1. IDENTIFICATION

1.1 Digital-8-16-S

1.2 Master Tape Duplicator/Verifier

1.3 July 20, 1965

2. ABSTRACT

This program will duplicate and verify 8-channel paper tapes using the PDP-8 with high-speed reader and high-speed punch. The program uses the program interrupt and allows both the reader and the punch to operate at maximum speed.

The program accumulates two types of checksums while reading and while punching: 1) the number of nonzero characters on the tape, and 2) the sum of characters on the tape (both are taken modulo 4096).

When duplicating, the program compares the checksums at the end of the tape with the checksums accumulated by the read routine. If these differ, a reader error has occurred and a message is typed. Tapes are verified by reading them and comparing accumulated checksums with those at the end of the tape. Only master tapes produced by the program may be duplicated. The master tape has the two checksums punched at the end.

3. REQUIREMENTS

3.1 Storage

The program uses all of memory, except for the last page, as a buffer.

3.3 Equipment

PDP-8 with high-speed reader and high-speed punch.

4. USAGE

4.1 Loading

The program is loaded with the Binary Loader (see Digital 8-2-U).

4.3 Switch Settings

4.3.1 Produce a Master Tape

A tape is read and duplicated by the punch. When the tape has run out of the reader, the accumulated checksums are punched. The tape that has been punched is the master tape used for duplication. It should be compared against the original to ensure that the tape was read correctly.

4.3.2 Duplicate the Master Tape

The master tape that has been produced (see 4.3.1) is reproduced by the punch. Checksums are accumulated by the read routine and are compared with the checksums at the end of the tape. Checksums are punched and are used for verification (see 4.3.3). If the master tape is short enough to fit into the buffer, the program will notify the operator that more copies may be remade without rereading the master. Blank tape is punched between copies.

4.3.3 Verify Duplication

Similar to duplication, but no punching takes place. Tapes are read and the accumulated checksums are compared against the checksums punched at the end.

4.3.4 General Procedure

4.3.4.1 Set C(SR) = 0200

4.3.4.2 Press LOAD ADDRESS; press START; the program will halt.

4.3.4.3 Set C(SR) for the mode of operation as follows:

Bit 0 = 1	Make master tape
Bit 1 = 1	Duplicate master tape
Bit 2 = 1	Verify duplication

4.3.4.4 Place tape in reader starting on blank tape (all modes of operation must be started with blank leader tape in the reader).

4.3.4.5 Turn reader on. Turn punch on.

4.3.4.6 Press CONTINUE.

4.3.4.7 The program will type a message when the operation has been completed and then it will halt.

4.3.4.8 Proceed from step 4.3.4.3 unless multiple copies are bing duplicated.

5. RESTRICTIONS (Not Applicable)

6. DESCRIPTION

6.1 Discussion

This program uses the program interrupt to keep the reader and the punch running at full speed. The reader fills a buffer and the punch punches from it. Checksums are accumulated by both the reader and the punch routines.

7. METHODS (Not Applicable)

8. FORMAT (Not Applicable)

9. EXECUTION TIME

9.3 Average

Execution time is a function of reader time and punch time and hence depends upon the length of the tape.

10. PROGRAM

10.4 Program Listing

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                /TAPE DUPLICATOR FOR PDP-5/8
                /  -DEC-1/15/65
                /SINGLE BUFFERING - READ AND PUNCH UTILIZING
                /PROGRAM INTERRUPT
                /COMPUTE A CHARACTER COUNT AND CHECKSUM
                /FOR EACH TAPE - COMPARE WITH CHECKS AT
                /END OF TAPE
                /CHECKS ARE ALSO COMPUTED DURING PUNCHING
                /AND COMPARED
                /THREE MODES OF OPERATION:
                /A. SWITCH Ø ON - MAKE MASTER TAPE
                /B. SWITCH 1 ON - DUPLICATE MASTER TAPE
                /C. SWITCH 2 ON - VERIFY DUPLICATION
                /DURING DUPLICATION, THE PROGRAM WILL NOTIFY
                /THE OPERATOR WHETHER OR NOT MORE COPIES
                /CAN BE MADE WITHOUT RE-READING THE
                /MASTER
                /DEFINITIONS OF INTERRUPT LOCATIONS:
                /FOR THE PDP-8; INTER=Ø
                /FOR THE PDP-5; INTER=1
                /PAGE 1
                INTER=Ø

                *INTER+1
0001  5020              JMP HNDL            /HANDLE INTERRUPT
0002  0632  NPNT,       DPRT
0003  0600  E1,         TES1
0004  0615  E2,         TES2
                *16
0016  0000  NDXR,       Ø                   /AUTO-INDEX REGISTER
0017  0000  NDXP,       Ø                   /AUTO-INDEX REGISTER
0020  6011  HNDL,       RSF
0021  7410              SKP
0022  5431              JMP I READ          /750 CAUSED INTERRUPT
0023  6021              PSF
0024  7410              SKP
0025  5434              JMP I PNC           /75A PUNCH CAUSED INTERRUPT
0026  4567              JMS I CRLF          /EXTRANEOUS-CLEAR FLAGS
0027  6001  DSMS,       ION                 /ENABLE INTERRUPT
0030  5400              JMP I INTER         /RETURN
0031  0000  READ,       Ø                   /CALLED AS A
0032  6014              RFC                 /SUBROUTINE TO PROVIDE
0033  5027              JMP DSMS            /RETURN ADDRESS
0034  0000  PNC,        Ø                   /CALLED AS SUBROUTINE
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0035  6026          PLS              /PROVIDES RETURN
0036  7200          CLA
0037  5027          JMP DSMS
0040  1417  PNCH,   TAD I NDXP       /GET NEXT CHARACTER
0041  7510          SPA              /IF IT IS 7777,IT
0042  5570          JMP I PDUN       /IS END OF TEXT
0043  3143          DCA HLD2
0044  1143          TAD HLD2
0045  7440          SZA
0046  2145          ISZ ZROP         /COUNT NON-ZERO CHARACTERS
0047  7000          NOP              /MODULO 4096
0050  1147          TAD CHKP         /ACCUMULATE SUM MODULO 4096
0051  3147          DCA CHKP
0052  1143          TAD HLD2
0053  4034          JMS PNC
0054  5040          JMP PNCH         /GO GET NEXT
0055  6012  RD1,     RRB              /READ 750 BUFFER
0056  3142          DCA HLD1         /SAVE IT
0057  5105  RST1,    JMP FRST         /OR "SCND" OR "THRD"
0060  1142          TAD HLD1
0061  7440          SZA
0062  2144          ISZ ZROR         /COUNT MODULO 4096
0063  7000          NOP
0064  1146          TAD CHKR         /ACCUMULATE SUM
0065  3146          DCA CHKR
0066  1160          TAD TIME         /RESET END-OF-TAPE TIMER
0067  3157          DCA TIMR
0070  7410  RST2,    SKP
0071  5155          JMP VY
0072  1142          TAD HLD1         /GET CHARACTER
0073  3416          DCA I NDXR       /PUT IN BUFFER
0074  2163          ISZ RCNT         /IS BUFFER FULL?
0075  7410          SKP              /NO
0076  5571          JMP I FUL        /YES
0077  4031          JMS READ         /FETCH NEXT CHARACTER
0100  2164          ISZ STRT         /DELAY START OF PUNCHING
0101  5055          JMP RD1
0102  7240          CLA CMA
0103  3175          DCA SCON
0104  5040          JMP PNCH         /START PUNCHING
0105  1142  FRST,    TAD HLD1         /TEST TO SEE IF
0106  1161          TAD TST1         /CHARACTER IS FIRST
0107  7640          SZA CLA          /IN CHECK-SUM IDENTIFIER
0110  5060          JMP RST1+1       /IF IT IS-SET SWITCH
0111  1153          TAD TRY2         /TO TEST FOR SECOND
0112  3057          DCA RST1         /CHARACTER NEXT
0113  5060          JMP RST1+1
0114  1142  SCND,    TAD HLD1         /CHECK FOR SECOND CHARACTER
0115  1162          TAD TST2         /IN IDENTIFIER - IF FOUND
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0116  7640          SZA CLA              /TEST FOR THIRD NEXT
0117  5123          JMP .+4              /IF NOT, RESET FOR FIRST
0120  1154          TAD TRY3
0121  3057          DCA RST1
0122  5060          JMP RST1+1
0123  1152          TAD TRY1
0124  5121          JMP .-3
0125  1142  THRD,    TAD HLD1             /TEST FOR THIRD CHARACTER
0126  1161          TAD TST1             /IN IDENTIFIER - IF FOUND
0127  7640          SZA CLA              /READ CHECKS FROM TAPE
0130  5123          JMP .-5              /IF NOT - RESET FOR FIRST
0131  7240          CLA CMA
0132  3416          DCA I NDXR           /SET END-OF PUNCH FLAG
0133  4541          JMS I GET1
0134  3151          DCA MCHK             /MEASURED CHECK-SUM
0135  4541          JMS I GET1
0136  3150          DCA MZRO             /MEASURED ZERO-COUNT
0137  5540          JMP I .+1
0140  0303          SWT1
0141  0565  GET1,    GET                  /GET 12-BIT WORD
0142  0000  HLD1,    0
0143  0000  HLD2,    0
0144  0000  ZROR,    0                    /# OF NON-ZERO READ
0145  0000  ZROP,    0                    /#OF NON-ZERO PUNCHED
0146  0000  CHKR,    0                    /CHECK SUM - READ
0147  0000  CHKP,    0                    /CHECK SUM - PUNCH
0150  0000  MZRO,    0                    /#OF NON-ZERO MEASURED
0151  0000  MCHK,    0                    /CHECK SUM - MEASURED
0152  5105  TRY1,    JMP FRST
0153  5114  TRY2,    JMP SCND
0154  5125  TRY3,    JMP THRD    /WHEN VERIFYING-DON' START
0155  4031  VY,      JMS READ    /PUNCHING
0156  5055          JMP RD1
0157  0000  TIMR,    0
0160  0000  TIME,    0
0161  7526  TST1,    7526        /2'S COMPLEMENT 1ST AND 3RD IDENTIFIER
0162  7653  TST2,    7653        /TWO'S COMPLEMENT OF 2ND IDENTIFIER
0163  0000  RCNT,    0
0164  0000  STRT,    0
0165  7000  NOPT,    NOP
0166  7410  SKIP,    SKP
0167  0345  CRLF,    CFLG
0170  0000  PDUN,    0
0171  0320  FUL,     BFUL
0172  0077  BIT6,    0077
0173  0000  DCON,    0
0174  0000  VCNT,    0
0175  0000  SCON,    0           /START OF PUNCHING FLAG
0176  0377  C377,    0377
0177  0002  TWO,     0002
```

```
                *200
0200    7200            CLA
0201    3174            DCA Z VCNT          /RESET VERIFY COUNT
0202    7200    LOOP,   CLA
0203    3144            DCA ZROR            /RESET PUNCH,READER
0204    3145            DCA ZROP            /COMPUTED CHECKS
0205    3146            DCA Z CHKR
0206    3147            DCA Z CHKP
0207    3173            DCA DCON            /RESET BUFFER OVER FLAG
0210    6012            RRB                 /CLEAR HARDWARE FLAGS
0211    6022            PCF
0212    7200            CLA
0213    3175            DCA SCON            /RESET START PUNCH FLAG
0214    1152            TAD Z TRY1          /SET PROGRAM SWITCHES
0215    3057            DCA Z RST1
0216    1166            TAD Z SKIP
0217    3070            DCA Z RST2
0220    1166            TAD Z SKIP
0221    3303            DCA SWT1
0222    1341            TAD DLAY            /SET START OF PUNCHING DELAY
0223    3164            DCA Z STRT
0224    7402    LOP1,   HLT
0225    7604            CLA OSR
0226    7004            RAL
0227    7430            SZL
0230    5250            JMP CRTE            /BIT 0=1, CREATE MASTER
0231    7004            RAL
0232    7430            SZL
0233    5255            JMP DUP             /BIT 1=1, DUPLICATE
0234    7004            RAL
0235    7630            SZL CLA
0236    5241            JMP .+3             /BIT 2=1, VERIFY
0237    7040            CMA                 /ERROR SET C(AC)=7777
0240    5224            JMP LOP1
0241    1165            TAD NOPT            /NO PUNCHING - DON'T
0242    3303            DCA SWT1            /WAIT FOR PUNCH
0243    1165            TAD Z NOPT
0244    3070            DCA RST2            /DON'T START PUNCHING
0245    1342            TAD VRPT
0246    3336            DCA CONR            /SET-UP RETURN FOR END
0247    5261            JMP GO
0250    7200    CRTE,   CLA
0251    1343            TAD CRPT
0252    3336            DCA CONR            /SET-UP RETURN FOR END
0253    3174            DCA Z VCNT
0254    5261            JMP GO
0255    7200    DUP,    CLA
0256    1344            TAD DUPT
0257    3336            DCA CONR            /SET-UP RETURN FOR END
0260    3174            DCA Z VCNT
0261    4345    GO,     JMS CFLG            /CLEAR FLAGS
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0262  1337          TAD BUF
0263  3016          DCA NDXR          /SET-UP BUFFER
0264  1337          TAD BUF           /POINTERS FOR
0265  3017          DCA NDXP          /READ AND PUNCH
0266  1340          TAD OVR
0267  3163          DCA RCNT          /SET BUFFER-FULL COUNT
0270  1333          TAD SA
0271  3000          DCA INTER         /INITIALIZE INTERRUPT
0272  1160          TAD Z TIME
0273  3157          DCA TIMR          /SET END-OF-TAPE TIMER
0274  4031          JMS READ          /START READING
0275  5055          JMP Z RD1
0276  2157  SAT,     ISZ Z TIMR
0277  5276          JMP .-1
0300  6002          IOF               /END-OF-TAPE
0301  7240          CLA CMA
0302  3416          DCA I Z NDXR      /SET END-OF-PUNCHING FLAG
0303  7410  SWT1,    SKP               /OR NOP FOR VERIFY
0304  5736          JMP I CONR
0305  1336          TAD CONR
0306  3170          DCA PDUN          /SET RETURN FOR PUNCH DONE
0307  1175          TAD Z SCON
0310  7700          SMA CLA           /DID WE START PUNCHING?
0311  5315          JMP .+4           /NO -
0312  6001          ION               /YES - WAIT FOR PUNCHING
0313  7200          CLA
0314  5313          JMP .-1
0315  1334          TAD SA1           /START PUNCHING
0316  3000          DCA INTER
0317  5102          JMP Z FRST-3
0320  7240  BFUL,    CLA CMA           /BUFFER-FULL
0321  3416          DCA I Z NDXR      /SET-UP END-OF-PUNCHING FLAG
0322  2173          ISZ Z DCON
0323  1335          TAD RET           /'FILL'
0324  3170          DCA Z PDUN
0325  5307          JMP BFUL-11
0326  1341  FILL,    TAD DLAY          /ENTER WHEN BUFFER
0327  3164          DCA STRT          /OVERFLOWED AND HAS
0330  3175          DCA Z SCON
0331  6022          PCF
0332  5262          JMP GO+1          /BEEN PUNCHED
0333  0276  SA,      SAT
0334  0312  SA1,     BFUL-6
0335  0326  RET,     FILL
0336  0000  CONR,    0
0337  1063  BUF,     X-1               /START OF BUFFER
0340  1274  OVR,     X+210             /BUFFER-FULL COUNT
0341  7760  DLAY,    7760              /DELAY START OF PUNCHING
0342  0400  VRPT,    VRFY              /DONE POINTERS
0343  0404  CRPT,    CRET
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0344  0445  DUPT,    DUPL
0345  0000  CFLG,    0                    /CLEAR FLAGS
0346  6042           TCF                  /TELEPRINTER
0347  6072           6072                 /LIGHT PEN
0350  6772           MMCF                 /MICRO TAPE
0351  6502           6502                 /PLOTTER
0352  6732           6732                 /DISABLE ERF FLAG (57A)
0353  7320           CLA CLL CML
0354  7012           RTR                  /SET C(AC)=2000
0355  6722           6722                 /DISABLE WCO FLAG (57A)
0356  7004           RAL                  /SET C(AC)=4000
0357  6702           6702                 /DISABLE TCR FLAG (57A)
0360  6652           6652                 /LINE-PRINTER FLAG
0361  6534           6534                 /138 ADC FLAG
0362  6032           KCC                  /KEY-BOARD (AND AC)
0363  5745           JMP I CFLG

                     PAUSE
                     *400
0400  2174  VRFY,    ISZ Z VCNT
0401  4403           JMS I E1             /COMPUTED VS MEASURED CHECKS
0402  5361           JMP VER              /VERIFY ERROR
0403  5351           JMP VOK              /VERIFY OK
0404  4404  CRET,    JMS I E2             /COMPUTED VS PUNCHED
0405  5345           JMP MER              /MEMORY ERROR
0406  4314           JMS BLNK
0407  1327           TAD HERE
0410  3000           DCA INTER            /SET INTERRUPT POINTER
0411  1325           TAD T1               /PUNCH CHECKSUM
0412  4034           JMS Z PNC            /IDENTIFIER CODES
0413  1326           TAD T2               /BIT PATTERN IS:
0414  4034           JMS PNC              /10101010
0415  1325           TAD T1               /01010101
0416  4034           JMS PNC              /10101010
0417  1146           TAD CHKR             /PUNCH CHECKS
0420  1176           TAD C377             /ALTER CHECKS
0421  4231           JMS SIX
0422  1144           TAD Z ZROR
0423  1177           TAD Z TWO
0424  4231           JMS SIX
0425  4314           JMS BLNK             /PUNCH BLANK TAPE
0426  1335           TAD AD1
0427  4734           JMS I PRNT
0430  5733           JMP I LOP
0431  0000  SIX,     0                    /PUNCH NUMBER IN AC
0432  3143           DCA Z HLD2
0433  1143           TAD HLD2             /IN BINARY FORMAT
0434  7012           RTR
0435  7012           RTR
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0436  7012            RTR
0437  0172            AND Z BIT6
0440  4034            JMS Z PNC
0441  1143            TAD Z HLD2
0442  0172            AND Z BIT6
0443  4034            JMS Z PNC
0444  5631            JMP I SIX
0445  4403  DUPL,     JMS I Z E1 /COMPARE COMPUTED VS MEASURED CHECKS
0446  5347            JMP RER    /READER ERROR
0447  4404  GO1,      JMS I Z E2 /COMPARE COMPUTED VS PUNCHED CHECKS
0450  5345            JMP MER    /MEMORY ERROR
0451  1327            TAD HERE
0452  3000            DCA INTER
0453  1325            TAD T1     /PUNCH THIRD IDENTIFIER
0454  4034            JMS Z PNC  /READER STOPPED WHEN THIRD IDENTIFIER
0455  1146            TAD Z CHKR /HAS BEEN FOUND, IE IT IS NOT IN THE
0456  4231            JMS SIX    /BUFFER
0457  1144            TAD Z ZROR
0460  4231            JMS SIX
0461  4314            JMS BLNK   /PUNCH BLANK TAPE
0462  1173            TAD Z DCON
0463  7640            SZA CLA
0464  5356            JMP DOK    /BUFFER OVERLAP-NO MORE DUP.
0465  1324            TAD DCNT
0466  7640            SZA CLA    /STARTED MULTIPLE DUPLICATION??
0467  5305            JMP TST4   /MULTIPLE DUPLICATION HAS STARTED
0470  1336            TAD AD2
0471  4734            JMS I PRNT
0472  7402            HLT        /READ NUMBER FROM SR
0473  7604            CLA OSR
0474  7041            CMA IAC
0475  3324            DCA DCNT
0476  1332            TAD HER1
0477  3170            DCA Z PDUN /SET RETURN FOR PUNCHING DONE
0500  1360            TAD BF     /RESET BUFFER POINTER
0501  3017            DCA Z NDXP /RESET PUNCH-COMPUTED CHECKS
0502  3145            DCA Z ZROP
0503  3147            DCA Z CHKP
0504  5040            JMP Z PNCH /START PUNCHING
0505  2324  TST4,     ISZ DCNT   /ARE WE DONE YET?
0506  7410            SKP
0507  5356            JMP DOK    /YES
0510  1337            TAD AD3    /NO
0511  4734            JMS I PRNT
0512  7602            HLT CLA    /HALT
0513  5300            JMP TST4-5 /MAKE NEXT COPY
0514  0000  BLNK,     0                    /SUBROUTINE TO PUNCH
0515  1323            TAD MCNT             /BLANK TAPE
0516  3157            DCA Z TIMR
0517  4034            JMS Z PNC
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0520  2157           ISZ Z TIMR
0521  5317           JMP .-2
0522  5714           JMP I BLNK
0523  7600  MCNT,     7600
0524  0000  DCNT,     0
0525  0252  T1,       0252                    /CODES FOR CHECK-SUM
0526  0125  T2,       0125                    /IDENTIFIERS
0527  0530  HERE,     HERE+1
0530  7200           CLA
0531  5330           JMP .-1
0532  0447  HER1,     GO1
0533  0202  LOP,      LOOP
0534  0673  PRNT,     PRIN
0535  0741  AD1,      TAB1                    /MASTER CREATED
0536  0751  AD2,      TAB2                    /PRINT TABLE
0537  1007  AD3,      TAB3                    /PRINT TABLE
0540  1017  AD4,      TAB4                    /VERIFY OK
0541  1026  AD5,      TAB5                    /DUP OK
0542  1036  AD6,      TAB6                    /MEMORY ERROR
0543  1045  AD7,      TAB7                    /READER ERROR
0544  1054  AD8,      TAB8                     /VERIFY ERROR
0545  1342  MER,      TAD AD6
0546  5354           JMP VOK+3
0547  1343  RER,      TAD AD7
0550  5354           JMP VOK+3
0551  1174  VOK,      TAD Z VCNT /VERIFY OK
0552  4402           JMS I Z NPNT
0553  1340           TAD AD4
0554  4734           JMS I PRNT
0555  5733           JMP I LOP
0556  1341  DOK,      TAD AD5    /DUPLICATION OK
0557  5354           JMP VOK+3
0560  1063  BF,       X-1
0561  1174  VER,      TAD Z VCNT /VERIFY OK
0562  4402           JMS I Z NPNT
0563  1344           TAD AD8
0564  5354           JMP VOK+3
0565  0000  GET,      0          /ROUTINE TO READ 2-6BIT CHARACTERS
0566  4031           JMS Z READ
0567  6012           RRB
0570  7106           CLL RTL
0571  7006           RTL
0572  7006           RTL
0573  3142           DCA Z HLD1
0574  4031           JMS Z READ
0575  6012           RRB
0576  1142           TAD Z HLD1
0577  5765           JMP I GET
```

```
                *600
0600  0000  TES1,    0           /COMPARE READER COMPUTED SUMS
0601  7200          CLA
0602  1144          TAD Z ZROR  /TO MEASURED SUMS
0603  7041          CMA IAC     /IF EQUAL, RETURN TO CALL+2
0604  1150          TAD Z MZRO  /OTHERWISE RETURN TO CALL +1
0605  7640          SZA CLA
0606  5600          JMP I TES1
0607  1146          TAD Z CHKR
0610  7041          CMA IAC
0611  1151          TAD Z MCHK
0612  7650          SNA CLA
0613  2200          ISZ TES1
0614  5600          JMP I TES1
0615  0000  TES2,    0           /COMPARE PUNCH COMPUTED SUMS
0616  7200          CLA
0617  1145          TAD Z ZROP  /TO READER COMPUTED SUMS
0620  7041          CMA IAC
0621  1144          TAD Z ZROR  /IF EQUAL, RETURN TO CALL+2
0622  7640          SZA CLA     /OTHERWISE RETURN TO CALL+1
0623  5615          JMP I TES2
0624  1146          TAD Z CHKR
0625  7041          CMA IAC
0626  1147          TAD Z CHKP
0627  7650          SNA CLA
0630  2215          ISZ TES2
0631  5615          JMP I TES2
0632  0000  DPRT,    0           /CONVERT BINARY WIRD IN AC
0633  3143          DCA Z HLD2  /TO 4 DIGIT UNSIGNED DECIMAL
0634  3142          DCA Z HLD1  /NUMBER AND TYPE IT
0635  1264          TAD CNTR
0636  3272          DCA CNT     /IDENTICAL TO ROUTINE IN LIBRARY
0637  1263          TAD ADDR
0640  3245          DCA XYZ+3
0641  7410          SKP
0642  3143  XYZ,    DCA Z HLD2
0643  7100          CLL
0644  1143          TAD Z HLD2
0645  1265          TAD CON
0646  7430          SZL
0647  2142          ISZ Z HLD1
0650  7430          SZL
0651  5242          JMP XYZ
0652  7200          CLA
0653  1142          TAD Z HLD1
0654  1271          TAD C260
0655  4325          JMS TYPE
0656  3142          DCA Z HLD1
0657  2245          ISZ XYZ+3
0660  2272          ISZ CNT
0661  5244          JMP XYZ+2
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0662  5632            JMP I DPRT
0663  1265  ADDR,     TAD CON
0664  7774  CNTR,     7774
0665  6030  CON,      6030
0666  7634            7634
0667  7766            7766
0670  7777            7777
0671  0260  C260,     0260
0672  0000  CNT,      0
0673  0000  PRIN,     0           /ROUTINE TO PRINT A STRING
0674  3143            DCA Z HLD2  /OF PACKED ASCII CHARACTERS
0675  1543            TAD I HLD2  /ENTER WITH S.A. OF STRING IN
0676  7450            SNA
0677  5320            JMP CR      /AC; EXIT ON 0 ELEMENT IN STRING
0700  7012            RTR         /AFTER TYPING CR-LF
0701  7012            RTR
0702  7012            RTR
0703  4310            JMS GPRT
0704  1543            TAD I Z HLD2
0705  4310            JMS GPRT
0706  2143            ISZ Z HLD2
0707  5275            JMP PRIN+2
0710  0000  GPRT,     0           /THIS ROUTINE CONVERTS
0711  0172            AND Z BIT6  /6BIT TO ASCII
0712  1334            TAD M40
0713  7510            SPA
0714  1335            TAD C100
0715  1336            TAD C200
0716  4325            JMS TYPE
0717  5710            JMP I GPRT
0720  1337  CR,       TAD CAR     /TYPE CR-LF
0721  4325            JMS TYPE
0722  1340            TAD LF
0723  4325            JMS TYPE
0724  5673            JMP I PRIN
0725  0000  TYPE,     0           /TYPE CHARACTER IN AC
0726  6046            TLS
0727  6041            TSF
0730  5327            JMP .-1
0731  6042            TCF
0732  7200            CLA
0733  5725            JMP I TYPE
0734  7740  M40,      7740
0735  0100  C100,     0100
0736  0240  C200,     0240
0737  0215  CAR,      0215
0740  0212  LF,       0212
0741  1501  TAB1,     1501        /PRINT TABLES
0742  2324            2324
0743  0522            0522
```

```
0744  4003              4003
0745  2205              2205
0746  0124              0124
0747  0504              0504
0750  0000              0000
0751  2305  TAB2,       2305
0752  2440              2440
0753  2327              2327
0754  1124              1124
0755  0310              0310
0756  0523              0523
0757  4024              4024
0760  1740              1740
0761  1625              1625
0762  1502              1502
0763  0522              0522
0764  4017              4017
0765  0640              0640
0766  0317              0317
0767  2011              2011
0770  0523              0523
0771  4024              4024
0772  1740              1740
0773  0205              0205
0774  4015              4015
0775  0104              0104
0776  0540              0540
0777  2022              2022
1000  0523              0523
1001  2340              2340
1002  0317              0317
1003  1624              1624
1004  1116              1116
1005  2505              2505
1006  0000              0000
1007  2022  TAB3,       2022
1010  0523              0523
1011  2340              2340
1012  0317              0317
1013  1624              1624
1014  1116              1116
1015  2505              2505
1016  0000              0000
1017  4040  TAB4,       4040
1020  2605              2605
1021  2211              2211
1022  0631              0631
1023  4017              4017
1024  1340              1340
1025  0000              0000
```

```
1026  0425  TAB5,     0425
1027  2014            2014
1030  1103            1103
1031  0124            0124
1032  1117            1117
1033  1640            1640
1034  1713            1713
1035  0000            0000
1036  1505  TAB6,     1505
1037  1517            1517
1040  2231            2231
1041  4005            4005
1042  2222            2222
1043  1722            1722
1044  0000            0000
1045  2205  TAB7,     2205
1046  0104            0104
1047  0522            0522
1050  4005            4005
1051  2222            2222
1052  1722            1722
1053  0000            0000
1054  4040  TAB8,     4040
1055  2605            2605
1056  2211            2211
1057  0631            0631
1060  4005            4005
1061  2222            2222
1062  1722            1722
1063  0000            0000
1064  0000  X,         0          /START OF BUFFER

ADDR    0663
AD1     0535
AD2     0536
AD3     0537
AD4     0540
AD5     0541
AD6     0542
AD7     0543
AD8     0544
BF      0560
BFUL    0320
BIT6    0172
BLNK    0514
BUF     0337
CAR     0737
CFLG    0345
CHKP    0147
CHKR    0146
CNT     0672
```

CNTR	0664
CON	0665
CONR	0336
CR	0720
CRET	0404
CRLF	0167
CRPT	0343
CRTE	0250
C100	0735
C200	0736
C260	0671
C377	0176
DCNT	0524
DCON	0173
DLAY	0341
DOK	0556
DPRT	0632
DSMS	0027
DUP	0255
DUPL	0445
DUPT	0344
E1	0003
E2	0004
FILL	0326
FRST	0105
FUL	0171
GET	0565
GET1	0141
GO	0261
GO1	0447
GPRT	0710
HERE	0527
HER1	0532
HLD1	0142
HLD2	0143
HNDL	0020
INTER	0000
LF	0740
LOOP	0202
LOP	0533
LOP1	0224
MCHK	0151
MCNT	0523
MER	0545
MZRO	0150
M40	0734
NDXP	0017
NDXR	0016
NOPT	0165
NPNT	0002

```
OVR     0340
PDUN    0170
PNC     0034
PNCH    0040
PRIN    0673
PRNT    0534
RCNT    0163
RD1     0055
READ    0031
RER     0547
RET     0335
RST1    0057
RST2    0070
SA      0333
SAT     0276
SA1     0334
SCND    0114
SCON    0175
SIX     0431
SKIP    0166
STRT    0164
SWT1    0303
TAB1    0741
TAB2    0751
TAB3    1007
TAB4    1017
TAB5    1026
TAB6    1036
TAB7    1045
TAB8    1054
TES1    0600
TES2    0615
THRD    0125
TIME    0160
TIMR    0157
TRY1    0152
TRY2    0153
TRY3    0154
TST1    0161
TST2    0162
TST4    0505
TWO     0177
TYPE    0725
T1      0525
T2      0526
VCNT    0174
VER     0561
VOK     0551
VRFY    0400
VRPT    0342
VY      0155
```

```
X       1064
XYZ     0642
ZROP    0145
ZROR    0144
```

11. DIAGRAMS (Not Applicable)

12. REFERENCES (Not Applicable)