```
MMM          MMM  TTTTTTTTTTTTTTT   HHH          HHH  RRRRRRRRRRR     TTTTTTTTTTTTTTT   LLL
MMM          MMM  TTTTTTTTTTTTTTT   HHH          HHH  RRRRRRRRRRRR    TTTTTTTTTTTTTTT   LLL
MMM          MMM  TTTTTTTTTTTTTTT   HHH          HHH  RRRRRRRRRRRR    TTTTTTTTTTTTTTT   LLL
MMMMMM    MMMMMM        TTT         HHH          HHH  RRR         RRR       TTT         LLL
MMMMMM    MMMMMM        TTT         HHH          HHH  RRR         RRR       TTT         LLL
MMMMMM    MMMMMM        TTT         HHH          HHH  RRR         RRR       TTT         LLL
MMM   MMM   MMM         TTT         HHH          HHH  RRR         RRR       TTT         LLL
MMM   MMM   MMM         TTT         HHH          HHH  RRR         RRR       TTT         LLL
MMM   MMM   MMM         TTT         HHH          HHH  RRR         RRR       TTT         LLL
MMM         MMM         TTT         HHHHHHHHHHHHHHHH  RRRRRRRRRRR           TTT         LLL
MMM         MMM         TTT         HHHHHHHHHHHHHHHH  RRRRRRRRRRRR          TTT         LLL
MMM         MMM         TTT         HHHHHHHHHHHHHHHH  RRRRRRRRRRRR          TTT         LLL
MMM         MMM         TTT         HHH          HHH  RRR   RRR             TTT         LLL
MMM         MMM         TTT         HHH          HHH  RRR   RRR             TTT         LLL
MMM         MMM         TTT         HHH          HHH  RRR   RRR             TTT         LLL
MMM         MMM         TTT         HHH          HHH  RRR      RRR          TTT         LLL
MMM         MMM         TTT         HHH          HHH  RRR      RRR          TTT         LLL
MMM         MMM         TTT         HHH          HHH  RRR      RRR          TTT         LLL
MMM         MMM         TTT         HHH          HHH  RRR         RRR       TTT         LLLLLLLLLLLLLLLL
MMM         MMM         TTT         HHH          HHH  RRR         RRR       TTT         LLLLLLLLLLLLLLLL
MMM         MMM         TTT         HHH          HHH  RRR         RRR       TTT         LLLLLLLLLLLLLLLL
```

FILEID**MTHDTANH

```
MM      MM  TTTTTTTTTT  HH      HH  DDDDDDDD    TTTTTTTTTT    AAAAAA    NN      NN  HH      HH
MM      MM  TTTTTTTTTT  HH      HH  DDDDDDDD    TTTTTTTTTT    AAAAAA    NN      NN  HH      HH
MMMM  MMMM      TT      HH      HH  DD      DD      TT      AA      AA  NN      NN  HH      HH
MMMM  MMMM      TT      HH      HH  DD      DD      TT      AA      AA  NN      NN  HH      HH
MM  MM  MM      TT      HH      HH  DD      DD      TT      AA      AA  NNNN    NN  HH      HH
MM  MM  MM      TT      HH      HH  DD      DD      TT      AA      AA  NNNN    NN  HH      HH
MM      MM      TT      HHHHHHHHHH  DD      DD      TT      AA      AA  NN  NN  NN  HHHHHHHHHH
MM      MM      TT      HHHHHHHHHH  DD      DD      TT      AA      AA  NN  NN  NN  HHHHHHHHHH
MM      MM      TT      HH      HH  DD      DD      TT      AAAAAAAAAA  NN    NNNN  HH      HH
MM      MM      TT      HH      HH  DD      DD      TT      AAAAAAAAAA  NN    NNNN  HH      HH
MM      MM      TT      HH      HH  DD      DD      TT      AA      AA  NN      NN  HH      HH    ....
MM      MM      TT      HH      HH  DD      DD      TT      AA      AA  NN      NN  HH      HH    ....
MM      MM      TT      HH      HH  DDDDDDDD        TT      AA      AA  NN      NN  HH      HH    ....
MM      MM      TT      HH      HH  DDDDDDDD        TT      AA      AA  NN      NN  HH      HH    ....

LL              IIIIII      SSSSSSSS
LL              IIIIII      SSSSSSSS
LL                II      SS
LL                II      SS
LL                II      SS
LL                II      SS
LL                II        SSSSSS
LL                II        SSSSSS
LL                II              SS
LL                II              SS
LL                II              SS
LL                II              SS
LLLLLLLLLL      IIIIII    SSSSSSSS
LLLLLLLLLL      IIIIII    SSSSSSSS
```

Table of contents

```
0000     1          .TITLE  MTH$DTANH       ; Floating Point Hyperbolic Tangent routine
0000     2                                  ; (DTANH)
0000     3          .IDENT /1-011/          ; File: MTHDTANH.MAR  Edit: JCW1011
0000     4 ;
0000     5 ;*****************************************************************************
0000     6 ;*                                                                           *
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0000    24 ;*                                                                           *
0000    25 ;*                                                                           *
0000    26 ;*****************************************************************************
0000    27 ;
0000    28 ;
0000    29 ; FACILITY: MATH LIBRARY
0000    30 ;++
0000    31 ; ABSTRACT:
0000    32 ;
0000    33 ; MTH$DTANH is a function  which  returns the floating point hyperbolic tangent
0000    34 ; of its single precision floating point argument. The call is standard
0000    35 ; call-by-reference.
0000    36 ;
0000    37 ;--
0000    38 ;
0000    39 ; VERSION: 01
0000    40 ;
0000    41 ; HISTORY:
0000    42 ; AUTHOR:
0000    43 ;       Peter Yuo, 29-Jun-77: Version 01
0000    44 ;
0000    45 ; MODIFIED BY:
0000    46 ;
0000    47 ;
0000    48 ;
```

```
                     50          .SBTTL  HISTORY ; Deta....d Current Edit History
                     51
                     52
                     53 ; ALGORITHMIC DIFFERENCES FROM FP-11/C ROUTINE: none
                     54 ;
                     55 ; Edit History for Version 01 of MTH$DTANH
                     56 ;
                     57 ; 0-3   Call MTH$DCOSH, MTH$DSINH directly instead of using POLY.
                     58 ; 0-4   - Add .EXTRNs.  TNH 13-June-78
                     59 ; 0-5   - Use W offset on externals.  TNH 13-June-78
                     60 ;       More accurrate.  TNH 13-June-78
                     61 ; 1-006 - Update version number and copyright notice.  JBS 16-NOV-78
                     62 ; 1-007 - Add "," to the PSECT directive.  JBS 22-DEC-78
                     63 ; 1-008 - Use MTH$DEXP_R6.  SBL 27-Sept-1979
                     64 ; 1-009 - Change constant 16.0 to 22.0 to correct inaccuracy.  The
                     65 ;         value of X above which 1.0 is the best machine approximation
                     66 ;         to DTANH(X) is about 20.10.  The next higher number that can
                     67 ;         be represented as a short literal is 22.0.  JAW 19-Sep-80
                     68 ; 1-010 - Use general mode addressing.  SBL 30-Nov-1981
                     69 ; 1-011 - Changed the constant 2^-14 to 2^-28 to correct inaccuracy. For
                     70 ;         values of !X! between 2^-14 and 2^-28 DTANH was only accurate
                     71 ;         to 8 decimal places since the assumption that DTANH(x)=x in that
                     72 ;         range of values is false. DTANH(X)=X for !X!<=2^-28 and
                     73 ;         DTANH(X)=DSINH(X)/DCOSH(X) for 2^-28<!X!<=.25 . All appropriate
                     74 ;         references to 2^-14 have been changed to 2^-28.  JCW 10-Jan-1983
```

```
                          0000     76          .SBTTL  DECLARATIONS    ; Declarative Part of Module
                          0000     77
                          0000     78 ;
                          0000     79 ; INCLUDE FILES:
                          0000     80 ;
                          0000     81 ; EXTERNAL SYMBOLS:     MTH$JACKET_HDLR
                          0000     82 ;
                          0000     83          .DSABL  GBL                     ; Force .EXTRN on all symbols
                          0000     84          .EXTRN  MTH$DCOSH               ; DCOSH
                          0000     85          .EXTRN  MTH$DSINH               ; DSINH
                          0000     86          .EXTRN  MTH$DEXP_R6             ; EXP
                          0000     87 ; EQUATED SYMBOLS:
                          0000     88
                 00004080 0000     89          SD_1.0  = ^F1.0                 ; 1.0
                 000042B0 0000     90          SD_22.0 = ^F22.0                        ; 22.0
                 00000004 0000     91          value   = 4                     ; value.rd.r
                          0000     92
                          0000     93 ;
                          0000     94 ; MACROS:       none
                          0000     95 ;
                          0000     96 ; PSECT DECLARATIONS:
                          0000     97
                 00000000 0000     98          .PSECT  _MTH$CODE       PIC,SHR,LONG,EXE,NOWRT
                          0000     99                                          ; program section for math routines
                          0000    100 ;
                          0000    101 ; OWN STORAGE:  none
                          0000    102 ;
                          0000    103 ;
                          0000    104 ; CONSTANTS:
                          0000    105 ;
                          0000    106
                          0000    107 D_0.25:
0000 0000 0000 3F80       0000    108          .WORD   ^X3F80, 0, 0, 0         ; 0.25
                          0008    109 D_2_POWER_M28:
0000 0000 0000 3280       0008    110          .WORD   ^X3280, 0, 0, 0         ; 2**-28
                          0010    111
```

```
                                0010   113          .SBTTL  MTH$DTANH  - Standard DOUBLE Precision Floating DTANH
                                0010   114
                                0010   115
                                0010   116 ;++
                                0010   117 ; FUNCTIONAL DESCRIPTION:
                                0010   118 ;
                                0010   119 ; DTANH  - double precision floating point function
                                0010   120 ;
                                0010   121 ; DTANH(X) is computed as:
                                0010   122 ;
                                0010   123 ;       If |X| =< 2**-28, then DTANH(X) = X.
                                0010   124 ;       If 2**-28 < |X| =< 0.25, then DTANH(X) = DSINH(X)/DCOSH(X).
                                0010   125 ;       If 0.25 < |X| < 22.0, then DTANH(X) = (DEXP(2*X) - 1) / (DEXP(2*X) + 1)
                                0010   126 ;       If 22.0 =< |X|, then DTANH(X) = sign(X) * 1
                                0010   127 ;
                                0010   128 ; CALLING SEQUENCE:
                                0010   129 ;
                                0010   130 ;       DTANH.wd.v = MTH$DTANH(x.rd.r)
                                0010   131 ;
                                0010   132 ; INPUT PARAMETERS:
                                0010   133
                00000004        0010   134          LONG = 4                        ; define longword multiplier
                00000004        0010   135          x = 1 * LONG                    ; Contents of x is the argument
                                0010   136
                                0010   137 ; IMPLICIT INPUTS:      none
                                0010   138 ;
                                0010   139 ; OUTPUT PARAMETERS:
                                0010   140 ;
                                0010   141 ;       VALUE:  double precision floating hyperbolic tangent of the argument
                                0010   142 ;
                                0010   143 ; IMPLICIT OUTPUTS:     none
                                0010   144 ;
                                0010   145 ; COMPLETION CODES:     none
                                0010   146 ;
                                0010   147 ; SIDE EFFECTS: none
                                0010   148 ;
                                0010   149 ; NOTE: This procedure disables floating point underflow, enables integer
                                0010   150 ; overflow.
                                0010   151 ;
                                0010   152 ;--
                                0010   153
                                0010   154
                        407C    0010   155          .ENTRY  MTH$DTANH, ^M<IV, R2, R3, R4, R5, R6>
                                0012   156                                          ; standard call-by-reference entry
                                0012   157                                          ; disable DV (and FU), enable IV
                                0012   158          MTH$FLAG_JACKET                 ; flag that this is a jacket procedure in
                                0012                                                ;  case of an error in routine
                                0012                                                ; If an error, convert signal to user PC
                                0012                                                ;  and resignal
    6D  00000000'GF     9E      0012                MOVAB   G^MTH$$JACKET_HND, (FP)
                                0019                                                ; set handler address to jacket
                                0019                                                ;  handler
                                0019
                                0019   159                                          ; case of an error in routine
                                0019   160                                          ; If an error, convert signal to user PC
                                0019   161                                          ;  and resignal
      50    04 BC     70      0019   162          MOVD    @value(AP), R0          ; R0/R1 = |X| = @value(AP)
    50    8000 8F     AA      001D   163          BICW    #^X8000, R0             ; R0/R1 = |X|
      E2 AF   50      71      0022   164          CMPD    R0, D_2_POWER_M28       ; compare |X| with 2**-28
```

```
                     43   15  0026   165          BLEQ    OUT_X                   ; branch if !X! =< 2**-28
                          0028   166
                          0028   167 ;
                          0028   168 ; 2**-28 < !X!
                          0028   169 ;
                          0028   170
                     2B   50   71  0028   171          CMPD    R0, S^#SD_22.0          ; compare !X! with 22.0
                          32   18  002B   172          BGEQ    GEQ_TO_22.0             ; branch if !X! >= 22.0
                          002D   173
                          002D   174 ;
                          002D   175 ; 2**-28 < !X! < 22.0
                          002D   176 ;
                          002D   177
                   CF AF   50   71  002D   178          CMPD    R0, D_0.25              ; compare !X! with 0.25
                          17   15  0031   179          BLEQ    LEQ_TO_0.25             ; branch if !X! =< 0.25
                          0033   180
                          0033   181 ;
                          0033   182 ; 0.25 < !X! < 22.0
                          0033   183 ;
                          0033   184
         50   04 BC   04 BC   61  0033   185          ADDD3   @value(AP), @value(AP), R0
                          0039   186                                                  ; R0/R1 = 2*X
                00000000'CF   16  0039   187          JSB     G^MTH$DEXP_R6           ; R0/R1 = DEXP(2*X)
               52   50   08   61  003F   188          ADDD3   S^#SD_1.0, R0, R2       ; R2/R3 = DEXP(2*X) + 1
                    50   08   62  0043   189          SUBD    S^#SD_1.0, R0           ; R0/R1 = DEXP(2*X) - 1
                    50   52   66  0046   190          DIVD    R2, R0                  ; R0/R1 = (DEXP(2*X) - 1) / (DEXP(2*X) + 1)
                         04   0049   191          RET                             ; return with result in R0/R1
                              004A   192
                              004A   193 ;
                              004A   194 ; 2**-1R6 < !X! =< 0.25
                              004A   195 ;
                              004A   196
                              004A   197 LEQ_TO_0.25:
00000000'GF        6C   FA  004A   198          CALLG   (AP), G^MTH$DCOSH       ; R0/R1 = DCOSH(X)
           52      50   70  0051   199          MOVD    R0, R2                  ; R2/R3 = DCOSH(X)
00000000'GF        6C   FA  0054   200          CALLG   (AP), G^MTH$DSINH       ; R0/R1 = DSINH(X)
           50      52   66  005B   201          DIVD    R2, R0                  ; R0/R1 = DSINH(X) / DCOSH(X)
                         04  005E   202          RET                             ; return with result in R0
                             005F   203
                             005F   204 ;
                             005F   205 ; !X! >= 22.0
                             005F   206 ;
                             005F   207
                             005F   208 GEQ_TO_22.0:
              50   08   70  005F   209          MOVD    S^#SD_1.0, R0           ; R0/R1 = 1.0
                04 BC   73  0062   210          TSTD    @value(AP)              ; test the sign of X
                    03   18  0065   211          BGEQ    10$                     ; branch if X >= 0
              50    50   72  0067   212          MNEGD   R0, R0                  ; R0/R1 = -1
                         04  006A   213 10$:     RET                             ; return with result in R0
                             006B   214
                             006B   215 ;
                             006B   216 ; !X! =< 2**-28
                             006B   217 ;
                             006B   218
            50   04 BC   70  006B   219 OUT_X:  MOVD    @value(AP), R0          ; R0/R1 = DTANH(X) = X
                         04  006F   220          RET                             ; return with result in R0/R1
                             0070   221
```

```
                0070   222
                0070   223
                0070   224          .END
```

```
D_0.25              00000000 R      01
D_2_POWER_M28       00000008 R      01
GEQ_TO_22.0         0000005F R      01
LEQ_TO_0.25         0000004A R      01
LONG            =   00000004
MTH$$JACKET_HND     ********   X    01
MTH$DCOSH           ********   X    00
MTH$DEXP_R6         ********   X    00
MTH$DSINH           ********   X    00
MTH$DTANH           00000010 RG     01
OUT_X               0000006B R      01
SD_1.0          =   00004080
SD_22.0         =   000042B0
VALUE           =   00000004
```

Psect synopsis

PSECT name	Allocation	PSECT No.	Attributes
. ABS .	00000000 (0.)	00 (0.)	NOPIC USR CON ABS LCL NOSHR NOEXE NORD NOWRT NOVEC BYTE
_MTH$CODE	00000070 (112.)	01 (1.)	PIC USR CON REL LCL SHR EXE RD NOWRT NOVEC LONG

Performance indicators

Phase	Page faults	CPU Time	Elapsed Time
Initialization	29	00:00:00.08	00:00:00.70
Command processing	124	00:00:00.74	00:00:05.34
Pass 1	83	00:00:00.78	00:00:02.13
Symbol table sort	0	00:00:00.01	00:00:00.01
Pass 2	53	00:00:00.58	00:00:01.77
Symbol table output	3	00:00:00.02	00:00:00.06
Psect synopsis output	1	00:00:00.03	00:00:00.18
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	295	00:00:02.26	00:00:10.21

The working set limit was 900 pages.
3389 bytes (7 pages) of virtual memory were used to buffer the intermediate code.
There were 10 pages of symbol table space allocated to hold 15 non-local and 1 local symbols.
284 source lines were read in Pass 1, producing 11 object records in Pass 2.
1 page of virtual memory was used to define 1 macro.

Macro library statistics

Macro library name	Macros defined
_255DUA28:[SYSLIB]STARLET.MLB;2	0

0 GETS were required to define 0 macros.

There were no errors, warnings or information messages.

```
MACRO/ENABLE=SUPPRESSION/DISABLE=(GLOBAL,TRACEBACK)/LIS=LIS$:MTHDTANH/OBJ=OBJ$:MTHDTANH MSRC$:MTHJACKET/UPDATE=(ENH$:MTHJACKET)+MSRC
```

MTHGCONJG
LIS

MTHGINT
LIS

MTHGMOD
LIS

MTHEXP
LIS

MTHFLOOR
LIS

MTHDTAN
LIS

MTHDTANH
LIS

MTHGEXP
LIS

MTHGFLOOR
LIS

MTHGMIN1
LIS

MTHGCOSH
LIS

MTHGLOG
LIS

MTHGACOS
LIS

MTHGASIN
LIS

MTHGNINT
LIS

MTHGATAN
LIS

MTHGATANH
LIS

MTHGMAX1
LIS