


```

MM      MM      TTTTTTTTTT  HH      HH      GGGGGGGG  AAAAAA  SSSSSSSS  IIIIII  NN      NN
MM      MM      TTTTTTTTTT  HH      HH      GGGGGGGG  AAAAAA  SSSSSSSS  IIIIII  NN      NN
MMMM    MMMM      TT      HH      HH      GG      AA      AA  SS      NN      NN
MMMM    MMMM      TT      HH      HH      GG      AA      AA  SS      NN      NN
MM      MM      TT      HH      HH      GG      AA      AA  SS      NNNN    NN
MM      MM      TT      HH      HH      GG      AA      AA  SS      NNNN    NN
MM      MM      TT      HHHHHHHHHH  GG      AA      AA  SSSSSS  NN      NN
MM      MM      TT      HHHHHHHHHH  GG      AA      AA  SSSSSS  NN      NN
MM      MM      TT      HH      HH      GG      GGGGGG  AAAAAAAAAA  SS      NN      NN
MM      MM      TT      HH      HH      GG      GGGGGG  AAAAAAAAAA  SS      NN      NN
MM      MM      TT      HH      HH      GG      GG      AA      AA  SS      NN      NN
MM      MM      TT      HH      HH      GG      GG      AA      AA  SS      NN      NN
MM      MM      TT      HH      HH      GG      GG      AA      AA  SSSSSSSS  IIIIII  NN      NN
MM      MM      TT      HH      HH      GG      GG      AA      AA  SSSSSSSS  IIIIII  NN      NN

```

```

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
LLLLLLLLLLLL  IIIIII  SSSSSSSS
LLLLLLLLLLLL  IIIIII  SSSSSSSS

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(2)	54	HISTORY ; Detailed Current Edit History
(3)	67	DECLARATIONS ; Declarative Part of Module
(4)	110	MTHSGASIN - Standard G Floating GASIN
(5)	170	MTHSGASIN R7 - Special GASIN routine
(6)	239	MTHSGASIND - Standard G Floating GASIND
(7)	299	MTHSGASIND_R7 - Special GASIND routine

```

0000 1      .TITLE  MTH$GASIN      ; G Floating Point Sine routine
0000 2      ; (GASIN,GASIND)
0000 3      .IDENT /1-005/      ; File: MTH$GASIN.MAR  EDIT: RNH1005
0000 4      :
0000 5      :*****
0000 6      :
0000 7      :*  COPYRIGHT (c) 1978, 1980, 1982, 1984 BY
0000 8      :*  DIGITAL EQUIPMENT CORPORATION, MAYNARD, MASSACHUSETTS.
0000 9      :*  ALL RIGHTS RESERVED.
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0000 17     :
0000 18     :*  THE INFORMATION IN THIS SOFTWARE IS SUBJECT TO CHANGE WITHOUT NOTICE
0000 19     :*  AND SHOULD NOT BE CONSTRUED AS A COMMITMENT BY DIGITAL EQUIPMENT
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0000 21     :
0000 22     :*  DIGITAL ASSUMES NO RESPONSIBILITY FOR THE USE OR RELIABILITY OF ITS
0000 23     :*  SOFTWARE ON EQUIPMENT WHICH IS NOT SUPPLIED BY DIGITAL.
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$GASIN is a function which returns the G floating point arcsine in
0000 34     : radians of its G floating point argument. The call is standard
0000 35     : call-by-reference.
0000 36     :
0000 37     : MTH$GASIND is a function which returns the G floating point arcsine
0000 38     : in degrees of its G floating point argument. The call is standard
0000 39     : call-by-reference.
0000 40     :
0000 41     :--
0000 42     :
0000 43     : VERSION: 1
0000 44     :
0000 45     : HISTORY:
0000 46     : AUTHOR:
0000 47     : Steven B. Lionel, 15-Jan-79: Version 1
0000 48     :
0000 49     : MODIFIED BY:
0000 50     :
0000 51     :
0000 52     :

```

```
0000 54 .SBTTL HISTORY ; Detailed Current Edit History
0000 55
0000 56
0000 57 : ALGORITHMIC DIFFERENCES FROM FP-11/C ROUTINE: none
0000 58 :
0000 59 : Edit History for Version 1 of MTH$GASIN
0000 60 :
0000 61 : 1-001 - Adapted from MTH$DASIN version 1-001. SBL 15-Jan-79
0000 62 : 1-002 - Change JSB entry to MTH$GASIN.R7. RBG 28-Sept-1979
0000 63 : 1-003 - Added degree entry points. RNH 29-MAR-1981
0000 64 : 1-004 - Changed shared external references to G^ RNH 25-Sept-1981
0000 65 : 1-005 - Eliminate symbolic short literals. RNH 15-Oct-81
```

```
0000 67 .SBTTL DECLARATIONS ; Declarative Part of Module
0000 68
0000 69 :
0000 70 : INCLUDE FILES: OTSPARAMS.MAR
0000 71 :
0000 72 : EXTERNAL SYMBOLS:
0000 73 :
0000 74 .DSABL GBL ; Force error for undefineds
0000 75 .EXTRN MTH$GSQRT_R5 ; Square root routine
0000 76 .EXTRN MTH$GATAN_R7 ; Arctangent routine
0000 77 .EXTRN MTH$GATAN_D_R7 ; Arctangent routine
0000 78 .EXTRN MTH$$SIGNAC ; Math signal routine
0000 79 .EXTRN MTH$K_INVARGMAT ; Error code
0000 80
0000 81 :
0000 82 : EQUATED SYMBOLS:
0000 83
00000004 0000 84 value = 4 ; value.rg.r
0000 85
0000 86 :
0000 87 : MACROS: none
0000 88 :
0000 89 : PSECT DECLARATIONS:
0000 90
00000000 0000 91 .PSECT _MTH$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 :
2D18 5444 21FB 4019 0000 100 G_PI_OVER_2:
0000 101 .WORD ^0040031, ^0020773, ^0052104, ^0026430
0008 102 ; PI/2
0008 103 G_PI:
2D18 5444 21FB 4029 0008 104 .WORD ^0040051, ^0020773, ^0052104, ^0026430
0010 105 ; PI
0010 106 G_90:
00000000 80004076 0010 107 .LONG ^X80004076, ^X0 ; 90
0018 108
```

```

0018 110          .SBTTL MTH$GASIN - Standard G Floating GASIN
0018 111
0018 112
0018 113 :++
0018 114 : FUNCTIONAL DESCRIPTION:
0018 115 :
0018 116 : GASIN - G floating point function
0018 117 :
0018 118 : GASIN(X) is computed as:
0018 119 :
0018 120 :     If X = 0, then GASIN(X) = 0.
0018 121 :     If X = 1, then GASIN(X) = PI/2.
0018 122 :     If X = -1, then GASIN(X) = -PI/2.
0018 123 :     If 0 < |X| < 1, then GASIN(X) = ATAN(X/SQRT(1-X**2)).
0018 124 :     If 1 < |X|, error.
0018 125 :
0018 126 : CALLING SEQUENCE:
0018 127 :
0018 128 :     gasin.wg.v = MTH$GASIN(x.rg.r)
0018 129 :
0018 130 : INPUT PARAMETERS:
0018 131 :
00000004 0018 132 :     LONG = 4 ; define longword multiplier
00000004 0018 133 :     x = 1 * LONG ; Contents of x is the argument
0018 134 :
0018 135 : IMPLICIT INPUTS: none
0018 136 :
0018 137 : OUTPUT PARAMETERS:
0018 138 :
0018 139 :     VALUE: G floating arcsine of the argument
0018 140 :
0018 141 : IMPLICIT OUTPUTS: none
0018 142 :
0018 143 : COMPLETION CODES: none
0018 144 :
0018 145 : SIDE EFFECTS:
0018 146 :
0018 147 : Signals: MTH$_INVARGMAT if |X| > 1 with reserved operand in R0/R1
0018 148 : (copied to the signal mechanism vector CHF$MCH_R0/R1 by LIB$SIGNAL).
0018 149 : Associated message is: "INVALID ARGUMENT". Result is reserved
0018 150 : operand -0.0 unless a user supplied (or any) error handler changes CHF$MCH_R0/R1
0018 151 :
0018 152 : NOTE: This procedure disables floating point underflow, enables integer
0018 153 : overflow.
0018 154 :
0018 155 : ---
0018 156 :
0018 157 :
0018 158 : .ENTRY MTH$GASIN, ^M<IV, R2, R3, R4, R5, R6, R7>
001A 159 : ; standard call-by-reference entry
001A 160 : ; disable DV (and FU), enable IV
001A 161 : MTH$FLAG_JACKET ; flag that this is a jacket procedure in
001A
6D 00000000'GF 9E 001A MOVAB G^MTH$$JACKET_HND, (FP)
0021 : ; set handler address to jacket
0021 : ; handler
0021

```



```

0029 170      .SBTTL  MTH$GASIN_R7 - Special GASIN routine
0029 171
0029 172      ; Special GASIN - used by the standard routine and direct JSB call.
0029 173      ;
0029 174      ; CALLING SEQUENCE:
0029 175      ; save anything needed in R0:R7
0029 176      ; MOVG      R0          ; input in R0/R1
0029 177      ; JSB      MTH$GASIN_R7
0029 178      ; RSB          ; return with result in R0/R1
0029 179      ;
0029 180
0029 181      MTH$GASIN_R7::      ; special GASIN routine
0029 182      MTH$GASIN_R9::      ; Release 1 name
0029 183      MOVG      R0, R6      ; save X in R6/R7
56 50 50FD 002D 184      BEQL     RETURN      ; return DASIN(0) = 0
34 13
002F 185
002F 186      ;
002F 187      ; 0 < |X|
002F 188      ;
002F 189
50 8000 8F AA 002F 190      BICW     #^X8000, R0      ; R0/R1 = |X|
08 50 51FD 0034 191      CMPG     R0, #1          ; compare |X| with 1.0
1A 18 0038 192      BGEQ     GEQ_TO_1.0      ; branch if |X| >= 1.0
003A 193
003A 194      ;
003A 195      ; 0 < |X| < 1.0
003A 196      ;
003A 197
50 50 50 44FD 003A 198      MULG2   R0, R0          ; R0/R1 = X**2
50 08 50 43FD 003E 199      SUBG3   R0, #1, R0      ; R0/R1 = 1.0 - X**2
00000000'EF 16 0043 200      JSB     MTH$GSQRT_R5      ; R0/R1 = GSQRT(1-X**2)
50 56 50 47FD 0049 201      DIVG3   R0, R6, R0      ; R0/R1 = X/GSQRT(1-X**2)
00000000'GF 17 004E 202      JMP     G^MTH$GATAN_R7      ; R0/R1 = GATAN(X/GSQRT(1-X**2))
0054 203
0054 204
0054 205      ;
0054 206      ; 1 <= |X|
0054 207      ;
0054 208
0054 209      GEQ_TO_1.0:
OE 14 0054 210      BGTR     ERROR          ; branch to ERROR if |X| > 1.0
0056 211
0056 212
0056 213      ;
0056 214      ; |X| = 1.0
0056 215      ;
0056 216
50 A7 AF 7D 0056 217      MOVQ    G_PI_OVER_2, R0      ; R0/R1 = PI/2
56 53FD 005A 218      TSTG    R6          ; test the sign of X
04 18 005D 219      BGEQ    RETURN      ; branch if X > 0
50 50 52FD 005F 220      MNEGG   R0, R0          ; R0/R1 = -PI/2
05 0063 221      RETURN: RSB      ; return with result in R0/R1
0064 222
0064 223      ;
0064 224      ; 1 < |X|, error
0064 225      ;
0064 226

```

MTHSGASIN
1-005

H 6
; G Floating Point Sine routine
MTHSGASIN_R7 - Special GASIN routine

16-SEP-1984 01:24:49 VAX/VMS Macro V04-00 Page 7
6-SEP-1984 11:23:19 [MTHRTL.SRC]MTHGASIN.MAR;1 (5)

7E	00	6E	DD	0064	227	ERROR:	PUSHL	(SP)	:	return PC from JSB routine
50	01	8F	9A	0066	228		MOVZBL	#MTH\$K INVARGMAT, -(SP)	:	condition value
		0F	79	006A	229		ASHQ	#15, #T, R0	:	R0 = result = reserved operand -0.0
				006E	230				:	goes to signal mechanism vector
				006E	231				:	(CHF\$MCH_R0/R1) so error handler
00000000	'GF			006E	232				:	can modify the result.
		02	FB	006E	233		CALLS	#2, G^MTH\$\$SIGNAL	:	signal error and use real user's PC
				0075	234				:	independent of CALL vs JSB
			05	0075	235		RSB		:	return - R0 restored from CHF\$MCH_R0/R1
				0076	236				:	
				0076	237				:	

```

0076 239          .SBTTL MTH$GASIND - Standard G Floating GASIND
0076 240
0076 241
0076 242 :++
0076 243 : FUNCTIONAL DESCRIPTION:
0076 244 :
0076 245 : GASIND - G floating point function
0076 246 :
0076 247 : GASIND(X) is computed as:
0076 248 :
0076 249 :     If X = 0, then GASIND(X) = 0.
0076 250 :     If X = 1, then GASIND(X) = 90.
0076 251 :     If X = -1, then GASIND(X) = -90.
0076 252 :     If 0 < |X| < 1, then GASIND(X) = ATAND(X/SQRT(1-X**2)).
0076 253 :     If 1 < |X|, error.
0076 254 :
0076 255 : CALLING SEQUENCE:
0076 256 :
0076 257 :     gasind.wg.v = MTH$GASIND(x.rg.r)
0076 258 :
0076 259 : INPUT PARAMETERS:
0076 260 :
00000004 0076 261 :     LONG = 4 ; define longword multiplier
00000004 0076 262 :     x = 1 * LONG ; Contents of x is the argument
0076 263 :
0076 264 : IMPLICIT INPUTS: none
0076 265 :
0076 266 : OUTPUT PARAMETERS:
0076 267 :
0076 268 :     VALUE: G floating arcsine of the argument
0076 269 :
0076 270 : IMPLICIT OUTPUTS: none
0076 271 :
0076 272 : COMPLETION CODES: none
0076 273 :
0076 274 : SIDE EFFECTS:
0076 275 :
0076 276 : Signals: MTH$_INVARGMAT if |X| > 1 with reserved operand in R0/R1
0076 277 : (co90ed to the signal mechanism vector CHF$MCH_R0/R1 by LIB$SIGNAL).
0076 278 : Associated message is: "INVALID ARGUMENT". Result is reserved
0076 279 : operand -0.0 unless a user supplied (or any) error handler changes CHF$MCH_R0/R1
0076 280 :
0076 281 : NOTE: This procedure disables floating point underflow, enables integer
0076 282 : overflow.
0076 283 :
0076 284 : ---
0076 285 :
40FC 0076 286 :
0076 287 : .ENTRY MTH$GASIND, ^M<IV, R2, R3, R4, R5, R6, R7>
0078 288 : ; standard call-by-reference entry
0078 289 : ; disable DV (and FU), enable IV
0078 290 : MTH$FLAG_JACKET ; flag that this is a jacket procedure in
0078 :
6D 00000000'GF 9E 0078 : MOVAB G^MTH$$JACKET_HND, (FP)
007F : ; set handler address to jacket
007F : handler
007F :

```

```
50 04 BC 50FD 007F 291      MOVG  @value(AP), R0
      01 10 0084 007F 292      BSBB  MTHSGASIND_R7
      04 0086 007F 293
      0087 007F 294
      0087 0084 295
      0087 0086 296
      0087 0087 297
```

```
; case of an error in routine
; If an error, convert signal to user PC
; and resignal
; R0/R1 = IXI = @value(AP)
; call special GASIND routine
; return with result in R0/R1
```

```

0087 299      .SBTTL  MTH$GASIND_R7 - Special GASIND routine
0087 300
0087 301      ; Special GASIND - used by the standard routine and direct JSB call.
0087 302      ;
0087 303      CALLING SEQUENCE:
0087 304      save anything needed in R0:R7
0087 305      MOVG   R0                ; input in R0/R1
0087 306      JSB   MTH$GASIND_R7
0087 307      RSB                ; return with result in R0/R1
0087 308      ;
0087 309
0087 310      MTH$GASIND_R7::
0087 311      MOVG   R0, R6          ; special GASIND routine
0087 312      BEQL  D_RETURN        ; save X in R6/R7
0087 313      ;
0087 314      ; 0 < |X|
0087 315      ;
0087 316      ;
0087 317
0087 318      BICW  #^X8000, R0     ; R0/R1 = |X|
0087 319      CMPG  R0, #1         ; compare |X| with 1.0
0087 320      BGEQ  D_GEQ_TO_1.0   ; branch if |X| >= 1.0
0087 321      ;
0087 322      ; 0 < |X| < 1.0
0087 323      ;
0087 324      ;
0087 325
0087 326      MULG2  R0, R0         ; R0/R1 = X**2
0087 327      SUBG3  R0, #1, R0    ; R0/R1 = 1.0 - X**2
0087 328      JSB   MTH$GSQRT_R5   ; R0/R1 = GSQRT(1-X**2)
0087 329      DIVG3  R0, R6, R0    ; R0/R1 = X/GSQRT(1-X**2)
0087 330      JMP   G^MTH$GATAND_R7 ; R0/R1 = GATAND(X/GSQRT(1-X**2))
0087 331
0087 332
0087 333      ; 1 <= |X|
0087 334      ;
0087 335      ;
0087 336
0087 337      D_GEQ_TO_1.0:
0087 338      BGTR  ERROR          ; branch to ERROR if |X| > 1.0
0087 339
0087 340
0087 341      ; |X| = 1.0
0087 342      ;
0087 343      ;
0087 344
0087 345      MOVQ  G 90, R0        ; R0/R1 = 90
0087 346      TSTG  R6             ; test the sign of X
0087 347      BGEQ  D_RETURN        ; branch if X > 0
0087 348      MNEGG R0, R0         ; R0/R1 = -90
0087 349      D_RETURN:
0087 350      RSB                ; return with result in R0/R1
0087 351
0087 352      .END

```

MTHSGASIN
Symbol table

; G Floating Point Sine routine L 6

16-SEP-1984 01:24:49
6-SEP-1984 11:23:19

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

Page 11
(7)

```

D_GEQ_TO_1.0      000000B2 R    01
D_RETURN-         000000C2 R    01
ERROR             00000064 R    01
GEQ_TO_1.0       00000054 R    01
G_90              00000010 R    01
G_PI              00000008 R    01
G_PI_OVER_2      00000000 R    01
LONG =           00000004
MTHSSJACKET_HND ***** X    01
MTHSSIGNAL        ***** X    00
MTHSGASIN         00000018 RG   01
MTHSGASIND        00000076 RG   01
MTHSGASIND_R7     00000087 RG   01
MTHSGASIN_R7      00000029 RG   01
MTHSGASIN_R9      00000029 RG   01
MTHSGATAN_R7     ***** X    00
MTHSGATAN_R7     ***** X    00
MTHSGSQRT_R5     ***** X    00
MTHSK_INVARGMAT ***** X    00
RETURN           00000063 R    01
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		
_MTHSCODE	000000C3 (195.)	01 (1.)	PIC	USR	CON	REL	LCL	SHR	EXE	RD	NOWRT	NOVEC	LONG		

! Performance indicators !

Phase	Page faults	CPU Time	Elapsed Time
Initialization	31	00:00:00.10	00:00:01.03
Command processing	112	00:00:00.65	00:00:03.93
Pass 1	94	00:00:00.96	00:00:03.43
Symbol table sort	0	00:00:00.01	00:00:00.01
Pass 2	72	00:00:00.79	00:00:03.74
Symbol table output	3	00:00:00.02	00:00:00.09
Psect synopsis output	2	00:00:00.03	00:00:00.10
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	316	00:00:02.57	00:00:12.47

The working set limit was 900 pages.

5179 bytes (11 pages) of virtual memory were used to buffer the intermediate code.

There were 10 pages of symbol table space allocated to hold 22 non-local and 0 local symbols.

412 source lines were read in Pass 1, producing 14 object records in Pass 2.

1 page of virtual memory was used to define 1 macro.

! Macro library statistics !

Macro library name

Macros defined

_S255SDUA28:[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\$:MTHGASIN/OBJ=OBJ\$:MTHGASIN MSRC\$:MTHJACKET/UPDATE=(ENH\$:MTHJACKET)+MSRC

