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MURA-573
Internal

IDENTIFICATION

Floating Point Exponential, MU EXP3
704 FORTRAN Program
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PURPOSE

To compute e^x in single precision floating point arithmetic.

RESTRICTIONS

$-88.028 < X < 88.028$. If $X \geq 88.028$, MU ERR1 prints

ERROR RETURN FROM EXP3

and returns control to the main program with X in the accumulator. If $X < -88.028$, control is returned without printing and with 0 in the accumulator.

METHOD

Let $e^x = 2^{x \log_2 e} = 2^{M+F}$ where M is the binary characteristic of e^x, and 2^F is computed by the formula

$$2^F = 1 + 2F \left[A + BF^2 - F - C\,(F^2+D)^{-1} \right]^{-1}$$

and

$$A = 9.95459578$$

$$B = 0.03465735903$$

$$C = 617.97226953$$

$$D = 87.417497202$$

$$\log_2 e = 1.4426950409$$

NOTE: This routine is essentially the same as IBFXPO with the addition of an error return to MU ERR1.

ACCURACY: The number of correct significant bits in e^x is at least equal to the number of correct fractional bits in the argument X.

USAGE

EXP3 is available on the FORTRAN II System tape or SAP-FORTRAN tape at this installation. It is obtained by use of the expression

EXP3F (X)

in a Fortran statement.

CODING INFORMATION

Average execution time is approximately 1.96 ms. Storage requirements are 54 words program and 4 words erasable.

```
MUEXP3 REM 0071 05010                                                  EXP3  0001
       REM        ADAPTED FROM IBFXP0                                  EXP3  0002
       FUL EXP3-MURA FLOATING POINT EXPONENTIAL                        EXP3  0003
       REM   DESIGNED FOR USE WITH FORTRAN II                          EXP3  0004
       MZE 0,0,4                                                       EXP3  0005
       OCT 656754136143                                                EXP3  0006
       HTR 54,0,1                                                      EXP3  0007
       HTR -4                                                          EXP3  0008
       BCD 1EXP3                                                       EXP3  0009
       HTR 1                                                           EXP3  0010
       REL                                                             EXP3  0011
       ORG 0                                                           EXP3  0012
       BCD 1(ERR1)                                                     EXP3  0013
EXP3   STO M                                                           EXP3  0014
       LDQ MAX                 TEST IF OUT OF RANGE                    EXP3  0015
       TLQ T2                                                          EXP3  0016
       CHS                                                             EXP3  0017
       TLQ T1                  IF TOO SMALL RETURN WITH ZERO           EXP3  0018
       LRS 27                                                          EXP3  0019
       SSM                                                             EXP3  0020
       ADD CHAR                CONVERT TO FIXED POINT                  EXP3  0021
       STA SH1                                                         EXP3  0022
       MPY LOGE                X TIMES LOG E BASE 2                    EXP3  0023
SH1    LRS 0                   SEPARATE INTEGER AND FRACTION           EXP3  0024
       ALS 27                                                          EXP3  0025
       STO M                                                           EXP3  0026
       LRS 4                                                           EXP3  0027
       STQ F                                                           EXP3  0028
       MPY F                   COMPUTE FRACTION SQUARED                EXP3  0029
       STO SQ                  COMPUTE CONTINUED FRACTION              EXP3  0030
       ADD A                   8,27 SCALING                            EXP3  0031
       STO T                   8,27                                    EXP3  0032
       CLA B                   12,23                                   EXP3  0033
       DVP T                   8,27 4,31                               EXP3  0034
       STQ T                   4,31                                    EXP3  0035
       LDQ SQ                  8,27                                    EXP3  0036
       MPY C                   0,35 8,27                               EXP3  0037
       LLS 4                   4,31                                    EXP3  0038
       SUB T                   4,31                                    EXP3  0039
       ADD D                   4,31                                    EXP3  0040
       SUB F                   4,31                                    EXP3  0041
       STO T                   4,31                                    EXP3  0042
       CLA F                   5,31 NUMERATOR EQUALS 2F                EXP3  0043
       DVP T                   4,31 1,34                               EXP3  0044
       STQ T                                                           EXP3  0045
       CLA T                                                           EXP3  0046
       LRS 8                                                           EXP3  0047
       ORA CH1                                                         EXP3  0048
       FAD CH                                                          EXP3  0049
T1     ADD M                                                           EXP3  0050
       TRA 1,4                                                         EXP3  0051
T2     SXD T3,4                                                        EXP3  0052
       TSX EXP3-1,4                                                    EXP3  0053
       BCD 1EXP                                                        EXP3  0054
       LXD T3,4                                                        EXP3  0055
       TRA 1,4                                                         EXP3  0056
T3     HTR **                                                          EXP3  0057
MAX    DEC 88,028                                                      EXP3  0058
LOGE   DEC -1,4426950409B1                                             EXP3  0059
CHAR   OCT 242                                                         EXP3  0060
```

```
CH      OCT 201400000000                                    EXP3  0061
CH1     OCT 201000000000                                    EXP3  0062
A       DEC 87.417497202B8                                  EXP3  0063
        DEC 617.9722695B12                                  EXP3  0064
C       DEC .03465735903B0                                  EXP3  0065
D       DEC 9.9545957821B4                                  EXP3  0066
M       EQU -4                                              EXP3  0067
F       EQU -3                                              EXP3  0068
SQ      EQU -2                                              EXP3  0069
T       EQU -1                                              EXP3  0070
        END                                                 EXP3  0071
```