```
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
```

```
MM      MM  TTTTTTTTTT  HH      HH    CCCCCCCC    SSSSSSSS    IIIIII    NN      NN    CCCCCCCC    OOOOOO
MM      MM  TTTTTTTTTT  HH      HH    CCCCCCCC    SSSSSSSS    IIIIII    NN      NN    CCCCCCCC    OOOOOO
MMMM  MMMM      TT      HH      HH  CC          SS              II      NN      NN  CC          OO      OO
MMMM  MMMM      TT      HH      HH  CC          SS              II      NN      NN  CC          OO      OO
MM  MM  MM      TT      HH      HH  CC          SS              II      NNNN    NN  CC          OO      OO
MM  MM  MM      TT      HH      HH  CC          SS              II      NNNN    NN  CC          OO      OO
MM      MM      TT      HHHHHHHHHH  CC            SSSSSS        II      NN  NN  NN  CC          OO      OO
MM      MM      TT      HHHHHHHHHH  CC            SSSSSS        II      NN  NN  NN  CC          OO      OO
MM      MM      TT      HH      HH  CC                  SS      II      NN    NNNN  CC          OO      OO
MM      MM      TT      HH      HH  CC                  SS      II      NN    NNNN  CC          OO      OO
MM      MM      TT      HH      HH  CC                  SS      II      NN      NN  CC          OO      OO
MM      MM      TT      HH      HH  CC                  SS      II      NN      NN  CC          OO      OO
MM      MM      TT      HH      HH    CCCCCCCC  SSSSSSSS      IIIIII    NN      NN    CCCCCCCC    OOOOOO
MM      MM      TT      HH      HH    CCCCCCCC  SSSSSSSS      IIIIII    NN      NN    CCCCCCCC    OOOOOO

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$CSINCOS     COMPLEX SINE AND COSINE
0000     2          .IDENT  /1-002/         ; File: MTHCSINCO.MAR
0000     3
0000     4 ;
0000     5 ;****************************************************************************
0000     6 ;*                                                                          *
0000     7 ;*  COPYRIGHT (c) 1978, 1980, 1982, 1984 BY                                 *
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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 ;       Return the SINE of a complex number
0000    33 ;       Return the COSINE of a complex number
0000    34 ;
0000    35 ;
0000    36 ;--
0000    37 ;
0000    38 ; VERSION: 0
0000    39 ;
0000    40 ; HISTORY:
0000    41 ;
0000    42 ; AUTHOR:
0000    43 ;       Jonathan M. Taylor, 19-JUL-77: Version 0
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 ; Edit History for Version 0 of MTH$CSINCO
0000     54 ;
0000     55 ; 1-001 - Update version number and copyright notice.  The last edit
0000     56 ; 1-002 - Add "_" to the PSECT directive.  JBS 21-DEC-78
0000     57 ;            number in version 0 was 3.  JBS 16-NOV-78
```

```
                     0000     59          .SBTTL  DECLARATIONS
                     0000     60
                     0000     61 ;
                     0000     62 ; INCLUDE FILES:
                     0000     63 ;        OERR.MAR
                     0000     64
                     0000     65 ;
                     0000     66 ; EXTERNAL SYMBOLS:
                     0000     67          .GLOBL  MTH$SIN_R4
                     0000     68          .GLOBL  MTH$COS_R4
                     0000     69          .GLOBL  MTH$EXP_R4
                     0000     70
                     0000     71 ;
                     0000     72 ; MACROS:
                     0000     73 ;        NONE
                     0000     74
                     0000     75 ;
                     0000     76 ; PSECT DECLARATIONS:
                00000000     77          .PSECT  _MTH$CODE       PIC, SHR, LONG, EXE, NOWRT
                     0000     78
                     0000     79 ;
                     0000     80 ; EQUATED SYMBOLS:
           00000004  0000     81          argadr  =       4       ; offset from AP of arg addr
                     0000     82
                     0000     83 ;
                     0000     84 ; OWN STORAGE:
                     0000     85 ;        NONE
```

```
                     0000     87          .SBTTL  MTH$CSIN - COMPLEX SINE
                     0000     88
                     0000     89 ;++
                     0000     90 ; FUNCTIONAL DESCRIPTION:
                     0000     91 ;
                     0000     92 ;       MTH$CSIN computes the SINE of a COMPLEX number (r, i) as
                     0000     93 ;
                     0000     94 ;       result = (SIN(r) * COSH(i), COS(r) * SINH(i))
                     0000     95 ;
                     0000     96 ; CALLING SEQUENCE:
                     0000     97 ;       Sine.wfc.v      = MTH$CSIN(arg.rfc.r)
                     0000     98 ;
                     0000     99 ;
                     0000    100 ; INPUT PARAMETERS:
                     0000    101 ;       The one input parameter is the address of a COMPLEX number (r, i),
                     0000    102 ;       where r and i are both single-precision floating point values.
                     0000    103 ;
                     0000    104 ; IMPLICIT INPUTS:
                     0000    105 ;       NONE
                     0000    106 ;
                     0000    107 ; OUTPUT PARAMETERS:
                     0000    108 ;       NONE
                     0000    109 ;
                     0000    110 ; IMPLICIT OUTPUTS:
                     0000    111 ;       NONE
                     0000    112 ;
                     0000    113 ; COMPLETION CODES:
                     0000    114 ;       NONE
                     0000    115 ;
                     0000    116 ; SIDE EFFECTS:
                     0000    117 ;       Signals:        Reserved Operand if r or i are invalid (-0.0)
                     0000    118 ;                       MTH$_SINSIGLOS if |r| > 2*PI*2**31.
                     0000    119 ;                       Floating Overflow if i > 88.028.
                     0000    120 ;
                     0000    121 ;--
                     0000    122
                     0000    123
                00FC 0000    124          .ENTRY  MTH$CSIN,       ^M<R2,R3,R4,R5,R6,R7>
00000025'EF       16 0002    125          JSB     WORKER                  ; R0 = SIN(r)
                     0008    126                                          ; R1 = COS(r)
                     0008    127                                          ; R2 = SINH(i)
                     0008    128                                          ; R3 = COSH(i)
     50   53    44 0008    129          MULF    R3, R0                  ; R0 = SIN(r) * COSH(i)
     51   52    44 000B    130          MULF    R2, R1                  ; R1 = COS(r) * SINH(i)
                04 000E    131          RET
```

```
                     000F   133          .SBTTL  MTH$CCOS - COMPLEX COSINE
                     000F   134
                     000F   135 ;++
                     000F   136 ; FUNCTIONAL DESCRIPTION:
                     000F   137 ;
                     000F   138 ;       MTH$CCOS computes the COSINE of COMPLEX number (r, i) as follows:
                     000F   139 ;
                     000F   140 ;       result = (COS(r) * COSH(i), -SIN(r) * SINH(-i))
                     000F   141 ;
                     000F   142 ; CALLING SEQUENCE:
                     000F   143 ;       Cosine.wfc.v    = MTH$CCOS (arg.rfc.r)
                     000F   144 ;
                     000F   145 ;
                     000F   146 ; INPUT PARAMETERS:
                     000F   147 ;       The one input parameter is the address of a COMPLEX number (r, i),
                     000F   148 ;       where r and i are both single-precision floating point values.
                     000F   149 ;
                     000F   150 ; IMPLICIT INPUTS:
                     000F   151 ;       NONE
                     000F   152 ;
                     000F   153 ; OUTPUT PARAMETERS:
                     000F   154 ;       NONE
                     000F   155 ;
                     000F   156 ; IMPLICIT OUTPUTS:
                     000F   157 ;       NONE
                     000F   158 ;
                     000F   159 ; COMPLETION CODES:
                     000F   160 ;       NONE
                     000F   161 ;
                     000F   162 ; SIDE EFFECTS:
                     000F   163 ;       Signals:        Reserved Operand if r or i are invalid (-0.0)
                     000F   164 ;                       MTH$_SINSIGLOS if |r| > 2*PI*2**31.
                     000F   165 ;                       Floating Overflow if i > 88.028.
                     000F   166 ;
                     000F   167 ;--
                     000F   168
                     000F   169
                00FC 000F   170          .ENTRY  MTH$CCOS,       ^M<R2,R3,R4,R5,R6,R7>
    00000025'EF   16 0011   171          JSB     WORKER                  ; R0 = SIN(r)
                     0017   172                                          ; R1 = COS(r)
                     0017   173                                          ; R2 = SINH(i)
                     0017   174                                          ; R3 = COSH(i)
          53   51   44 0017   175          MULF    R1, R3                  ; R3 = COS(r) * COSH(i)
          50   50   52 001A   176          MNEGF   R0, R0                  ; R0 = -SIN(r)
    51    52   50   45 001D   177          MULF3   R0, R2, R1              ; R1 = -SIN(r) * SINH(i)
          50   53   D0 0021   178          MOVL    R3, R0                  ; R0 = COS(r) * COSH(i)
                    04 0024   179          RET
```

```
                                0025   181          .SBTTL  WORKER - do all the work
                                0025   182
                                0025   183 ;+
                                0025   184 ; Setup error handler
                                0025   185 ; Compute:
                                0025   186 ;       R0 = SIN(r)
                                0025   187 ;       R1 = COS(r)
                                0025   188 ;       R2 = SINH(i)
                                0025   189 ;       R3 = COSH(i)
                                0025   190 ;-
                                0025   191
                                0025   192 WORKER:
                                0025   193          MTH$FLAG_JACKET                    ; set up error handler
                                0025
  6D   00000000'GF    9E        0025                MOVAB   G^MTH$$JACKET_HND, (FP)
                                002C                                                   ; set handler address to jacket
                                002C                                                   ; handler
                                002C
    50    04 AC     D0        002C   194          MOVL    argadr(AP), R0             ; R0 -> (r, i)
    50    04 A0     50        0030   195          MOVF    4(R0), R0                  ; R0 = i
  00000000'EF       16        0034   196          JSB     MTH$EXP_R4                 ; R0 = EXP(i)
 51    08    50     47        003A   197          DIVF3   R0, #1.0, R1               ; R1 = EXP(-i)
                                003E   198
 55    50    51     43        003E   199          SUBF3   R1, R0, R5                 ; R5 = EXP(i) - EXP(-i)
       55    00     44        0042   200          MULF    #0.5, R5                   ; R5 = (EXP(i) - EXP(-i))/2
                                0045   201
 56    50    51     41        0045   202          ADDF3   R1, R0, R6                 ; R6 = EXP(i) + EXP(-i)
       56    00     44        0049   203          MULF    #0.5, R6                   ; R6 = (EXP(i) + EXP(-i))/2
                                004C   204
    50    04 BC     50        004C   205          MOVF    @argadr(AP), R0            ; R0 = r
  00000000'EF       16        0050   206          JSB     MTH$COS_R4                 ; R0 = COS(r)
    57    50        D0        0056   207          MOVL    R0, R7                     ; R7 = COS(r)
                                0059   208
    50    04 BC     50        0059   209          MOVF    @argadr(AP), R0            ; R0 = r
  00000000'EF       16        005D   210          JSB     MTH$SIN_R4                 ; R0 = SIN(r)
                                0063   211
    51    57        D0        0063   212          MOVL    R7, R1                     ; R1 = COS(r)
    52    55        D0        0066   213          MOVL    R5, R2                     ; R2 = SINH(i)
    53    56        D0        0069   214          MOVL    R6, R3                     ; R3 = COSH(i)
                                006C   215
                    05        006C   216          RSB
                                006D   217
                                006D   218
                                006D   219
                                006D   220          .END
```

```
ARGADR          = 00000004
MTH$$JACKET_HND  ********    X   01
MTH$CCOS         0000000F RG     01
MTH$COS_R4       ******** G      00
MTH$CSIN         00000000 RG     01
MTH$EXP_R4       ******** G      00
MTH$SIN_R4       ******** G      00
WORKER           00000025 R      01
```

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	0000006D (109.)	01 (1.)	PIC USR CON REL LCL SHR EXE RD NOWRT NOVEC LONG

Performance indicators

Phase	Page faults	CPU Time	Elapsed Time
Initialization	33	00:00:00.09	00:00:01.38
Command processing	126	00:00:00.60	00:00:03.69
Pass 1	84	00:00:00.72	00:00:02.16
Symbol table sort	0	00:00:00.00	00:00:00.00
Pass 2	51	00:00:00.59	00:00:01.94
Symbol table output	2	00:00:00.01	00:00:00.37
Psect synopsis output	2	00:00:00.02	00:00:00.01
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	300	00:00:02.06	00:00:09.56

```
The working set limit was 900 pages.
3332 bytes (7 pages) of virtual memory were used to buffer the intermediate code.
There were 10 pages of symbol table space allocated to hold 8 non-local and 0 local symbols.
280 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
_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$:MTHCSINCO/OBJ=OBJ$:MTHCSINCO MSRC$:MTHJACKET/UPDATE=(ENH$:MTHJACKET)+MS
```

MTHCVTDG
LIS

MTHDACOS
LIS

MTHCGABS
LIS

MTHCDSINC
LIS

MTHCLOG
LIS

MTHDASIN
LIS

MTHCGLOG
LIS

MTHCONVER
LIS

MTHDATAN
LIS

MTHCSQRT
LIS

MTHCEXP
LIS

MTHCGSQRT
LIS

MTHCGEXP
LIS

MTHCSINCO
LIS

MTHCONJG
LIS

MTHCDSQRT
LIS

MTHCGSINC
LIS

MTHCOSH
LIS