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CPS PROGRAM LOGIC MANUAL

Volume IV

CPS SYSTEM UTILITY PROGRAMS

by

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for

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PREFACE

TO THE SERIES

This report of four volumes is intended to document the May 21, 1969 version of the Cooley Programming System (CPS) which was developed at the Cooley Electronics Laboratory of The University of Michigan. The four volumes are titled:

Volume 1: CPS System Architecture and Conventions

Volume 2: CPS Basic Programming Package

Volume 3: CPS FORTRAN Package

Volume 4: CPS System Utility Programs

The four volumes were written in order to take a snapshot of CPS at one point in its continuing development. This version of CPS is considered to be a first generation system; successive versions are on the drawing boards and internally resemble their parent less and less every day.

CPS is a generalized programming and file management system written for use on the PDP-8 processor of Digital Equipment Corporation's LINC-8 computer. A minimum memory size of 8192 words is required. Extensive use is made of the two tape units present on every LINC-8 for both file storage and system residence.

Using CPS, programs can be entered, edited, assembled (or

compiled), loaded and executed entirely from the keyboard without the use of paper tape. CPS provides power and flexibility normally only found on larger computers and in fact was modeled after the Michigan Terminal System which operates on an IBM SYSTEM/360 model 67.

In addition to a comprehensive file management and control system CPS contains:

Symbolic Text Editor	8-K FORTRAN Compiler
MACRO-8 Assembler	Two loaders
SABR Assembler	Various utility programs

Each of the above programs contains service routines which permit automatic communication with the central file system and which allow direct access to CPS files. The general policy followed in implementing CPS was to borrow and adapt as much of DEC's software as possible in order to speed system development.

The responsibility (or blame) for various segments of CPS is divided as follows:

Gerald Cederquist	System design and conventions, Control Program, Absolute Assembler, Absolute Loader, MARKP8 (tape marking program), and FILECOPY (file copying program).

Kurt Metzger	SABR, FORTRAN, Relocating Loader, PAPERBIN (binary paper tape input program), TAPCOPY (tape copying program), and assorted tape routines.
joint effort	Text Editor, I/O Control System, and various compromises.

Work started on CPS in November of 1968 with the first workable version being completed in February of 1969. The FORTRAN-SABR package was incorporated in the March-April period of 1969. Since this time CPS has been in use at CEL in the development of digital signal processing programs for project MIMI. It has been found to be a very effective tool and has greatly decreased program development time and programmer frustration. Tasks which formerly took over a month to complete using the DEC 8-LIBRARY System are now routinely completed in one to two weeks.

The bulk of CPS and the associated routines were hurriedly written since the authors were effectively stealing time from their thesis research. Consequently portions of the code were done in a quick and dirty manner. Now that several months have passed, the fact that these portions were quick has dimmed in memory but the dirt remains.

The authors would like to thank Dr. T. G. Birdsall of CEL for his continued encouragement and support and Mr. C. Conley of DEC for his assistance in providing the FORTRAN-SABR package for use in CPS.

G. Cederquist
K. Metzger

Ann Arbor, Michigan
December 1969

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PREFACE

TO VOLUME 4

This volume contains the user descriptions and program listings of four CPS utility programs and two LINC-tape read/write routines.

CHAPTER 1

FILECOPY

FILECOPY may be used to copy a symbolic or binary file from one set of CPS tapes to another. It is an interactive program run completely from the 33ASR Teletype. When the file copying process is complete, the copied file will reside in either -S or -B depending upon the type of file copies - symbolic or binary respectively. The user may then save the copy into a permanent file using the SAVE command in CPS.

```
                /CPS FILE TRANSFER PROGRAM
                /WILL TRANSFER A FILE FROM A CPS FILE TAPE
                /TO THE WORKING AREA OF THE SAME TYPE OF
                /FILE TAPE; E.G., SYMBOLIC FILES ARE TRANSFERRED
                 /FROM THE SOURCE TAPE WHICH WILL BE MOUNTED
                /ON DRIVE 1 ONTO THE SYMBOLIC WORKING AREA OF
                /THE USER'S SYSTEM SYMBOLIC FILE TAPE WHICH
                /IS MOUNTED ON DRIVE ZERO.  THE COPIER
                /SETS THE WORKING AREA UPDATING KEY AND
                /PARAMETERS TO CAUSE THE CONTENTS OF THE
                /SINK FILE TAPE VTOC TO BE UPDATED WHEN
                /IT INVOKES CPS UPON COMPLETION OF THE COPY.
                /
                /ROUTINE USES IOCS3
                /
                *2000
2000  7300       CLA CLL
2001  4442       CALL RESET
2002  4447       RDROPN
2003  4455       SEARCH /REWIND UNIT 0
2004  0005       UNITO 5
2005  3106       DCA RWIFLG
2006  4777     GETYPE, JMS MESAGI
2007  4543       TEXT ;%#
2010  0317     CO
2011  2031     PY
2012  4023      S
2013  3115     YM
2014  0240     B
2015  1722     OR
2016  4002      B
2017  1116     IN
2020  4006      F
2021  1114     IL
2022  0577     E?
2023  4050      (
2024  2340     S
2025  1722     OR
2026  4002      B
2027  5172     ):
2030  4000      ;
2031  4451     GTYP, RDRTAG
2032  7410       SKP
2033  5253       JMP GOTTYP
2034  4236       JMS REWI
2035  5231       JMP GTYP
2036  0000     REWI, 0
2037  1106       TAD RWIFLG
2040  7640       SZA CLA
2041  5636       EXIT REWI
2042  6147       INTS
2043  7012       RTR
2044  7710       SPA CLA
2045  5636       JMP I REWI
```

```
2046  7240   STA
2047  3106   DCA RWIFLG
2050  4455   SEARCH
2051  4005   UNIT1 5
2052  5636   EXIT REW1
2053  0376  GOTTYP, AND (177
2054  1375   TAD (200
2055  3101   DCA CHAR
2056  1101   TAD CHAR
2057  4453   PTRPUT
2060  1101   TAD CHAR
2061  1374   TAD (-302
2062  7450   SNA
2063  5270   JMP B /SOURCE TAPE WILL BE ON UNIT 0
2064  1373   TAD (-21
2065  7640   SZA CLA
2066  5206   JMP GETYPE /BAD ANSWER
2067  1372   TAD (4210 /SOURCE TAPE ON UNIT 1
             /4120+170 (SEE GCTLC+6) = 4600, U&BLK FOR VTOCO
2070  3103  B, DCA STYPE
2071  4777   JMS MESAGI
2072  4543   TEXT ;%#
2073  1517  MO
2074  2516  UN
2075  2440  T
2076  2317  SO
2077  2522  UR
2100  0305  CE
2101  4006   F
2102  1114  IL
2103  0540  E
2104  2401  TA
2105  2005  PE
2106  4017   0
2107  1640  N
2110  2516  UN
2111  1124  IT
2112  4000   ;
2113  4236   JMS REW1
2114  1103   TAD STYPE
2115  7640   SZA CLA
2116  7001   IAC
2117  1371   TAD (260
2120  4453   PTRPUT
2121  4777   JMS MESAGI
2122  5440   TEXT ;,
2123  1011  HI
2124  2440  T
2125  0322  CR
2126  2414  TL
2127  5503  -C
2130  0000  ;
2131  4450  GCTLC, RDRGET
2132  0376   AND (177
2133  1375   TAD (200 /CONVERT TO DEC ASCII
```

```
2134  1370   TAD (-203
2135  7640   SZA CLA
2136  5271   JMP B+1
2137  4453   PTRPUT
2140  1103   TAD STYPE
2141  1367   TAD (170
2142  3344   DCA VTOCLOC
2143  4445   RDSTAP
2144  0000  VTOCLOC, 0
2145  4010   FLDI 10
2146  4000   4000
2147  5766   JMP .&7600+200
2166  2200  PAGE
2167  0170
2170  7575
2171  0260
2172  4210
2173  7757
2174  7476
2175  0200
2176  0177
2177  3000
2200  4777  GETFN, JMS MESAGI
2201  4543   TEXT ;%#
2202  0711  GI
2203  2605  VE
2204  4006   F
2205  1114  IL
2206  0540  E
2207  1601  NA
2210  1505  ME
2211  4027   W
2212  1124  IT
2213  1040  H
2214  0140  A
2215  2422  TR
2216  0111  AI
2217  1411  LI
2220  1607  NG
2221  4002   B
2222  1401  LA
2223  1613  NK
2224  7240  :
2225  0000  ;
2226  1376   TAD (27
2227  3010   DCA 10
2230  4450  GLOOP, RDRGET
2231  0375   AND (177
2232  1374   TAD (200
2233  3101   DCA CHAR
2234  1101   TAD CHAR
2235  4453   PTRPUT
2236  1101   TAD CHAR
2237  1373   TAD (-215
2240  7650   SNA CLA
```

```
2241  5247   JMP GOTFN
2242  1101   TAD CHAR
2243  6211   CDF 10
2244  3410   DCA I 10
2245  6201   CDF
2246  5230   JMP GLOOP
2247  1372 GOTFN, TAD (212
2250  4453   PTRPUT
2251  1371   TAD (10
2252  6212   CIF 10
2253  4770   JMS COMPRESS
2254  0030   30 /SOURCE
2255  0020   20 /SINK
2256  6211   CDF 10 /IN FLD 1
2257  7201   CLA IAC
2260  6211   CDF 10
2261  3767   DCA I (0 /SET VTOC FOR SEARCH
2262  6201   CDF
2263  4444   TPWAIT /WAIT TIL VTOC IS IN
2264  6212   CIF 10
2265  4766   JMS SRCHVTOC
2266  5301   JMP FFND
2267  4777   JMS MESAGI
2270  0611   TEXT ;FI
2271  1405 LE
2272  4016   N
2273  1724 OT
2274  4006   F
2275  1725 OU
2276  1604 ND
2277  0000   ;
2300  5200   JMP GETFN
2301  1365 FFND, TAD (3 /PTR TO FILE INFO
2302  3010   DCA 10
2303  1103   TAD STYPE
2304  7650   SNA CLA
2305  1365   TAD (3
2306  1364   TAD (7764
2307  3011   DCA 11
2310  6211   CDF 10
2311  1410   TAD I 10
2312  3100   DCA EBLKNO
2313  7001   IAC
2314  3411   DCA I 11
2315  1410   TAD I 10
2316  0363   AND (377
2317  3104   DCA BLKSLEFT
2320  1104   TAD BLKSLEFT
2321  3411   DCA I 11
2322  1410   TAD I 10
2323  3411   DCA I 11
2324  6201   CDF
2325  1103   TAD STYPE
2326  7650   SNA CLA
2327  7330   STL CLA RAR
```

```
2330  7001    IAC
2331  3762    DCA KTPBLN
2332  1100    TAD EBLKNO
2333  7104    CLL RAL
2334  7030    CML RAR
2335  3761    DCA ETPBLN
2336  1104  COPY, TAD BLKSLEFT
2337  1360    TAD (-40
2340  7700    SMA CLA
2341  5344    JMP .+3
2342  1104    TAD BLKSLEFT
2343  7410    SKP
2344  1357    TAD (40
2345  3105    DCA NBLKS
2346  1105    TAD NBLKS
2347  1356    TAD (FLD1
2350  3755    DCA EBLKS
2351  5754    JMP .&7600+200
2354  2400  PAGE
2355  2405
2356  4000
2357  0040
2360  7740
2361  2404
2362  2410
2363  0377
2364  7764
2365  0003
2366  1000
2367  0000
2370  0400
2371  0010
2372  0212
2373  7563
2374  0200
2375  0177
2376  0027
2377  3000
2400  1205    TAD EBLKS
2401  1377    TAD (CHECK
2402  3211    DCA KBLKS
2403  4445    RDSTAP
2404  0000  ETPBLN, 0
2405  0000  EBLKS, 0
2406  0000    0 /LOCN
2407  4446    WRSTAP
2410  0000  KTPBLN, 0
2411  0000  KBLKS, 0
2412  0000    0 /LOCN
2413  1204    TAD ETPBLN
2414  1105    TAD NBLKS
2415  3204    DCA ETPBLN
2416  1210    TAD KTPBLN
2417  1105    TAD NBLKS
2420  3210    DCA KTPBLN
```

```
2421  1105   TAD NBLKS
2422  7041   CIA
2423  1104   TAD BLKSLEFT
2424  7450   SNA
2425  5230   JMP .+3
2426  3104   DCA BLKSLEFT
2427  5776   JMP COPY
2430  4775   JMS MESAGI
2431  2710   TEXT ;WH
2432  0516  EN
2433  4024   T
2434  1005  HE
2435  4004   D
2436  2211  RI
2437  2605  VE
2440  4000   ;
2441  1025   TAD LTON
2442  7650   SNA CLA
2443  4774   JMS REWSOU
2444  4775   JMS MESAGI
2445  2324   TEXT ;ST
2446  1720  OP
2447  2354  S,
2450  4022   R
2451  0515  EM
2452  1725  OU
2453  1624  NT
2454  4025   U
2455  1611  NI
2456  2440  T
2457  0000   ;
2460  1103   TAD STYPE
2461  7640   SZA CLA
2462  7001   IAC
2463  1373   TAD (260
2464  4453   PTRPUT
2465  1025   TAD LTON
2466  7650   SNA CLA
2467  4774   JMS REWSOU
2470  4775   JMS MESAGI
2471  4023   TEXT ; S
2472  3123  YS
2473  2405  TE
2474  1540  M
2475  2401  TA
2476  2005  PE
2477  5645  .%
2500  4327  #W
2501  1005  HE
2502  1640  N
2503  0417  DO
2504  1605  NE
2505  5440  ,
2506  1011  HI
2507  2440  T
```

```
2510  0324  CT
2511  2214  RL
2512  5503  -C
2513  5600  .;
2514  4444   TPWAIT
2515  4774   JMS REWSOU
2516  6147   INTS
2517  7012   RTR
2520  7710   SPA CLA
2521  5316   JMP .-3
2522  1772   TAD VTOCLOC
2523  7004   RAL
2524  7030   CML RAR
2525  3327   DCA .+2
2526  4455   SEARCH
2527  0000   0000
2530  4450  CTLC, RDRGET
2531  0371   AND (177
2532  1370   TAD (200
2533  3101   DCA CHAR
2534  1101   TAD CHAR
2535  4453   PTRPUT
2536  1101   TAD CHAR
2537  1367   TAD (-203
2540  7640   SZA CLA
2541  5330   JMP CTLC
2542  4452   RDRCLO
2543  1366   TAD (7773 /INSERT UPDATE KEY
2544  3010   DCA 10
2545  6211   CDF 10
2546  1365   TAD (-7402
2547  3410   DCA I 10
2550  7240   STA
2551  3410   DCA I 10
2552  7001   IAC
2553  3410   DCA I 10
2554  1364   TAD (HLT
2555  3410   DCA I 10
2556  6201   CDF
2557  4454   PTRCLO
2560  6002   IOF
2561  5763   JMP 7600
2563  7600  PAGE
2564  7402
2565  0376
2566  7773
2567  7575
2570  0200
2571  0177
2572  2144
2573  0260
2574  2600
2575  3000
2576  2336
2577  2000
```

```
2600  0000  REWSOU, 0
2601  1777   TAD ETPBLN
2602  7104   CLL RAL
2603  7210   CLA RAR
2604  3206   DCA .+2
2605  4455   SEARCH
2606  0000   0000
2607  5600   EXIT REWSOU
2777  2404  PAGE
            *100
0100  0000  EBLKNO, 0
0101  0000  CHAR, 0
0102  0000  COUNT, 0
0103  0000  STYPE, 0
0104  0000  BLKSLEFT, 0
0105  0000  NBLKS, 0
0106  0000  RWIFLG, 0
            PAGE
            MESAGI=3000
            COMPRESS=400
            SRCHVTOC=1000
```

CHAPTER 2

*MARKP8

*MARKP8 is a tape marking program which was generated by overlaying the program MARKL8 with a program called XMARK, available from DECUS as DECUS number L-32. XMARK was modified before making the overlay so that *MARKP8 marks tapes using 2000_8 blocks containing 200_8 words apiece.

*MARKP8 is completely interactive and may be run entirely from the LINC display and the 33ASR keyboard. It is invoked from CPS by the command

RUN *MARKP8

To return to CPS after marking a tape, be certain that both CPS system tapes are mounted, and then load address 7600 into the program counter and press START.

Note that CPS tapes must be marked using *MARKP8.

```
/XMARK - MODIFICATIONS TO MARKL8 TO
/MARK PDP-8 PROGRAMMING SYSTEM TAPES IN 2000(OCTAL)
/BLOCKS OF 128(DECIMAL) WORDS APIECE.  THIS
/PROGRAM MODIFIED FOR CEL USE BY JERRY CEDERQUIST
/FROM DECUS L-32.  6 NOVEMBER, 1968
/
*2000
START, CLA CLL
 TAD C10
 ICON /SELECT LINC
 IAC  /DESELECT TO CLEAR ALL FF'S
 ICON
 TAD M1 /AND NOW RESELECT
 ICON
 TAD C23 /SET LINC P REG TO 23 - NOTE THAT
/THIS LAST LINE WAS WRONG IN DECUS L-32.
 ISSP
 JMP I .+1 /GO TO PROGOFOP TO START LINC
 313
C10, 10
C23, 23
M1, -1
/
/
/MODIFICATIONS TO PROGOFOP
/
*1124
 TAD C1600 /PATCH FOR PROPER ADDR REF
 DCA 23
 JMS I 1175
 JMP I 1123
C1600, 1600
/
*1166
 7600 /CHANGE -400 TO -200 FOR SMALLER BLOCKS
/
*1170
 1777 /CHANCE MASK 777 TO 1777 FOR LARGER BN'S
/
/
/MODIFICATIONS TO LINC PROGRAM PART OF MARKL8
/
*4023
6036 /JUMP AROUND LINC TEST
*4042
 1577 /PATTERN CODE ADDRESS -1
*4052
 0000 /BN IS ALL THAT IS NECESSARY
*4065
 2000 /FINAL BN + 1
*4115
 2000 /DITTO
*4122
 1577 /SAME AS *4042
/DELETE THE GUIDE RETURN BIT
*4210
 0000 /HLT
```

```
 6210 /JMP .-1
*4174
 7774 /ONE LESS LINE IN GOOD TAPE DISPLAY
/
/CHANGE THE GOOD TAPE MESSAGE
*4314
 1246
4724
4547
1402
0014
4742
1440
2445
3612
2441
4247
3330
4514
4724
4330
1277
/
/
/MODIFICATION TO PDP-8 PART OF MARKL8
/
*4536
 7614 /200 LESS DATA MARKS PER BLOCK
/
*4541
 5757 /2000 BLOCKS PER TAPE
$
```

CHAPTER 3

PAPERBIN

This program reads binary paper tapes into CPS from either the LINC ASR-33 or from any remote 8-level Teletype through the data phone. The binary paper tape is read into the binary working area -B and can be saved in a file using the CPS SAVE command.

Instructions

To load and start PAPERBIN use the command

```
RUN PAPERBIN
```

The program is self starting and will type out

```
BINARY TO CPS
R=REL A=ABS
MODE =
```

If a SABR produced binary paper tape is to be read, type "R" followed by a carriage return (CR). If an absolute binary paper tape is to be read (such as produced by PAL-III or MACRO-8), type "A" followed by a (CR).

When PAPERBIN is ready to start reading in the binary paper tape the message

START READER

will be typed. This is the time to turn on the paper tape reader, not before!

The program ignores leader code (200 octal) and also throws away the first character read in. Always start reading the paper tape in the leader section.

The program terminates when 3 trailer (also 200 octal) frames have been read. The binary working area then contains a copy of the information on the paper tape properly formatted for use by the CPS loaders. CPS is automatically reloaded after the comment

DONE. RETURNING TO CPS.

is typed. Turn off the paper tape reader when this message appears.

Once back in CPS the binary can be saved using the command

SAVE -B FNAME

where FNAME is a file name chosen by the user.

```
                /BINARY TO CPS UTILITY
                /USES IOCS3
                /
                *2000
                /
2000  7300      CLA CLL
2001  4442      CALL RESET /INIT I-O
2002  4445      RDSTAP /ADVANCE TAPE TO BLK 1
2003  4001      4001
2004  2001      CHECK 1
2005  7200      7200
2006  1342    REDO, TAD MWHICH /ABS OR REL?
2007  4777      JMS MESAGE
2010  4447      RDROPN /OPEN READER
2011  4450    REDO2, RDRGET /SEE HWAT HE WANTS
2012  0376      AND (177
2013  1375      TAD (200
2014  3334      DCA TEMP /SAVE
2015  1334      TAD TEMP /ECHO
2016  4453      PTRPUT
2017  1334      TAD TEMP /TEST
2020  1374      TAD (-215 /CR?
2021  7450      SNA /S IF NOT
2022  5226      JMP TYPLF /NEED LINE FEED
2023  1373      TAD (215 /RESTORE AC
2024  3335      DCA CHAR /SAVE
2025  5211      JMP REDO2 /ALLOW FUNNY INPUT
                /
2026  1372    TYPLF, TAD (212 /LF
2027  4453      PTRPUT
2030  1335      TAD CHAR /SEE IF VALID
2031  1371      TAD (-301 /A?
2032  7450      SNA
2033  5243      JMP XESA
2034  1370      TAD (-21 /R?
2035  7650      SNA CLA
2036  5242      JMP YESR
2037  1341      TAD ERMES /BAD COMMAND
2040  4777      JMS MESAGE
2041  5206      JMP REDO
                /
2042  7240    YESR, CLA CMA /R=-1
2043  3336    YESA, DCA MODE /A=0
2044  4444      TPWAIT /WAIT FOR TAPE TO GET TO BLOCK 1
2045  1340      TAD GOM /START INPUT MESSAGE
2046  4777      JMS MESAGE
2047  4450      RDRGET /IGNORE FIRST CHARACTER
2050  7300      CLA CLL
2051  1367      TAD (-3 /SET LT CNT
2052  3337      DCA LTCNT /3 TRAILERS TERMINATE (IN A ROW)
    2   0  53  4450      RDRGET /IGNORE LEADER
2054  1366      TAD (-200
2055  7450      SNA
2056  5253      JMP .-3
```

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```
2057  1375  STOWIT, TAD (200 /RESTORE AC
2060  4765    JMS PUT /STORE IT PACKED
2061  4450    RDRGET /GET MORE
2062  1366    TAD (-200 /3 IN A ROW TERMINATE
2063  7450    SNA
2064  5272    JMP MAYBT
2065  3334    DCA TEMP
2066  1367    TAD (-3 /RESET CNTR
2067  3337    DCA LTCNT
2070  1334    TAD TEMP
2071  5257    JMP STOWIT
              /
2072  2337  MAYBT, ISZ LTCNT /3?
2073  5257    JMP STOWIT /NO
2074  4452    RDRCLO /TURN OFF INPUT
2075  1764    TAD PLOC /SEE IF WE HAVE TO WRT BUFFER
2076  1363    TAD (-7200
2077  7640    SZA CLA
2100  4762    JMS WBUF
2101  7240    CLA CMA
2102  1761    TAD PBLK /AC=NUM BLKS
2103  0360    AND (3777
2104  6211    CDF 10
2105  3757    DCA 7771
2106  7201    CLA IAC /START BLK
2107  3756    DCA 7770
2110  1355    TAD (1000 /R
2111  2336    ISZ MODE
2112  1355    TAD (1000 /A
2113  3754    DCA 7772
2154  7772    TAD (-
2155  1000
2156  7770
2157  7771
2160  3777
2161  2267
2162  2257
2163  0600
2164  2301
2165  2200
2166  7600
2167  7775
2170  7757
2171  7477
2172  0212
2173  0215
2174  7563
2175  0200
2176  0177
2177  2307
2114  1353  7402
2115  3752    DCA 7774
2116  7240    CLA CMA
2117  3751    DCA 7775
2120  7201    CLA IAC
```

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```
2121  3750     DCA 7776
2122  1347     TAD (7402
2123  3746     DCA 7777
2124  6201     CDF 0
2125  1343     TAD DONE
2126  4745     JMS MESAGE
2127  4454     PTRCLO
2130  4444     TPWAIT
2131  6203     CDF CIF
2132  6002     IOF
2133  5744     JMP 7600
               /
2134  0000   TEMP, 0
2135  0000   CHAR, 0
2136  0000   MODE, 0
2137  0000   LTCNT, 0
2140  2424   GOM, GOMS
2141  2434   ERMES, ERM
2142  2400   MWHICH, MWH
2143  2442   DONE, DON
               /
2144  7600   PAGE
2145  2307
2146  7777
2147  7402
2150  7776
2151  7775
2152  7774
2153  0376
```

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```
                *2400
                /
2400   4543     MWH, TEXT :%#
2401   4302     #B
2402   1115     IN
2403   0122     AR
2404   3140     Y
2405   2417     TO
2406   4003      C
2407   2023     PS
2410   4543     %#
2411   2275     R=
2412   2205     RE
2413   1440     L
2414   0175     A=
2415   0102     AB
2416   2345     S%
2417   4343     ##
2420   1517     MO
2421   0405     DE
2422   4075      =
2423   4000      :
2424   4543     GOMS, TEXT :%#
2425   2324     ST
2426   0122     AR
2427   2440     T
2430   2205     RE
2431   0104     AD
2432   0522     ER
2433   0000     :
2434   4543     ERM, TEXT :%#
2435   0705     GE
2436   2440     T
2437   1005     HE
2440   1420     LP
2441   4100     !:
2442   4543     DON, TEXT :%#
2443   0417     DO
2444   1605     NE
2445   5640     .
2446   2205     RE
2447   2425     TU
2450   2216     RN
2451   1116     IN
2452   0740     G
2453   2417     TO
2454   4003      C
2455   2023     PS
2456   5600     .:
                PAGE
```

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```
                *2200
                /
2200  0000      PUT, 0 /PUT AND PACK SABR BINARY
2201  0377        AND (377
2202  3302        DCA IPT
2203  1303        TAD PUTSW /WHICH THIRD?, INIT = 0
2204  7450        SNA /0=LEFT
2205  5236        JMP PART1
2206  7700        SMA CLA /-1=RIGHT
2207  5215        JMP PART2 /+1=MID
2210  1302        TAD IPT /DO RIGHT SIDE
2211  1701        TAD I PLOC
2212  3701        DCA I PLOC /PACKED IN
2213  4250        JMS TSTPLC /GET NEXT WORD ADVANCE
2214  3303        DCA PUTSW /SET FOR LSIDE
2215  5245        JMP PRET
2215  1302      PART2, TAD IPT /SPLITS TWO WORDS
2217  7112        RTR CLL
2220  7012        RTR
2221  0376        AND (17
2222  1701        TAD I PLOC
2223  3701        DCA I PLOC /PACKED HIGH 4 BITS
2224  4250        JMS TSTPLC /ADVANCE TO THE NEXT WORD
2225  1302        TAD IPT
2226  7112        RTR CLL
2227  7012        RTR
2230  7010        RAR
2231  0375        AND (7400
2232  3701        DCA I PLOC
2233  7240        CLA CMA
2234  3303        DCA PUTSW
2235  5245        JMP PRET
2236  1302      PART1, TAD IPT
2237  7006        RTL
2240  7006        RTL
2241  0374        AND (7760
2242  3701        DCA I PLOC
2243  7201        CLA IAC
2244  3303        DCA PUTSW
2245  7000      PRET, NOP
2246  6202        CIF
2247  5600        JMP I PUT
                /
2250  0000      TSTPLC, 0 /ADVANCE PLOC AND SEE IF IN CORE
2251  2301        ISZ PLOC
2252  1373        TAD (-7400
2253  1301        TAD PLOC
2254  7700        SMA CLA /-IS IN CORE
2255  4257        JMS WBUF
2256  5650        JMP I TSTPLC
                /
2257  0000      WBUF, 0 /WRITE BUFFER
2260  1267        TAD PBLK /IEST FOR END OF BUFFER
2261  1270        TAD PBLK+1
2262  0372        AND (777
```

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```
2263  1371    TAD (-150
2264  7700    SMA CLA
2265  5305    JMP TOOFAR
2266  4446  WRSTAP
2267  4001  PBLK, 4001
2270  0001    1
2271  7200  PLOCI, 7200
2272  4444    IPWAIT
2273  1267    TAD PBLK
2274  1270    TAD PBLK+1
2275  3267    DCA PBLK
2276  1271    TAD PLOCI
2277  3301    DCA PLOC
2300  5657    JMP I WBUF
              /
2301  7200  PLOC, 7200 /INIT VALUE TO START
2302  0000  IPT, 0
2303  0000  PUTSW, 0
2304  3167  L3167, 3167
              /
2305  7402  TOOFAR, HLT
2306  5305    JMP .-1
              /
2307  0000  MESAGE, 0 /AC=ADDR OF TEXT
2310  1362    TAD MESN1 /-1
2311  3010    DCA 10 /USES AUTO-INDEX
2312  1410    TAD I 10
2313  3324    DCA MSRGHT /SAVE PACKED WORD
2314  1324    TAD MSRGHT
2315  7012    RTR
2316  7012    RTR
2317  7012    RTR
2320  4325    JMS TYPCH /TYPE LH
2321  1324    TAD MSRGHT
2322  4325    JMS TYPCH /TYPE RH
2323  5312    JMP MESAGE+3
2324  0000  MSRGHT, 0 /TEMP
2325  0000  TYPCH, 0 /TYPES
2326  0353    AND MASK77
2327  7450    SNA /0 TERMINATES
2330  5707    JMP I MESAGE /RETURN
2331  1354    TAD MESN40 /-40
2332  7500    SMA /<40?
2333  5336    JMP .+3
2334  1355    TAD C340MES /340
2335  5351    JMP MTP
2336  1356    TAD M3MES /-3
2337  7440    SZA /LFD
2340  5343    JMP .+3
2341  1357    TAD C212MES
2342  5351    JMP MTP
2343  1363    TAD M2MES /-2
2344  7440    SZA /CR?
2345  5350    JMP .+3
2346  1360    TAD C215MES
```

```
2347  5351    JMP MTP
2350  1361    TAD C245MES
2351  4453  MTP, PTRPUT /TYPE IT
2352  5725    JMP I TYPCH /RET
              /
              /
2353  0077  MASK77, 77
2354  7740  MESN40, -40
2355  0340  C340MES, 340
2356  7775  M3MES, -3
2357  0212  C212MES, 212
2360  0215  C215MES, 215
2361  0245  C245MES, 245
2362  7777  MESN1, -1
2363  7776  M2MES, -2
              /
2371  7630  PAGE
2372  0777
2373  0400
2374  7760
2375  7400
2376  0017
2377  0377
```

CHAPTER 4

*TAPCOPY

*TAPCOPY is a general purpose magnetic tape copying utility program. It can be used to copy blocks of LINC or PDP-8 formatted magnetic tapes onto another or the same tape using either the LINC or PDP-8 format.

Instructions

The program *TAPCOPY is loaded and started by the command

```
RUN *TAPCOPY
```

The following heading is typed

```
TAPE COPY UTILITY
CTRL-C RETS TO CPS
RUBOUT RESTARTS
```

The following control options are provided to the user on the input lines.

A (CTRL-C) on any line immediately terminates program execution and automatically returns control of the computer to CPS (provided the proper CPS tapes are mounted at the time!).

A (RUBOUT) on any line immediately deletes all previously entered data and causes a return to the first input request.

A (BACK-ARROW) deletes the information entered on the current line. The request is not retyped.

Lines should be terminated by a (CARRIAGE RETURN) or a (CTRL-C) or a (RUBOUT).

The following is a description of the input requests on a line by line basis. These requests are typed by the program and the user must type the appropriate responses. Minimal error checking is done by this program. Be careful! All numbers used below are octal.

Request 1 FRM BLK =

The user should type in the tape block number on the source tape at which the transfer is to start. Inputs on this line are treated modulo-4000.

Request 2 FRM UNT =

Type in the tape unit upon which the source tape is mounted. Only units 0 and 1 are valid inputs.

Request 3 AMT =

Type in the number of blocks to be transferred (octal). Values of 1 through 3777 are acceptable. (PDP-8 format tapes contain ?000 blocks and LINC format tapes contain 1000 blocks.)

Request 4 L OR 8 =

The format of the source tape is either PDP-8 or LINC. Type "L" for LINC format or "8" for PDP-8 format.

Request 5 TO BLK =

Type the starting block number of the sink tape to which the transfer is to be made. This number is taken modulo-4000.

Request 6 TO UNT =

Type the unit number upon which the sink tape is mounted. Only units 0 and 1 are valid inputs.

Request 7 L OR 8 =

The tape format to be used in writing the transferred information onto the sink tape. Type "L" for LINC format or "8" for PDP-8 format. No checking is done for consistent source and sink specifications or formats.

Comments

If a LINC tape is being transferred to a PDP-8 tape, twice as many blocks will be written as were read because of the difference in size of the data blocks.

If an odd number of PDP-8 blocks are being transferred to a LINC tape format, the first 200 words of the last LINC block will correspond to the last PDP-8 block. The remaining 200 words in the

last LINC block will be undetermined. The normal transfer is two PDP-8 blocks per LINC block.

When request line 7 is terminated by a (CR) the requested transfer will take place. When the transfer has been completed the following message will be typed

0000 CHECK SUM ERRORS

Which gives the number of check sum errors which occurred in reading the source tape.

```
                /TAPE COPY UTILITY
                /USES IOCS3
                /
                CHECKER=31
                IGNORE=34
                /
                *100
                /
0100  0000      TEMP, 0
0101  2422      L1, LN1
0102  2434      L2, LN2
0103  2447      L3, LN3
0104  2460      L4, LN4
0105  2467      L5, LN5
0106  2476      L6, LN6
0107  2505      L7, LN7
0110  2514      L8, LN8
0111  2523      L9, LN9
0112  2532      L10, LN10
0113  2534      L11, LN11
0114  2545      L12, LN12
0115  0000      FRMODE, 0
0116  0000      TOMODE, 0
0117  0000      AMT, 0
0120  0000      DONESW, 0
0121  0000      ERRAC, 0
                /
                *2000
                /
2000  7300        CLA CLL
2001  4442        CALL RESET
2002  4447        RDROPN
2003  7240        CLA CMA /IGNORE READ ERRORS
2004  3034        DCA IGNORE
2005  1101        TAD L1 /PRINT HEADER
2006  4777        JMS MESAGE
2007  1102        TAD L2
2010  4777        JMS MESAGE
2011  1103        TAD L3
2012  4777        JMS MESAGE
2013  7300      AGAIN, CLA CLL
2014  3121        DCA ERRAC /ZERO ERROR COUNT
2015  1104        TAD L4
2016  4777        JMS MESAGE /FRM BLK =
2017  4776        JMS OCTIN /GET BLK NUM
2020  4775        JMS CHECKA /CHECK TERMINATOR
2021  0374        AND (3777 /FORCE VALID
2022  3773        DCA FRMBLK /SAVE
2023  1105        TAD L5
2024  4777        JMS MESAGE /FRM UNT =
2025  4776        JMS OCTIN /GET UNIT
2026  4775        JMS CHECKA
2027  3100        DCA TEMP
2030  1100        TAD TEMP
```

```
2031  7450    SNA /0 OK
2032  7410    SKP
2033  1372    TAD (-1 /1 OK
2034  7640    SZA CLA
2035  5213    JMP AGAIN /BAD UNIT
2036  1100    TAD TEMP
2037  7112    CLL RTR
2040  1773    TAD FRMBLK
2041  3773    DCA FRMBLK
2042  1106    TAD L6
2043  4777    JMS MESAGE /AMOUNT
2044  4776    JMS OCTIN
2045  4775    JMS CHECKA
2046  1371    TAD (4000 /LINK WAS 0
2047  7430    SZL
2050  5213    JMP AGAIN
2051  1371    TAD (4000 /RESTORE AC
2052  7450    SNA /DONT DO 0
2053  5213    JMP AGAIN
2054  3117    DCA AMT /SAVE
2055  1107    TAD L7
2056  4777    JMS MESAGE /L OR 8
2057  4770    JMS SEELOR8
2060  3115  SET8F, DCA FRMODE /SET FROM MODE, 0=PDP
2061  1110    TAD L8 /TO BLOCK
2062  4777    JMS MESAGE
2063  4776    JMS OCTIN
2064  4775    JMS CHECKA
2065  0374    AND (3777 /FORCE VALID
2066  3767    DCA TOBLK
2067  1111    TAD L9
2070  4777    JMS MESAGE /TO UNIT
2071  4776    JMS OCTIN
2072  4775    JMS CHECKA
2073  3100    DCA TEMP
2074  1100    TAD TEMP
2075  7450    SNA
2076  7410    SKP
2077  1372    TAD (-1
2100  7640    SZA CLA
2101  5213    JMP AGAIN
2102  1100    TAD TEMP
2103  7112    CLL RTR
2104  1767    TAD TOBLK
2105  3767    DCA TOBLK
2106  1107    TAD L7 /L OR 8
2107  4777    JMS MESAGE
2110  4770    JMS SEELOR8
2111  3116  SET8T, DCA TOMODE
              /
              /ALL DATA IN, GO TO IT
              /
2112  1114    TAD L12 /ALLOW USER TO START TRANSFER
2113  4777    JMS MESAGE
2114  4776    JMS OCTIN
```

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```
2115  4775     JMS CHECKA
2116  7300     CLA CLL
2117  5766     JMP TRANSF
               /
2166  2200   PAGE
2167  2316
2170  3000
2171  4000
2172  7777
2173  2245
2174  3777
2175  2400
2176  2654
2177  2600
```

```
                *2200
                /
2200    3120    TRANSF, DCA DONESW
2201    4216      JMS READ /GET IN AS MUCH AS POSSIBLE
2202    4276      JMS WRITE /WRITE IT OUT
2203    2120      ISZ DONESW /-1=DONE
2204    5200      JMP TRANSF
2205    4444      TPWAIT
2206    1112      TAD L10
2207    4777      JMS MESAGE
2210    1121      TAD ERRAC
2211    4776      JMS OCTOUT /TYPE NUMB OF READ ERRORS
2212    7300      CLA CLL
2213    1113      TAD L11
2214    4777      JMS MESAGE
2215    5775      JMP AGAIN
                /
                /
2216    0000    READ, 0 /READS INTO FIELD 1, 36 PAGES MAX (OCTAL)
2217    4444      TPWAIT
2220    1115      TAD FRMODE
2221    7004      RAL /L=1=LINC
2222    4443      CALL TPMODE /SET MODE
2223    1115      TAD FRMODE
2224    7004      RAL
2225    1374      TAD (17 /LINC SIZE
2226    7420      SNL
2227    1374      TAD (17 /8 SIZE
2230    3330      DCA RMAX
2231    1330      TAD RMAX
2232    7041      CIA
2233    1117      TAD AMT /AC .G. 0 =AMT LEFT
2234    7450      SNA
2235    5272      JMP RDONE
2236    7510      SPA
2237    5272      JMP RDONE
2240    3117      DCA AMT /UPDATE NEW AMOUNT
2241    1330      TAD RMAX
2242    1373    RDDI, TAD (4000 /FIELD 1
2243    3246      DCA RNUM
2244    4445      RDSTAP
2245    0000    FRMBLK, 0
2246    0000    RNUM, 0
2247    0000    LOC, 0
2250    1246      TAD RNUM
2251    0372      AND (77
2252    1245      TAD FRMBLK
2253    3245      DCA FRMBLK
2254    1115      TAD FRMODE
2255    7004      RAL
2256    1246      TAD RNUM /HOW MANY PAGES TO WRITE?
2257    0372      AND (77
2260    3326      DCA TEM
2261    1326      TAD TEM
2262    7430      SZL
```

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```
2263  1326    TAD TEM
2264  3327    DCA PAGECN
2265  4444    TPWAIT
2266  1031    TAD CHECKER
2267  1121    TAD ERRAC
2270  3121    DCA ERRAC
2271  5616    JMP I READ /RETURN
              /
2272  7240  RDONE, CLA CMA /READ ALL DONE
2273  3120    DCA DONESW
2274  1117    TAD AMT
2275  5242    JMP RDDI
              /
              /
2276  0000  WRITE, 0
2277  4444    TPWAIT
2300  1116    TAD TOMODE
2301  7004    RAL
2302  4443    CALL TPMODE
2303  1116    TAD TOMODE
2304  7004    RAL
2305  1327    TAD PAGECN
2306  7430    SZL
2307  7010    RAR
2310  7430    SZL
2311  7001    IAC /ROUND UP
2312  0372    AND (77 /MASK
2313  1371    TAD (6000 /FIELD 1 CHECK
2314  3317    DCA TNUM
2315  4446    WRSTAP
2316  0000  TOBLK, 0
2317  0000  TNUM, 0
2320  0000  TLOC, 0
2321  1317    TAD TNUM
2322  0372    AND (77
2323  1316    TAD TOBLK
2324  3316    DCA TOBLK
2325  5676    JMP I WRITE
              /
2326  0000  TEM, 0
2327  0000  PAGECN, 0
2330  0000  RMAX, 0
              /
2371  6000  PAGE
2372  0077
2373  4000
2374  0017
2375  2013
2376  2733
2377  2600
```

```
                *2400
                /
2400    0000    CHECKA, 0
2401    3221      DCA CHTM
2402    1777      TAD OCTINP
2403    1376      TAD (-203 /CTRL-C ?
2404    7450      SNA
2405    5214      JMP RET
2406    1375      TAD (-174 /RUBOUT ?
2407    7650      SNA CLA
2410    5774      JMP AGAIN
2411    1221      TAD CHTM
2412    7100      CLL
2413    5600      JMP I CHECKA
                /
2414    4444    RET, TPWAIT
2415    4454      PTRCLO
2416    6203      CDF CIF
2417    6002      IOF
2420    5773      JMP 7600
                /
2421    0000    CHTM, 0
                /
2422    4543    LN1, TEXT :%#
2423    2401    TA
2424    2005    PE
2425    4003     C
2426    1720    OP
2427    3140    Y
2430    2524    UT
2431    1114    IL
2432    1124    IT
2433    3100    Y:
2434    4543    LN2, TEXT :%#
2435    0324    CT
2436    2214    RL
2437    5503    -C
2440    4022     R
2441    0524    ET
2442    2340    S
2443    2417    TO
2444    4003     C
2445    2023    PS
2446    0000    :
2447    4543    LN3, TEXT :%#
2450    2225    RU
2451    0217    BO
2452    2524    UT
2453    4022     R
2454    0523    ES
2455    2401    TA
2456    2224    RT
2457    2300    S:
2460    4543    LN4, TEXT :%#
2461    0622    FR
```

```
2462  1540  M
2463  0214  BL
2464  1340  K
2465  7540  =
2466  0000  :
2467  4543  LN5, TEXT :%#
2470  0622  FR
2471  1540  M
2472  2516  UN
2473  2440  T
2474  7540  =
2475  0000  :
2476  4543  LN6, TEXT :%#
2477  0115  AM
2500  1725  OU
2501  1624  NT
2502  4040
2503  7540  =
2504  0000  :
2505  4543  LN7, TEXT :%#
2506  1440  L
2507  1722  OR
2510  4070   8
2511  4040
2512  7540  =
2513  0000  :
2514  4543  LN8, TEXT :%#
2515  2417  TO
2516  4040
2517  0214  BL
2520  1340  K
2521  7540  =
2522  0000  :
2523  4543  LN9, TEXT :%#
2524  2417  TO
2525  4040
2526  2516  UN
2527  2440  T
2530  7540  =
2531  0000  :
2532  4543  LN10, TEXT :%#
2533  0000  :
2534  4003  LN11, TEXT : C
2535  1005  HE
2536  0313  CK
2537  4023   S
2540  2515  UM
2541  4005   E
2542  2222  RR
2543  1722  OR
2544  2300  S:
2545  4543  LN12, TEXT :%#
2546  5003  (C
2547  2251  R)
2550  4023   S
```

```
2551   2401   TA
2552   2224   RT
2553   2340   S
2554   0317   CO
2555   2031   PY
2556   1116   IN
2557   0700   G:
                /
2573   7600   PAGE
2574   2013
2575   7604
2576   7575
2577   2731
```

```
                *3000
                /
3000    0000    SEELOR8, 0 /TEST FOR LINC OR PDP-8
3001    4777      JMS RDRINT /GET CHAR
3002    3100      DCA TEMP /SAVE
3003    1100      TAD TEMP
3004    4776      JMS PTROUT /ECHO
3005    1100      TAD TEMP
3006    3775      DCA OCTINP
3007    4774      JMS CHECKA
3010    1100      TAD TEMP
3011    1373      TAD (-215 /CR?
3012    7640      SZA CLA
3013    5225      JMP UPDATE
3014    1230      TAD CHARAC
3015    1372      TAD (-270
3016    7450      SNA
3017    5600      JMP I SEELOR8 /PDP-8
3020    1371      TAD (-24 /L?
3021    7640      SZA CLA
3022    5770      JMP AGAIN /OOPS
3023    1367      TAD (4000
3024    5600      JMP I SEELOR8
3025    1100    UPDATE, TAD TEMP
3026    3230      DCA CHARAC
3027    5201      JMP SEELOR8+1
                /
                /
3030    0000    CHARAC, 0
                /.
3167    4000    PAGE
3170    2013
3171    7754
3172    7510
3173    7563
3174    2400
3175    2731
3176    2764
3177    2757
```

```
                /I-O UTILITY
                /CONTAINS MESAGE, OCTIN, OCTOUT
                /
                *2600
                /
2600  0000  MESAGE, 0 /AC=ADDR OF TEXT
2601  3254    DCA OCTIN /USE AS A TEMP
2602  1654    TAD I OCTIN /GET WORD
2603  2254    ISZ OCTIN /ADV PTR
2604  3215    DCA MSRGHT /SAVE PACKED WORD
2605  1215    TAD MSRGHT
2606  7012    RTR
2607  7012    RTR
2610  7012    RTR
2611  4216    JMS TYPCH /TYPE LH
2612  1215    TAD MSRGHT
2613  4216    JMS TYPCH /TYPE RH
2614  5202    JMP MESAGE+2
2615  0000  MSRGHT, 0 /TEMP
2616  0000  TYPCH, 0 /TYPES
2617  0244    AND MASK77
2620  7450    SNA /0 TERMINATES
2621  5600    JMP I MESAGE /RETURN
2622  1245    TAD MESN40 /-40
2623  7500    SMA /<40?
2624  5227    JMP .+3
2625  1246    TAD C340MES /340
2626  5242    JMP MTP
2627  1247    TAD M3MES /-3
2630  7440    SZA /LFD
2631  5234    JMP .+3
2632  1250    TAD C212MES
2633  5242    JMP MTP
2634  1253    TAD M2MES /-2
2635  7440    SZA /CR?
2636  5241    JMP .+3
2637  1251    TAD C215MES
2640  5242    JMP MTP
2641  1252    TAD C245MES
2642  4364  MTP, JMS PTROUT
2643  5616    JMP I TYPCH /RET
                /
                /
2644  0077  MASK77, 77
2645  7740  MESN40, -40
2646  0340  C340MES, 340
2647  7775  M3MES, -3
2650  0212  C212MES, 212
2651  0215  C215MES, 215
2652  0245  C245MES, 245
2653  7776  M2MES, -2
                /
2654  0000  OCTIN, 0 /OCTAL INPUT, 4 DIGITS MAX
2655  7300    CLA CLL
2656  1322    TAD M40C /-4
```

```
2657  3330    DCA OCTCNT
2660  3332    DCA OCTOPT /0 OUTPUT VALUE
2661  4357  OCTA, JMS RDRINT /GET CHAR
2662  3331    DCA OCTINP /SAVE
2663  1331    TAD OCTINP
2664  0323    AND MS7770 /MASK OFF LAST DIGIT
2665  1324    TAD M2600C /SEE IF OCTAL DIGIT
2666  7640    SZA CLA /S IF YES
2667  5306    JMP OCTC /NO
2670  1331    TAD OCTINP
2671  4364    JMS PTROUT /ECHO
2672  1332    TAD OCTOPT /MULTIPLY BY 8
2673  7004    RAL
2674  7006    RTL
2675  3332    DCA OCTOPT
2676  1331    TAD OCTINP
2677  0325    AND MS0007 /GET OCTAL DIGIT
2700  1332    TAD OCTOPT /UPDATE VALUE
2701  3332    DCA OCTOPT
2702  2330    ISZ OCTCNT /SEE IF WE HAVE DONE 4
2703  5261    JMP OCTA /MORE ALLOWED
2704  4357    JMS RDRINT /TERMINATE
2705  3331    DCA OCTINP
2706  1331  OCTC, TAD OCTINP /WHICH NON OCTAL?
2707  1326    TAD M3370C /BACK ARROW?
2710  7640    SZA CLA /S IF YES
2711  5317    JMP OCTB /RETURN
2712  1331    TAD OCTINP /ECHO
2713  4364    JMS PTROUT
2714  1327    TAD C2400C /SPACE
2715  4364    JMS PTROUT /TYPE IT
2716  5255    JMP OCTIN+1 /RESTART
2717  7300  OCTB, CLA CLL /EXIT NOW
2720  1332    TAD OCTOPT
2721  5654    JMP I OCTIN /RET W AC=VALUE L=0
              /
2722  7774  M40C, -4
2723  7770  MS7770, 7770
2724  7520  M2600C, -260
2725  0007  MS0007, 7
2726  7441  M3370C, -337
2727  0240  C2400C, 240
2730  0000  OCTCNT, 0
2731  0000  OCTINP, 0
2732  0000  OCTOPT, 0
              /
              /
2733  0000  OCTOUT, 0
2734  3254    DCA OCTIN /SAVE AC
2735  1322    TAD M40C
2736  3330    DCA OCTCNT /4 DIGITS OUT
2737  1254    TAD OCTIN
2740  3332    DCA OCTOPT
2741  1332  OCTD, TAD OCTOPT
2742  7006    RTL
```

```
2743  7004    RAL /ROTATE LEFT 3
2744  3332    DCA OCTOPT /SAVE
2745  1332    TAD OCTOPT /GET AGAIN
2746  7004    RAL /FINISH GETTING DIGIT
2747  0325    AND MS0007 /MASK
2750  1356    TAD C2600C /MAKE ASCII
2751  4364    JMS PTROUT /TYPE
2752  2330    ISZ OCTCNT /DONE?
2753  5341    JMP OCTD /NO
2754  1254    TAD OCTIN /RESTORE AC
2755  5733    JMP I OCTOUT /L=0
              /
2756  0260  C2600C, 260
              /
2757  0000  RDRINT, 0
2760  4450    JMS I 50 /USE USER ROUTINE
2761  0377    AND (177 /FORCE PARITY
2762  1376    TAD (200
2763  5757    JMP I RDRINT
              /
2764  0000  PTROUT, 0
2765  4453    JMS I 53 /USE USER ROUTINE
2766  7300    CLA CLL
2767  5764    JMP I PTROUT
              /
2776  0200  PAGE
2777  0177
```

CHAPTER 5

ONE PAGE TAPE ROUTINES

5.1 PAGER

This is a compact read-write magnetic tape subroutine which requires only one page of memory in the PDP-8. It is intended for use in data processing and system programs where space is at a premium. This program's predecessors have been used extensively at CEL. PAGER is page-relocatable.

This subroutine, as documented in this memo, is set up to handle tapes using the PDP-8 format and to work in field 0 into and out of field 0. By properly modifying the 4 CDF's in this routine it can read into and out of any memory field while resident in any memory field. An external subroutine can be used to make the required changes under program control. Similarly an external subroutine can be used to alter the tape format used by the tape routine.

Data Field Modifications

The CDF instructions labeled RCDF and WCDF should be set to the memory field corresponding to that of the data to be transferred. The CDF's two instructions later should be set to correspond to the memory field the tape routine is in.

Tape Format Modifications

This routine can be modified to handle LINC format tapes by changing

LMOD1	to a	CIA
LMOD2	to a	NOP
NTSIZE	to a	7400

Calling Sequence

This subroutine includes a time-out delay loop of about .08 seconds duration in order to allow the tape units to settle down on successive read/write operations. This is only necessary with PDP-8 format tapes because of the small block size.

This subroutine always starts tapes in the backwards direction.

The calling sequence is

```
JMS RTAPE (OR WTAPE)   / READ OR WRITE
BLN                    / STARTING AT TAPE BLOCK
NUMBLK                 / FOR THIS MANY BLOCKS > 0
UNIT                   / USING THIS TAPE UNIT
LOC                    / THIS IS WHERE IN CORE TO START
        / CONTROL RETS HERE WITH AC AND L EQUAL TO 0
```

Do not attempt to use this subroutine to transfer 0 blocks.

0 blocks gets treated as 4096.

All starting block numbers between 0 and 3777 (inclusive) are accepted, however, they may not exist on your tape!

Notes

The symbolic version of PAGER is stored on the CPS library tapes under the name SPAGER. The following line numbers are handy:

WCDF	line 90
RCDF	line 117
LMOD1	line 103
LMOD2	line 125
NTSIZE	line 146

```
                /TAPE ROUTINE FOR READING
                /AND WRITING SIZE 128 BLOCKS ON
                /THE LINC 8
                /
                /CAN BE MODIFIED TO SIZE 256 BLOCKS
                /CHANGE LOCATIONS LMOD1, LMOD2 AND NTSIZE
                /AS INDICATED BELOW
                /
                /TO USE:
                /
                /  JMS RTAPE OR WTAPE  READ OR WRITE
                /  XXXX                BLOCK NUMBER
                /  YYYY                NUMBER OF BLOCKS > 0
                /  0 OR 1              UNIT NUMBER
                /  ZZZZ                WHERE IN CORE
                /  CONTROL RETS HERE WITH CLEAR AC AND LINK
                /
                /K. METZGER 5/21/69
                /
                *1200
                /
1200  0000  RTAPE, 0
1201  7300    CLA CLL
1202  1200    TAD RTAPE /MOVE POINTER
1203  3205    DCA WTAPE
1204  5207    JMP INTO
1205  0000  WTAPE, 0
1206  7320    CLA STL /SET LINK FOR WRITE
1207  1342  INTO, TAD C6 /ROTATE MAKES INTO 3
1210  7010    RAR
1211  3372    DCA FUNCT
1212  1605    TAD I WTAPE /BLOCK NUMBER
1213  3373    DCA BLN
1214  2205    ISZ WTAPE
1215  1605    TAD I WTAPE /NUMB OF BLOCKS
1216  7041    CIA
1217  3374    DCA NUMB
1220  2205    ISZ WTAPE
1221  1605    TAD I WTAPE /UNIT
1222  7112    RTR CLL /PUT INTO BIT 0
1223  1313    TAD C2 /TO SET SEARCH
1224  3375    DCA UNIT
1225  2205    ISZ WTAPE
1226  1605    TAD I WTAPE /CORE LOC
1227  3376    DCA LOC
1230  2377    ISZ CNTR /TIMEOUT TO ALLOW
1231  5226    JMP .-3 /TAPE DRIVE TO SETTLE
1232  2205    ISZ WTAPE
1233  7120    STL /LINC = 1, FIRST PASS
1234  2373  SERCHA, ISZ BLN /1'S COMPL ON TAPE
1235  3200  SERCHB, DCA CSUM /ZERO CHECK SUM
1236  1371    TAD NTSIZE
1237  3377    DCA CNTR /WORD COUNT
1240  1375    TAD UNIT /NOW SET SERCH
1241  6141    ICON
```

```
1242  7201    CLA IAC /TO START MOTION BACKWARDS
1243  7430    SZL /SEE IF MOVING
1244  6141    ICON
1245  1342    TAD C6 /TO CLEAR INTS
1246  6141  B, ICON
1247  4356  A, JMS WAIT /FOR BLK INT
1250  7500    SMA /ONLY NEG VALID
1251  7120    STL /POS WANT FWD FOR BLK 0
1252  1373    TAD BLN
1253  7650    SNA CLA /L=1, WANT FWD
1254  5270    JMP THERE /ON BLOCK
1255  6147    INTS /WANT MQ
1256  7010    RAR /MQ TO L, L TO BIT 0
1257  0370    AND M4000
1260  7460    SZA SNL
1261  5247    JMP A /WANT FORE, GOT FORE
1262  7020    CML
1263  7520    SNL SMA
1264  5247    JMP A /BACKWARDS
1265  6141    ICON /STOP
1266  7001    IAC /BIT 0 IS OK HERE
1267  5246    JMP B /CHANGE MOTION
1270  6147  THERE, INTS /WANT M1
1271  7012    RTR
1272  7620    SNL CLA /ON AND FOREW
1273  5247    JMP A /ON AND GOING BACK, REVERSE
1274  1372    TAD FUNCT
1275  6141    ICON /SET BLOCK MODE
1276  7500    SMA /S IF TO WRITE
1277  5331    JMP RDATA
1300  1313    TAD C2 /TO GET 5
1301  6141    ICON /TURN WRITERS ON
1302  7200  WRITE, CLA
1303  6201  WCDF, CDF /SET TO DESIRED FIELD
1304  1776    TAD I LOC
1305  6201    CDF /SET TO FIELD ROUTINE IS IN
1306  6161    IACB /AC TO LINC REG
1307  1200    TAD CSUM
1310  3200    DCA CSUM
1311  4356    JMS WAIT /PUT IT OUT
1312  2376    ISZ LOC
1313  0002  C2, 2 /STORAGE, THIS HAS NO EFFECT
1314  2377    ISZ CNTR /DONE?
1315  5302    JMP WRITE /NO
1316  7200    CLA
1317  1200    TAD CSUM
1320  7000  LMOD1, NOP /MAKE CIA FOR LINC FORMAT
1321  6161    IACB /WRITE CHECK SUM
1322  4356    JMS WAIT
1323  4356    JMS WAIT /ALLOW ACTUAL WRITE OF CS
1324  7300  DONE, CLA CLL
1325  2374    ISZ NUMB /ALL BLOCKS DONE?
1326  5234    JMP SERCHA /NO
1327  6141    ICON /STOP
1330  5605    JMP I WTAPE /GO HOME
1331  4356  RDATA, JMS WAIT /GUARD
```

```
1332  4356  RDTA, JMS WAIT
1333  1200    TAD CSUM
1334  3200    DCA CSUM
1335  6171    IAAC /GET AGAIN
1336  6201  RCDF, CDF /SET TO DESIRED FIELD
1337  3776    DCA I LOC /PUT IN CORE
1340  6201    CDF /SET TO FIELD ROUTINE IS IN
1341  2376    ISZ LOC
1342  0006  C6, 6 /STORAGE, NO EFFECT
1343  2377    ISZ CNTR
1344  5332    JMP RDTA /CONTINUE
1345  4356    JMS WAIT /CSUM
1346  7041  LMOD2, CIA /SET TO NOP FOR LINC FORMAT
1347  1200    TAD CSUM
1350  7650    SNA CLA /MAYBE BAD
1351  5324    JMP DONE /CHECKSUM OK
1352  1371    TAD NTSIZE
1353  1376    TAD LOC /FIX BACK
1354  3376    DCA LOC
1355  5235    JMP SERCHB /TRY AGAIN
1356  0000  WAIT, 0
1357  7300  W1, CLA CLL
1360  6147  C7, INTS
1361  7700    SMA CLA /TAPE?
1362  5357    JMP W1
1363  1360    TAD C7
1364  6141    ICON /CLEAR INTS
1365  7300    CLA CLL
1366  6171    IAAC /GET FROM TAPE
1367  5756    JMP I WAIT
              /
              /
1370  4000  M4000, 4000
1371  7600  NTSIZE, 7600 /MAKE 7400 FOR LINC FORMAT
1372  0000  FUNCT, 0
1373  0000  BLN, 0
1374  0000  NUMB, 0
1375  0000  UNIT, 0
1376  0000  LOC, 0
1377  0000  CNTR, 0
              /
              CSUM=RTAPE
              /
```

5.2 F1TAPE

This is PAGER's immediate predecessor set up to reside in memory field 1 and to read/write into/out of field 1. As programs are revised this routine is being replaced by PAGER.

The main external difference between F1TAPE and PAGER is the location of the entry point for writing tape.

```
                CSUM=RTAPE
                INTS=6147
                IAAC=6171
                IACB=6161
                ICON=6141
                /
                /
                /TAPE ROUTINE FOR READING
                /AND WRITING SIZE 128 BLOCKS ON
                /THE LINC 8
                /
                /THIS IS TO REPLACE THE ONE
                /I STOLE FROM DEC
                /
                *400
                /
0400  0000      RTAPE, 0
0401  7300        CLA CLL
0402  1200        TAD RTAPE /MOVE POINTER
0403  3206        DCA WTAPE
0404  1367        TAD M4000 /TO FORCE FUNCT = 3
0405  5210        JMP INTO
0406  0000      WTAPE, 0
0407  7300        CLA CLL
0410  1370      INTO, TAD C4003 /WRITE WITH SWITCH
0411  3371        DCA FUNCT
0412  1606        TAD I WTAPE /BLOCK NUMBER
0413  3372        DCA BLN
0414  2206        ISZ WTAPE
0415  1606        TAD I WTAPE /NUMB OF BLOCKS
0416  7041        CIA
0417  3373        DCA NUMB
0420  2206        ISZ WTAPE
0421  1606        TAD I WTAPE /UNIT
0422  7112        RTR CLL /PUT INTO BIT 0
0423  1313        TAD C2 /TO SET SEARCH
0424  3374        DCA UNIT
0425  2206        ISZ WTAPE
0426  1606        TAD I WTAPE /CORE LOC
0427  3375        DCA LOC
0430  2376       ISZ CNTR /TIMEOUT TO ALLOW TAPE
0431  5226       JMP .-3  /DRIVE TO SETTLE DOWN
0432  2206        ISZ WTAPE
0433  7120        STL /LINC = 1, FIRST PASS
0434  2372      SERCHA, ISZ BLN /1'S COMPL ON TAPE
0435  3200      SERCHB, DCA CSUM /ZERO CHECK SUM
0436  1316        TAD C7600
0437  3376        DCA CNTR /WORD COUNT
0440  1374        TAD UNIT /NOW SET SERCH
0441  6141        ICON
0442  7201        CLA IAC /TO START MOTION BACKWARDS
0443  7430        SZL /SEE IF MOVING
0444  6141        ICON
0445  1341        TAD C6 /TO CLEAR INTS
```

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```
0446  6141  B, ICON
0447  4355  A, JMS WAIT /FOR BLK INT
0450  7500    SMA /ONLY NEG VALID
0451  7120    STL /POS WANT FWD FOR BLK 0
0452  1372    TAD BLN
0453  7650    SNA CLA /L=1, WANT FWD
0454  5270    JMP THERE /ON BLOCK
0455  6147    INTS /WANT MQ
0456  7010    RAR /MQ TO L, L TO BIT 0
0457  0367    AND M4000
0460  7460    SZA SNL
0461  5247    JMP A /WANT FORE, GOT FORE
0462  7020    CML
0463  7520    SNL SMA
0464  5247    JMP A /BACKWARDS
0465  6141    ICON /STOP
0466  7001    IAC /BIT 0 IS OK HERE
0467  5246    JMP B /CHANGE MOTION
0470  6147  THERE, INTS /WANT M1
0471  7012    RTR
0472  7620    SNL CLA /ON AND FOREW
0473  5247    JMP A /ON AND GOING BACK, REVERSE
0474  1371    TAD FUNCT
0475  6141    ICON /SET BLOCK MODE
0476  7500    SMA /S IF TO WRITE
0477  5330    JMP RDATA
0500  1313    TAD C2 /TO GET 5
0501  6141    ICON /TURN WRITERS ON
0502  7200  WRITE, CLA
0503  6211    CDF 10
0504  1775    TAD I LOC
0505  6211    CDF 10
0506  6161    IACB /AC TO LINC REG
0507  1200    TAD CSUM
0510  3200    DCA CSUM
0511  4355    JMS WAIT /PUT IT OUT
0512  2375    ISZ LOC
0513  0002  C2, 2 /STORAGE, THIS HAS NO EFFECT
0514  2376    ISZ CNTR /DONE?
0515  5302    JMP WRITE /NO
0516  7600  C7600, 7600 /ALSO A CLA
0517  1200    TAD CSUM
0520  6161    IACB /WRITE CHECK SUM
0521  4355    JMS WAIT
0522  4355    JMS WAIT /ALLOW ACTUAL WRITE OF CS
0523  7300  WAIT2, CLA CLL
0524  2373    ISZ NUMB /ALL BLOCKS DONE?
0525  5234    JMP SERCHA /NO
0526  6141    ICON /STOP
0527  5606    JMP I WTAPE /GO HOME
0530  4355  RDATA, JMS WAIT /GUARD
0531  4355  RDTA, JMS WAIT
0532  1200    TAD CSUM
0533  3200    DCA CSUM
0534  6171    IAAC /GET AGAIN
```

```
0535  6211     CDF 10
0536  3775     DCA I LOC /PUT IN CORE
0537  6211     CDF 10
0540  2375     ISZ LOC
0541  0006   C6, 6 /STORAGE, NO EFFECT
0542  2376     ISZ CNTR
0543  5331     JMP RDTA /CONTINUE
0544  4355     JMS WAIT /CSUM
0545  7041     CIA
0546  1200     TAD CSUM
0547  7650     SNA CLA /MAYBE BAD
0550  5323     JMP WAIT2 /THIS IS OK
0551  1316     TAD C7600
0552  1375     TAD LOC /FIX BACK
0553  3375     DCA LOC
0554  5235     JMP SERCHB /TRY AGAIN
0555  0000   WAIT, 0
0556  7300   W1, CLA CLL
0557  6147   C7, INTS
0560  7700     SMA CLA /TAPE?
0561  5356     JMP W1
0562  1357     TAD C7
0563  6141     ICON /CLEAR INTS
0564  7300     CLA CLL
0565  6171     IAAC /GET FROM TAPE
0566  5755     JMP I WAIT
              /
              /
0567  4000   M4000, 4000
0570  4003   C4003, 4003
0571  0000   FUNCT, 0
0572  0000   BLN, 0
0573  0000   NUMB, 0
0574  0000   UNIT, 0
0575  0000   LOC, 0
0576  0000   CNTR, 0
```

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13. ABSTRACT CPS is a generalized programming and file management system written for use on the PDP-8 processor of Digital Equipment Corporation's LINC-8 computer. A minimum memory size of 8192 words is required. Extensive use is made of the two tape units present on every LINC-8 for both file storage and system residence. The four volumes entitled CPS System Architecture and Conventions, CPS Basic Programming Package, CPS 8-K FORTRAN Package, and CPS System Utility Programs were written in order to take a snapshot of CPS at one point in its continuing development. This version of CPS is considered to be a first generation system; successive versions are on the drawing boards and internally resemble their parent less and less every day.

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