NATIONAL RADIO ASTRONOMY OBSERVATORY

ELECTRONICS DIVISION TECHNICAL NOTE NO. 109

TITLE: HP 9825 BLOCK DIAGRAM PROGRAM

AUTHOR(S):   James R. Coe

DATE: April 8, 1982

HP 9825 BLOCK DIAGRAM PROGRAM

James R. Coe

General

A program has been written to utilize the HP 9825 calculator and the 9862 HP plotter to help prepare block diagrams, flow charts and view graphs. This program plots the various symbols shown on the attached diagram. The symbol size and location are selected by the user. Titles and labels can be conveniently added and lines drawn to interconnect the symbols.

Operation

The maximum plotting area is 10" x 15". Any suitable paper could be used. Using mylar material with 0.1" grid helps in constructing the diagram. Errors also can be readily corrected on this material.

Turn the HP 9825 calculator ON.

Insert the tape labeled "Block Diagram Program".

Press LOAD 1 and then EXECUTE.

After the tape has stopped driving press RUN.

The calculator displays "Set Up Plotter" and loads the special function keys from file 0. Put the paper on the plotter. Set the lower left and upper right limits on the plotter.

When the display shows "Horizontal Scale?", enter the horizontal length of the plot in units of 0.1 inch, i.e., 10 inches enter 100. Then enter the number of 0.1 inch units in the vertical height of the plot.

The calculator displays "Select Operation".

Using the special function keys, select the symbol type, label or line required. The program prompts, on the display, guide you through most of the operations.

When the calculator displays "Here?" to verify a location prior to plotting a symbol, you can push YES or 1 and CONTINUE. If the plotter is not at the right location, press CONTINUE.

When the operation "Draw" is selected, the keys (as shown below) move
the plotter pen in the direction indicated by the key position.

4	5	6
1		3
0	.	,
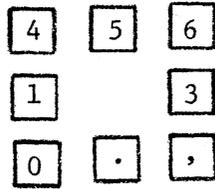
Pressing key 2 causes the pen to go down. By releasing key 2 after
one of the other keys is depressed allows you to draw a line. The pen
does not stay down going to the left for some unknown reason. The
horizontal and vertical locations are displayed with 0.01 inch resolu-
tion. Pressing key 9 returns to "Select Operation".

When the operation "Label" is selected, the display is CHARACTER SIZE?
The number entered determines the height of the characters as a percent-
age of the total vertical height of the plot. Enter a number, generally
in the 1 to 2 range. Then press CONTINUE.

Next it displays "Label? 15 Characters Max". Enter the desired label
and press CONTINUE. The program then moves the pen to the last loca-
tion used and offsets the pen to the left one-half the label length
and down one-half the character height and displays "Here?". If you
want the label started here, press YES or 1 and CONTINUE. If you want
to move the label just press CONTINUE and the horizontal and vertical
positions will be displayed and the numeric key pad allows you to move
the pen. When you locate the pen at the point you want the label cen-
tered, press numeric key 8 . The pen will offset to the starting
position for the label and the display will be "Here?". Proceed as
outlined above. The label or character size need not be re-entered if
no changes are required.

You can also use the "PTYP" mode of labeling with the plotter in the
typewriter mode. The keys

| ← | → | ↑ | ↓ |

will move the pen with a resolution of one character space and will
plot any character you type. Type slow or you will lose characters.

If you decide not to use a symbol after you have selected it, press
STOP. Then select a new operation. If all else fails, press STOP
and RUN. You then will have to re-enter the scale factors.

It takes two to three hours to make and label a detailed block dia-
gram, but at least it is legible when you finish.

BLOCK DIAGRAM PROGRAM

DRAW
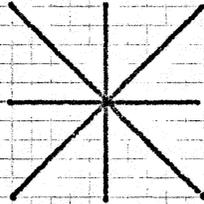
LINE

TRIANGLE
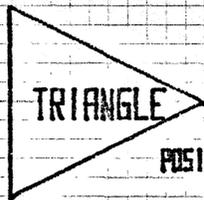
POSITION 0   1   2   3

RECTANGLE

VERTICAL

SCALE = 100

START   CHARACTER SIZE = 1.5

RHOMBIC   CHARACTER SIZE = 1.0
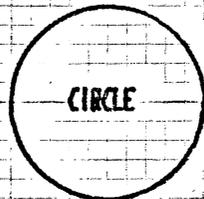
CIRCLE   DIAMETER=10

HORIZONTAL SCALE = 70

```
0: "BLOCK DIAGRA
   M PROGRAM":
1: "INITIALIZE":
2: dim H[1],J[1]
   ,K[1],L[1],D$[1
   5]
3: dsp "Block
   Diagram Program
   ";wait 2000
4: dsp "Set Up
   Plotter";ldk Q;
   wait 2000

5: "SCALE":
6: ent "Horizont
   al Scale?",X,
   "Vertical Scale
   ?",Y;scl 0,X,0,
   Y

7: "SELECT":
8: dsp "Select
   Operation";stp
   ;jmp 0

9: "LOCATION":
10: ent "Horizon
    tal Position?",
    H,"Vertical
    Position?",V
11: plt H,V,1;
    ent "Here? 1
    if OK",G;if
    G#1;jmp -1
12: 0→G;ret

13: "CIRCLE":
14: if not flg1;
    ent "Diameter?"
    ,R
15: if flg1;dsp
    "Diameter = ",
    R;wait 1500;
    ent "Change
    Diameter?",R
16: gsb "LOCATIO
    N"
17: for B=0 to
    360 by 3;plt
    (R/2)cos(B)+H,
    (R/2)sin(B)+V
18: next B;pen;
    sfg 1;gto "SELE
    CT"
```

```
19: "REC ANGLE":
20: if not flg3;
    ent "Length?",
    L,"Width?",W
21: if flg3;dsp
    "Length=",L,
    "Width=",W;wait
    1500
22: if flg3;ent
    "Change Length?
    ",L,"Change
    Width?",W
23: gsb "LOCATIO
    N";sfg 3
24: iplt -L/2,-
    W/2,1;iplt 0,W,
    2;iplt L,0;iplt
    0,-W;iplt -L,
    0;pen
25: gto "SELECT"

26: "TRIANGLE":
27: if not flg4;
    ent "Length of
    side?",S
28: if not flg4;
    ent "Orientatio
    n",T
29: if flg4;dsp
    "Length of Side
    =",S;wait 1500
30: if flg4;dsp
    "Orientation=",
    T;wait 1000
31: if flg4;ent
    "Change Length?
    ",S,"Change
    Orientation?",T
32: sfg 4;gsb
    "LOCATION"
33: if T=0;iplt
    S/2,0,1;iplt -
    S,S/2,2;iplt 0,
    -S;iplt S,S/2;
    pen
34: if T=1;iplt
    0,-S/2,1;iplt -
    S/2,S,2;iplt S,
    0;iplt -S/2,-S;
    pen
35: if T=2;iplt
    -S/2,0,1;iplt
    S,S/2,2;iplt 0,
    -S;iplt -S,S/2;
    pen
36: if T=3;iplt
    0,S/2,1;iplt -
    S/2,-S,2;iplt
    S,0;iplt -S/2,
    S;pen
37: gto "SELECT"

38: "RHOMBIC":
39: if not flg5;
    ent "Length?",
    C,"Width",D
40: if flg5;dsp
    "Rhombic Length
    =",C,"Width=",
    D;wait 1500
41: if flg5;ent
    "Change Length?
    ",C,"Width?",D
42: gsb "LOCATIO
    N";sfg 5
43: iplt 0,-D/2,
    1;wait 200;iplt
    -C/2,D/2,2;
    wait 200;iplt
    C/2,D/2;wait
    200
44: iplt C/2,-D/
    2;wait 200;iplt
    -C/2,-D/2;pen
45: gto "SELECT"
```

```
46: "START":
47: ent "Length?
    ",E,"Width?",F
48: gsb "LOCATIO
    N"
49: iplt -E/2,-
    F/2,1;iplt E,0,
    2;for B=-90 to
    90 by 3
50: iplt -Fsin(B
    )/38.2,Fcos(B)/
    38.2;next B;
    iplt -E,0
51: for B=90 to
    270 by 3;iplt -
    Fsin(B)/38.2,
    Fcos(B)/38.2;
    next B;pen
52: gto "SELECT"

53: "RESISTOR":
54: gsb "LOCATIO
    N"
55: ent "Horizon
    tal to right?",
    G;if G;iplt .5,
    -.5,2;iplt .5,
    1;iplt .5,-1
56: if G;iplt
    .5,1;iplt .5,-
    1;iplt .5,1;
    iplt .5,-1;iplt
    .5,.5;pen;jmp
    4
57: if not G;
    ent "Vertical
    Down?",G;if
    not G;jmp 3
58: iplt -.5,-
    .5,2;iplt 1,-
    .5;iplt -1,-.5;
    iplt 1,-.5;iplt
    -1,-.5
59: iplt 1,-.5;
    iplt -.5,-.5;
    pen
60: 0→G;gto "SEL
    ECT"

61: "DRAW LINE":
    lkd
62: plt H,V,1
63: rdi 4→A;rdi
    4→K;if A=K;gsb
    "DRAW"
64: if A#K;0→Q;
    1→U;jmp -1
65: fxd 1;dsp
    "HorizPos",H,",
    VertPos.",V;
    0→P→0;jmp -2
66: "DRAW":if
    K=79;-.1→P
67: if K=81;.1→P
68: if K=83;.1→Q
69: if K=88;-
    .1→Q
70: if K=78;-
    .1→P;-.1→Q
71: if K=82;-
    .1→P;.1→Q
72: if K=84;.1→P
    ;.1→Q
73: if K=89;.1→P
    ;-.1→Q
74: if K=80;2→U
75: if K=87;gto
    "SELECT"
76: plt H,V,U
77: Q+.1→Q;if
    Q>2;2→Q
78: H+QP→H;V+
    QQ→V;ret
79: gto "SELECT"
```

Column 1 (Program Listing)

```
81: ent "Line
    From Horizontal
    Position?",
    H[I],"Vertical
    Position?",J[I]
82: plt H[I],
    J[I],1;ent "Her
    e?",G;if G#1;
    jmp -2
83: 0→G;ent "Lin
    e To Horizontal
    Position?",
    K[I];if flg13;
    H[I]→K[I]
84: cfg 13;ent
    "Line To Vertic
    al Pos?",L[I];
    if flg13;J[I]→L
    [I]
85: plt K[I],
    L[I],1;ent "To
    Here?",G;if
    G#1;jmp -2
86: plt H[I],
    J[I],1;plt K[I]
    ,L[I],2;pen;
    0→G;K[I]→H;L[I]
    →V
87: ent "Arrow
    Here?",G;if
    G#1;gto "SELECT
    "
88: 0→G
89: if J[I]=L[I]
    ;if K[I]>H[I];
    iplt -1.5,.5,1;
    wait 500
90: if J[I]=L[I]
    ;if K[I]>H[I];
    plt K[I],L[I],
    2;wait 100;iplt
    -1.5,-.5
91: if J[I]=L[I]
    ;if H[I]>K[I];
    iplt 1.5,.5,1;
    wait 500
92: if J[I]=L[I]
    ;if H[I]>K[I];
    plt K[I],L[I],
    2;wait 50;iplt
    1.5,-.5
93: if H[I]=K[I]
    ;if L[I]>J[I];
    iplt -.5,-1.5,
    1;wait 500
94: if H[I]=K[I]
    ;if L[I]>J[I];
    plt K[I],L[I],
    2;wait 50;iplt
    .5,-1.5
95: if H[I]=K[I]
    ;if J[I]>L[I];
    iplt -.5,1.5,1;
    wait 500
96: if H[I]=K[I]
    ;if J[I]>L[I];
    plt K[I],L[I],
    2;wait 50;iplt
    .5,1.5
97: gto "SEL
    ECT"
```

Column 2 (Program Listing)

```
    er Size?",Z;
    csiz Z
100: ent "Label?
     15 Characters
     max.",D$;0→G;
     1→U;lkd
101: plt H,V,1;
     cplt -len(D$)/
     2,-.3;ent "Here
     ?",G;if G=1;
     jmp 6
102: rdi 4→A;
     rdi 4→K;if A=K;
     gsb "DRAW"
103: if A#K;0→Q;
     1→U;jmp -1
104: fxd 1;dsp
     "HorizPos",H,";
     VertPos",V;0→P→
     Q
105: if K=86;
     jmp -4
106: jmp -4
107: lbl D$;0→G;
     gto "SELECT"

08: "PT.PT";
109: ent "Charac
     ter Size?",Z;
     csiz Z
110: dsp "Plotte
     r Type Mode";
     plt H,V,1;ptyp
111: gto "SELECT
     "

*26626
```

```
f0: *1→G

f1: *cont"CIRCLE
    "

f2: *cont"RECTAN
    GLE"

f3: *cont"TRIANG
    LE"

f4: *cont "RHOMB
    IC"

f5: *cont"START"

f7: *cont"LINE"

f8: *cont"RESIST
    OR"

f9: *cont"DRAW L
    INE"

f10: *cont"LABEL
     "

f11: *cont "PTYP
```

Column 3 (Variables / Line No.'s)

Key Identifier
B	63	63	64
102	102	103	

"CIRCLE" Angle
B	17	17	17
18	49	50	50
50	51	51	51
51			

"RHOMBIC" Length
C	39	40	41
43	43	44	44

"RHOMBIC" Width
D	39	40	41
43	43	43	44
44			

"START" Length
E	47	49	49
50			

"START" Width
F	47	49	50
50	51	51	

G = 1 YES; G = 0 NO
G	11	11	12
55	55	56	57
57	57	60	82
82	83	85	85
86	87	87	88
100	101	101	107

Horizontal Position
H	10	11	17
62	65	76	78
78	86	101	104
110			

Array Index
I	80	81	81
82	82	83	83
83	84	84	84
85	85	86	86
86	86	86	86
89	89	89	89
90	90	90	90
90	90	91	91
91	91	92	92
92	92	92	92
93	93	93	93
94	94	94	94
94	94	95	95
95	95	96	96
96	96	96	96

Key Verifier
K	63	63	64
66	67	68	69
70	71	72	73
74	75	102	102
103	105		

"RECTANGLE" Length
L	20	21	22
24	24	24	

Vertical Increment
O	65	66	69
70	71	72	73
78	104		

Horizontal Increment
P	65	66	67
70	71	72	73
78	104		

Increment Multiplier
Q	64	77	77
77	77	78	78
103			

Column 4 (Variables / Line No.'s)

"CIRCLE" Diameter
17	17

"TRIANGLE" Side Length
S	27	29	31
33	33	33	33
33	33	34	34
34	34	34	34
35	35	35	35
35	35	36	36
36	36	36	36

"TRIANGLE" Orientation
T	28	30	31
33	34	35	36

Pen Control   1 UP; 2 DOWN
U	64	74	78
100	103		

VERTICAL POSITION
V	10	11	17
62	65	76	78
78	86	101	104
110			

"RECTANGLE" Width
W	20	21	22
24	24	24	

HORIZONTAL SCALE
X	6

VERTICAL SCALE

CHARACTER SIZE
Z	99	99	109	109

LINE START HORIZONTAL
I[*]2		81	82
83	86	89	90
91	92	93	94
95	96		

LINE START VERTICAL
J[*]2		81	82
84	86	89	90
91	92	93	94
95	96		

LINE END HORIZONTAL
K[*]2		83	83
85	86	86	89
90	90	91	92
92	93	94	94
95	96	96	

LINE END VERTICAL
L[*]2		84	84
85	86	86	89
90	90	91	92
92	93	94	94
95	96	96	

LABEL
D$	2	100	101
107			

Block Diagram

BLOCK DIAGRAM

f0	f1	f2	f3	f4	f5
YES	○	□	△	◇	▭

f6	f7	f8	f9	f10	f11
	LINE	⌇	DRAW	LABEL	PTYP