```
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       HHHHHHHHHHHHHHH  RRRRRRRRRRR           TTT         LLL
MMM         MMM         TTT       HHHHHHHHHHHHHHH  RRRRRRRRRRRR          TTT         LLL
MMM         MMM         TTT       HHHHHHHHHHHHHHH  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         LLLLLLLLLLLLLLL
MMM         MMM         TTT       HHH          HHH  RRR         RRR     TTT         LLLLLLLLLLLLLLL
MMM         MMM         TTT       HHH          HHH  RRR         RRR     TTT         LLLLLLLLLLLLLLL
```

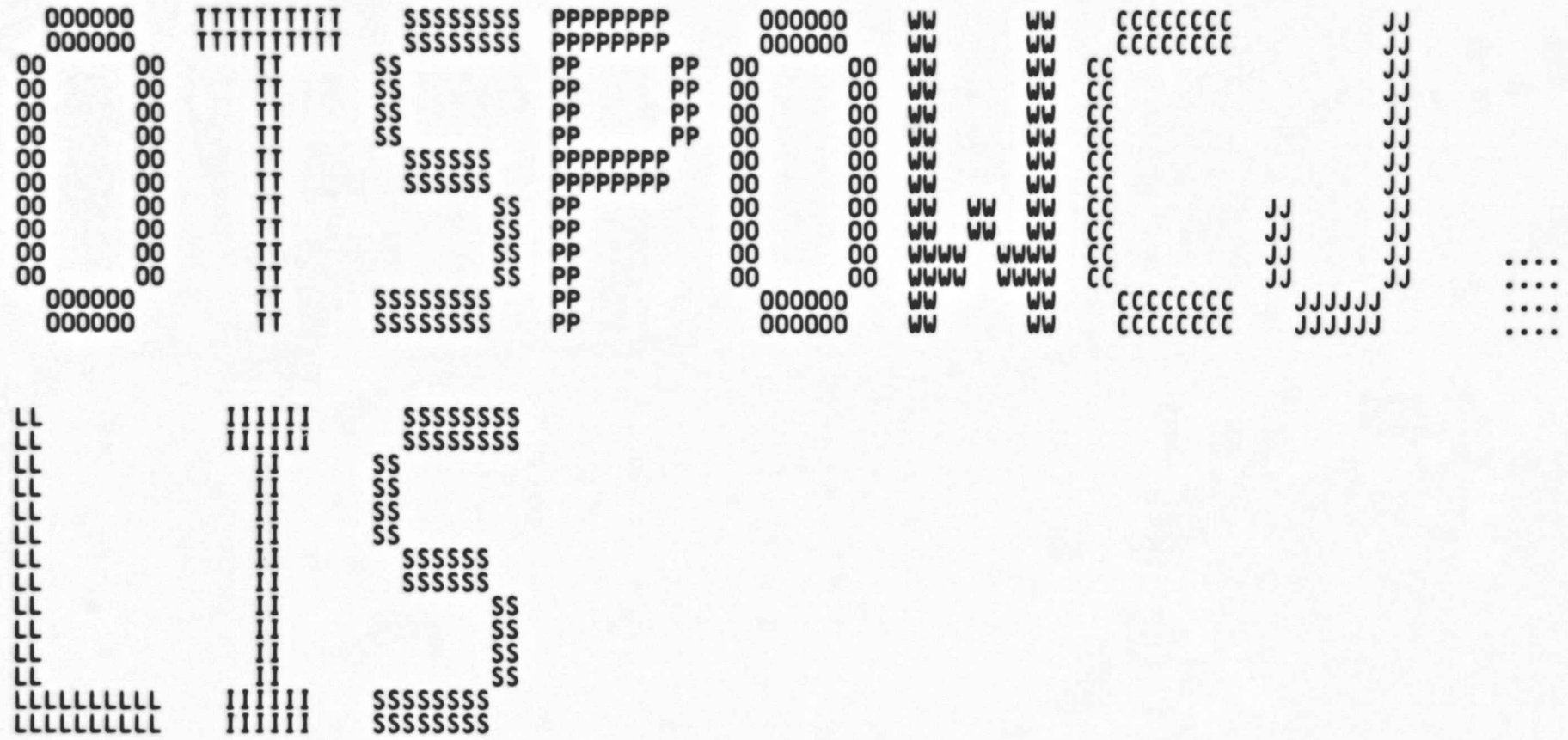
OTSPOWCJ
LLLLLLLLLL IIIIII SSSSSSSS

Table of contents

```
0000     1          .TITLE  OTS$POWCJ - COMPLEX ** INTEGER*4 power routine
0000     2          .IDENT  /1-004/         ; File OTSPOWCJ.MAR  Edit: SBL1004
0000     3  ;*******************************************************************************
0000     4  ;*                                                                             *
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0000    22  ;*                                                                             *
0000    23  ;*                                                                             *
0000    24  ;*******************************************************************************
0000    25  ;
0000    26  ;
0000    27  ; FACILITY: Language support library - user callable
0000    28  ;++
0000    29  ; ABSTRACT:
0000    30  ;
0000    31  ;       COMPLEX base to INTEGER*4 power.
0000    32  ;       Floating overflow can occur.
0000    33  ;       Undefined exponentiation can occur if
0000    34  ;       base = (0.,0.) and exp <=0
0000    35  ;
0000    36  ;--
0000    37  ;
0000    38  ; VERSION: 0
0000    39  ;
0000    40  ; HISTORY:
0000    41  ; AUTHOR:
0000    42  ;       Jonathan M. Taylor, 29-jun-77: Version 0
0000    43  ;
0000    44  ; Edit history for version 0
0000    45  ;
```

```
0000     47          .SBTTL  HISTORY         ; Detailed Current Edit History
0000     48
0000     49
0000     50 ; Edit History for Version 0 of OTS$POWCJ
0000     51 ; 0-2 change MTH$$ERROR to MTH$$SIGNAL JMT 5-OCT-77
0000     52 ; 0-6   - Change FOR$FLAG_JACKET to MTH$FLAG_JACKET.  TNH 17-July-78
0000     53 ; 0-7   - Fix bug giving divide fault, or wrong results for
0000     54 ;         some negative powers. Also clean up comments.
0000     55 ;         SPR 20364  SBL 27-Oct-78
0000     56 ; 1-001 - Change version number to 1 and MTH__UNDEXP
0000     57 ;         to MTH$K_UNDEXP.  JBS 07-DEC-78
0000     58 ; 1-002 - Add "_" to the PSECT directive.  JBS 22-DEC-78
0000     59 ; 1-003 - Declare externals.  SBL 17-May-1979
0000     60 ; 1-004 - Use general mode addressing.  SBL 30-Nov-1981
```

```
                     0000     62          .SBTTL  DECLARATIONS
                     0000     63
                     0000     64 ;
                     0000     65 ; INCLUDE FILES:
                     0000     66 ;
                     0000     67
                     0000     68 ; EXTERNAL SYMBOLS:
                     0000     69 ;
                     0000     70
                     0000     71          .DSABL  GBL
                     0000     72          .EXTRN  MTH$$SIGNAL             ; Math error routine
                     0000     73          .EXTRN  OTS$DIVC                ; COMPLEX division routine
                     0000     74          .EXTRN  MTH$K_UNDEXP
                     0000     75
                     0000     76 ;
                     0000     77 ; MACROS:
                     0000     78 ;
                     0000     79
                     0000     80 ;
                     0000     81 ; EQUATED SYMBOLS:
                     0000     82 ;
                     0000     83          base = 4                        ; base input formal - by-value
                     0000     84          exp = 12                        ; exponent intpu formal - by-value
                     0000     85
                     0000     86 ;
                     0000     87 ; OWN STORAGE:
                     0000     88 ;
                     0000     89
                     0000     90 ;
                     0000     91 ; PSECT DECLARATIONS:
                     0000     92 ;
                     0000     93
                     0000     94          .PSECT  _OTS$CODE PIC,SHR,LONG,EXE,NOWRT
                     0000     95                                          ; program section for OTS$ code
                     0000     96
```

```
                        98          .SBTTL  OTS$POWCJ - COMPLEX*8 ** INTEGER*4
                        99
                       100 ;++                                                                  ;**-
                       101 ; FUNCTIONAL DESCRIPTION:
                       102 ;
                       103 ;       COMPLEX result = COMPLEX base ** INTEGER*4 exponent
                       104 ;       The COMPLEX result is given by:
                       105 ;
                       106 ;       base            exponent        result
                       107 ;
                       108 ;       any               >0            PRODUCT (base * 2**i) where
                       109 ;                                       i is each non-zero bit in
                       110 ;                                       exponent.
                       111 ;
                       112 ;       (0., 0.)          <=0           Undefined exponentiation.
                       113 ;
                       114 ;       not (0., 0.)      <0            PRODUCT (base * 2**i) where
                       115 ;                                       i is each non-zero bit in
                       116 ;                                       !exponent!.
                       117 ;
                       118 ;       not (0., 0.)      =0            (1.0, 0.0)
                       119 ;
                       120 ;                                                                    ;**-
                       121 ;       Floating overflow can occur.
                       122 ;       Undefined exponentiation occurs if base is 0 and
                       123 ;       exponent is 0 or negative.
                       124 ;
                       125 ; CALLING SEQUENCE:
                       126 ;
                       127 ;       Power.wfc.v = OTS$POWCJ (base.rfc.v,  exponent.rl.v)
                       128 ;
                       129 ; INPUT PARAMETERS:
                       130 ;       The base input parameter is standard FORTRAN COMPLEX.
                       131 ;       The exponent input parameter is a signed longword integer.
                       132 ;       Both input parameters are CALL BY VALUE.
                       133 ;
                       134 ; IMPLICIT INPUTS:
                       135 ;       NONE
                       136 ;
                       137 ; OUTPUT PARAMETERS:
                       138 ;       NONE
                       139 ;
                       140 ; IMPLICIT OUTPUTS:
                       141 ;       NONE
                       142 ;
                       143 ; FUNCTION VALUE:
                       144 ;
                       145 ;       COMPLEX base ** INTEGER*4 exponent
                       146 ;
                       147 ; SIDE EFFECTS:
                       148 ;
                       149 ;       SIGNALs SS$_ARITH with floating overflow hardware code if
                       150 ;       floating overflow.
                       151 ;       SIGNALs MTH$_UNDEXP (82 = ' UNDEFINED EXPONENTATION') if
                       152 ;       base is 0 and exponent is 0 or negative.
                       153 ;
                       154 ;--
```

```
                     007C  0000   156          .ENTRY  OTS$POWCJ, ^M<R2,R3,R4,R5,R6>
                           0002   157                                              ; disable integer overflow
          52   04 AC     7D  0002   158          MOVQ    base(AP), R2             ; R2/R3 gets COMPLEX base
          54   0C AC     D0  0006   159          MOVL    exp(AP), R4              ; R4 = longword exponent
                  03     18  000A   160          BGEQ    1$                       ; R4 = ! exponent !
               54 54     CE  000C   161          MNEGL   R4, R4
          0C   54 00     E5  000F   162 1$:      BBCC    #0, R4, EVEN             ; branch if even and clear low bit
          50   52        7D  0013   163          MOVQ    R2, R0                   ; R0/R1 = initial result
    54    54   FF 8F     9C  0016   164          ROTL    #-1, R4, R4              ; R4 = unsigned_exponent / 2
                  58     13  001B   165          BEQL    DONE                     ; done if exponent was 1
                  27     11  001D   166          BRB     SQUAR1                   ; else use rest of exponent
                         001F   167
                         001F   168 EVEN:
          50   08        70  001F   169          MOVD    #1, R0                   ; R0/R1 = initial result
    54    54   FF 8F     9C  0022   170          ROTL    #-1, R4, R4              ; R4 = unsigned_exponent / 2
                  1D     12  0027   171          BNEQ    SQUAR1                   ; branch if exponent not 0
                  52     53  0029   172          TSTF    R2                       ; exponent was 0, test RP(base)
                  48     12  002B   173          BNEQ    DONE                     ; done if non-0, answer is 1.0
                  53     53  002D   174          TSTF    R3                       ; IP(base) better not be zero
                  44     12  002F   175          BNEQ    DONE                     ; it isn't return 1.0
                         0031   176
                         0031   177 UNDEFINED:
       50   01   0F     79  0031   178          ASHQ    #15, #1, R0              ; return R0 = reserved operand
         7E   00'8F     9A  0035   179          MOVZBL  #MTH$K_UNDEXP, -(SP)     ; FORTRAN error number
00000000'GF   01        FB  0039   180          CALLS   #1, G^MTH$$SIGNAL        ; convert to 32-bit condition code
                         0040   181                                              ; and SIGNAL MTH$_UNDEXP
                     04  0040   182          RET
                         0041   183
                         0041   184 SQUAR:
54    54   FF 8F     78  0041   185          ASHL    #-1, R4, R4              ; R4 = !reduced exponent! / 2
                         0046   186 ;
                         0046   187 ; R2/R3 = square current base
                         0046   188 ;
                         0046   189 SQUAR1:
    55   53   52     45  0046   190          MULF3   R2, R3, R5               ; R5 = tmp = RP(base)*IP(base)
         52   52     44  004A   191          MULF    R2, R2                   ; R2 = RP(base)**2
         53   53     44  004D   192          MULF    R3, R3                   ; R3 = IP(base)**2
         52   53     42  0050   193          SUBF    R3, R2                   ; R2 = RP(base)**2 - IP(base)**2
    53   55   55     41  0053   194          ADDF3   R5, R5, R3               ; R3 = 2*RP(base)*IP(base)
           E7 54     E9  0057   195          BLBC    R4, SQUAR                ; branch if next exponent bit is 0
                         005A   196 ;
                         005A   197 ; R0/R1 = partial result * current power of base
                         005A   198 ;
    55   53   50     45  005A   199          MULF3   R0, R3, R5               ; R5 = tmp = RP(part) * IP(base)
         50   52     44  005E   200          MULF    R2, R0                   ; R0 = RP(part) * RP(base)
    56   53   51     45  0061   201          MULF3   R1, R3, R6               ; R6 = tmp = IP(part) * IP(base)
         50   56     42  0065   202          SUBF    R6, R0                   ; R0=RP(part)*RP(base)-IP(part)*IP(base)
         51   52     44  0068   203          MULF    R2, R1                   ; R1 = IP(part) * RP(base)
         51   55     40  006B   204          ADDF    R5, R1                   ; R1=IP(part)*RP(base)+RP(part)*IP(base)
54   54   FF 8F     78  006E   205          ASHL    #-1, R4, R4              ; R4 = !reduced exponent! / 2
                  D1  12  0073   206          BNEQ    SQUAR1                   ; loop if more exponent bits left
                         0075   207 DONE:
          0C AC     D5  0075   208          TSTL    exp(AP)                  ; test exponent sign
                  15  18  0078   209          BGEQ    POWCJ                    ; done if positive
                  50  53  007A   210          TSTF    R0                       ; test RP(result)
                  04  12  007C   211          BNEQ    RECIP                    ; if non-0, OK to take reciprocal
                  51  53  007E   212          TSTF    R1                       ; RP(result) was 0, test IP(result)     ;**-
```

```
              AF   13  0080   213          BEQL    UNDEFINED            ; undefined (0.0+0.0i) ** -n
                       0082   214 RECIP:
          7E  50   7D  0082   215          MOVQ    R0, -(SP)            ; second arg pair is divisor
          7E  08   70  0085   216          MOVD    S^#1, -(SP)          ; push (1.,0.) on stack
   00000000'GF  04  FB  0088   217          CALLS   #4, G^OTS$DIVC       ; R0/R1 = reciprocal
                       008F   218 POWCJ:                                                                  ;**-
                   04  008F   219          RET                          ; result in R0/R1
                       0090   220
                       0090   221          .END
```

OTS
2-0

```
BASE            = 00000004
DONE              00000075 R      01
EVEN              0000001F R      01
EXP             = 0000000C
MTH$$SIGNAL       ********   X    00
MTH$K_UNDEXP      ********   X    00
OTS$DIVC          ********   X    00
OTS$POWCJ         00000000 RG     01
POWCJ             0000008F R      01
RECIP             00000082 R      01
SQUAR             00000041 R      01
SQUAR1            00000046 R      01
UNDEFINED         00000031 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
_OTS$CODE	00000090 (144.)	01 (1.)	PIC USR CON REL LCL SHR EXE RD NOWRT NOVEC LONG

Performance indicators

Phase	Page faults	CPU Time	Elapsed Time
Initialization	32	00:00:00.09	00:00:00.89
Command processing	122	00:00:00.45	00:00:06.31
Pass 1	75	00:00:00.69	00:00:04.26
Symbol table sort	0	00:00:00.01	00:00:00.10
Pass 2	54	00:00:00.46	00:00:01.69
Symbol table output	2	00:00:00.02	00:00:00.02
Psect synopsis output	2	00:00:00.02	00:00:00.02
Cross-reference output	0	00:00:00.00	00:00:00.00
Assembler run totals	289	00:00:01.76	00:00:13.35

The working set limit was 900 pages.
3043 bytes (6 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.
221 source lines were read in Pass 1, producing 11 object records in Pass 2.
0 pages of virtual memory were used to define 0 macros.

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$:OTSPOWCJ/OBJ=OBJ$:OTSPOWCJ MSRC$:OTSPOWCJ/UPDATE=(ENH$:OTSPOWCJ)
```

OTSMULCD
LIS

OTSPOWCGC
LIS

OTSDIVC
LIS

OTSPOWDD
LIS

OTSPOWCC
LIS

OTSPOWGG
LIS

OTSPOWGJ
LIS

OTSPOWCDJ
LIS

MTHTAN
LIS

MTHVECTOR
LIS

OTSDIVCG
LIS

OTSPOWCJ
LIS

OTSPOWDLJ
LIS

MTHTANH
LIS

OTSMULCG
LIS

OTSPOWCGJ
LIS

OTSPOWDJ
LIS

OTSDIVCD
LIS

OTSPOWCDC
LIS