DECUS
PROGRAM LIBRARY

DECUS NO.	8-243
TITLE	AMPLITUDE DISTRIBUTION
AUTHOR	H.-D. Schenk,
COMPANY	Deutsche Forschungs und Versuchsan stalt fur Luft, Germany
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SOURCE LANGUAGE	MACRO-8

AMPLITUDE DISTRIBUTION

DECUS Program Library Write-up

DECUS No. 8-243

ABSTRACT

The program calculates the amplitude distribution of a set of points which are given on tape or are typed on the Teletype. The output is via two D/A Converters. The mean, the variance and the standard deviation are typed on the teleprinter.

REQUIREMENTS

Storage

The program requires the following core sections:
7; 63 - 1400;
Additional place must be reserved for a buffer beginning at 1400, which contains the outcoming data.

Equipment

Basic PDP8, two D/A converters, x-y Plotter.

USAGE

Loading

The program is loaded by the Binary Loader. It uses the Floating Point Package No. 3.

Calling Sequence

None.

Switch Setting

The switch register is only used to start the program.

Start Up

Load the program and the Floating Point Package No. 3. Start the program at location 200. The program will type the next doings.

RESTRICTION

The smallest class width, which can be used, is 4.
The number of data is unlimited.

DESCRIPTION

Discussion

The program types a head and waits for the input of the class width. Herewith the number of classes is calculated by:

$$NRCLA = \frac{FK\ 2048}{FDX}$$

with NRCLA number of classes
FK 2048 2048_{10}, the full range of the input data (-1024 to +1024)
FDX class width

Next the program requests the data input and halts. The tape with the data is loaded in the High Speed Reader and by hitting the "Continue" key, the program reads the characters from the tape. The leader trailer codes are ignored. If the program has read a full word the number is classified in the appropriate class and the specified core is incremented by one. The appropriate core is calculated by:

$$CORE = 3 \cdot POICLA + BUFBEG$$

with

CORE appropriate core address
BUFBEG Buffer begin
POICLA Class Number

The class number POICLA, which is multiplied by three to get the exact core address in floating point format, is calculated by the expression:

$$\text{POICLA} = \text{VAL} / \text{FDX} + \text{NRCLA}/2$$

with VAL value from tape.

The content of the calculated core address is incremented by one in floating point arithmetic. The values and their squares are summed and the values are counted. The end of the data tape is recognized by the leader trailer code. Then the mean of the data set is calculated by

$$\text{FXM} = \left(\sum_{1}^{N} \text{VAL} \right)/\text{FN}$$

and typed out.
The variance of the data is calculated by

$$s^2 = \left(\sum_{1}^{N} \text{VAL}^2 - 1/N \left(\sum_{1}^{N} \text{VAL} \right)^2 \right)/(N-1).$$

and the standard deviation by squarerooting the variance.

To load the D/A converters (10 bit) properly, the buffer which contains the distribution in floating point format must be scaled. For this purpose the maximal value of the buffer is typed out and a scaling factor is read in. The scaling factor must be greater than the maximal value. Before the plotting of each value it is scaled by the expression

$$y = 1777_8 \cdot x/\text{FSCA} - 1000_8$$

For this the full range of the D/A Converters ($\pm\ 1000_8$), which have the device codes No. 55 and No. 56, can be used. The increment Δx for the x-axis is calculated by

$\Delta x = FDX/2.$

After each loading of the D/A Converter the program waits to allow the settling of the pen. The program draws the distribution like a histrogram. A second program, starting at location 1200, draws the normal distribution with the variance and the maximal value found in the main program. Also the calculated mean is taken into consideration. The formula is

$$y = FMAX \exp\left[-(x - \bar{x})/2s^2\right] .$$

This function can be plotted to compare the data set with the appropriate normal distribution. It is also possible to type the dataset on the teletype. To do so, a patch must be read in. The typed value must be greater than 1 but smaller than 1024.

Example

An example is given in the appendix. It shows the amplitude distribution of a data set and the appropriate normal distribution. The teletype output, which is organized in a conversational form, is shown with the values and the statistical constants.

FORMAT

Input Data

The input of the constants FDX and FSCA is on the Teletype in floating point format, while the data set is read by the High Speed Reader in Binary Format (two characters per word). The tape must begin and end with Leader Trailer code. By reading in a patch it is also possible to type the values on the keyboard.

EXECUTION TIME

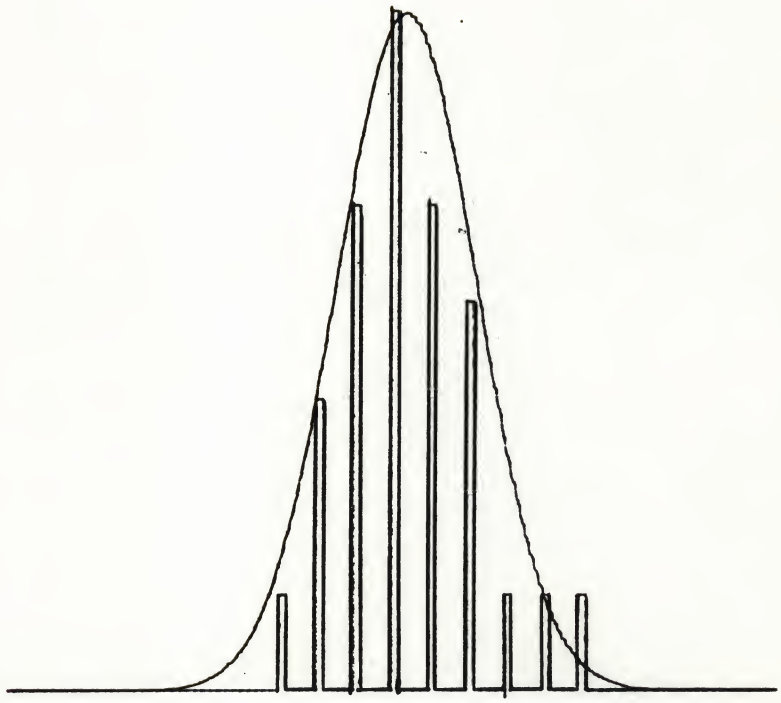
The execution time depends on the number of data which are read by the HSR and on the number of classes.

PROGRAM

Core Map

Core Sections	Content
41 - 62	FAC
63 - 177	Constants
200 - 1177	Main Program
1200 - 1377	Normal Distribution Drawing
1400 - 5377	Max. Buffer for Amplitude Distribution
4757 - 7777	FFP No. 3, Loaders

```
AMPLITUDE DISTRIBUTION

CLASS WIDTH IN BITS (GREATER THAN 4) 20

TYPE DATA SET. END WITH $

100
100
100
100
100
-100
-100
-100
-100
-100
200
200
200
200
-200
-200
-200
0
0
0
0
0
0
0
300
-300
400
500
$


N: +0.2800000E+02
MEAN: +0.3928571E+02
VARIANCE: +0.3432540E+05
STANDARD DEVIATION: +0.1852711E+03

MAX = +0.7000000E+01
DIVIDE BY 8
SET PEN


NORMAL DISTRIBUTION
SET PEN
```



```
                                        / DEVLN-BRG.-L-LA
                                        / USE 22 - 00
                                        / AMPLITUDE DISTRIBUTION
                                        / JULY 17, 1969
                                        / PDP8, BASIC CONFIG.
                                        / FLOATING POINT #3
                /
                /
                / DEFINITIONS TO ASSEMBLER
                /
                SQROOT=2
                FEXP=6
                INPUT=13
                OUTPUT=14
                CALLIN=JMS I 7
                EXIT=FEXT
                / .
                *7
0007  5600            5600                / POINTER TO INTERPRETER
                /
                / BUFFER
                /
                *1400
1400  0000      BUFF1,  0                 / BUFFER
                /
                *63
                / CONSTANTS AND STORAGES
                /
0063  1400      PUBUF1, BUFF1             / BEGIN OF BUFFER
0064  0000      PROGR,  0
0065  0000      NRCLA,  0                 / NUMBER OF CLASSES
0066  0000      CTR,    0                 / COUNTER
0067  0000      N,      0                 / NUMBER OF DATA
0070  0000      SAVE,   0
0071  0000      FNRCL2, 0
0072  0000              0
0073  0000              0
0074  0000      FN,     0                 / NUMBER OF DATA
0075  0000              0
0076  0000              0
0077  0000      FXM,    0                 / MEAN
0100  0000              0
0101  0000              0
0102  0000      FTEMP1, 0                 / TEMPORARY STORAGES
0103  0000              0
0104  0000              0
0105  0000      FTEMP2, 0
0106  0000              0
0107  0000              0
0110  0000      FTEMP3, 0
0111  0000              0
0112  0000              0
0113  0000      FVARIA, 0                 / VARIANCE
0114  0000              0
0115  0000              0
0116  0000      FMAX,   0
0117  0000              0
0120  0000              0
0121  0000      FDX,    0                 / CLASS WIDTH
```

```
0122  0000            0
0123  0000            0
0124  0000  FZER,      0                       / ZERO
0125  0000            0
0126  0000            0
0127  0001  F1,        1                       / ONE
0130  2000            2000
0131  0000            0
                      /
                      /
0132  0000  FLOFIX,    0                       / CONVERSION FLOAT TO FIX
0133  7200            CLA
0134  1044            TAD 44                  / FETCH EXPONENT
0135  7540            SZA SMA                 / IS VALUE <1
0136  5141            JMP .+3                 / NO
0137  7200            CLA
0140  5532            JMP I FLOFIX            / YES, FIX IT TO ZERO
0141  1157            TAD M13                 / SET BINARY POINT TO RIGHT
0142  7450            SNA
0143  5155            JMP DONE                / IT IS ALREADY THERE
0144  3044            DCA 44                  / NO, SET SCALE COUNT
0145  7100  GO,        CLL
0146  1045            TAD 45                  / FETCH MANTISSA
0147  7510            SPA                     / IS IT <0
0150  7020            CML                     / YES, A 1 IN LEFT BIT
0151  7010            RAR                     / SCALE RIGHT
0152  3045            DCA 45                  / RESTORE
0153  2044            ISZ 44                  / TEST, IF SHIFTED ENOUGH
0154  5145            JMP GO                  / NO
0155  1045  DONE,      TAD 45                  / ANSWER IN AC
0156  5532            JMP I FLOFIX
0157  7765  M13,       -13
                      /
                      /
0160  0000  FIXFLO,    0                       / CONVERT FIX TO FLOAT
0161  3045            DCA 45                  / INTO HIGH ORDER MANTISSA
0162  3046            DCA 46                  / CLEAR LOW ORDER MANTISSA
0163  1171            TAD C13                 / 11
0164  3044            DCA 44                  / INTO EXPONENT
0165  4407            JMS I 7
0166  7000            FNOR                    / NORMALIZE
0167  0000            FEXT
0170  5560            JMP I FIXFLO            / EXIT
0171  0013  C13,       13
                      /
                      /
                      *200
                      /
0200  7200  START,     CLA
0201  6046            TLS                     / SET FLAG
0202  4342            JMS INITIA              / INITIALIZE PROGRAM
0203  4777            JMS HEAD                / TYPE HEAD
0204  4776            JMS ACCEPT              / ACCEPT CLASS WIDTH FDX
0205  4407            CALLIN
0206  5256            FGET FK2048             / GET CONSTANT
0207  4121            FDIV FDX                / GET NUMBER OF CLASSES
0210  0000            EXIT
0211  4132            JMS FLOFIX              / CONVERT
0212  3065            DCA NRCLA               / STORE NUMBER OF CLASSES
0213  1065            TAD NRCLA
0214  7110            RAR CLL                 / GET HALF OF NRCLA
```

```
0215  4160            JMS FIXFLO          / CONVERT
0216  4407            CALLIN
0217  6071            FPUT FNRCL2         / STORE
0220  0000            EXIT
0221  4775            JMS TAPBEG          / READ DATA TAPE
0222  7410            SKP
0223  4774  LOOP1,    JMS DATAIN          / READ VALUE
0224  4773            JMS DATSUM          / CALCULATE MEAN
0225  4407            CALLIN
0226  5105            FGET FTEMP2         / GET VALUE
0227  4121            FDIV FDX
0230  1071            FADD FNRCL2         / MAKE IT POSITIVE
0231  0000            EXIT                / CLASSIFIED
0232  4132            JMS FLOFIX          / CONVERT TO FIX
0233  3261            DCA POICLA          / STORE CLASS NUMBER
0234  1261            TAD POICLA          / GET NUMBER
0235  1261            TAD POICLA
0236  1261            TAD POICLA          / MULTIPLY BY THREE
0237  1063            TAD POBUF1          / HAVE CLASS ADDRESS
0240  3064            DCA PROGR           / STORE ADDRESS
0241  4407            CALLIN
0242  5464            FGET I PROGR        / GET CLASS CONTENT
0243  1127            FADD F1             / ADD ONE
0244  6464            FPUT I PROGR        / STORE AGAIN
0245  0000            EXIT
0246  5223            JMP LOOP1
                /
0247  4772  TAPEND,   JMS XMEAN           / END OF TAPE, GET MEAN
0250  4771            JMS NORM            / NORMALIZE FOR OUTPUT
0251  4770            JMS DISP            / PLOT BUFFER
0252  1767            TAD YBEG
0253  6566            6566                / RESET PEN
0254  7402            HLT                 / END
0255  5766            JMP NBSTAR          / DRAW NORMAL DISTRIBUTION
                /
0256  0014  FK2048,   14
0257  2000            2000
0260  0000            0
0261  0000  POICLA,   0
                /
                /DIGITAL 8-18-U
                /MESSAGE TYPE-OUT
                /
0262  0000  MESAGE,     0
0263  7240              CLA CMA           /SET C(AC)=-1
0264  1262              TAD MESAGE        /ADD LOCATION
0265  3010              DCA 10            /AUTO-INDEX REGISTER
0266  1410              TAD I 10          /FETCH FIRST WORD
0267  3300              DCA MSRGHT        /SAVE IT
0270  1300              TAD MSRGHT
0271  7012              RTR
0272  7012              RTR               /ROTATE 6 BITS RIGHT
0273  7012              RTR
0274  4301              JMS TYPECH        /TYPE IT
0275  1300              TAD MSRGHT        /GET DATA AGAIN
0276  4301              JMS TYPECH        /TYPE RIGHT HALF
0277  5266              JMP MESAGE+4      /CONTINUE
0300  0000  MSRGHT,     0                 /TEMPORARY STORAGE
0301  0000  TYPECH,     0                 /TYPE CHARACTER IN C(AC)6-11
0302  0332              AND MASK77
0303  7450              SNA               /IS IT END OF MESSAGE?
```

```
0304  5410              JMP I 10              /YES: EXIT
0305  1333              TAD M40               /SUBTRACT 40
0306  7500              SMA                   /<40?
0307  5312              JMP .+3               /NO
0310  1334              TAD C340              /YES: ADD 300
0311  5325              JMP MTP               /TO CODES <40
0312  1335              TAD M3                /SUBTRACT 3
0313  7440              SZA                   /IS IT ZERO?
0314  5317              JMP .+3               /NO
0315  1336              TAD C212              /YES: CODE 43 IS
0316  5325              JMP MTP               /LINE-FEED (212)
0317  1337              TAD M2                /SUBTRACT 2
0320  7440              SZA                   /IS IT ZERO?
0321  5324              JMP .+3               /NO
0322  1340              TAD C215              /YES: CODE 45 IS
0323  5325              JMP MTP               /CARRIAGE-RETURN (215)
0324  1341              TAD C245              /ADD 200 TO OTHERS >40
0325  6041  MTP,        TSF                   /TRANSMIT CHARACTER
0326  5325              JMP .-1
0327  6046              TLS
0330  7200              CLA                   /SET: CLEAR C(AC)
0331  5701              JMP I TYPECH          /RETURN
                /
                /
                /CONSTANTS
0332  0077  MASK77,     77
0333  7740  M40,        -40
0334  0340  C340,       340
0335  7775  M3,         -3
0336  0212  C212,       212
0337  7776  M2,         -2
0340  0215  C215,       215
0341  0245  C245,       245
                /
                /
                /
0342  0000  INITIA, 0
0343  4407              CALLIN
0344  5124              FGET FZER
0345  6074              FPUT FN                 / CLEAR FN
0346  6102              FPUT FTEMP1             / CLEAR FTEMP1
0347  6110              FPUT FTEMP3             / CLEAR FTEMP3
0350  0000              EXIT
0351  7240              STA                     / SET AC TO -1
0352  1063              TAD POBUF1
0353  3010              DCA 10                  / SET BUFFER ENTRY
0354  1362              TAD M3000
0355  3066              DCA CTR                 / SET COUNTER
0356  3410              DCA I 10                / CLEAR BUFFER
0357  2066              ISZ CTR                 / ENOUGH ?
0360  5356              JMP .-2                 / NO
0361  5742              JMP I INITIA            / YES, EXIT
0362  5000  M3000,      -3000
                /
                /
0366  1200  PAGE
0367  1057
0370  1000
0371  0675
0372  0600
0373  0540
```

```
0374  0526
0375  0455
0376  0423
0377  0400
                /
                /
0400  0000  HEAD,    0                       / TYPE HEAD
0401  4777          JMS CRTLF               / TYPE CR AND LF
0402  4777          JMS CRTLF
0403  4776          JMS MESAGE              / TYPE TEXT
0404  0115          TEXT !AM
0405  2014  PL
0406  1124  IT
0407  2504  UD
0410  0540  E
0411  0411  DI
0412  2324  ST
0413  2211  RI
0414  0225  BU
0415  2411  TI
0416  1716  ON
0417  0000  !
0420  4777          JMS CRTLF               / TYPE CR AND LF
0421  4777          JMS CRTLF
0422  5600          JMP I HEAD              / EXIT
                /
0423  0000  ACCEPT,  0                       / ACCEPT CLASS WIDTH
0424  4776          JMS MESAGE              / TYPE TEXT
0425  0314          TEXT !CL
0426  0123  AS
0427  2340  S
0430  2711  WI
0431  0424  DT
0432  1040  H
0433  1116  IN
0434  4002   B
0435  1124  IT
0436  2340  S
0437  5007  (G
0440  2205  RE
0441  0124  AT
0442  0522  ER
0443  4024   T
0444  1001  HA
0445  1640  N :
0446  6451  4)
0447  4000   !
0450  4407          CALLIN
0451  0013          INPUT                   / GET VALUE
0452  6121          FPUT FDX                / STORE
0453  0000          EXIT
0454  5623          JMP I ACCEPT
                /
0455  0000  TAPBEG,  0                       / READ DATA TAPE
0456  4776          JMS MESAGE              / TYPE TEXT
0457  1417          TEXT !LO
0460  0104  AD
0461  4024   T
0462  0120  AP
0463  0540  E
0464  1116  IN
```

```
0465  4010   H
0466  2322  SR
0467  5640  .
0470  1011  HI
0471  2440  T
0472  0317  CO
0473  1624  NT
0474  1116  IN
0475  2505  UE
0476  5600  .!
0477  4777          JMS CRTLF              / TYPE CR AND LF
0500  7402          HLT                    / WAIT
0501  4316          JMS REAPR              / READ CHARACTER
0502  1324          TAD M200
0503  7450          SNA                    / CHECKING FOR LEADER
0504  5301          JMP .-3                / FOUND LEADER
0505  1325          TAD P200
0506  7106          CLL RTL
0507  7006          RTL                    / CHANNEL 8 IN AC0
0510  7510          SPA
0511  5302          JMP .-7                / ASC II CODE, IGNORE
0512  7006          RTL
0513  4316          JMS REAPR              / READ SECOND HALF
0514  3070          DCA SAVE               / SAVE
0515  5655          JMP I TAPREG
                /
                /
0516  0000  REAPR, 0
0517  6014          RFC
0520  6011          RSF
0521  5320          JMP .-1
0522  6012          RRB                    / READ CHARACTER
0523  5716          JMP I REAPR
0524  7600  M200,   -200
0525  0200  P200,   200
                /
                /
                /
0526  0000  DATAIN, 0                      / READ DATA
0527  4316          JMS REAPR              / READ FIRST HALF
0530  7106          CLL RTL
0531  7006          RTL                    / CHANNEL 8 IN AC0
0532  7510          SPA                    / END OF TAPE ?
0533  5775          JMP TAPEND             / YES
0534  7006          RTL
0535  4316          JMS REAPR              / READ SECOND HALF
0536  3070          DCA SAVE               / SAVE
0537  5726          JMP I DATAIN
                /
0540  0000  DATSUM, 0                      / ADD DATA
0541  1070          TAD SAVE
0542  4160          JMS FIXFLO             / CONVERT
0543  4407          CALLIN
0544  6105          FPUT FTEMP2            / STORE
0545  5105          FGET FTEMP2
0546  1102          FADD FTEMP1            / ADD SUM
0547  6102          FPUT FTEMP1            / STORE AGAIN
0550  5105          FGET FTEMP2
0551  3105          FMPY FTEMP2            / SQUARE VALUE
0552  1110          FADD FTEMP3            / ADD ALL
0553  6110          FPUT FTEMP3            / STORE AGAIN
```

```
0554  5074          FGET FN
0555  1127          FADD F1                 / UPDATE N
0556  6074          FPUT FN
0557  0000          EXIT
0560  5740          JMP I DATSUM
                    /
                    /
0575  0247    PAGE
0576  0262
0577  0657
                    /
                    /
0600  0000    XMEAN, 0                     / CALCULATE MEAN
0601  4257          JMS CRTLF
0602  4777          JMS MESAGE              / TYPE TEXT
0603  1672          TEXT !N:
0604  4000     !
0605  4407          CALLIN
0606  5074          FGET FN                 / GET NUMBER OF DATA
0607  0014          OUTPUT                  / TYPE NUMBER
0610  0000          EXIT
0611  4777          JMS MESAGE              / TYPE TEXT
0612  1505          TEXT !ME
0613  0116    AN
0614  7240    :
0615  0000    !
0616  4407          CALLIN
0617  5102          FGET FTEMP1             / GET SUM OF DATA
0620  4074          FDIV FN                 / DIVIDE BY N
0621  6077          FPUT FXM                / STORE
0622  5077          FGET FXM
0623  0014          OUTPUT                  / TYPE MEAN
0624  0000          EXIT
0625  4777          JMS MESAGE              / TYPE TEXT
0626  2601          TEXT !VA
0627  2211    RI
0630  0116    AN
0631  0305    CE
0632  7240    :
0633  0000    !
0634  4407          CALLIN
0635  5102          FGET FTEMP1
0636  3102          FMPY FTEMP1             / SQUARE SUM
0637  4074          FDIV FN                 / DIVIDE BY N
0640  6102          FPUT FTEMP1             / STORE
0641  5110          FGET FTEMP3
0642  2102          FSUB FTEMP1
0643  6102          FPUT FTEMP1
0644  5074          FGET FN
0645  2127          FSUB F1                 / HAVE N-1
0646  6110          FPUT FTEMP3             / STORE
0647  5102          FGET FTEMP1
0650  4110          FDIV FTEMP3             / HAVE VARIANCE
0651  6113          FPUT FVARIA             / STORE VARIANCE
0652  5113          FGET FVARIA
0653  0014          OUTPUT                  / TYPE VARIANCE
0654  0000          EXIT
0655  4776          JMS STADEV              / TYPE STANDARD DEVIATION
0656  5600          JMP I XMEAN
                    /
0657  0000    CRTLF, 0                      / TYPE CARRIAGE RETURN
```

```
0660  1273          TAD CR                    / AND LINE FEED
0661  4266          JMS TYPE
0662  1274          TAD LF
0663  4266          JMS TYPE
0664  7200          CLA
0665  5657          JMP I CRTLF
0666  0000  TYPE,    0                         / TYPE CHARACTER
0667  6041          TSF
0670  5267          JMP .-1
0671  6046          TLS
0672  5666          JMP I TYPE
0673  0215  CR,      215
0674  7775  LF,      -3
              /
              /
0675  0000  NORM,    0                         / NORMALIZE
0676  1063          TAD POBUF1
0677  3064          DCA PROGR                 / SET BUFFER ENTRY
0700  1065          TAD NRCLA
0701  7041          CIA
0702  3066          DCA CTR                   / SET COUNTER
0703  4407          CALLIN
0704  5124          FGET FZER
0705  6102          FPUT FTEMP1               / CLEAR TEMPORARY STORAGE
0706  0000          EXIT
0707  4407  NOLOOP, CALLIN
0710  5464          FGET I PROGR              / GET VALUE
0711  2102          FSUB FTEMP1               / SUBTRACT MAX
0712  0000          EXIT
0713  1045          TAD 45                    / CHECK SIGN OF DIFFERENCE
0714  7710          SPA CLA
0715  5322          JMP .+5
0716  4407          CALLIN                    / FOUND NEW MAX
0717  5464          FGET I PROGR
0720  6102          FPUT FTEMP1               / STORE NEW MAX
0721  0000          EXIT
0722  2064          ISZ PROGR
0723  2064          ISZ PROGR
0724  2064          ISZ PROGR                 / UPDATE POINTER
0725  2066          ISZ CTR                   / HAVE ALL CHECKED ?
0726  5307          JMP NOLOOP                / NO
0727  4777          JMS MESAGE                / TYPE.TEXT
0730  1501          TEXT !MA
0731  3040  X
0732  7540  =
0733  0000  !
0734  4407          CALLIN
0735  5102          FGET FTEMP1               / GET MAX
0736  6116          FPUT FMAX                 / STORE
0737  5116          FGET FMAX
0740  0014          OUTPUT                    / TYPE IT
0741  0000          EXIT
0742  4777          JMS MESAGE                / TYPE TEXT
0743  0411          TEXT !DI
0744  2611  VI
0745  0405  DE
0746  4002   B
0747  3140  Y
0750  0000  !
0751  4407          CALLIN
0752  0013          INPUT                     / GET SCALING FACTOR
```

```
0753  6356           FPUT FSCA                / STORE
0754  0000           EXIT
0755  5675           JMP I NORM               / EXIT
0756  0000  FSCA,    0
0757  0000           0
0760  0000           0
                /
0761  0000  DELAY,   0                        / DELAY FOR SETTLING
0762  1371           TAD DELCTR
0763  3372           DCA DELCR1               / LOAD DELAYCOUNTER 1
0764  2373           ISZ DELCR2
0765  5364           JMP .-1
0766  2372           ISZ DELCR1               / DELAY COMPLETE ?
0767  5364           JMP .-3                  / NO
0770  5761           JMP I DELAY              / YES, EXIT
0771  7770  DELCTR,  -10
0772  0000  DELCR1,  0
0773  0000  DELCR2,  0
                /
0776  1065  PAGE
0777  0262
                /
                /
1000  0000  DISP,    0                        / PLOT BUFFER
1001  1063           TAD POBUF1
1002  3064           DCA PROGR                / SET BUFFER ENTRY
1003  1065           TAD NRCLA
1004  7041           CIA
1005  3066           DCA CTR                  / SET COUNTER
1006  1256           TAD XBEG
1007  6552           6552                     / SET PEN
1010  3260           DCA XVAL                 / STORE INITIAL VALUE IN X
1011  1257           TAD YBEG
1012  6562           6562                     / SET INITIAL VALUE IN Y
1013  7200           CLA
1014  4777           JMS MESAGE               / TYPE TEXT
1015  2305           TEXT !SE
1016  2440  T
1017  2005  PE
1020  1600  N!
1021  4776           JMS CRTLF                / TYPE CR AND LF
1022  7402           HLT                      / WAIT
1023  4407           CALLIN
1024  5121           FGET FDX                 / GET CLASS WIDTH
1025  0000           EXIT
1026  4132           JMS FLOFIX               / CONVERT TO FIX
1027  7110           RAR CLL                  / DIVIDE BY TWO
1030  3261           DCA XDEL                 / STORE SPACING
1031  4407  DILOOP,  CALLIN
1032  5464           FGET I PROGR             / GET VALUE
1033  4775           FDIV FSCA
1034  3262           FMPY F2000               / SCALE VALUE
1035  0000           EXIT
1036  4132           JMS FLOFIX               / CONVERT TO FIX
1037  1257           TAD YBEG                 / ADD INITIAL VALUE
1040  6562           6562                     / PLOT
1041  7200           CLA
1042  4774           JMS DELAY                / DELAY FOR SETTLING
1043  1260           TAD XVAL
1044  1261           TAD XDEL
1045  6552           6552                     / PREPARE NEXT CLASS
```

```
1046  3260            DCA XVAL
1047  4774            JMS DELAY                 / DELAY
1050  2064            ISZ PROGR
1051  2064            ISZ PROGR
1052  2064            ISZ PROGR                 / UPDATE POINTER
1053  2066            ISZ CTR                   / END OF PLOT ?
1054  5231            JMP DILOOP                / NO
1055  5600            JMP I DISP                / YES, EXIT
1056  7000  XBEG,     -1000
1057  7000  YBEG,     -1000
1060  0000  XVAL,     0
1061  0000  XDEL,     0
1062  0012  F2000,    12
1063  3776            3776
1064  0000            0
                /
1065  0000  STADEV,  0                          / CALCULATE STANDARD DEV.
1066  4777            JMS MESAGE                / TYPE TEXT
1067  2324            TEXT !ST
1070  0116  AN
1071  0401  DA
1072  2204  RD
1073  4004   D
1074  0526  EV
1075  1101  IA
1076  2411  TI
1077  1716  ON
1100  7240  :
1101  0000  !
1102  4407            CALLIN
1103  5113            FGET FVARIA               / GET VARIANCE
1104  0002            SQROOT
1105  0014            OUTPUT                    / TYPE STANDARD DEVIATION
1106  0000            EXIT
1107  4776            JMS CRTLF                 / TYPE CR AND LF
1110  5665            JMP I STADEV
                /
1174  0761  PAGE
1175  0756
1176  0657
1177  0262
                /
                /
                / ADDITIONAL PART TO USE 22 - 00
                / AMPLITUDE DISTRIBUTION
                / DRAWING OF NORMAL DISTRIBUTION
                / NUMBER OF DATA AND VARIANCE COME FROM MAIN PROGRAM
                /
                /
                /
                /
                /
                /
1200  7200  NBSTAR,  CLA
1201  6046            TLS                       / ENABLE TELETYPE
1202  4777            JMS CRTLF                 / TYPE CR AND LF
1203  4777            JMS CRTLF
1204  4776            JMS MESAGE                / TYPE TEXT
1205  1617            TEXT !NO
1206  2215  RM
1207  0114  AL
```

```
1210  4004   D
1211  1123  IS
1212  2422  TR
1213  1102  IB
1214  2524  UT
1215  1117  IO
1216  1600  N!
1217  4777          JMS CRTLF                   / TYPE CR AND LF
1220  4776          JMS MESAGE                  / TYPE TEXT
1221  2305          TEXT !SE
1222  2440  T
1223  2005  PE
1224  1600  N!
1225  4777          JMS CRTLF
1226  1775          TAD XBEG                    / SET PEN
1227  6552          6552                        / TO INITIAL POSITION
1230  7200          CLA
1231  1774          TAD YBEG
1232  6562          6562
1233  7200          CLA
1234  7402          HLT
1235  4407          CALLIN
1236  5127          FGET F1
1237  4113          FDIV FVARIA
1240  4310          FDIV FM2
1241  6105          FPUT FTEMP2                 / STORE CONSTANT
1242  5313          FGET FXBEG
1243  6316          FPUT FX                     / INITIALIZE X
1244  0000          EXIT
1245  1321          TAD NBND
1246  3066          DCA CTR                     / SET COUNTER
1247  4407  NDLOOP, CALLIN
1250  5316          FGET FX                     / GET X
1251  2077          FSUB FXM                    / SUBTRACT MEAN
1252  6102          FPUT FTEMP1                 / STORE TEMPORARY
1253  5102          FGET FTEMP1
1254  3102          FMPY FTEMP1                 / SQUARE
1255  3105          FMPY FTEMP2                 / HAVE EXPONENT
1256  0006          FEXP                        / EXPONENTIAL
1257  3116          FMPY FMAX                  / HAVE VALUE
1260  4773          FDIV FSCA
1261  3772          FMPY F2000                  / SCALE
1262  0000          EXIT
1263  4132          JMS FLOFIX                  / CONVERT
1264  1774          TAD YBEG                    / ADD INITIAL VALUE
1265  6562          6562
1266  7200          CLA
1267  4407          CALLIN
1270  5316          FGET FX
1271  4322          FDIV F2                     / HAVE X COORDINATE
1272  0000          EXIT
1273  4132          JMS FLOFIX                  / CONVERT
1274  6552          6552
1275  7200          CLA
1276  4771          JMS DELAY                   / DELAY FOR SETTLING
1277  4407          CALLIN
1300  5316          FGET FX
1301  1325          FADD FXSPA                  / UPDATE X
1302  6316          FPUT FX
1303  0000          EXIT
1304  2066          ISZ CTR                     / HAVE ALL ?
```

```
1305  5247          JMP NDLOOP                / NO
1306  7402          HLT
1307  5200          JMP NBSTAR
                    /
1310  0002  FM2,     2                         / -2
1311  6000          6000
1312  0000          0
1313  0013  FXBEG,   13                        / -1024 DEC
1314  6000          6000
1315  0000          0
1316  0000  FX,      0
1317  0000          0
1320  0000          0
1321  7540  NBND,    -240                      / -160 DEC
1322  0002  F2,      2                         / 2
1323  2000          2000
1324  0000          0
1325  0004  FXSPA,   4
1326  3100          3100
1327  0000          0
                    /
1371  0761  $
1372  1062
1373  0756
1374  1057
1375  1056
1376  0262
1377  0657
```

```
ACCEPT 0423
BUFF1  1400
CALLIN 4407
CR     0673
CRTLF  0657
CTR    0066
C13    0171
C212   0336
C215   0340
C245   0341
C340   0334
DATAIN 0526
DATSUM 0540
DELAY  0761
DELCR1 0772
DELCR2 0773
DELCTR 0771
DILOOP 1031
DISP   1000
DONE   0155
EXIT   0000
FDX    0121
FEXP   0006
FIXFLO 0160
FK2048 0256
FLOFIX 0132
FMAX   0116
FM2    1310
FN     0074
FNRCL2 0071
FSCA   0756
FTEMP1 0102
FTEMP2 0105
FTEMP3 0110
FVARIA 0113
FX     1316
FXBEG  1313
FXM    0077
FXSPA  1325
FZER   0124
F1     0127
F2     1322
F2000  1062
GO     0145
HEAD   0400
INITIA 0342
INPUT  0013
LF     0674
LOOP1  0223
MASK77 0332
MESAGE 0262
MSRGHT 0300
MTP    0325
M13    0157
M2     0337
M200   0524
M3     0335
M3000  0362
M40    0333
N      0067
```

```
NBND    1321
NBSTAR  1200
NDLOOP  1247
NOLOOP  0707
NORM    0675
NRCLA   0065
OUTPUT  0014
POBUF1  0063
POICLA  0261
PROGR   0064
P200    0525
REAPR   0516
SAVE    0070
SQROOT  0002
STADEV  1065
START   0200
TAPBEG  0455
TAPEND  0247
TYPE    0666
TYPECH  0301
XBEG    1056
XDEL    1061
XMEAN   0600
XVAL    1060
YBEG    1057
```

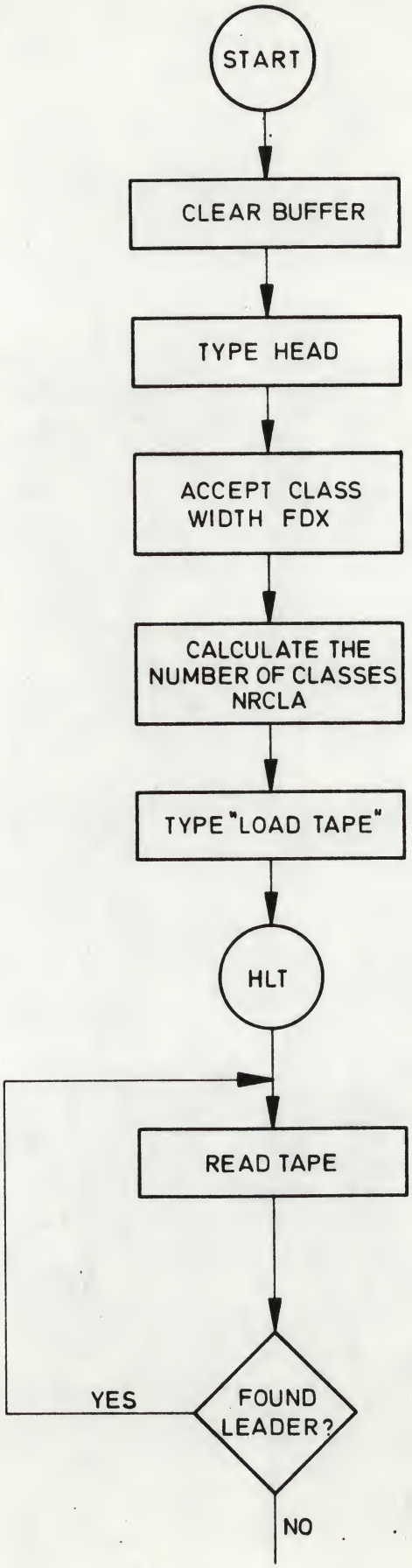
```
                / PATCH TO DFVLR-BRG.-L-LA USE 22-00
                / INPUT OF DATA SET ON TELETYPE
                /
                FTEMP2=105
                TAPEND=247
                CRTLF=657
                MESAGE=262
                CALLIN=JMS I 7
                EXIT=FEXT
                INPUT=13
                OUTPUT=14
                /
                *222
0222  7000              NOP
                /
                *455
0455  0000      TAPBEG, 0
0456  4777              JMS CRTLF                 / TYPE CR AND LF
0457  4776              JMS MESAGE                / TYPE TEXT
0460  2431              TEXT !TY
0461  2005      PE
0462  4004       D
0463  0124      AT
0464  0140      A
0465  2305      SE
0466  2456      T.
0467  4005       E
0470  1604      ND
0471  4027       W
0472  1124      IT
0473  1040      H
0474  4400      $!
0475  4777              JMS CRTLF
0476  4777              JMS CRTLF                 / TYPE CR AND LF
0477  5655              JMP I TAPBEG
                /
                *526
0526  0000      DATAIN, 0
0527  4407              CALLIN
0530  0013              INPUT                     / GET DATA
0531  6105              FPUT FTEMP2               / STORE
0532  0000              EXIT
0533  5300              JMP 500
                / :
                *500
0500  1057              TAD 57                    / GET TERMINATING CHARACTER
0501  1307              TAD M244                  / $
0502  7640              SZA CLA                   / END OF INPUT ?
0503  5726              JMP I DATAIN              / NO, CONTINUE
0504  4777              JMS CRTLF                 / TYPE CR AND LF
0505  4777              JMS CRTLF
0506  5775              JMP TAPEND                / YES
0507  7534      M244,   -244
                /
                *540
0540  0000      DATSUM, 0
0541  7000              NOP
0542  7000              NOP
0543  7000              NOP
```

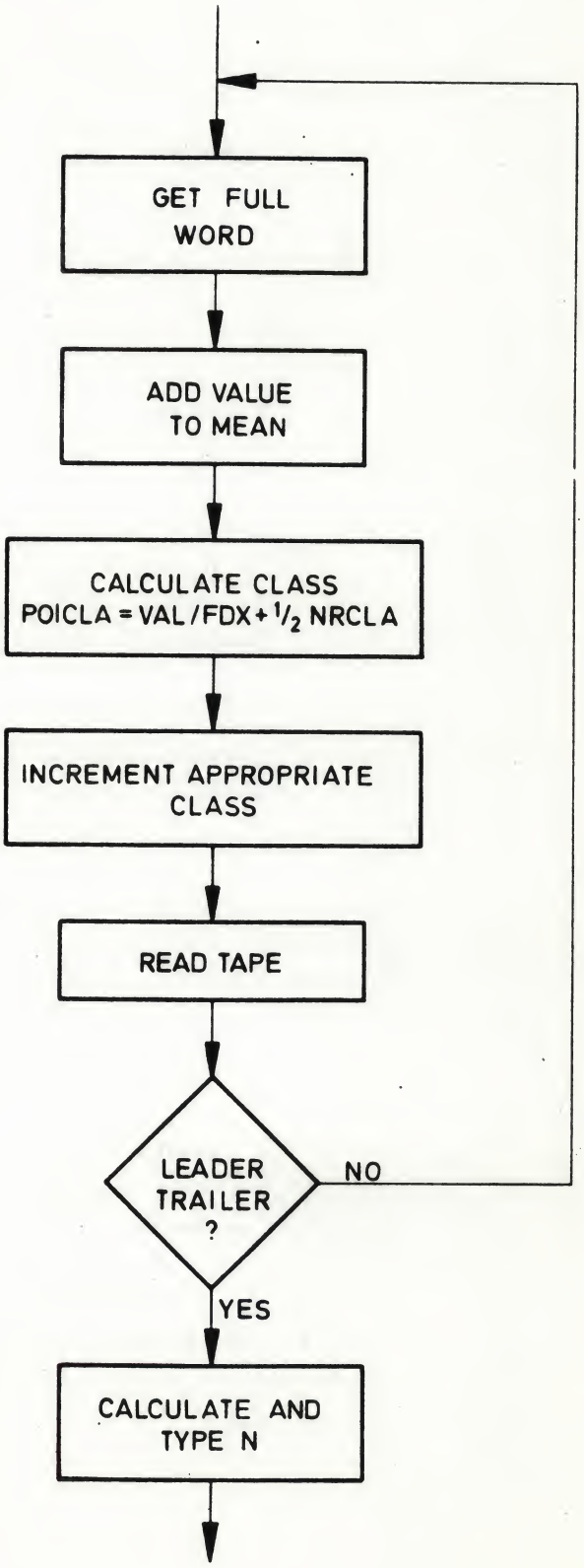
```
0544  4407          CALLIN
                    /
0575  0247  $
0576  0262
0577  0657


CALLIN 4407
CRTLF  0657
DATAIN 0526
DATSUM 0540
EXIT   0000
FTEMP2 0105
INPUT  0013
MESAGE 0262
M244   0507
OUTPUT 0014
TAPBEG 0455
TAPEND 0247
```

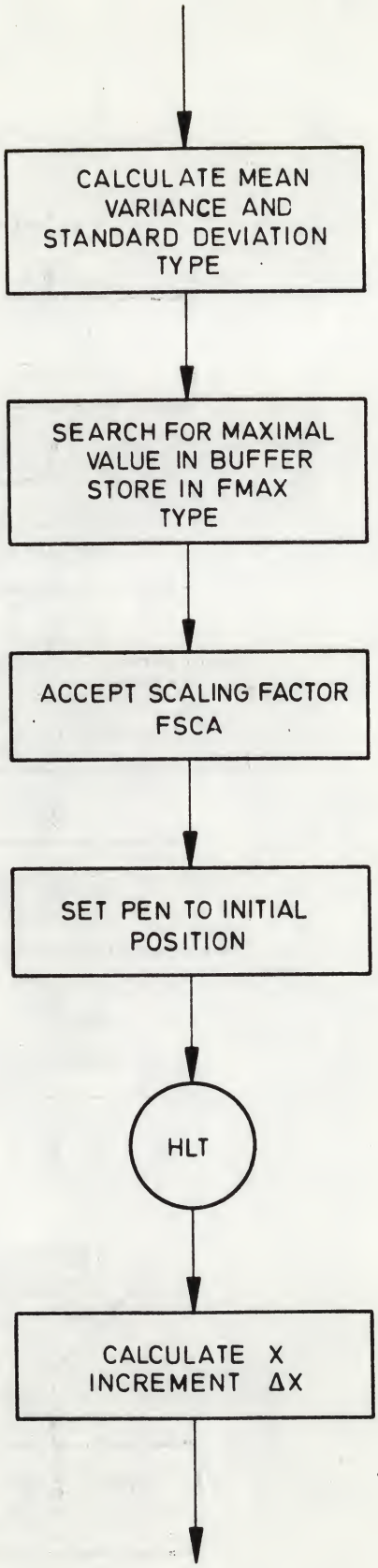
FLOW CHART

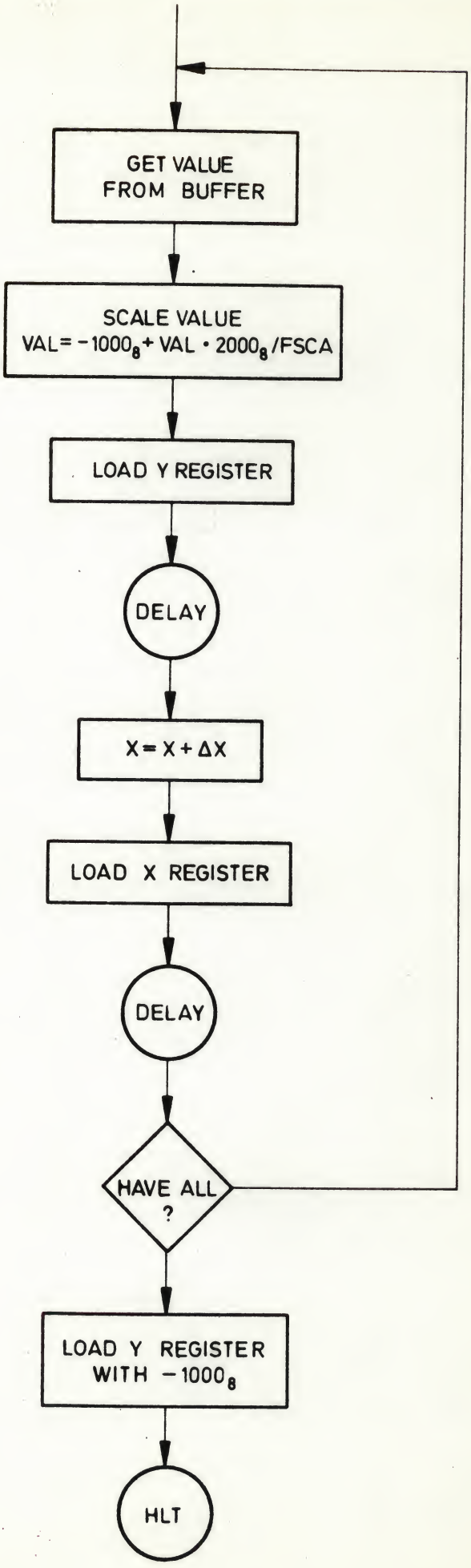
DFVLR-BRG.-L-LA

USE 22-00




GET FULL WORD
ADD VALUE TO MEAN
CALCULATE CLASS
POICLA = VAL/FDX + 1/2 NRCLA
INCREMENT APPROPRIATE CLASS
READ TAPE
LEADER TRAILER ?
NO
YES
CALCULATE AND TYPE N


CALCULATE MEAN
VARIANCE AND
STANDARD DEVIATION
TYPE
SEARCH FOR MAXIMAL
VALUE IN BUFFER
STORE IN FMAX
TYPE
ACCEPT SCALING FACTOR
FSCA
SET PEN TO INITIAL
POSITION
HLT
CALCULATE X
INCREMENT ΔX


GET VALUE
FROM BUFFER
SCALE VALUE
VAL= -1000$_8$ + VAL • 2000$_8$ /FSCA
LOAD Y REGISTER
DELAY
X = X + ΔX
LOAD X REGISTER
DELAY
HAVE ALL
?
LOAD Y REGISTER
WITH -1000$_8$
HLT