IDENTIFICATION

PRODUCT CODE:	DEC-14-MWZB-D
PRODUCT NAME:	RUN-14
DATE CREATED:	JUNE 18, 197Ø
MAINTAINER:	DIAGNOSTIC GROUP
AUTHOR:	EDWARD P. STEINBERGER

1. ABSTRACT

RUN-14 is a program, written in PDP-8 language, which allows a PDP-8-type computer connected to a PDP-14 to act as the memory of the PDP-14 and allow the PDP-14 to execute the PDP-14 program contained in the PDP-8 memory.

2. LOADING PROCEDURE

RUN-14 is loaded into PDP-8 memory using the "standard" binary loader technique.

3. USING THE PROGRAM

3.1 Load RUN-14 into 8 memory using the Binary Loader program (Note: Load into memory bank 1 if a 4K PDP-14 program is to be run, otherwise, load into memory bank 0).

3.2. Load LOAD-14 into 8 memory using the Binary Loader program (See Note in 3.1)

3.3 Use LOAD-14 to read into 8 memory the binary image(s) of the PDP-14 program to be run, into memory bank 0.

3.4 Power down the PDP-8 I/L, connect the PDP-14 to the PDP-8 I/L using the appropriate cables and revision of the M745 interface module. Install INPUT and OUTPUT Register modules (M746's). Power up the PDP-8 I/L. (Ignore this paragraph is PDP-14 is already connected to the 8 and the modules plugged in).

3.5 Power up the PDP-14 computer while depressing PDP-14 "STOP"

3.6.1 If a 4K PDP-14 program is to be executed, set IF switches to 1, DF switches to 0, Switch Register (SR) to 6000, depress "LOAD ADDRESS".

3.6.2 If a 1K PDP-14 program is to be executed, set IF switches to 0, DF switches to 0, SR to 6001, depress "LOAD ADDRESS".

3.7 Set SR to starting address (4K)of PDP-14 program (usually 0000), depress PDP-8 I/L "START".

3.8 Depress PDP-14 "START".

3.9 PDP-14 program will be executed by the PDP-14 using PDP-8 I/L memory for instructions and memory source data.

3.10 If the PDP-14 loaded its OUTPUT Register because of an instruction in the PDP-14 program, the number in the OUTPUT Register will be typed out on the teleprinter in the form:

OUTPUT = XXXX

3.11 If the PDP-14 stops, RUN-14 will type out a message in the form:

PDP-14 STOPPED AT XXXX

RUN-14 will then wait for the operator to depress PDP-14 "CONTINUE".

3.14 If for some unknown reason the PDP-14 hangs (does not complete an instruction), RUN-14 will type out:

PDP-14 HUNG

4. DETAILS OF OPERATION

4.1 Upon starting, the program decides whether a 1K or 4K program is to be executed and sets up an address mask accordingly (The decision is made by the address at which the program is started).

4.2 The program then obtains the starting address of the PDP-14 program from the SR and saves it.

4.3 Upon detection of the PDP-14 running, the 14 is interrupted and placed in the external mode. PC1 is then loaded using a 6164 IOT to load and execute a PDP-14 JMP NNNN instruction.

4.4. The PDP-14 is checked to see if it is still running. If so, the contents of PC1 is read into the 8 AC to determine the location of the next instruction to be executed by the 14. If the 14 is not running, RUN-14 waits for 14 "CONTINUE" to be depressed, and "PDP-14 STOPPED AT c(PC1)" is displayed.

4.5 The next 14 instruction is then obtained from memory and sent to the 14 for execution.

4.6 The instruction obtained by 4.5 (above) is checked to see if it is a 2-word instruction. If it is, the program goes to 4.7. If it is not, the program goes to 4.8.

4.7 The second word of the 2-word instruction is obtained from 8 memory and sent to the 14.

4.8 If the OUTPUT Register flag is set, the contents of the OUTPUT Register is typed out on the teleprinter. In any case, the program then goes back to 4.4.

```
                        /
                        /RUN 14
                        /
                        /COPYRIGHT 1970, DIGITAL EQUIPMENT CORP, MAYNARD, MASS,
                        /
                        /
                        /PROGRAM TO EXECUTE A PROGRAM IN THE MEMORY OF A PDP-8
                        /ON A POP-14,  THE PDP-14 IS RUN IN EXTERNAL MODE,
                        /THE POP-14 PC1 REGISTER IS ACCESSED AFTER EACH
                        /INSTRUCTION TRANSFER OF THE POP-8 TO SEE FROM
                        /WHERE THE NEXT MEMORY REFERENCE SHOULD BE OBTAINED
                        /THE POP-14 PROGRAM OCCUPIES POP-8 MEMORY FROM LOCATION 00000
                        /THIS PROGRAM SHOULD BE LOADED INTO MEMORY BANK 1 IF
                        /A 4K POP-14 PROGRAM HAS BEEN LOADED INTO MEMORY BANK 0
                        /START RUN14 AT LOCATION 6000 IF A 4K POP-14
                        /PROGRAM IS BEING RUN
                        /START RUN14 AT 6001 IF A 1K POP-14 PROGRAM
                        /STARTING ADDRESS OF POP-14 PROGRAM IS IN SWITCH REGISTER
                        /IF THE POP-14 STOPS, THIS PROGRAM WILL LOOP AT LOCATION "LOOP"
                        /UNTIL POP-14 "CONTINUE" IS DEPRESSED,
                        /IF A LOAD OUTPUT REGISTER INSTRUCTION IS GIVEN, THE
                        /PROGRAM WILL TYPE OUT THE
                        /CONTENTS OF THE OUTPUT REGISTER
                        / ON THE POP-8 TELETYPE AND CONTINUE THE PROGRAM

                6000    *6000

6000  1315      RUN14,  TAD K6000
6001  1313              TAD K1777
6002  3316              DCA MASK          /SET UP PC1 MASK FOR 1K OR 4K
6003  7604              LAS
6004  3307              DCA PC1           /SET PC1 TO STARTING ADDRESS
6005  6175              SCRF              /WAIT FOR SOME ONE TO DEPRESS POP-14 START
6006  5205              JMP .-1
6007  1312              TAD K0600
6010  4777'             JMS INTER         /INTERRUPT POP-14 TO EXECUTE AN EEM
6011  1307              TAD PC1
6012  4776'             JMS SETPC1        /SET PC1 TO STARTING ADDRESS OF PDP-14 PROGRAM,
6013  6175      LOOP,   SCRF              /IS THE POP-14 STILL RUNNING
6014  5213              JMP .-1           /NO
6015  7200              CLA               /YES
6016  1310              TAD K0246
6017  6165              ILEX              /INTERRUPT POP-14
6020  4221              JMS .+1           /TO EXECUTE
6021  0000              0                 /TRR P1, OT
6022  6175              SCRF
6023  5317              JMP NORUN
6024  6161              SIOF
6025  7410              SKP
6026  5232              JMP .+4
6027  2221              ISZ .-6
6030  5222              JMP .-6
6031  4327              JMS TYMOUT
6032  6171              SOTF              /OUTPUT FLAG SET?
```

```
56    6033  7402          HLT                 /NO
57    6034  6176          ROTR                /YES, READ BACK NEW PC1
58    6035  0316          AND MASK
59    6036  3307          DCA PC1
60    6037  1707          TAD I PC1           /GET NEXT INSTRUCTION
61    6040  6164          LDEX                /EXECUTE IT
62    6041  4242          JMS .+1
63    6042  0000          0
64    6043  6175          SCRF
65    6044  5317          JMP NORUN
66    6045  6161          SIDF
67    6046  7410          SKP
68    6047  5253          JMP .+4
69    6050  2242          ISZ .-6
70    6051  5243          JMP .-6
71    6052  4327          JMS TYMOUT
72    6053  0260          AND K7000
73    6054  1314          TAD K4000
74    6055  7640          SZA CLA /TWO WORD?
75    6056  5275          JMP PROCED          /NO
76    6057  2307          ISZ PC1             /YES,BUMP PC1
```

```
6060  7000  K7000,  NOP
6061  1707          TAD I PC1        /GET SECOND WORD
6062  6164          LDEX             /TRANSFER IT TO PDP-14
6063  4264          JMS .+1
6064  0000          0
6065  6175          SCRF
6066  5317          JMP NORUN
6067  6161          SIOF
6070  7410          SKP
6071  5275          JMP .+4
6072  2264          ISZ .-6
6073  5265          JMP .-6
6074  4327          JMS TYMOUT
6075  6171  PROCED, SDTF             /OUTPUT REGISTER LOADED?
6076  5213          JMP LOOP         /NO
6077  7200          CLA
6100  4775'         JMS CRLF
6101  1774'         TAD OUTPUT
6102  4773'         JMS MESAG
6103  6176          ROTR             /READ OUTPUT REGISTER
6104  4772'         JMS PRINT
6105  4775'         JMS CRLF
6106  5213          JMP LOOP
6107  0000  PC1,    0
6110  0246  K0246,  246
6111  0264  K0264,  264
6112  0600  K0600,  600
6113  1777  K1777,  1777
6114  4000  K4000,  4000
6115  6000  K6000,  6000
6116  0000  MASK,   0
6117  7200  NORUN,  CLA
6120  4775'         JMS CRLF
6121  1771'         TAD PNORUN
6122  4773'         JMS MESAG
6123  1307          TAD PC1
6124  4772'         JMS PRINT
6125  4775'         JMS CRLF
6126  5213          JMP LOOP
6127  0000  TYMOUT, 0
6130  7200          CLA
6131  4775'         JMS CRLF
6132  1770'         TAD PHUNG
6133  4773'         JMS MESAG
6134  4775'         JMS CRLF
6135  7402          HLT
6136  5727          JMP I TYMOUT
```

```
125
126     6170  6336
127     6171  6312
128     6172  6254
129     6173  6353
130     6174  6301
131     6175  6242
132     6176  6221
133     6177  6215
              6200    *6200
134
135                   /
136                   /CHECK PDP-14 RUNNING AND WAIT ONLY SO LONG FOR DONE FLAG.
137                   /
138     6200  0000    WAIT,   0
139     6201  4202            JMS .+1
140     6202  0000            0
141     6203  6175            SCRF
142     6204  5777'           JMP NORUN
143     6205  6161            SIOF
144     6206  7410            SKP
145     6207  5213            JMP .+4
146     6210  2202            ISZ .-6
147     6211  5203            JMP .-6
148     6212  4776'           JMS TYMOUT
149     6213  7200            CLA
150     6214  5600            JMP I WAIT
151
152                   /
153                   /INTERRUPT THE PDP-14 AND EXECUTE 1 INSTRUCTION (IN AC).
154                   /
155     6215  0000    INTER,  0
156     6216  6165            ILEX
157     6217  4200            JMS WAIT
158     6220  5615            JMP I INTER
159                   /
160                   /SET PC1 TO NNNN USING JMP NNNN,  ENTERED WITH NNNN IN AC.
161                   /
162     6221  0000    SETPC1, 0
163     6222  3232            DCA SETTEM      /SAVE NNNN.
164     6223  1233            TAD K4224       /EXECUTE PDP-14 JMP.
165     6224  6164            LDEX
166     6225  4200            JMS WAIT        /WAIT FOR DONE FLAG.
167     6226  1232            TAD SETTEM      /SET PC1 TO NNNN.
168     6227  6164            LDEX
169     6230  4200            JMS WAIT        /WAIT FOR DONE FLAG.
170     6231  5621            JMP I SETPC1    /EXIT.
171     6232  0000    SETTEM, 0
172     6233  4224    K4224,  4224            /CODE FOR PDP-14 JMP INST.
173                   /
174                   /
175                   /TYPE SUBROUTINE
176
177     6234  0000    TYPE,   0
178     6235  6046            TLS
```

```
                6236  6041            TSF
                6237  5236            JMP .-1
                6240  7200            CLA
                6241  5634            JMP I TYPE
                                      
                                      /CR-LF SUBROUTINE
                                      
                6242  0000      CRLF, 0
                6243  1250            TAD K0215
                6244  4234            JMS TYPE
                6245  1251            TAD K0212
                6246  4234            JMS TYPE
                6247  5642            JMP I CRLF
                6250  0215      K0215, 215
                6251  0212      K0212, 212
                6252  0007      K0007, 7
                6253  0260      K0260, 260
```

```
                        /TYPE OUT THE CONTENTS OF THE AC IN OCTAL

6254  0000  PRINT,  0
6255  3276          DCA NUMBER
6256  1300          TAD M0004
6257  3277          DCA PCNTR
6260  1276          TAD NUMBER
6261  7104          RAL CLL
6262  7004          RAL
6263  7006          RTL
6264  3276          DCA NUMBER
6265  1276          TAD NUMBER
6266  0252          AND K0007
6267  1253          TAD K0260
6270  4234          JMS TYPE
6271  1276          TAD NUMBER
6272  2277          ISZ PCNTR
6273  5262          JMP .-11
6274  7200          CLA
6275  5654          JMP I PRINT
6276  0000  NUMBER, 0
6277  0000  PCNTR,  0
6300  7774  M0004,  -4

                        /OUTPUT REGISTER MESSAGE

6301  6302  OUTPUT, OUTPUT+1
6302  0317          317             /O
6303  0325          325             /U
6304  0324          324             /T
6305  0320          320             /P
6306  0325          325             /U
6307  0324          324             /T
6310  0275          275             /=
6311  0000          0               /END

                        /PDP-14 STOPPED AT

6312  6313  PNORUN, .+1
6313  0320          320
6314  0304          304
6315  0320          320
6316  0255          255
6317  0261          261
6320  0264          264
6321  0240          240
6322  0323          323
6323  0324          324
6324  0317          317
6325  0320          320
6326  0320          320
6327  0305          305
6330  0304          304
6331  0240          240
6332  0301          301
```

```
251    6333  0324          324
252    6334  0240          240
253    6335  0000          0
```

```
                                /PDP-14 HUNG
                                
6336  6337      PHUNG,  .+1
6337  0320              320
6340  0304              304
6341  0320              320
6342  0255              255
6343  0261              261
6344  0264              264
6345  0240              240
6346  0310              310
6347  0325              325
6350  0316              316
6351  0307              307
6352  0000              0

                        /MESSAGE PRINT SUBROUTINE
                        /ENTTER WITH MESSAGE ADDRESS IN AC

6353  0000      MESAG,  0
6354  3277              DCA PCNTR
6355  1677              TAD I PCNTR
6356  7450              SNA
6357  5753              JMP I MESAG
6360  4234              JMS TYPE
6361  2277              ISZ PCNTR
6362  5355              JMP .-5
                        /INSTRUCTION DEFINITIONS

      6161      SIDF=6161               /SKIP IF INSTRUCTION DONE
      6162      LDIN=6162               /LOAD PDP-14 INPUT REGISTER
      6164      LDEX=6164               /LOAD AND EXECUTE PDP-14 INSTRUCTION
      6165      ILEX=6165               /INTERRUPT, LOAD AND EXECUTE PDP-14 INSTRUCTION
      6167      CIDF=6167               /CLEAR INSTRUCTION DONE FLAG
      6171      SOTF=6171               /SKIP IF PDP-14 OUTPUT REGISTER LOADED
      6172      COTF=6172               /CLEAR OUTPUT FLAG
      6173      STFF=6173               /SKIP IF PDP-14 TEST FLOP SET
      6174      CTFF=6174               /CLEAR TEST FLOP
      6175      SCRF=6175               /SKIP IF PDP-14 RUNNING
      6176      ROTR=6176               /CLEAR AC, READ OUTPUT REGISTER INTO PDP-8 AC

                        $
6376  6127
6377  6117
```

```
0000
0100

0200
0300

0400
0500

0600
0700


1000
1100

1200
1300

1400
1500

1600
1700


2000
2100

2200
2300

2400
2500

2600
2700


3000
3100

3200
3300

3400
3500

3600
3700
```

```
4000
4100

4200
4300

4400
4500

4600
4700


5000
5100

5200
5300

5400
5500

5600
5700

6000  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
6100  11111111  11111111  11111111  11111110  00000000  00000000  00000000  11111111

6200  11111111  11111111  11111111  11111111  11111111  11111111  11111111  11111111
6300  11111111  11111111  11111111  11111111  11111111  11111111  11100000  00000011

6400
6500

6600
6700


7000
7100

7200
7300

7400
7500

7600
7700
```

```
CIDF    6167
COTF    6172
CRLF    6242
CTFF    6174
ILEX    6165
INTER   6215
K0007   6252
K0212   6251
K0215   6250
K0246   6110
K0260   6253
K0264   6111
K0600   6112
K1777   6113
K4000   6114
K4224   6233
K6000   6115
K7000   6060
LDEX    6164
LDIN    6162
LOOP    6013
M0004   6300
MASK    6116
MESAG   6353
NORUN   6117
NUMBER  6276
OUTPUT  6301
PC1     6107
PCNTR   6277
PHUNG   6336
PNORUN  6312
PRINT   6254
PROCED  6075
ROTR    6176
RUN14   6000
SCRF    6175
SETPC1  6221
SETTEM  6232
SIDF    6161
SOTF    6171
STFF    6173
TYMOUT  6127
TYPE    6234
WAIT    6200
```

ERRORS DETECTED: 0

LINKS GENERATED: 18

RUN-TIME: 3 SECONDS

2K CORE USED

```
CIDF        288#
COTF        290#
CRLF         94      99      110     113     119     122     186#    191
CTFF        292#
ILEX         44     156     287#
INTER        37     155#    158
K0007       194#    208
K0212       189     193#
K0215       187     192#
K0246        43     102#
K0260       195#    209
K0264       103#
K0600        36     104#
K1777        30     105#
K4000        73     106#
K4224       164     172#
K6000        29     107#
K7000        72      78#
LDEX         61      80      165     168     286#
LDIN        285#
LOOP         40#     92      100     116
M0004       200     210#
MASK         31      58     108#
MESAG        96     112     121     274#    278
NORUN        48      65      84     109#    142
NUMBER      199     202     206     207     211     216#
OUTPUT       95     222#    222
PC1          33      38      59      60      76      79     101#    113
PCNTR       201     212     217#    275     276     280
PHUNG       120     257#
PNORUN      111     234#
PRINT        98     114     198#    215
PROCED       75      91#
ROTR         57      97     294#
RUN14        29#
SCRF         34      40      47      64      83     141     293#
SETPC1       39     162#    170
SETTEM      163     167     171#
SIDF         49      66      85     143     284#
SOTF         55      91     289#
STFF        291#
TYMOUT       54      71      90     117#    124     148
TYPE        177#    182     188     190     210     279
WAIT        138#    150     157     166     169
.L0170      120     126#
.L0171      111     127#
.L0172       98     114     128#
.L0173       96     112     121     129#
.L0174       95     130#
.L0175       94      99     110     113     119     122     131#
.L0176       39     132#
.L0177       37     133#
.L0376      148     297#
```

L6377 142 298#