1.   IDENTIFICATION

1.1   Digital-8-12-U

1.2   Incremental Plotter Subroutine

1.3   Revised June 1, 1966

2. ABSTRACT

This subroutine moves the pen of an incremental plotter to a new position along the best straight line. The pen may be raised or lowered during the motion.

3. REQUIREMENTS

3.1 Storage

The subroutine requires one memory page (128 registers).

3.2 Equipment

Basic PDP-8
Type 350 Plotter Control and Plotter

4. USAGE

4.1 Loading

The library tape that is supplied is a symbolic tape which has no origin setting and which ends with the statement "PAUSE". This tape may be assembled with a user program (which supplies an origin) or assembled by itself if a dollar sign ($) is supplied.

4.2 Calling Sequence

The Plot subroutine is called with an effective JMS PLOTX. The contents of the accumulator specify the operation of the subroutine:

C(AC) = −1: The location registers internal to the subroutine are reset to 0 and the pen is raised. Control returns to the instruction following the calling JMS instruction;

C(AC) = 0: The pen is lowered (if it was up) and is moved to the new location (see below);

C(AC) = 1: The pen is raised (if it was down) and is moved to the new location;

The two locations following the calling JMS instructions contain, respectively, the new X coordinate and the new Y coordinate in steps (<4096). The pen is moved from the previous location to this new location along the best straight line with the pen up or down depending upon the contents of the accumulator when the subroutine is called. Control returns to the instruction following the Y coordinate.

Examples:

Initialize	Plot with Pen Down	Plot with Pen Up
CLA CMA	CLA	CLA IAC
JMS I PLOT	JMS I PLOT	JMS I PLOT
Return	X Coordinate	X Coordinate
....	Y Coordinate	Y Coordinate
PLOT, PLOTX	Return	Return
	....	....

5.   RESTRICTIONS (Not Applicable)

6.   DESCRIPTION

6.1   Discussion

       The Plot subroutine has two registers which contain the location of the last position plotted. When the subroutine is entered, the accumulator is tested to determine if initialization is being called. If so, the location registers are set to 0, the pen is raised, and the subroutine exits. If it is not initialization, the subroutine compares the current pen position (up or down) with the requested one and raises or lowers the pen if appropriate. The new X and Y coordinates are picked up and placed in the location registers. The X and Y differences between the current location and the desired location are computed and compared. The subroutine selects motion commands depending upon the quadrant of the new location compared to the old. The possible motions are now parallel to either the X-axis (drum motion) or the Y-axis (pen motion) or a combined motion. The subroutine determines which of these motions to use, and when the new location is reached, it exits.

7.   METHODS (Not Applicable)

8.   FORMAT

8.1   Input Data

       The X and Y coordinates are specified in numbers of steps. Increasing X corresponds to lowering the drum. Increasing Y corresponds to moving the pen left.

9.   EXECUTION TIME

9.1   Minimum (Not Applicable)

9.2   Maximum (Not Applicable)

9.3   Average

       This subroutine is device speed limited, although the minor subroutine, PLOTWT, could be replaced by a routine making use of the program interrupt.

10.   PROGRAM

10.1   Core Map (None)

10.2   Dimension List (None)

10.3   Macro, Parameter, and Variable Lists (None)

10.4   Program Listing

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                    /DIGITAL 8-12-U
                    /PLOT SUBROUTINE
                    /CALLING SEQUENCE

                    /    C(AC)=-1;  INITIALIZE
                    /    C(AC)= 0;   PLOT WITH PEN DOWN
                    /    C(AC)= 1; PLOT WITH PEN UP
                    /       JMS PLOTX
                    /       X CO-ORDINATE (IN STEPS) (RETURN IF AC=-1)
                    /       Y CO-ORDINATE (IN STEPS)

0200    0000    PLOTX,        0
0201    7510        SPA                 /MOVE THE PEN?
0202    5220        JMP PLOTA           /NO: CONTINUE
0203    1361        TAD PLOTPN          /ADD PEN STATUS
0204    7112        CLL RTR
0205    7710        SPA CLA             /ANY CHANGE?
0206    5227        JMP PLOT1           /NO: CONTINUE
0207    7620        SNL CLA
0210    5214        JMP .+4             /LOWER THE PEN
0211    3361        DCA PLOTPN          /RAISE THE PEN
0212    6504        PLPU
0213    5216        JMP .+3
0214    2361        ISZ PLOTPN          /LOWER THE PEN
0215    6524        PLPD
0216    4370        JMS PLOTWT          /WAIT FOR FLAG
0217    5227        JMP PLOT1           /CONTINUE
0220    7200    PLOTA,        CLA
0221    6504        PLPU                /RAISE THE PEN
0222    3361        DCA PLOTPN
0223    3362        DCA PLOTNX          /0 TO X CO-ORDINATE
0224    3363        DCA PLOTNY          /0 TO Y CO-ORDINATE
0225    4370        JMS PLOTWT
0226    5600        JMP I PLOTX


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                    /PAGE 2
                    /PICK UP ARGUMENTS

0227    1362    PLOT1,        TAD PLOTNX          /FETCH PREVIOUS X CO-ORDINATE
0230    7141        CIA CLL
0231    1600        TAD I PLOTX         /FORM NX-NPX
0232    7420        SNL                 /L=0: NX<NPX
0233    7041        CIA
0234    3364        DCA PLOTDX          /ABSOLUTE VALUE OF DIFFERENCE
0235    7004        RAL
0236    3367        DCA PLOTMV          /SAVE SIGN BIT
0237    1600        TAD I PLOTX         /SET NEW
0240    3362        DCA PLOTNX          /PREVIOUS X
0241    2200        ISZ PLOTX           /INCREMENT POINTER
0242    1363        TAD PLOTNY          /FETCH PREVIOUS Y CO-ORDINATE
0243    7141        CIA CLL
0244    1600        TAD I PLOTX         /FORM NY-NPY
0245    7420        SNL                 /<=0: NPY<NY
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0246   7041    CIA
0247   3365    DCA PLOTDY              /ABSOLUTE VALUE OF DIFFERENCE
0250   1367    TAD PLOTMV              /SAVE SIGN BIT
0251   7004    RAL                     /BIT 10(1)= DRUM-DOWN(POSITIVE)
0252   3367    DCA PLOTMV              /BIT 11(1)=PEN-LEFT (POSITIVE)
0253   1600    TAD I PLOTX             /SET NEW
0254   3363    DCA PLOTNY              /PREVIOUS Y
0255   2200    ISZ PLOTX               /INCREMENT POINTER
0256   1364    TAD PLOTDX
0257   7141    CIA CLL
0260   1365    TAD PLOTDY
0261   7620    SNL CLA                 /L=0: DELTA Y < DELTA X
0262   5275    JMP PLOT2
0263   1364    TAD PLOTDX              /REVERSE NUMBERS
0264   3366    DCA PLOTNA
0265   1365    TAD PLOTDY
0266   3364    DCA PLOTDX
0267   1366    TAD PLOTNA
0270   3365    DCA PLOTDY
0271   7001    IAC                     /SET MAJOR MOTION
0272   0367    AND PLOTMV              /INSTRUCTION
0273   1342    TAD PLOTT1
0274   5300    JMP .+4

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0275   1367    PLOT2,      TAD PLOTMV
0276   7110        CLL RAR
0277   1345        TAD PLOTT2
0300   3366        DCA PLOTNA
0301   1766        TAD I PLOTNA
0302   3340        DCA PLOT4
0303   1367        TAD PLOTMV          /SET COMBINED MOTION
0304   1350        TAD PLOTT3
0305   3367        DCA PLOTMV
0306   1767        TAD I PLOTMV
0307   3331        DCA PLOTDB
0310   1364        TAD PLOTDX
0311   7110        CLL RAR
0312   3366        DCA PLOTNA
0313   1364        TAD PLOTDX
0314   7040        CMA
0315   3367        DCA PLOTMV
0316   2367    PLOT3,      ISZ PLOTMV
0317   7410        SKP
0320   5600        JMP I PLOTX         /ALL DONE
0321   1366        TAD PLOTNA
0322   1365        TAD PLOTDY
0323   3366        DCA PLOTNA
0324   1366        TAD PLOTNA
0325   7140        CMA CLL
0326   1364        TAD PLOTDX
0327   7630        SZL CLA
0330   5340        JMP PLOT4           /SINGLE MOTION
0331   0000    PLOTDB,     0                       /COMBINED MOTION
0332   1364        TAD PLOTDX
0333   7041        CIA
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0334   1366      TAD  PLOTNA
0335   3366      DCA  PLOTNA
0336   4370      JMS  PLOTWT
0337   5316      JMP  PLOT3

0340   0000  PLOT4,          0
0341   5336      JMP  .-3

0342   0343  PLOTT1,         .+1
0343   6511      PLPR                          /PEN-RIGHT
0344   6521      PLPL                          /PEN-LEFT
0345   0346  PLOTT2,         .+1
0346   6512      PLDU                          /DRUM-UP
0347   6514      PLDD                          /DRUM-DOWN
0350   0351  PLOTT3,         .+1
0351   6513      PLDU PLPR                     /UP-RIGHT
0352   6523      PLUD PLPL                     /UP-LEFT
0353   6515      PLDD PLPR                     /DOWN-RIGHT
0354   4355      JMS  .+1                      /DOWN-LEFT
0355   0000      0
0356   6514      PLDD
0357   6521      PLPL
0360   5755      JMP  I  .-3

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0361   0000  PLOTPN,         0
0362   0000  PLOTNX,         0
0363   0000  PLOTNY,         0
0364   0000  PLOTDX,         0
0365   0000  PLOTDY,         0
0366   0000  PLOTNA,         0
0367   0000  PLOTMV,         0

0370   0000  PLOTWT,         0
0371   6501      PLSF                          /WAIT FOR DONE FLAG
0372   5371      JMP  .-1                      /NOT YET
0373   6502      PLCF                          /CLEAR FLAG
0374   5770      JMP  I  PLOTWT                /EXIT

              PAUSE
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PLOTA    0220
PLOTDB   0331
PLOTDX   0364
PLOTDY   0365
PLOTMV   0367
PLOTNA   0366
PLOTNX   0362
PLOTNY   0363
PLOTPN   0361
PLOTT1   0342
PLOTT2   0345
PLOTT3   0350
PLOTWT   0370
PLOTX    0200
PLOT1    0227
PLOT2    0275
PLOT3    0316
PLOT4    0340
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