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LLLLLLLLLLLL IIIIII          SSSSSSSS

```

(2) 49
(3) 69
(4) 108

HISTORY : Detailed Current Edit History
DECLARATIONS : Declarative Part of Module
MTH\$HTANH - H Floating Point TANH


```

0000 1      .TITLE  MTH$HTANH      ; H Floating Hyperbolic Tangent routine
0000 2      ; (HTANH)
0000 3      .IDENT /1-006/        ; File: MTHHTANH.MAR  Edit: JCW1006
0000 4      ;
0000 5      ;*****
0000 6      ;
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0000 24     ;*
0000 25     ;*
0000 26     ;*****
0000 27     ;
0000 28     ;
0000 29     ; FACILITY: MATH LIBRARY
0000 30     ;++
0000 31     ; ABSTRACT:
0000 32     ;
0000 33     ; MTH$HTANH is a function which returns the H floating hyperbolic tangent
0000 34     ; of its H floating argument. The call is standard call-by-reference.
0000 35     ;
0000 36     ;--
0000 37     ;
0000 38     ; VERSION: 1
0000 39     ;
0000 40     ; HISTORY:
0000 41     ; AUTHOR:
0000 42     ;      John A. Wheeler, 20-Oct-1979: Version 1
0000 43     ;
0000 44     ; MODIFIED BY:
0000 45     ;
0000 46     ;
0000 47     ;

```

MTH\$HTANH
1-006

M 13
; H Floating Hyperbolic Tangent routine 16-SEP-1984 01:41:24 VAX/VMS Macro V04-00
HISTORY ; Detailed Current Edit History 6-SEP-1984 11:25:54 [MTHRTL.SRC]MTHHTANH.MAR;1

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```
0000 49      .SBTTL  HISTORY ; Detailed Current Edit History
0000 50
0000 51
0000 52 : Edit History for Version 1 of MTH$HTANH
0000 53 :
0000 54 : 1-001 - Adapted from MTH$GTANH version 1-002. JAW 20-Oct-1979
0000 55 : 1-002 - Change constant 16.0 to 40.0 to correct inaccuracy. The
0000 56 : value of X above which 1.0 is the best machine approximation
0000 57 : to HTANH(X) is about 39.86. The next higher number that can
0000 58 : be represented as a short literal is 40.0. JAW 19-Sep-80
0000 59 : 1-003 - Eliminated symbolic short literals. RNH 15-Oct-81
0000 60 : 1-004 - Changed #40 to S^#40 to circumvent assembler problem RNH 23-Oct-81
0000 61 : 1-005 - Use general mode addressing. SBL 30-Nov-1981
0000 62 : 1-006 - Changed the constant 2^59 to 2^57 to correct inaccuracy. For
0000 63 : values of |X| between 2^59 and 2^57 no noticeable loss of
0000 64 : significance was noticed by the assumption that HTANH(x)=x starting
0000 65 : at |X|<=2^59 instead of 2^57, but a loss of performance was felt
0000 66 : do to unnecessary computation of HSINH(X)/HCOSH(X). All appropriate
0000 67 : references to 2^59 have been changed to 2^57. JCW 10-Jan-1983
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0000 69 .SBTTL DECLARATIONS ; Declarative Part of Module
0000 70
0000 71 :
0000 72 : INCLUDE FILES:
0000 73 :
0000 74 : EXTERNAL SYMBOLS: MTH$JACKET_HDLR
0000 75 :
0000 76 : .DSABL GBL ; Force .EXTRN on all symbols
0000 77 : .EXTRN MTH$HCOSH ; HCOSH
0000 78 : .EXTRN MTH$HSINH ; HSINH
0000 79 : .EXTRN MTH$HEXP_R6 ; EXP
0000 80 :
0000 81 : EQUATED SYMBOLS:
0000 82 :
0000 83 :
00000004 0000 84 y = 4 ; Offset for first argument
0000 85
0000 86 :
0000 87 : MACROS: none
0000 88 :
0000 89 : PSECT DECLARATIONS:
0000 90 :
00000000 0000 91 .PSECT _MTH$CODE PIC,SHR,LONG,EXE,NOWRT
0000 92 ; Program section for math routines
0000 93 :
0000 94 : OWN STORAGE: none
0000 95 :
0000 96 :
0000 97 : CONSTANTS:
0000 98 :
0000 99 :
00000000 00003FFF 0000 100 H_0.25:
00000000 00000000 0008 101 .LONG ^X00003FFF, ^X00000000 ; 0.25
0010 102 .LONG ^X00000000, ^X00000000
00000000 00003FC8 0010 103 H_2_POWER_M57:
00000000 00000000 0018 104 .LONG ^X00003FC8, ^X00000000 ; 2**-57
0018 105 .LONG ^X00000000, ^X00000000
0020 106
```



```
0020 108 .SBTTL MTH$HTANH - H Floating Point TANH
0020 109
0020 110
0020 111 :++
0020 112 : FUNCTIONAL DESCRIPTION:
0020 113
0020 114 : HTANH - H floating point hyperbolic tangent function
0020 115
0020 116 : HTANH(X) is computed as:
0020 117
0020 118 : If |X| <= 2**(-57), then HTANH(X) = X.
0020 119 : If 2**(-57) < |X| <= 0.25, then HTANH(X) = HSINH(X)/HCOSH(X).
0020 120 : If 0.25 < |X| < 40.0, then HTANH(X) = (HEXP(2*X) - 1) / (HEXP(2*X) + 1)
0020 121 : If 40.0 <= |X|, then HTANH(X) = sign(X) * 1
0020 122
0020 123 : CALLING SEQUENCE:
0020 124
0020 125 : htanh.wh.v = MTH$HTANH(x.rh.r)
0020 126
0020 127 : -or-
0020 128
0020 129 : CALL MTH$HTANH(htanh.wh.r, x.rh.r)
0020 130
0020 131 : Because an H-floating result cannot be expressed in 64 bits, it is
0020 132 : returned as the first argument, with the input parameter displaced
0020 133 : to the second argument, in accordance with the Procedure Calling
0020 134 : Standard.
0020 135
0020 136 : INPUT PARAMETERS:
0020 137
00000004 0020 138 : LONG = 4 ; Define longword multiplier
00000008 0020 139 : x = 2 * LONG ; Contents of x is the argument
0020 140
0020 141 : IMPLICIT INPUTS: none
0020 142
0020 143 : OUTPUT PARAMETERS:
0020 144
0020 145 : VALUE: H floating hyperbolic tangent of the argument
0020 146
00000004 0020 147 : htanh = 1 * LONG ; htanh is the result
0020 148
0020 149 : IMPLICIT OUTPUTS: none
0020 150
0020 151 : COMPLETION CODES: none
0020 152
0020 153 : SIDE EFFECTS: none
0020 154
0020 155 : NOTE: This procedure disables floating point underflow, enables integer
0020 156 : overflow.
0020 157
0020 158 : ---
0020 159
0020 160
0020 161 : .ENTRY MTH$HTANH, ^M<IV, R2, R3, R4, R5, R6, R7>
0022 162 : Standard call-by-reference entry
0022 163 : Disable DV (and FU), enable IV
0022 164 : MTH$FLAG_JACKET ; Flag that this is a jacket procedure in
```

```
6D 00000000'GF 9E 0022      MOVAB  G^MTH$$JACKET_HND, (FP)
                                ; set handler address to jacket
                                ; handler
                                0029
                                0029
                                0029 165      ; case of an error in routine
                                0029 166      ; If an error, convert signal to user PC
                                0029 167      ; and resignal
                                0029 168      ; R0/R3 = X = @x(AP)
50 08 BC 70FD 0029 168      MOVH  @x(AP), R0
50 8000 8F AA 002E 169      BICW  #^X8000, R0
D8 AF 50 71FD 0033 170      CMPL  R0, H_2_POWER_M57
5B 15 0038 171      BLEQ  OUT_X      ; R0/R3 = |X|
                                ; Compare |X| with 2**-57
                                ; Branch if |X| <= 2**-57
003A 172
003A 173      ;
003A 174      ; 2**-57 < |X|
003A 175      ;
003A 176
32 50 71FD 003A 177      CMPL  R0, S^#40      ; Compare |X| with 40.0
41 18 003E 178      BGEQ  GEQ_TO_40.0      ; Branch if |X| >= 40.0
0040 179
0040 180      ;
0040 181      ; 2**-57 < |X| < 40.0
0040 182      ;
0040 183
BB AF 50 71FD 0040 184      CMPL  R0, H_0.25      ; Compare |X| with 0.25
1C 15 0045 185      BLEQ  LEQ_TO_0.25      ; Branch if |X| <= 0.25
0047 186
0047 187      ;
0047 188      ; 0.25 < |X| < 40.0
0047 189      ;
0047 190
50 08 BC 08 BC 61FD 0047 191      ADDH3  @x(AP), @x(AP), R0      ; R0/R3 = 2*X
00000000'GF 16 004E 192      JSB  G^MTH$HEXP_R6      ; R0/R3 = HEXP(2*X)
54 50 08 61FD 0054 193      ADDH3  #1, R0, R4      ; R4/R7 = HEXP(2*X) + 1
50 08 62FD 0059 194      SUBH2  #1, R0      ; R0/R3 = HEXP(2*X) - 1
50 54 66FD 005D 195      DIVH2  R4, R0      ; R0/R3 = (HEXP(2*X) - 1) / (HEXP(2*X) + 1)
2C 11 0061 196      BRB  RETURN      ; Store result and return
0063 197
0063 198      ;
0063 199      ; 2**-57 < |X| <= 0.25
0063 200      ;
0063 201
0063 202      LEQ_TO_0.25:
0063 203      CALLG  (AP), G^MTH$HCOSH      ; @y(AP) = HCOSH(X)
006A 204      MOVO  @y(AP), R4      ; R4/R7 = HCOSH(X)
006F 205      CALLG  (AP), G^MTH$HSINH      ; @y(AP) = HSINH(X)
0076 206      MOVO  @y(AP), R0      ; R0/R3 = HSINH(X)
007B 207      DIVH2  R4, R0      ; R0/R3 = HSINH(X) / HCOSH(X)
0E 11 007F 208      BRB  RETURN      ; Store result and return
0081 209
0081 210      ;
0081 211      ; |X| >= 40.0
0081 212      ;
0081 213
50 08 70FD 0081 214      GEQ_TO_40.0:
08 BC 73FD 0085 215      MOVH  #1, R0      ; R0/R3 = 1.0
                                ; Test the sign of X
                                216      TSTH  @x(AP)
```


MTH\$HTANH
1-006

D 14
; H Floating Hyperbolic Tangent routine 16-SEP-1984 01:41:24 VAX/VMS Macro V04-00
MTH\$HTANH - H Floating Point TANH 6-SEP-1984 11:25:54 [MTHRTL.SRC]MTHHTANH.MAR;1

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```
04 50 04 18 0089 217 BGEQ RETURN ; Branch if X >= 0
04 BC 50 72FD 008B 218 MNEGH R0, R0 ; R0/R3 = -1
50 7DFD 008F 219 RETURN: MOVO R0, @htanh(AP) ; Store result in first argument
04 0094 220 RET ; Return to caller
0095 221
0095 222 ;
0095 223 ; |X| <= 2**-57
0095 224 ;
0095 225
04 BC 08 BC 7DFD 0095 226 OUT_X: MOVO @x(AP), @htanh(AP) ; Store result in first argument
04 009B 227 RET ; Return to caller
009C 228
009C 229 .END
```

```

GEQ_TO_40.0      00000081 R    01
HTANH            = 00000004
H_0.25          00000000 R    01
H_2_POWER_M57   00000010 R    01
LEQ_TO_0.25     00000063 R    01
LONG            = 00000004
MTH$$JACKET_HND ***** X    01
MTH$HCOSH       ***** X    00
MTH$HEXP_R6     ***** X    00
MTH$HSINR       ***** X    00
MTH$HTANH       00000020 RG    01
OUT_X           00000095 R    01
RETURN          0000008F R    01
X               = 00000008
Y               = 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	0000009C (156.)	01 (1.)	PIC	USR	CON	REL	LCL	SHR	EXE	RD	NOWRT	NOVEC	LONG				

```

+-----+
! Performance indicators !
+-----+
  
```

Phase	Page faults	CPU Time	Elapsed Time
Initialization	30	00:00:00.07	00:00:01.03
Command processing	117	00:00:00.64	00:00:04.22
Pass 1	88	00:00:00.70	00:00:05.40
Symbol table sort	0	00:00:00.00	00:00:00.00
Pass 2	57	00:00:00.63	00:00:02.68
Symbol table output	2	00:00:00.03	00:00:00.04
Psect synopsis output	2	00:00:00.02	00:00:00.06
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	298	00:00:02.10	00:00:13.43

The working set limit was 750 pages.
 3485 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 0 local symbols.
 289 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
_\$255\$DUA28:[SYSLIB]STARLET.MLB;2	0

0 GETS were required to define 0 macros.

MTH\$HTANH ; H Floating Hyperbolic Tangent routine F 14 16-SEP-1984 01:41:24 VAX/VMS Macro V04-00 Page 8
VAX-11 Macro Run Statistics 6-SEP-1984 11:25:54 [MTHRTL.SRC]MTHHTANH.MAR;1 (4)

There were no errors, warnings or information messages.

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

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VAX/VMS V4.0

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