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DECUS NO.	8-201
TITLE	DECSW
AUTHOR	Kenneth B. Wiberg
COMPANY	Yale University New Haven, Connecticut
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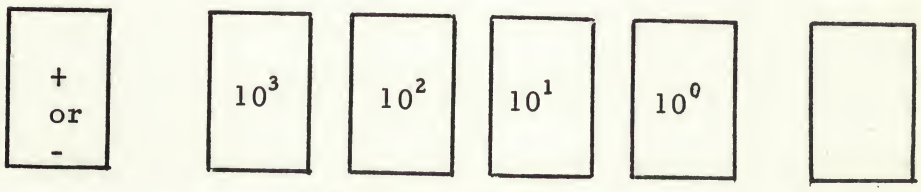
SOURCE LANGUAGE	

DECUS Program Library Write-up

DECUS No. 8-201

This subroutine accepts the contents of decimal switches at a remote location, and converts the number into several forms: 1, as an insert into a BCD string which may be typed out or displayed on a CRT screen; 2, as a floating point number in the floating point accumulator; and 3, if an integer, as the binary equivalent in the accumulator.

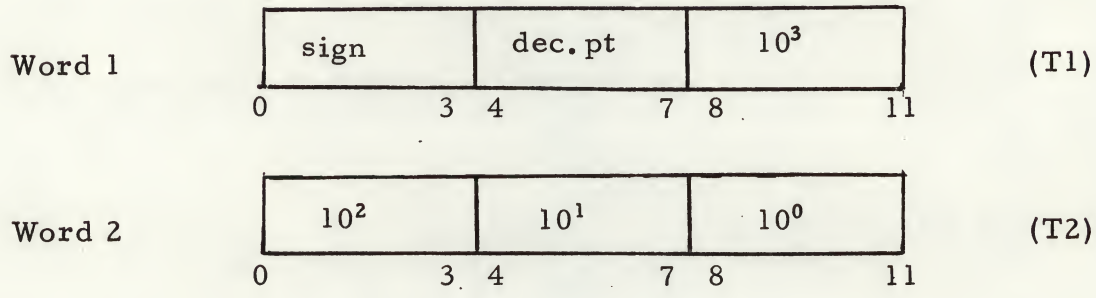
Specifications: The subroutine assumes that a set of input switches are attached to the computer via an interface. The binary coded switches are arranged as follows:



The sign switch is EECo No. 165M (0 indicates + and 1 indicates -), the decimal switches are EECo No. 119M (1-2-4-8 output), and the decimal point location switch is EECo No. 148M (1-2-4-8 output plus a decimal, 0-9, output). The latter may be used to light pilot lights which indicate the location of the decimal point with respect to the decimal switches. An indication of 6 is arbitrarily taken as indicating the decimal point just to the right of the decimal switches, i.e., an integer. Smaller numbers shift the decimal point to the left. The

subroutine requires two pages in memory and uses the floating point interpreter.

Description: The contents of the decimal switches are read into the computer via IOT1 and IOT2 pulses (from a W103 device selector) and four R123 modules. The -3v source is supplied by W005 clamped loads. When read in as two words, the number appears as follows:



The decimal point is extracted from word 1, incremented and stored in DVAL. The integers in the number are then extracted in turn after checking for the decimal point. The BCD representations of the sign, the decimal point and four integers are packed two to a word into the three locations starting with the address LOC. At the same time, the integers are converted to binary form by multiplying the previously developed number by ten and adding the new integer. The final double precision binary number is converted to floating point form with the correct exponent by converting to a floating point integer and then multiplying or dividing by ten the required number of times. If the

number is an integer (i. e. the decimal point indicator was set to six), the number is also found in the accumulator on return from the subroutine.

The internal subroutine SHIFTS shifts the two word BCD input number in order to extract the individual decimal integers. MPY10S effects multiplication of the double precision binary number by ten. SIGNS sets the sign of the binary number after the BCD to binary conversion.

Usage: The subroutine is designed to be used with the Teletype output routine, TYPSTG (DIGITAL 8-20-U) or the CRT output routine, GIAN (DECUS 8-23). The address of the first of three successive locations into which the BCD representation is to be inserted is loaded into the accumulator before calling the subroutine. When called, the subroutine directs the computer to read the contents of the digital switches and effect the conversion. On return from the subroutine, the BCD representation is in the proper locations, the floating point representation is in the floating point interpreter (locations 44, 45 and 46), and if an integer, the binary representation is found in the accumulator.

Note: The subroutine may be checked independently of the switches by using the attached program which simulates the decimal switches using the console switch register.

The binary version of the test program is loaded after the DECSW subroutine, and version C of the floating point interpreter is also loaded. Start at location 200. The computor will halt. Word 1 (see pg. 2 of writeup) is formed using the switch register, and the Continue key is depressed. Another halt occurs, and word 2 is entered in the same fashion. The BCD representation of the number will by typed followed by the floating point form. Note that a decimal point is not printed if the proper position is not within the character string (ie. the number is too small or too large to be typed in fixed point form). Also, remember that a decimal point setting of six indicates the decimal point to follow the least significant integer.

```
                    /SUBROUTINE FOR READING CONTENTS OF DECIMAL SWITCHES
                    /INPUT WITH LOCATION OF BCD STRING IN AC
                    /OUTPUT IN FLOATING POINT ACCUMULATOR AND BCD STRING
                    /ALSO IN AC IF INTEGER <2048
                    *3400
3400  0000  DECSW,  0
3401  3363          DCA LOC
3402  3044          DCA 44            /CLEAR FL PT AC
3403  3045          DCA 45
3404  3046          DCA 46
3405  6371          6371              /READ UPPER HALF OF SWITCH
3406  3353          DCA T1
3407  6372          6372              /READ LOWER HALF OF SWITCH
3410  3354          DCA T2
3411  1353          TAD T1            /LOCATE DECIMAL POINT
3412  7012          RTR
3413  7012          RTR
3414  0355          AND MASK
3415  7041          CIA
3416  7001          IAC
3417  3361          DCA DVAL
3420  1361          TAD DVAL
3421  3364          DCA INDX
3422  1363          TAD LOC           /LOCATION OF BCD STRING
3423  3365          DCA INDLOC
3424  1352          TAD M4
3425  3367          DCA IN4           /CHARACTER COUNTER
3426  1351          TAD M2
3427  3366          DCA IN2           /BCD POSITION COUNTER
3430  4776          CALL SIGN         /SET SIGN OF NUMBER
3431  2364  LOOP,   ISZ INDX         /DECIMAL POINT?
3432  5241          JMP A2            /NO
3433  1362          TAD PER           /YES
3434  2366          ISZ IN2           /SECOND ENTRY IN WORD?
3435  5240          JMP A1            /NO
3436  4774          CALL SHIFT        /YES
3437  5241          JMP A2
3440  3765  A1,     DCA I INDLOC
3441  1353  A2,     TAD T1            /GET DECIMAL CHARACTER
3442  0355          AND MASK
3443  3357          DCA TEMP
3444  1357          TAD TEMP
3445  1356          TAD SIXTY         /FORM BCD CHARACTER
3446  2366          ISZ IN2           /SECOND ENTRY?
3447  5252          JMP B1            /NO
3450  4774          CALL SHIFT        /YES
3451  5253          JMP B2
3452  3765  B1,     DCA I INDLOC
3453  1352  B2,     TAD M4
3454  3370          DCA INX
3455  1354  LOOP2,  TAD T2           /SHIFT DOUBLE PRECISION WORD
3456  7104          CLL RAL
3457  3354          DCA T2
3460  1353          TAD T1
```

```
3461  7004          RAL
3462  3353          DCA T1
3463  2370          ISZ INX          /SHIFT FINISHED?
3464  5255          JMP LOOP2        /CONTINUE LOOP
3465  4775          CALL MPY10       /FIX DECIMAL NUMBER
3466  7100          CLL
3467  1046          TAD 46
3470  1357          TAD TEMP
3471  3046          DCA 46
3472  7430          SZL
3473  2045          ISZ 45
3474  2367          ISZ IN4          /ALL CHARACTERS DECODED?
3475  5231          JMP LOOP         /NO: CONTINUE LOOP
3476  2364          ISZ INDX         /FINAL DECIMAL POINT?
3477  5306          JMP D2
3500  1362          TAD PER          /YES
3501  2366          ISZ IN2
3502  5305          JMP D1
3503  4774          CALL SHIFT
3504  5306          JMP D2
3505  3765  D1,     DCA I INDLOC
3506  2366  D2,     ISZ IN2          /SHIFT LAST CHARACTER?
3507  5311          JMP D3           /NO
3510  4774          CALL SHIFT       /YES
3511  4777  D3,     CALL SIGN2       /CHECK SIGN OF NUMBER
3512  1046          TAD 46
3513  3357          DCA TEMP         /SAVE LOW ORDER PART OF NUMBER
3514  1360          TAD DCONST       /PUT IN FL. PT. FORM
3515  3044          DCA 44
3516  4407          FLPT
3517  7000          FNOR
3520  0000          FEXT
3521  1361          TAD DVAL         /MULT OR DIVIDE BY 10**I
3522  1350          TAD CV
3523  7550          SPA SNA
3524  5335          JMP MPY
3525  7041          CIA
3526  3364          DCA INDX         /DIVIDE
3527  4407          FLPT
3530  4371          FDIV TEN
3531  0000          FEXT
3532  2364          ISZ INDX
3533  5327          JMP .-4
3534  5345          JMP C1
3535  7500  MPY,     SMA
3536  5346          JMP C2
3537  3364          DCA INDX         /MULTIPLY
3540  4407          FLPT
3541  3371          FMPY TEN
3542  0000          FEXT
3543  2364          ISZ INDX
3544  5340          JMP .-4
3545  5600  C1,     RETURN DECSW
3546  1357  C2,     TAD TEMP
```

```
3547  5345            JMP .-2
3550  0005  CV,       5
3551  7776  M2,       -2
3552  7774  M4,       -4
3553  0000  T1,       0
3554  0000  T2,       0
3555  0017  MASK,     0017
3556  0060  SIXTY,    0060
3557  0000  TEMP,     0
3560  0027  DCONST,   27
3561  0000  DVAL,     0
3562  0056  PER,      0056
3563  0000  LOC,      0
3564  0000  INDX,     0
3565  0000  INDLOC,   0
3566  0000  IN2,      0
3567  0000  IN4,      0
3570  0000  INX,      0
3571  0004  TEN,      FLTG 10.0
3572  2377
3573  7776
3574  3600  SHIFT,    SHIFTS
3575  3623  MPY10,    MPY10S
3576  3662  SIGN,     SIGNS
3577  3712  SIGN2,    SIGNS2
```

```
                /DECSW SUBROUTINES


                *3600
3600  0000      SHIFTS, 0
3601  3307              DCA TEMV
3602  1617              TAD I LOCV
3603  3220              DCA LOCS
3604  7100              CLL
3605  1620              TAD I LOCS
3606  7006              RTL
3607  7006              RTL
3610  7006              RTL
3611  1307              TAD TEMV
3612  3620              DCA I LOCS
3613  1221              TAD MM2
3614  3622              DCA I INN2
3615  2617              ISZ I LOCV
3616  5600              RETURN SHIFTS
3617  3565      LOCV,   INDLOC
3620  0000      LOCS,   0
3621  7776      MM2,    -2
3622  3566      INN2,   IN2
3623  0000      MPY10S, 0
3624  7200              CLA
3625  1045              TAD 45
3626  3246              DCA T4
3627  1046              TAD 46
3630  3247              DCA T5
3631  4250              JMS SHFT2
3632  4250              JMS SHFT2
3633  7300              CLA CLL
3634  1046              TAD 46
3635  1247              TAD T5
3636  3046              DCA 46
3637  7430              SZL
3640  2045              ISZ 45
3641  1045              TAD 45
3642  1246              TAD T4
3643  3045              DCA 45
3644  4250              JMS SHFT2
3645  5623              RETURN MPY10S
3646  0000      T4,     0
3647  0000      T5,     0
3650  0000      SHFT2,  0
3651  7300              CLA CLL
3652  1046              TAD 46
3653  7004              RAL
3654  3046              DCA 46
3655  1045              TAD 45
3656  7004              RAL
3657  3045              DCA 45
3660  5650              RETURN SHFT2
```

```
3661  3557  TVAL,   TEMP
3662  0000  SIGNS,  0                 /SET BCD SIGN
3663  1711          TAD I TT1
3664  0310          AND MASK2
3665  3307          DCA TEMV
3666  1617          TAD I LOCV
3667  3220          DCA LOCS
3670  3306          DCA FLAG          /CLEAR MINUS FLAG
3671  1307          TAD TEMV
3672  7450          SNA
3673  5302          JMP PLUS          /PLUS
3674  7300          CLA CLL           /MINUS
3675  2306          ISZ FLAG          /SET MINUS FLAG
3676  1304          TAD MINUS         /YES
3677  3620          DCA I LOCS
3700  2622          ISZ I INN2
3701  5662          RETURN SIGNS
3702  1305  PLUS,   TAD PLUSS
3703  5277          JMP .-4
3704  0055  MINUS,  0055
3705  0053  PLUSS,  0053
3706  0000  FLAG,   0
3707  0000  TEMV,   0
3710  7400  MASK2,  7400
3711  3553  TT1,    T1
3712  0000  SIGNS2, 0
3713  7200          CLA
3714  1306          TAD FLAG          /CHANGE SIGN OF FL AC?
3715  7550          SPA SNA
3716  5712          RETURN SIGNS2     /NO: EXIT
3717  7300          CLA CLL           /YES
3720  1046          TAD 46
3721  7041          CIA
3722  3046          DCA 46
3723  1045          TAD 45
3724  7040          CMA
3725  7430          SZL
3726  7101          CLL IAC
3727  3045          DCA 45
3730  5712          RETURN SIGNS2
```

```
A1       3440
A2       3441
B1       3452
B2       3453
CV       3550
C1       3545
C2       3546
DCONST   3560
DECSW    3400
DVAL     3561
D1       3505
D2       3506
D3       3511
FLAG     3706
INDLOC   3565
INDX     3564
INN2     3622
INX      3570
IN2      3566
IN4      3567
LOC      3563
LOCS     3620
LOCV     3617
LOOP     3431
LOOP2    3455
MASK     3555
MASK2    3710
MINUS    3704
MM2      3621
MPY      3535
MPY10    3575
MPY10S   3623
M2       3551
M4       3552
PER      3562
PLUS     3702
PLUSS    3705
SHFT2    3650
SHIFT    3574
SHIFTS   3600
SIGN     3576
SIGNS    3662
SIGNS2   3712
SIGN2    3577
SIXTY    3556
TEMP     3557
TEMV     3707
TEN      3571
TT1      3711
TVAL     3661
T1       3553
T2       3554
T4       3646
T5       3647
```

```
                /DECSW CHECKING PROGRAM
                *200
0200  6046      TLS
0201  7200      CLA
0202  7402      HLT
0203  7404      OSR
0204  3777      DCA T1
0205  7402      HLT
0206  7404      OSR
0207  3776      DCA T2
0210  1252      TAD LOCATN
0211  4656      CALL DEC
0212  4407      FLPT
0213  0014      OUTPUT
0214  0000      FEXT
0215  7200      CLA
0216  1253      TAD L1
0217  4227      JMS PRT
0220  7200      CLA
0221  1254      TAD L2
0222  4227      JMS PRT
0223  7200      CLA
0224  1255      TAD L3
0225  4227      JMS PRT
0226  5201      JMP 201
0227  0000      PRT,0
0230  3260      DCA TEMPZ
0231  1260      TAD TEMPZ
0232  7012      RTR
0233  7012      RTR
0234  7012      RTR
0235  0257      AND MASKS
0236  4244      JMS PTS
0237  7200      CLA
0240  1260      TAD TEMPZ
0241  0257      AND MASKS
0242  4244      JMS PTS
0243  5627      RETURN PRT
0244  0000      PTS,0
0245  1261      TAD X
0246  6041      TSF
0247  5246      JMP .-1
0250  6046      TLS
0251  5644      RETURN PTS
0252  0253      LOCATN,L1
0253  0000      L1,0
0254  0000      L2,0
0255  0000      L3,0
0256  3400      DEC,3400
0257  0077      MASKS,0077
0260  0000      TEMPZ,0
0261  0200      X,200
0376  3554      *3405
0377  3553
3405  7000      NOP
3406  7000      NOP
3407  7000      NOP
3410  7000      NOP
                *3553
3553  0000      T1,0
3554  0000      T2,0
```