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(2) 50
(3) 72
(4) 107

HISTORY ; Detailed Current Edit History
DECLARATIONS ; Declarative Part of Module
MTH\$GTANH - G Double Precision Floating DTANH

```
0000 1      .TITLE  MTH$GTANH      ; G Floating Hyperbolic Tangent routine
0000 2      ; (DTANH)
0000 3      .IDENT  /1-005/        ; File: MTHGTANH.MAR  Edit: JCW1005
0000 4      :
0000 5      :*****
0000 6      :
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0000 24     :
0000 25     :
0000 26     :*****
0000 27     :
0000 28     :
0000 29     : FACILITY: MATH LIBRARY
0000 30     :++
0000 31     : ABSTRACT:
0000 32     :
0000 33     : MTH$GTANH is a function which returns the G floating hyperbolic tangent
0000 34     : of its G floating point argument. The call is standard
0000 35     : call-by-reference.
0000 36     :
0000 37     :--
0000 38     :
0000 39     : VERSION: 1
0000 40     :
0000 41     : HISTORY:
0000 42     : AUTHOR:
0000 43     :     Steven B. Lionel, 26-Jan-79: Version 1
0000 44     :
0000 45     : MODIFIED BY:
0000 46     :
0000 47     :
0000 48     :
```

```
0000 50      .SBTTL HISTORY ; Detailed Current Edit History
0000 51
0000 52
0000 53 : ALGORITHMIC DIFFERENCES FROM FP-11/C ROUTINE: none
0000 54 :
0000 55 : Edit History for Version 1 of MTH$GTANH
0000 56 :
0000 57 : 1-001 - Adapted from MTH$DTANH version 1-006. SBL 26-Jan-79
0000 58 : 1-002 - Use MTH$GEXP_R6. SBL 27-Sept-1979
0000 59 : 1-003 - Change constant 16.0 to 20.0 to correct inaccuracy. The
0000 60 : value of X above which 1.0 is the best machine approximation
0000 61 : to GTANH(X) is about 19.06. The next higher number that can
0000 62 : be represented as a short literal is 20.0. JAW 19-Sep-80
0000 63 : 1-004 - Eliminated symbolic short literals. RNH 15-Oct-81
0000 64 : 1-005 - Changed the constant 2^-14 to 2^-27 to correct inaccuracy. For
0000 65 : values of |X| between 2^-14 and 2^-27 GTANH was only accurate
0000 66 : to 8 decimal places since the assumption that GTANH(x)=x in that
0000 67 : range of values is false. GTANH(X)=X for |X|<=2^-27 and
0000 68 : GTANH(X)=GSINH(X)/GCOSH(X) for 2^-27<|X|<=.25. All appropriate
0000 69 : references to 2^-14 have been changed to 2^-27. JCW 10-Jan-83
0000 70
```

```
0000 72      .SBTTL  DECLARATIONS      ; Declarative Part of Module
0000 73
0000 74 :
0000 75 : INCLUDE FILES:
0000 76 :
0000 77 : EXTERNAL SYMBOLS:      MTH$JACKET_HDLR
0000 78 :
0000 79      .DSABL  GBL              ; Force .EXTRN on all symbols
0000 80      .EXTRN  MTH$GCOSH        ; GCOSH
0000 81      .EXTRN  MTH$GSINH        ; GSINH
0000 82      .EXTRN  MTH$GEXP_R6     ; EXP
0000 83 : EQUATED SYMBOLS:
0000 84
00000004 0000 85      value      = 4              ; value.rg.r
0000 86
0000 87 :
0000 88 : MACROS:      none
0000 89 :
0000 90 : PSECT DECLARATIONS:
0000 91
00000000 0000 92      .PSECT  _MTH$CODE      PIC,SHR, LONG, EXE, NOWRT
0000 93      ; program section for math routines
0000 94 :
0000 95 : OWN STORAGE:  none
0000 96 :
0000 97 :
0000 98 : CONSTANTS:
0000 99 :
0000 100
0000 101 G_0.25:
0000 102      .WORD  ^X3FF0, 0, 0, 0      ; 0.25
0008 103 G_2_POWER M27:
0008 104      .WORD  ^X3E60, 0, 0, 0      ; 2**-27
0010 105
```

```
0010 107 .SBTTL MTH$GTANH - G Double Precision Floating DTANH
0010 108
0010 109
0010 110 :++
0010 111 : FUNCTIONAL DESCRIPTION:
0010 112 :
0010 113 : GTANH - G floating point function
0010 114 :
0010 115 : GTANH(X) is computed as:
0010 116 :
0010 117 :     If |X| <= 2**(-27), then GTANH(X) = X.
0010 118 :     If 2**(-27) < |X| <= 0.25, then GTANH(X) = GSINH(X)/GCOSH(X).
0010 119 :     If 0.25 < |X| < 20.0, then GTANH(X) = (GEXP(2*X) - 1) / (GEXP(2*X) + 1)
0010 120 :     If 20.0 <= |X|, then GTANH(X) = sign(X) * 1
0010 121 :
0010 122 : CALLING SEQUENCE:
0010 123 :
0010 124 :     GTANH.wg.v = MTH$GTANH(x.rg.r)
0010 125 :
0010 126 : INPUT PARAMETERS:
0010 127 :
00000004 0010 128 :     LONG = 4 ; define longword multiplier
00000004 0010 129 :     x = 1 * LONG ; Contents of x is the argument
0010 130 :
0010 131 : IMPLICIT INPUTS: none
0010 132 :
0010 133 : OUTPUT PARAMETERS:
0010 134 :
0010 135 :     VALUE: G floating hyperbolic tangent of the argument
0010 136 :
0010 137 : IMPLICIT OUTPUTS: none
0010 138 :
0010 139 : COMPLETION CODES: none
0010 140 :
0010 141 : SIDE EFFECTS: none
0010 142 :
0010 143 : NOTE: This procedure disables floating point underflow, enables integer
0010 144 : overflow.
0010 145 :
0010 146 : ---
0010 147 :
407C 0010 148 :
0010 149 : .ENTRY MTH$GTANH, ^M<IV, R2, R3, R4, R5, R6>
0012 150 : ; standard call-by-reference entry
0012 151 : ; disable DV (and FU), enable IV
0012 152 : ; flag that this is a jacket procedure in
0012 153 :
0012 154 : MTH$FLAG_JACKET
0012 155 :
6D 00000000'GF 9E 0012 156 : MOVAB G^MTH$$JACKET_HND, (FP)
0019 157 : ; set handler address to jacket
0019 158 : ; handler
0019 159 :
0019 160 :
0019 161 : ; case of an error in routine
0019 162 : ; If an error, convert signal to user PC
0019 163 : ; and resignal
0019 164 : ; R0/R1 = |X| = @value(AP)
0019 165 : ; R0/R1 = |X|
0019 166 : ; compare |X| with 2**(-27)
50 04 BC 50FD 0019 167 : MOVG @value(AP), R0
50 8000 8F AA 001E 168 : BICW #^X8000, R0
E0 AF 50 51FD 0023 169 : CMPG R0, G_2_POWER_M27
```

```
47 15 0028 159 BLEQ OUT_X ; branch if !X! <= 2**-27
002A 160
002A 161
002A 162 : 2**-27 < !X!
002A 163 :
002A 164
2A 50 51FD 002A 165 CMPG R0, #20 ; compare !X! with 20.0
32 18 002E 166 BGEQ GEQ_TO_20.0 ; branch if !X! >= 20.0
0030 167
0030 168 :
0030 169 : 2**-27 < !X! < 20.0
0030 170 :
0030 171
CB AF 50 51FD 0030 172 CMPG R0, G_0.25 ; compare !X! with 0.25
19 15 0035 173 BLEQ LEQ_TO_0.25 ; branch if !X! <= 0.25
0037 174
0037 175 :
0037 176 : 0.25 < !X! < 20.0
0037 177 :
0037 178
50 04 BC 04 BC 41FD 0037 179 ADDG3 @value(AP), @value(AP), R0
003E 180 ; R0/R1 = 2*X
003E 181 JSB W^MTH$GEXP_R6 ; R0/R1 = GEXP(2*X)
52 50 08 41FD 0042 182 ADDG3 #1, R0, R2 ; R2/R3 = GEXP(2*X) + 1
50 08 42FD 0047 183 SUBG2 #1, R0 ; R0/R1 = GEXP(2*X) - 1
50 52 46FD 004B 184 DIVG2 R2, R0 ; R0/R1 = (GEXP(2*X) - 1) / (GEXP(2*X) + 1)
04 004F 185 RET ; return with result in R0/R1
0050 186
0050 187 :
0050 188 : 2**-1R6 < !X! <= 0.25
0050 189 :
0050 190
0050 191 LEQ_TO_0.25:
0050 192 CALLG (AP), W^MTH$GCOSH ; R0/R1 = GCOSH(X)
52 50 7D 0055 193 MOVQ R0, R2 ; R2/R3 = GCOSH(X)
0050 194 CALLG (AP), W^MTH$GSINH ; R0/R1 = GSINH(X)
50 52 46FD 005D 195 DIVG2 R2, R0 ; R0/R1 = GSINH(X) / GCOSH(X)
04 0061 196 RET ; return with result in R0
0062 197
0062 198 :
0062 199 : !X! >= 20.0
0062 200 :
0062 201
0062 202 GEQ_TO_20.0:
50 08 50FD 0062 203 MOVG #1, R0 ; R0/R1 = 1.0
04 BC 53FD 0066 204 TSTG @value(AP) ; test the sign of X
04 18 006A 205 BGEQ 10$ ; branch if X >= 0
50 50 52FD 006C 206 MNEGG R0, R0 ; R0/R1 = -1
04 0070 207 10$: RET ; return with result in R0
0071 208
0071 209 :
0071 210 : !X! <= 2**-27
0071 211 :
0071 212
50 04 BC 7D 0071 213 OUT_X: MOVQ @value(AP), R0 ; R0/R1 = GTANH(X) = X
04 0075 214 RET ; return with result in R0/R1
0076 215
```

MTHSGTANH
1-005

E 9
: G Floating Hyperbolic Tangent routine 16-SEP-1984 01:32:44 VAX/VMS Macro V04-00 Page 6
MTHSGTANH - G Double Precision Floating 6-SEP-1984 11:24:27 [MTHRTL.SRC]MTHGTANH.MAR;1 (4)

0076 216
0076 217
0076 218 .END

MTH
1-0

MTH\$GTANH
Symbol table

F 9
; G Floating Hyperbolic Tangent routine

16-SEP-1984 01:32:44
6-SEP-1984 11:24:27

VAX/VMS Macro V04-00
[MTHRTL.SRC]MTHGTANH.MAR;1

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(4)

GEQ_TO_20.0	00000062	R	01
G_0.25	00000000	R	01
G_2_POWER M27	00000008	R	01
LEQ_TO_0.25	00000050	R	01
LONG	= 00000004		
MTH\$JACKET_HND	*****	X	01
MTH\$GCOSH	*****	X	00
MTH\$GEXP R6	*****	X	00
MTH\$GSINH	*****	X	00
MTH\$GTANH	00000010	RG	01
OUT_X	00000071	R	01
VALUE	= 00000004		

+-----+
! Psect synopsis !
+-----+

PSECT name	Allocation	PSECT No.	Attributes
ABS	00000000 (0.)	00 (0.)	NOPIC USR
MTH\$CODE	00000076 (118.)	01 (1.)	PIC USR

CON ABS LCL NOSHR NOEXE NORD NOWRT NOVEC BYTE
CON REL LCL SHR EXE RD NOWRT NOVEC LONG

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

Phase	Page faults	CPU Time	Elapsed Time
Initialization	30	00:00:00.09	00:00:00.74
Command processing	112	00:00:00.65	00:00:03.02
Pass 1	83	00:00:00.70	00:00:04.34
Symbol table sort	0	00:00:00.00	00:00:00.00
Pass 2	52	00:00:00.58	00:00:01.95
Symbol table output	2	00:00:00.02	00:00:00.08
Psect synopsis output	2	00:00:00.02	00:00:00.18
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	283	00:00:02.06	00:00:10.31

The working set limit was 900 pages.
3309 bytes (7 pages) of virtual memory were used to buffer the intermediate code.
There were 10 pages of symbol table space allocated to hold 13 non-local and 1 local symbols.
278 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.

There were no errors, warnings or information messages.

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

0261

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CON