```
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**MTHCDSINC

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

LL              IIIIII      SSSSSS
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$CDSINCOS    D COMPLEX*16 Sine and Cosine
0000     2          .IDENT  /1-002/         ; File: MTHCDSINC.MAR Edit: RNH1002
0000     3
0000     4 ;
0000     5 ;****************************************************************************
0000     6 ;*                                                                          *
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0000    24 ;*                                                                          *
0000    25 ;*                                                                          *
0000    26 ;****************************************************************************
0000    27 ;
0000    28 ;
0000    29 ;
0000    30 ; FACILITY: MATH LIBRARY
0000    31 ;++
0000    32 ; ABSTRACT:
0000    33 ;       Return the SINE of a D COMPLEX*16 number
0000    34 ;       Return the COSINE of a D COMPLEX*16 number
0000    35 ;
0000    36 ;
0000    37 ;--
0000    38 ;
0000    39 ; VERSION: 1
0000    40 ;
0000    41 ; HISTORY:
0000    42 ;
0000    43 ; AUTHOR:
0000    44 ;       Steven B. Lionel, 26-July-1979
0000    45 ;
0000    46 ; MODIFIED BY:
0000    47 ;
0000    48 ;
0000    49 ;
```

```
0000     51          .SBTTL  HISTORY         ; Detailed Current Edit History
0000     52
0000     53
0000     54 ; Edit History
0000     55 ;
0000     56 ; 1-001 - Adapted from MTH$CSINCOS version 1-002.  SBL 26-July-1979
0000     57 ; 1-002 - Changed shared external references to G^ RNH 25-Sep-81
```

```
                        59          .SBTTL  DECLARATIONS
                        60
                        61 ;
                        62 ; INCLUDE FILES:
                        63 ;
                        64
                        65 ;
                        66 ; EXTERNAL SYMBOLS:
                        67          .DSABL  GBL
                        68          .EXTRN  MTH$DSIN_R7
                        69          .EXTRN  MTH$DCOS_R7
                        70          .EXTRN  MTH$DEXP_R7
                        71
                        72 ;
                        73 ; MACROS:
                        74 ;
                        75
                        76 ;
                        77 ; PSECT DECLARATIONS:
00000000                78          .PSECT  _MTH$CODE       PIC, SHR, LONG, EXE, NOWRT
                        79
                        80 ;
                        81 ; EQUATED SYMBOLS:
                        82
                        83 ;
                        84 ; OWN STORAGE:
                        85 ;        NONE
```

```
                                        .SBTTL  MTH$CDSIN - D COMPLEX*16 SINE

                                ;++
                                ; FUNCTIONAL DESCRIPTION:
                                ;
                                ;       MTH$CDSIN computes the SINE of a D COMPLEX*16 number (r, i) as
                                ;
                                ;       result = (SIN(r) * COSH(i), COS(r) * SINH(i))
                                ;
                                ; CALLING SEQUENCE:
                                ;       CALL MTH$CDSIN (result.wdc.r, arg.rdc.r)
                                ;
                                ;
                                ; INPUT PARAMETERS:
00000008                        ;       arg     = 8             ; D COMPLEX*16 argument by reference
                                ;
                                ; IMPLICIT INPUTS:
                                ;       NONE
                                ;
                                ; OUTPUT PARAMETERS:
                                ;
00000004                        ;       result  = 4             ; D COMPLEX*16 result by reference
                                ;
                                ; IMPLICIT OUTPUTS:
                                ;       NONE
                                ;
                                ; COMPLETION CODES:
                                ;       NONE
                                ;
                                ; SIDE EFFECTS:
                                ;       Signals:        Reserved Operand if r or i are invalid (-0.0)
                                ;                       MTH$_SINSIGLOS if |r| > 2*PI*2**31.
                                ;                       Floating Overflow if i > 88.028.
                                ;
                                ;--

                        00FC    0000    .ENTRY  MTH$CDSIN,      ^M<R2,R3,R4,R5,R6,R7>
00000039'EF               16    0002    JSB     WORKER                  ; R0-R1 = SIN(r)
                                0008                                    ; R2-R3 = COS(r)
                                0008                                    ; R4-R5 = SINH(i)
                                0008                                    ; R6-R7 = COSH(i)
                50      56      64    0008    MULD2   R6, R0                  ; R0-R1 = SIN(r) * COSH(i)
                52      54      64    000B    MULD2   R4, R2                  ; R2-R3 = COS(r) * SINH(i)
          54    04      AC      D0    000E    MOVL    result(AP), R4          ; get result address
                84      50      7D    0012    MOVQ    R0, (R4)+               ; Store real part
                64      52      7D    0015    MOVQ    R2, (R4)                ; Store imaginary part
                                04    0018    RET
```

```
                          0019   136          .SBTTL  MTH$CDCOS - D COMPLEX*16 Cosine
                          0019   137
                          0019   138 ;++
                          0019   139 ; FUNCTIONAL DESCRIPTION:
                          0019   140 ;
                          0019   141 ;       MTH$CDCOS computes the COSINE of D COMPLEX*16 number (r, i) as follows:
                          0019   142 ;
                          0019   143 ;       result = (COS(r) * COSH(i), -SIN(r) * SINH(-i))
                          0019   144 ;
                          0019   145 ; CALLING SEQUENCE:
                          0019   146 ;       CALL MTH$CDCOS (result.wdc.r, arg.rdc.r)
                          0019   147 ;
                          0019   148 ;
                          0019   149 ; INPUT PARAMETERS:
                 00000008 0019   150 ;       arg     = 8             ; D COMPLEX*16 argument by reference
                          0019   151 ;
                          0019   152 ; IMPLICIT INPUTS:
                          0019   153 ;       NONE
                          0019   154 ;
                          0019   155 ; OUTPUT PARAMETERS:
                          0019   156 ;
                 00000004 0019   157 ;       result  = 4             ; D COMPLEX*16 result by reference
                          0019   158 ;
                          0019   159 ; IMPLICIT OUTPUTS:
                          0019   160 ;       NONE
                          0019   161 ;
                          0019   162 ; COMPLETION CODES:
                          0019   163 ;       NONE
                          0019   164 ;
                          0019   165 ; SIDE EFFECTS:
                          0019   166 ;       Signals:        Reserved Operand if r or i are invalid (-0.0)
                          0019   167 ;                       MTH$_SINSIGLOS if |r| > 2*PI*2**31.
                          0019   168 ;                       Floating Overflow if i > 88.028.
                          0019   169 ;
                          0019   170 ;--
                          0019   171
                          0019   172
                    00FC  0019   173          .ENTRY  MTH$CDCOS,      ^M<R2,R3,R4,R5,R6,R7>
 00000039'EF        16    001B   174          JSB     WORKER                          ; R0-R1 = SIN(r)
                          0021   175                                                  ; R2-R3 = COS(r)
                          0021   176                                                  ; R4-R5 = SINH(i)
                          0021   177                                                  ; R6-R7 = COSH(i)
      56    52    64    0021   178          MULD2   R2, R6                          ; R6-R7 = COS(r) * COSH(i)
      50    50    72    0024   179          MNEGD   R0, R0                          ; R0-R1 = -SIN(r)
52    54    50    65    0027   180          MULD3   R0, R4, R2                      ; R2-R3 = -SIN(r) * SINH(i)
      50    56    7D    002B   181          MOVQ    R6, R0                          ; R0-R1 = COS(r) * COSH(i)
  54    04    AC    D0    002E   182          MOVL    result(AP), R4                  ; get result address
      84    50    7D    0032   183          MOVQ    R0, (R4)+                       ; Store real part
      64    52    7D    0035   184          MOVQ    R2, (R4)                        ; Store imaginary part
                  04    0038   185          RET
```

```
                                0039   187          .SBTTL  WORKER - do all the work
                                0039   188
                                0039   189 ;+
                                0039   190 ; Setup error handler
                                0039   191 ; Compute:
                                0039   192 ;       R0-R1 = SIN(r)
                                0039   193 ;       R2-R3 = COS(r)
                                0039   194 ;       R4-R5 = SINH(i)
                                0039   195 ;       R6-R7 = COSH(i)
                                0039   196 ;-
                                0039   197
                                0039   198 WORKER:
                                0039   199          MTH$FLAG_JACKET                 ; set up error handler
                                0039
    6D   00000000'GF    9E      0039                 MOVAB   G^MTH$$JACKET_HND, (FP)
                                0040                                                 ; set handler address to jacket
                                0040                                                 ; handler
                                0040
      50    08 AC       D0      0040   200          MOVL    arg(AP), R0             ; R0 -> (r, i)
      50    08 A0       70      0044   201          MOVD    8(R0), R0               ; R0-R1 = i
   00000000'GF          16      0048   202          JSB     G^MTH$DEXP_R7           ; R0-R1 = EXP(i)
   52    08    50       67      004E   203          DIVD3   R0, #1, R2              ; R2-R3 = EXP(-i)
                                0052   204
   54    50    52       63      0052   205          SUBD3   R2, R0, R4              ; R4-R5 = EXP(i) - EXP(-i)
   7E    54    00       65      0056   206          MULD3   #0.5, R4, -(SP)         ; (SP) = SINH(i)
                                005A   207
   54    50    52       61      005A   208          ADDD3   R2, R0, R4              ; R4-R5 = EXP(i) + EXP(-i)
   7E    54    00       65      005E   209          MULD3   #0.5, R4, -(SP)         ; (SP) = COSH(i)
                                0062   210
      50    08 BC       70      0062   211          MOVD    @arg(AP), R0            ; R0-R1 = r
   00000000'GF          16      0066   212          JSB     G^MTH$DCOS_R7           ; R0-R1 = COS(r)
      7E    50          7D      006C   213          MOVQ    R0, -(SP)               ; (SP) = COS(r)
                                006F   214
      50    08 BC       7D      006F   215          MOVQ    @arg(AP), R0            ; R0-R1 = r
   00000000'GF          16      0073   216          JSB     G^MTH$DSIN_R7           ; R0-R1 = SIN(r)
      52    8E          7D      0079   217          MOVQ    (SP)+, R2               ; R2-R3 = COS(r)
      56    8E          7D      007C   218          MOVQ    (SP)+, R6               ; R6-R7 = COSH(i)
      54    8E          7D      007F   219          MOVQ    (SP)+, R4               ; R4-R5 = SINH(i)
                                0082   220
                          05    0082   221          RSB
                                0083   222
                                0083   223
                                0083   224
                                0083   225          .END
```

```
ARG             =  00000008
MTH$$JACKET_HND    ********    X   01
MTH$CDCOS          00000019 RG    01
MTH$CDSIN          00000000 RG    01
MTH$DCOS_R7        ********    X   00
MTH$DEXP_R7        ********    X   00
MTH$DSIN_R7        ********    X   00
RESULT          =  00000004
WORKER             00000039 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	00000083 (131.)	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	00:00:01.26
Command processing	111	00:00:00.63	00:00:03.38
Pass 1	89	00:00:00.73	00:00:02.56
Symbol table sort	0	00:00:00.01	00:00:00.01
Pass 2	54	00:00:00.61	00:00:03.07
Symbol table output	2	00:00:00.03	00:00:00.25
Psect synopsis output	2	00:00:00.02	00:00:00.08
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	293	00:00:02.14	00:00:10.62

```
The working set limit was 900 pages.
3610 bytes (8 pages) of virtual memory were used to buffer the intermediate code.
There were 10 pages of symbol table space allocated to hold 9 non-local and 0 local symbols.
285 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$:MTHCDSINC/OBJ=OBJ$:MTHCDSINC 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