D**, **E**, or **N**).

EDITING COMMANDS

Q	Swap Nibbles.	Exchanges high- and low-order halves of every word in RAM.
\	RAM-RAM Block Move.	Initiates data transfer from one RAM location to another. Block Limits L1, L2 and L3 must be set first.
(HHHH) **?**	Split RAM Data.	For 16-bit microprocessor data. Splits even- and odd-numbered bytes into two blocks separated by a center point, HHHH, which must be a power of 2 between Ø and RAM midpoint. Default Value — RAM midpoint.
(HHHH) **>**	Shuffle RAM Data.	For 16-bit microprocessor data. Merges block above center point HHHH with block below. Center point must be a power of 2 between Ø and RAM midpoint. Default Value — RAM midpoint.

PROGRAMMER RESPONSES	**DESCRIPTION**
> + RETURN + LINE FEED	Prompt character. Informs the computer that the programmer has successfully executed a command.
F + RETURN + LINE FEED	Fail character. Informs the computer that the programmer has failed to execute the last-entered command.
? + RETURN + LINE FEED	Question mark. Informs the computer that the programmer does not understand a command.

3.3 PROGRAMMER RESPONSES TO THE COMPUTER

3.3.1 RESPONSE CHARACTERS

The programmer must send a response character — the prompt character **>** or **F** or ? — to the computer before it can execute another command (except a control command). Table 3-2 shows how to interpret each response character.

Table 3-2. Response Characters

The programmer sends this response character to the computer	In these cases
>	1. on entering remote control 2. after successfully executing a command 3. after the BREAK or ESCAPE key has halted a command
F	after failing to execute a valid command
?	after receiving an invalid command or a message it did not "understand."

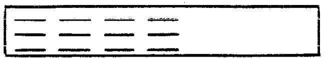
3.3.2 ERRORS AND WHAT TO DO ABOUT THEM

Whenever an error occurs, the System 19 sends an F to the computer. The computer or the operator can respond by interrogating the programmer with the **X** or **F** command. The X command causes the programmer to send to the computer a complete listing of Error Codes which reports every error that occurred. Error Codes are described in Appendix 1 of the System 19 Operation and Maintenance Manual. The **F** command codes all errors into a single 32-bit "error-status word" which is shown in Figure 3-2.

3.4 ACCESS TO REMOTE CONTROL

3.4.1 ENTRY

To place the System 19 under remote control, enter Select Code **F1** at the programmer's keyboard. On entering remote control, the programmer will retain all RAM data.

ENTER REMOTE CONTROL (from programmer)	SELECT **F1**
[SELECT] [F] [1] [START]	

(Programmer display during remote-control operation.)

3.4.2 EXIT

On exiting remote control, the programmer retains all RAM data.

Exiting remote control via the programmer's keyboard retains all operating parameters in effect. To exit remote control via the programmer's keyboard, press **KEYBD**.

To exit remote control via the computer, it must send **Z** to the programmer, followed by RETURN (the execute code). Exiting remote control from the computer retains all operating parameters except the address offset.

EXIT REMOTE CONTROL (from programmer)	**KEYBD**

The programmer retains all operating parameters.

EXIT REMOTE CONTROL (from computer)	**Z** RETURN

The programmer retains all operating parameters except the address offset.

3.5 COMMAND SUMMARY

The range of commands is divided into groups according to the purpose of each command. The entire Command Summary, with each command explained in detail, is described in paragraphs 3.5.1 — 3.5.5.

3.5.1 CONTROL COMMANDS

RETURN	RETURN executes each command. It must be sent to the programmer immediately after the command. All commands are ignored if not followed by RETURN.
ESC **BREAK**	The ESCAPE and BREAK commands cause the programmer to unconditionally halt (abort) any operation in progress, output the prompt character (**>**), and await further instruction from the computer.

3.5.2 UTILITY COMMANDS

SOFTWARE-CONFIGURATION NUMBER **G** RETURN

On this command, the programmer sends the 4-digit hex number representing the particular configuration of software resident in the programmer. The proper software configuration number appears on the "Programmer Configuration" page at the front of the System 19 Operation and Maintenance Manual, received with the programmer.

BIT NUMBER	VALUE	RECEIVE ERRORS
31	8	ANY ERROR. If the word contains *any* errors, the most significant bit (bit 31) will be high.
30		
29		
28		
27		
26	4	Serial-overrun error (42)
25	2	Serial-framing error (41, 43)
24	1	Buffer overflow, i.e., >15 characters (48)
		PROGRAMMING ERRORS
23	8	Any device-related error
22	4	Start line not set high (26)
21	2	L2 + L3>RAM
20	1	Composite DAC error (UniPak only)
19	8	Device not blank (20)
18	4	Illegal bit (21)
17	2	Nonverify (23, 24, 29)
16	1	Incomplete programming, or no card set (22, 25, 30-39)
		I/O ERRORS
15	8	I/O error (46, 50, 58, 59, 94, 95 or any I/O error)
14		
13		
12	1	Compare error (52)
11	8	Sum-check error (82)
10	4	Record-count error, MOS Technology (93) Address-check error, Signetics and Tek Hex (92) Record-type error, Intel Intellec 8/MDS (94)
9	2	Address error, i.e., > word limit (27, 28, 51, 56, 57)
8	1	Data not hexadecimal (84, 86, 91) Insufficient data received, ASCII-Hex and Octal (54)
		RAM ERRORS
7	8	RAM-hardware error (64, 66 or any RAM error)
6		
5	2	L2 + L3>RAM (in RAM-RAM block move)
4	1	Invalid center point for split or shuffle
3	8	Illegal split or shuffle
2	4	No RAM or insufficient RAM resident (61)
1	2	RAM write error, or program-memory failure (63)
0	1	RAM end not on 1K boundary (62)

EXAMPLE:

What errors are indicated in this error status word: 80C80081?

8 —	the word contains error information
0 —	no receive errors
C —	(= 8 + 4): 8 = Device-related error 4 = Start line not set high (ERROR 26)
8 —	device is not blank (ERROR 20)
0 —	no input errors
0 —	no input errors
8 —	RAM error (ERROR 62, and possibly 64 and 66)
1 —	RAM end is not on 1K boundary (ERROR 62)

NOTES

1. **The numbers in parentheses are System 19 Error Codes.**
2. **An error can cause as many as 3 bits to be high: the bit which represents the error, the most significant bit of the 8-bit word in which the error bit occurs, and bit 31.**
3. **After being read, the error-status word resets to zeros.**

Figure 3-2. The Error-Status Word

SET BEGIN RAM (L1) [HHHH] < RETURN

This command, preceded by a 4-digit hex address, sets BLOCK LIMIT L1, the first RAM address to be used for data transfers. This variable is also the RAM-source address when used in a RAM-RAM block move. Default Value — Ø.

SET BLOCK SIZE (L2) [HHHH] ; RETURN

The semicolon sets BLOCK LIMIT L2, the hex number of bytes to be transferred. L2 must be specified again if L1 is changed. Default Values — programming-electronics word limit for device-related operations; RAM limit less L1 for I/O operations; no default for RAM-RAM block move.

SET BEGIN DEVICE (L3) [HHHH] : RETURN

The colon sets BLOCK LIMIT L3, a 4-digit hex address telling the programmer the first device address to use for programming, verifying or loading device data. It is also used as the RAM-destination address in RAM-RAM block moves. Default Value — Ø. L3 is not used in serial-I/O data transfers.

SUM-CHECK S RETURN

This command instructs the programmer to calculate the sum-check of RAM data from Ø to the word limit of the programming module in use, and to output the sum-check to the computer. Sum-checks are useful in ensuring RAM data integrity. After a load operation, for instance, the computer can assure the operator that input data is identical with source data.

SELECT EXTERNAL FUNCTION [HH]] RETURN

This command allows entry of Select Codes (HH) carried in extended software on some programming modules. See the operation instructions for the programming module.

ERROR-STATUS INQUIRY F RETURN

On this Command, the programmer accumulates a 32-bit error word and sends it to the computer. The error word is sent as 8 hex characters in the code illustrated in Figure 3-2. When the error-status word is read, it resets to zeros.

ERROR-CODES INQUIRY X RETURN

This command instructs the programmer to output the error codes accumulated in scratch-pad memory. Up to 16 error codes can be stored. The command also clears these error codes from the memory.

NO OPERATION H RETURN

This is a null command and always returns a prompt character (>).

EXIT REMOTE CONTROL Z RETURN

All operating parameters except the address offset are retained. All RAM data is retained.

3.5.3 DEVICE COMMANDS

ILLEGAL-BIT TEST T RETURN

This command instructs the programmer to test the device for illegal bits. An illegal bit is defined as a programmed bit in the device that does not exist in RAM. A prompt character (>) is returned following a successful test. A fail character (F) indicates detection of an illegal bit.

BLANK CHECK B RETURN

This command instructs the programmer to search the device for programmed bits. The return of a prompt character (>) indicates a blank device; a fail character (F) indicates a device that is not blank.

FAMILY AND PINOUT INQUIRY [RETURN

On this command, the programmer sends to the computer a 4-digit hex number consisting of a 2-digit Family Code and a 2-digit Pinout Code, in that order. These codes identify the PROM which the UniPak is configured to program. Command is valid only with the UniPak installed in the programmer.

SELECT FAMILY AND PINOUT [FFPP] @ RETURN

A 2-digit Family Code (FF) and a 2-digit Pinout Code (PP) are sent to the programmer ahead of this command. These codes configure the UniPak to program a particular device. The command is valid only with the UniPak installed in the programmer.

RESPOND R RETURN

This command instructs the programmer to indicate the status of the installed programming electronics and socket adapter by outputting data in the form AAA/B/C or AAAA/B/C to the computer, where A, B and C represent hexadecimal characters. AAA = word limit of 4K or smaller devices; AAAA = word limit of devices larger than 4K; B = word size, 4 or 8; C = VOH or VOL — 0 for VOH, 1 for VOL.

LOAD L RETURN

This command instructs the programmer to load data into RAM from the device in the socket adapter, within the parameters defined by BLOCK LIMITS L1, L2 and L3. A prompt character (>) indicates a successful Load operation; a fail character (F) indicates that device data did not load.

PROGRAM P RETURN

This command instructs the programmer to program RAM contents into the device in the socket adapter, within the parameters defined by BLOCK LIMITS L1, L2 and L3. A prompt character (>) indicates a successful programming operation; a fail character (F) indicates failure to program.

VERIFY V RETURN

This command instructs the programmer to compare RAM data with the data of the device in the socket adapter, within the parameters defined by BLOCK LIMITS L1, L2 and L3. A prompt character (>) indicates that the device and RAM are identical; a fail character (F) indicates that they are not identical.

3.5.4 I/O COMMANDS

SELECT ODD PARITY D RETURN

This command instructs the programmer to set odd parity for output data and inspect incoming data for odd parity. The **D** command overrides the programmer's parity switch. Default Value – programmer's parity-switch setting.

SELECT EVEN PARITY E RETURN

This command instructs the programmer to set even parity for output data and inspect incoming data for even parity. The **E** command overrides the programmer's parity switch. Default Value – programmer's parity-switch setting.

SELECT NO PARITY N RETURN

This command instructs the programmer to not check incoming data for parity, and to output data without parity. The **N** command overrides the programmer's parity switch. Default Value – programmer's parity-switch setting.

SET 1 STOP BIT J RETURN

On receiving this command, the programmer sets one stop bit for serial data transfers. Default Value – programmer's stop-bit switch.

SET 2 STOP BITS K RETURN

On receiving this command, the programmer sets two stop bits for serial data transfers. Default Value – programmer's stop-bit switch.

SELECT TRANSLATION FORMAT [FC] A RETURN

This command selects the input or output data translation format expressed by the format code (FC) in the command. Table 3-3 lists the format codes. Default Value = MOS Technology Format, #81.

NOTE

All translation formats are detailed in the Translation Formats Package Manual (055-1901), also included under this cover.

Table 3-3. Format Codes

FORMAT	CODE
Binary	10
DEC Binary	11
ASCII-BNPF	01 (05) *
ASCII-BHLF	02 (06) *
ASCII-B1ØF	03 (07) *
5-level BNPF	08 (09) *
Spectrum	12 (13) *
ASCII-Octal (Space)	30 (35) †
ASCII-Octal (Percent)	31 (36) †
ASCII-Octal (Apostrophe)	32
ASCII-Octal SMS	37
ASCII-Hex (Space)	50 (55) †
ASCII-Hex (Percent)	51 (56) †
ASCII-Hex (Apostrophe)	52
ASCII-Hex (Comma)	53 (58) †
ASCII-Hex SMS	57
RCA Cosmac	70
Fairchild Fairbug	80
MOS Technology	81
Motorola Exorciser	82
Intel Intellec 8/MDS	83
Signetics Absolute Object	85
Tektronix Hexadecimal	86

* For transmission of data without start codes, these alternate codes are used.

† For transmission of data with the SOH start code, these alternate codes are used.

SET RECORD SIZE [HH] M RETURN

The 2 hex characters (HH) before **M** define the number of data bytes per record in serial-output operations. Default Value – 16 bytes per record for translation formats with a variable record size (all formats except ASCII-Binary, Spectrum and Fairchild Fairbug).

SET NULLS [HH] U RETURN

The 2 hex characters (HH) before **U** set the number of nulls to be output following the carriage return in serial-output operations, and enable line feeds. Default Value – no nulls or line feeds. Entering FF before **U** will also invoke the default value.

SET ADDRESS OFFSET [HHHH] W RETURN

The 4 hex characters (HHHH) preceding **W** specify an address to be subtracted from all addresses input to the programmer and added to all addresses output from the programmer. The address offset adjusts RAM addresses to the address range of larger memories. Default Value — Ø.

DISABLE TIMEOUT = RETURN

This command disables the 25-second I/O timeout. The timeout can be restored only by turning OFF the programmer and turning it ON again.

INPUT DATA I RETURN

This command instructs the programmer to accept formatted data from the computer. Any error on input returns the fail character (F). Successful input returns the prompt character (**>**).

OUTPUT DATA O RETURN

This command instructs the programmer to translate RAM data into the selected translation format and output this data to the computer.The programmer will stop outputting on receipt of the X-OFF character,DC-3 (Control S), and will resume on receipt to the X—ON character, DC-1 (Control Q). Successful output is indicated by a prompt character (**>**). Any errors will return the fail character (F).

COMPARE DATA C RETURN

This command instructs the programmer to compare data in RAM with data in the computer. Identity of the two returns the prompt character (**>**). Nonidentity is indicated by the fail character (F).

PARITY-ERROR INQUIRY Y RETURN

This command instructs the programmer to output the hex number of parity errors (up to FFF) encountered since power-ON, since the last **Y** command, or since the last parity command (**D**, **E**, or **N**).

3.5.5 EDITING COMMANDS

SWAP NIBBLES Q RETURN

This command instructs the programmer to exchange high- and low-order halves of every word in RAM. This is useful when programming 4-bit devices with only one—half of RAM at a time.

RAM-RAM BLOCK MOVE \ RETURN

This command moves a specified number of bytes (L2) from one RAM location (starting at L1) to another (starting at L3). These Block Limits are set with the "Set Begin RAM", "Set Block Size" and "Set Begin Device" commands, respectively, as explained in paragraph 3.5.3.

SPLIT RAM DATA [HHHH] ? RETURN

For 16-bit microprocessor data; complement of Shuffle Ram Data (below). After a block of data is input or loaded to RAM (each sequential pair of 8-bit bytes representing a 16-bit word), the command "splits" the block into two adjacent blocks, separated by the specified center point (HHHH). The split stores the even-numbered 8-bit bytes of each byte pair in sequence from address Ø to the center point; odd-numbered bytes are stored in sequence at addresses beginning at the center point. The reorganized data occupies the same original block in RAM.

Each block of data can then be programmed into an 8-bit device, and the 2 devices can be addressed in parallel (while in use) to deliver 16-bit words to the processor.

Typically, the center point will equal the number of words in the 8-bit device to be programmed. In any event, it must meet two requirements:

1. It must be a power of 2.
2. It must be less than or equal to half the size of the resident RAM.

Center-point default value — RAM midpoint.

SHUFFLE RAM DATA [HHHH]> RETURN

For 16-bit microprocessor data. Complement of Split RAM Data, this command merges into one block the two adjacent blocks of data which meet at the specified center point address (HHHH). Two 8-bit devices are first loaded adjacent to each other in RAM, beginning at address Ø, to create the two blocks, which are then merged for serial transfer. The center point must be a power of 2 between Ø and RAM midpoint. Center-point default value — RAM midpoint.