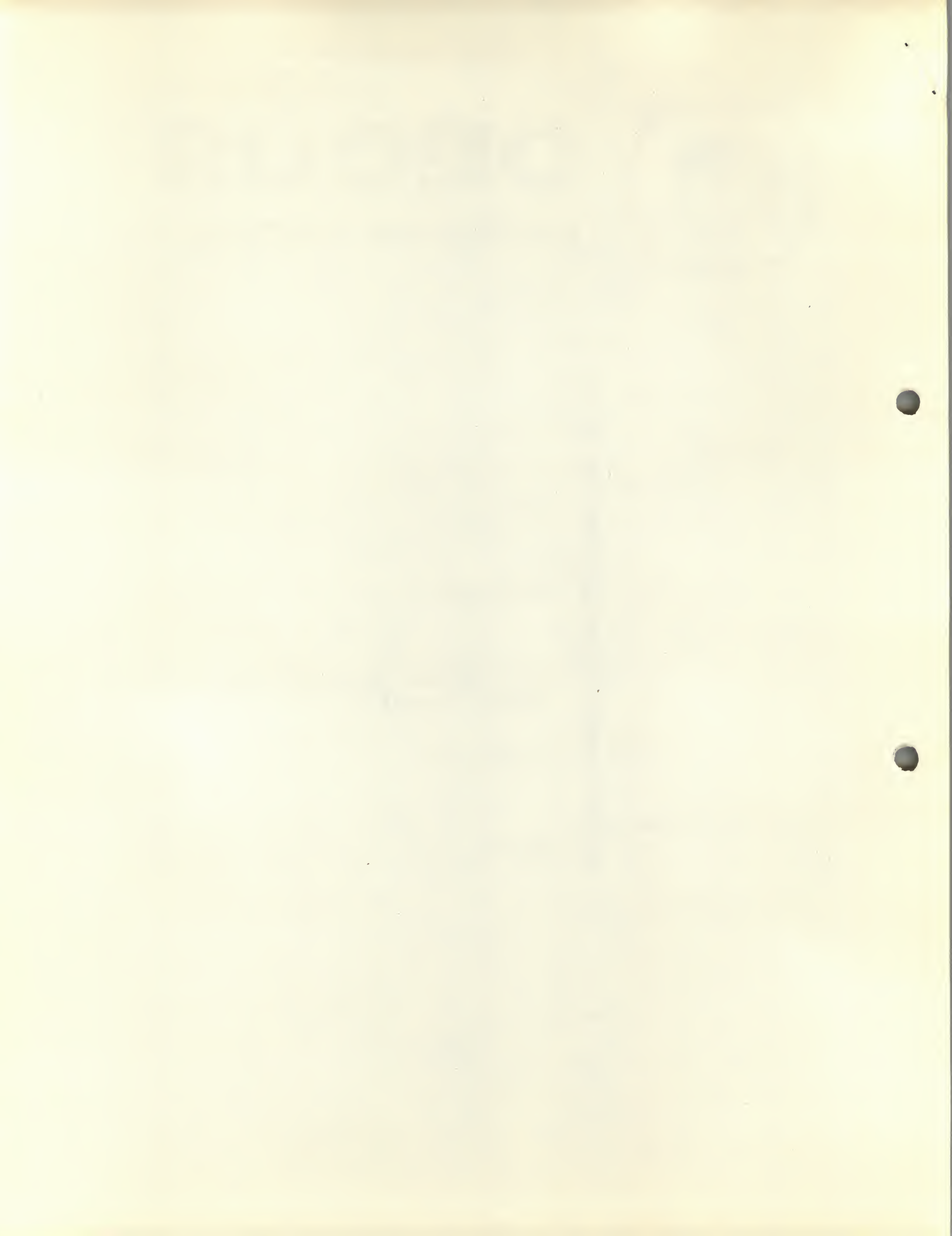# DECUS
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8-365

TITLE

CARD

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COMPANY

Lamont Geological Observatory of Columbia University
Palisades, New York

DATE

November 1970

SOURCE LANGUAGE

PAL-D

NAME: CARD

VERSION: 1

MOD: 0

DATE: November, 1970

PROGRAMMER: Herbert Poppe

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PURPOSE:

To transfer characters on cards from a CR03 card reader to DECTAPE as an ASCII file compatible with the DISK/DECTAPE MONITOR SYSTEM.

INTRODUCTION:

None of the DEC systems software supports the CR03 card reader. It would be desirable, for example, to be able to input a program on cards to the PAL ASSEMBLER. The PALD ASSEMBLER of the DISK/DECTAPE MONITOR SYSTEM will accept source input on paper tape from the teletype reader, the high speed reader, DECtape or disk (DF32 or RF08). In order to have input from cards, PALD could be modified or a stand-alone program could be written to convert card media to any other media, and use this media as input to PALD. This latter course was chosen-- card media converted to DECtape media in a format compatible with the DISK/DECTAPE MONITOR SYSTEM. PIP can then be used to change DECtape to any other media supported by that systems program.

RESTRICTIONS:

The program was written specifically for operation under the DECtape version of the MONITOR SYSTEM. Refer to APPENDIX B for information on modifying the program to run under control of the DISK version of the MONITOR SYSTEM. Columns 61-80 of the card are ignored. See APPENDIX C to change this feature.

MINIMUM EQUIPMENT:

A 4K PDP-8 series computer, card reader and control (CR01-2-3, CR8I/L, etc.) one DECtape unit and control.

OTHER PROGRAMS REQUIRED:

DISK/DECTAPE MONITOR SYSTEM, DEC-D8-SDAB.

CORE REQUIREMENTS:

The program proper occupies locations ØØØØ - 1577; locations 2ØØØ - 3ØØ1 are used for I/O buffers and the COMMAND DECODER and SAM blocks are stored in locations 4ØØØ - 54Ø5.

PROGRAM DESCRIPTION:

The program initially calls the COMMAND DECODER (CD) into memory from DECtape using the systems I/O routine (DECTAPE) of the MONITOR SYSTEM (MS). The CD requests the DECtape unit number and the file name, and creates a DN entry for the file. The six SAM blocks are read from tape on the specified drive using the TCØl DECTAPE routines modified to read 129 (10) words, and are stored sequentially over the locations formerly occupied by the command decoder. The interrupt is enabled as a result. The first card is read using a routine that runs with the interrupt enabled. From a search of the SAM blocks, the first available block of DECtape is determined and a search is initiated for that block. Overlapped card reading with output to DECtape occurs until a control card (exclamation mark in card column 1) indicates the last card. Two form feeds (ASCII 214) are added to the end of the output buffer to close the file for compatibility with the MONITOR SYSTEM. The last block(s) are written on DECtape -- the last block containing a link word = ØØØØ. Then the SAM blocks are searched for any remaining slots that contain the internal file number of this file and they are made free (i.e. = ØØ). The updated SAM blocks are written on to DECtape and when tape motion has stopped, the interrupt is turned off and control is returned to the MS.

The I/O is overlapped using a double buffer technique which allows the card reader to run at its fully-rated speed with character transfer to DECtape occurring simultaneously. The action proceeds as follows: characters on a card are read into input buffer A. The interrupt service routine portion of the card reader subroutine converts the card code into 8-bit ASCII before storing it in the buffer. The next card is read into input buffer B. Overlapped with this input, the following conversion of buffer A is made. The buffer is scanned backwards from the 60th character until the column of the first non-blank character is found. Characters from beginning of input buffer A to the last non-blank character in the buffer are transferred to output buffer C followed by a carriage return and a line feed. This process saves space on DECtape over arbitrarily storing the same number of card columns for each card. Blank cards are stored as a space-carriage return-line feed group so that a blank line will be output to the Teleprintee on a third pass listing of PALD (DEC-D8-ASAA and DEC-D8-ASAB). A check is made to see if column 1 is an exclamation mark indicating "end-of-deck." This card is not transferred to any output buffer. When conversion of buffer A is complete, the next card is read into buffer A and simultaneous conversion of buffer B to output buffer C begins. When buffer B is converted, the next card is read into it and conversion of buffer A begins. This process continues until the last card is read.

When output buffer C is full (128 (10) words), the following action
takes place. The next available DECtape block is found by a search
through the SAM blocks, and this number is stored as word 129 (10)
of output buffer C thus forming the link from the first block of the
file to the second block of the file. Output buffer C is then
written on DECtape. While this block is being written, transfer is
made from input buffers A and B to output buffer D. When D is full,
the link to the next block is determined. The transfer of output
buffer D to DECtape begins and transfer is made from input buffers
A and B to output buffer C. This process continues until the last
card is read.

A conversion is made in the transfer from input to output buffers
in the form of character stripping and packing. The 8-bit ASCII
characters are stripped to 6-bits. All non-printing characters
(2∅∅ - 237 and 34∅ - 377) have a 77 prefix added to the 6-bit form.
All printing characters have no prefix with the exception of "?"
(ASCII 277) which is packed as 7777. Rub out (377) is non-existent.
This is the format of ASCII files in the DISK/DECTAPE MONITOR SYSTEM.
As an example, the following sequence of ASCII 8-bit codes (stored
in a 12-bit word) would be converted as follows:

∅323	S
∅324	T
∅3∅1	A
∅322	R
∅324	T
∅254	,
∅24∅	space
∅24∅	space
∅3∅3	C
∅314	L
∅3∅1	A
∅215	carriage return
∅212	line feed
2324	ST
∅122	AR
2454	T,
4∅4∅	space, space
∅414	CL
∅177	A
1577	CR
12..	LF

The programs determines the block number at which data is written in
the following manner. The CD creates an entry in the MONITOR SYSTEM
DIRECTORY and returns the internal file number via the output list of
the CD. Beginning with the first SAM slot, a search is made through
consecutive SAM slots until a file number of ∅∅ (indicating a free
block) or the new file number (indicating that an old file of the same

name is being overwritten) is found. The slot number (determined by counting from the first slot) is the block number. If the slot contains $\emptyset\emptyset$, it is filled with the present file number. The routine checks to see if the tape becomes full and, if so, types out an error message and returns to the MS without writing the SAM blocks on tape. When the last block has been written, a search is made through the remaining SAM slots changing to $\emptyset\emptyset$ those slots which have the present internal file number, thus deleting reference to any remaining blocks of the old file of the same name as the new file.

The card reader subroutine is divided into two logical parts. The first part of the subroutine (entry at CARD) initiates the reading of a card. The second part of the subroutine handles interrupts that indicate that a column is ready to be read (entry at CDATSV) and that the card has passed through the reader (CDONSV). The first part of the subroutine is called from the main-line program and entry to the second part of the subroutine is made via the skip chain (see below). The calling sequence is:

```
JMS (CARD
BUFFER
```

where BUFFER is the starting address of a buffer in memory of 81 (10) consecutive locations. Upon entry, the program checks a location which indicates that a card is in the process of being read. The program loops until the previous card has been read. When this occurs, the routine is made "busy". The buffer address is obtained and some parameters are initialized. Then the program tests the card reader to see if it is ready to read cards. If so, a card is started on its way to the read station and control returns to the user. If the reader is not ready, the computer is placed in a "wait" condition with the C(AC)= $6\emptyset\emptyset1$. The operator must make the reader ready, hold down CTRL, and then press S on the teletype. A card is then selected and started toward the read station and control is returned to the user.

Each time a column is ready to be read, the card reader control raises the data ready flag and an interrupt occurs. The skip chain identifies the interrupt and passes control to CDATSV. If entry is made here without the card reader subroutine indicated as "busy", the interrupt must be invalid and is ignored. If the interrupt is valid, the character is read, converted to ASCII by table look up, and stored in the buffer. The table look-up procedure uses the internal card code to compute the address where the corresponding ASCII code is stored. Control is then returned to the user via the dismiss routine at the point his program was interrupted.

When the card has passed the read station, the card reader control raises the card done flag and an interrupt occurs. The skip chain identifies the interrupt and transfers control to CDONSV. If the interrupt is valid, the routine checks to see that 80 columns were read. If so, the end of

buffer character (carriage return - ASCII 215) is stored in the buffer after the last character. The routine is made "not busy" and control returns to the user via the dismiss routine. If 80 columns were not read, the computer is placed in a "wait" condition with 6ØØ2 displayed in the accumulator. The operator should remove the last card from the stacker, place it in the hopper, ready the reader, and depress S on the teletype while holding down CTRL. The card routine will be reinitialized and the card that was read incorrectly will be reread.

If the computer is halted, either by pressing "STOP" on the console or by executing a "HLT" instruction while the DECTAPES are in motion, they will not be restarted when "CONT" is pressed on the console. Likewise, if a card is in the middle of a read cycle when the computer is halted, all of the columns will not be read. To overcome these problems, coding is provided to simulate pressing "STOP" on the console or executing a "HLT" instruction while allowing the DECTAPES and card reader to complete their write and/or read cycles.

To simulate pressing "STOP" on the console, hold down CTRL on the teletype and then depress S. An interrupt is generated, the skip chain identifies the device, and control is transferred to the keyboard service routine. The routine tests for the CONTROL/S combination (ASCII 223) and jumps to the STOP/GO routine. The routine tests an indicator word which indicates the "wait" status of the computer. In this case, this word would indicate that the computer should be placed in the "wait" state. This word is then changed to indicate that the computer is in the "wait" state, the contents of the accumulator, link and location ØØØØ at the time of the interrupt are saved, the message 5ØØl is loaded into the accumulator, the interrupt is enabled and the computer "waits" at a "JMP" instruction.

To simulate pressing "CONT" on the console, depress the CONTROL/S combination on the teletype. An interrupt is generated, control is passed to the keyboard service routine which determines that CONTROL/S has been pressed. The "wait" status indicator reveals that the computer is in the "wait" state. This word is changed to indicate that the computer is running, the status of the accumulator and link are restored to their values at the time when CONTROL/S was depressed to simulate a "STOP" and control is returned to the user's program at the point it was interrupted when the "STOP" was simulated.

The routine pause simulates the "HLT" instruction. The calling sequence is:

```
               TAD CODE
               JMS (PAUSE
```

where CODE is the address of a number to be displayed in the accumulator when the computer is placed in the "wait" state. CONTROL/S is pressed to bring the computer out of the "wait" state. This routine is used by the card reader routine to indicate that the card reader is not ready or that 80 columns were not read.

The teletype service routine also checks for the CONTROL/C combination.
If CONTROL/C is depressed on the teletype, control is returned to the
DISK/DECTAPE MONITOR SYSTEM.

The interrupt service routine is conventional. If an interrupt is not
identified by the skip chain, the flags on devices not used in the program
are cleared and the interrupt is dismissed. Users with different peripheral
configurations must modify this portion of the program to clear their
device flags. Device flags for incremental plotter, teleprinter, and high
speed reader and punch are cleared by this version of the program.

COMPILING AND/OR LOADING THE PROGRAM:

An ASCII source paper tape is available for users who wish to modify the
program. It may be compliled with PALD.

To load and save the binary paper tape copy of the program, follow the
procedure below (output typed by the MS is underlined -- the symbol ")"
indicates a carriage return).

. LOAD)	Call Loader
* IN- R:) or T:)	Input on high speed or teletype reader
OPT - 1	One Pass Load
ST =)	Return to MS after load
↑↑	User types CONTROL/P in response to ↑
. SAVE CARD! ∅∅∅∅ - 1577:∅2∅∅)	Save Core Image

PROGRAM OPERATION:

Mount the DECtape containing CARD on Unit 8. If the ASCII file is to
be stored on another DECtape, mount this DECtape on any other available
drive. Set the appropriate switches to "REMOTE" and "WRITE ENABLED."
Turn the card reader ON, load the input hopper with the card deck to
be transferred to DECTAPE, and ready the reader by pressing "MOTOR
START" and "READ START". (Although the reader may be made ready after
the program is started, the power must be turned on before the interrupt
is enabled.) If necessary, bootstrap the Monitor or start the computer
at 76∅∅. To call in and execute the program:

> . CARD)
>
> *OUT - S:FILE) or DX:FILE) Where FILE is the
> name of the file to be stored on the systems DECtape
> (Unit 8) or on the DECtape mounted on Unit X.
>
> *IN -) The CD does not recognize the card reader as
> input so this is ignored.

Card reading will commence after a short delay of tape motion and

continue until the last card is read. Control is returned to the
Monitor System when the program is finished.

OPERATION NOTES:

1) Cards may be prepared on either an IBM 029 or IBM 026 keypunch.
Appendix A lists the relationship between the codes of these keypunches,
the internal card code, and the ASCII equivalent. Note that the same
characters on an 029 and 026 generate different internal card codes, but
the conversion is made to the same ASCII Code. Therefore, cards punched
on 029 and 026 keypunches may be intermixed. This convenience is obtained
at the loss of a few characters that a 029 will punch that an 026 will
not. Note also that there are some 029 characters that have no ASCII
equivalents. The resulting conversion was arbitrarily chosen.

2) To indicate the end of the card deck to the program, the last cards
must be a card with an exclamation mark (11-8-2 punch) in column 1 and
one or more blank cards.

3) If the card deck is bigger than will fit in the hopper, it may be
divided into two or more sections -- the last section having the end
of deck cards. When the hopper is empty, the computer will "wait"
with 6001 displayed in the accumulator. Place the next section in the
reader, ready the reader, and depress CONTROL/S on the teletype.

4) Do not press STOP on the computer console while the tapes or cards
are running. Instead press CONTROL/S -- 5001 will be displayed in the
accumulator. Press CONTROL/S to continue.

5) Control may be returned to the MONITOR SYSTEM at any time by
pressing CONTROL/C on the teletype keyboard.

6) The card reader may be stopped at any time by pressing "READ STOP"
on the reader. To continue, ready the reader and press CONTROL/S on
the teletype.

7) If the DECtape should become full before the program has finished,
an error message 'ERROR, NO MORE BLOCKS AVAILABLE' will be printed and
control will return to the MS.

8) Any DECtape errors (select, parity, etc.) will result in a HLT at
location 0066 with Status Register B displayed in the AC. Press "CONT"
to return control to the MS.

9) If the computer appears to be halted, but 6001 is displayed in the
accumulator, the card reader is not ready. This may be due to not
having made ready the card reader initially, to an empty hopper, or to
a full stacker. Rectify the condition and press CONTROL/S. Such a
condition will also result if an error has been detected by the card
reader. Consult the card reader error lamps for the problem. These
conditions are not recoverable. Press CONTROL/C to return to the MS.

10) If the computer appears to be halted, but 6ØØ2 is displayed in the accumulator, the card reader did not read 80 columns. To recover from this error, remove the card from the stacker (the one not read properly) and return it to the bottom of the hopper, ready the reader, and press CONTROL/S. If the error persists, the card reader requires service.

11) Once execution of the program has begun, it may not be restarted from the beginning. The program must be reloaded each time it is used.

12) This version of the program ignores columns 61-80 of a card. See APPENDIX C for modifying the program to read a full card or to ignore some other number of consecutive columns to the end of the card.

APPENDIX A

CARD INTERNAL CODE	IBM 029	IBM 026	ASCII	ASCII CODE
00	space	space	space	240
01	1	1	1	261
02	2	2	2	262
03	3	3	3	263
04	4	4	4	264
05	5	5	5	265
06	6	6	6	266
07	7	7	7	267
10	8	8	8	270
11	9	9	9	271
12	:	NA	:	272
13	#	=	=	275
14	@	'	'	247
15	'	NA	'	247
16	=	NA	=	275
17	"	NA	"	242
20	0	0	0	260
21	/	/	/	257
22	S	S	S	323
23	T	T	T	324
24	U	U	U	325
25	V	V	V	326
26	W	W	W	327
27	X	X	X	330
30	Y	Y	Y	331
31	Z	Z	Z	332
32	0-8-2	0-8-2	<	274
33				254
34	, %	(	(	250
35	_	NA	←	337
36	>	NA	>	276
37	?	NA	?	277
40	-	-	-	255
41	J	J	J	312
42	K	K	K	313
43	L	L	L	314
44	M	M	M	315
45	N	N	N	316
46	O	O	O	317
47	P	P	P	320
50	Q	Q	Q	321
51	R	R	R	322
52	!	NA	!	241
53	$	$	$	244
54	*	*	*	252
55	)	NA	)	251

APPENDIX A

(con't)

CARD INTERNAL CODE	IBM 029	IBM 026	ASCII	ASCII CODE
56	;	NA	;	273
57	¬	NA	#	243
60	&	+	+	253
61	A	A	A	301
62	B	B	B	302
63	C	C	C	303
64	D	D	D	304
65	E	E	E	305
66	F	F	F	306
67	G	G	G	307
70	H	H	H	310
71	I	I	I	311
72	¢	NA	%	245
73	.	.	.	256
74	<	)	)	251
75	(	NA	(	250
76	+	NA	+	253
77			NA	↑	336

NA = not assigned

APPENDIX B

To modify this program to run under the DISK version of the
MONITOR SYSTEM, it is only necessary to change those locations of the
program which contain the number of the first block of the COMMAND
DECODER. After loading the binary tape, manually change the contents
of locations Ø172 and Ø2Ø3 from ØØ2Ø to ØØ15. Then save the program
on the disk. The user must not respond to the COMMAND DECODER dialogue
*OUT - with an S:FILE either accidentally or in an attempt to get the
program to transfer data from cards to disk. If S:FILE is typed, the
DN entry for FILE will be created on the disk, but the SAM blocks as
well as the ASCII file will be read and/or written on the DECtape on
Unit 8.

APPENDIX C

In our application, only 60 columns of the card are used because 60 characters are the maximum that can be printed without overprinting on a third pass PAL listing. To change this to some other number of columns, change the contents of C73 (location ∅443) to the octal value of the last column desired - 1. Set the contents of M74 (location ∅444) to the octal value of the negative of the last column desired. For example, if all 80 columns of the card are desired, set location ∅443 to ∅117 (79 decimal) and set location ∅444 to 7651 (-80 decimal).