F 1

```
DDDDDDDDDDDD     EEEEEEEEEEEEEEE  BBBBBBBBBBBB     UUU         UUU     GGGGGGGGGGGG
DDDDDDDDDDDD     EEEEEEEEEEEEEEE  BBBBBBBBBBBB     UUU         UUU     GGGGGGGGGGGG
DDDDDDDDDDDD     EEEEEEEEEEEEEEE  BBBBBBBBBBBB     UUU         UUU     GGGGGGGGGGGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG
DDD         DDD  EEEEEEEEEEEE     BBBBBBBBBBBB     UUU         UUU  GGG
DDD         DDD  EEEEEEEEEEEE     BBBBBBBBBBBB     UUU         UUU  GGG
DDD         DDD  EEEEEEEEEEEE     BBBBBBBBBBBB     UUU         UUU  GGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG   GGGGGGGGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG   GGGGGGGGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG   GGGGGGGGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG         GGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG         GGG
DDD         DDD  EEE              BBB         BBB  UUU         UUU  GGG         GGG
DDDDDDDDDDDD     EEEEEEEEEEEEEEE  BBBBBBBBBBBB     UUUUUUUUUUUUUUU     GGGGGGGGG
DDDDDDDDDDDD     EEEEEEEEEEEEEEE  BBBBBBBBBBBB     UUUUUUUUUUUUUUU     GGGGGGGGG
DDDDDDDDDDDD     EEEEEEEEEEEEEEE  BBBBBBBBBBBB     UUUUUUUUUUUUUUU     GGGGGGGGG
```

```
**FILE**ID**DBGSTART                                J 12
```

```
DDDDDDDD    BBBBBBBB      GGGGGGGG    SSSSSSSS  TTTTTTTTTT    AAAAAA    RRRRRRRR    TTTTTTTTTT
DDDDDDDD    BBBBBBBB      GGGGGGGG    SSSSSSSS  TTTTTTTTTT    AAAAAA    RRRRRRRR    TTTTTTTTTT
DD      DD  BB      BB  GG          SS              TT      AA      AA  RR      RR      TT
DD      DD  BB      BB  GG          SS              TT      AA      AA  RR      RR      TT
DD      DD  BB      BB  GG          SS              TT      AA      AA  RR      RR      TT
DD      DD  BB      BB  GG          SS              TT      AA      AA  RR      RR      TT
DD      DD  BBBBBBBB    GG            SSSSSS        TT      AA      AA  RRRRRRRR        TT
DD      DD  BBBBBBBB    GG            SSSSSS        TT      AA      AA  RRRRRRRR        TT
DD      DD  BB      BB  GG  GGGGGG          SS      TT      AAAAAAAAAA  RR  RR          TT
DD      DD  BB      BB  GG  GGGGGG          SS      TT      AAAAAAAAAA  RR  RR          TT
DD      DD  BB      BB  GG      GG          SS      TT      AA      AA  RR    RR        TT          ....
DD      DD  BB      BB  GG      GG          SS      TT      AA      AA  RR    RR        TT          ....
DDDDDDDD    BBBBBBBB      GGGGGG    SSSSSSSS        TT      AA      AA  RR      RR      TT          ....
DDDDDDDD    BBBBBBBB      GGGGGG    SSSSSSSS        TT      AA      AA  RR      RR      TT          ....

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
```

```
0000            .TITLE  DBGSTART
0000            .IDENT  'V04-000'
0000
0000
0000    ;****************************************************************************
0000    ;*                                                                          *
0000    ;*  COPYRIGHT (c) 1978, 1980, 1982, 1984 BY                                 *
0000    ;*  DIGITAL EQUIPMENT CORPORATION, MAYNARD, MASSACHUSETTS.                  *
0000    ;*  ALL RIGHTS RESERVED.                                                    *
0000    ;*                                                                          *
0000    ;*  THIS SOFTWARE IS FURNISHED UNDER A LICENSE AND MAY BE USED AND COPIED   *
0000    ;*  ONLY IN  ACCORDANCE WITH  THE  TERMS  OF  SUCH  LICENSE  AND WITH THE   *
0000    ;*  INCLUSION OF THE ABOVE COPYRIGHT NOTICE. THIS SOFTWARE OR  ANY  OTHER   *
0000    ;*  COPIES THEREOF MAY NOT BE PROVIDED OR OTHERWISE MADE AVAILABLE TO ANY   *
0000    ;*  OTHER PERSON.  NO TITLE TO AND OWNERSHIP OF  THE  SOFTWARE IS  HEREBY   *
0000    ;*  TRANSFERRED.                                                            *
0000    ;*                                                                          *
0000    ;*  THE INFORMATION IN THIS SOFTWARE IS  SUBJECT TO CHANGE WITHOUT NOTICE   *
0000    ;*  AND  SHOULD  NOT  BE  CONSTRUED AS  A COMMITMENT BY DIGITAL EQUIPMENT   *
0000    ;*  CORPORATION.                                                            *
0000    ;*                                                                          *
0000    ;*  DIGITAL ASSUMES NO RESPONSIBILITY FOR THE USE  OR  RELIABILITY OF ITS   *
0000    ;*  SOFTWARE ON EQUIPMENT WHICH IS NOT SUPPLIED BY DIGITAL.                 *
0000    ;*                                                                          *
0000    ;*                                                                          *
0000    ;****************************************************************************
0000
0000    ;++
0000    ; FACILITY: DEBUG
0000    ;
0000    ; ABSTRACT:
0000    ;       Start-up module for DEBUG facility.
0000    ;
0000    ; ENVIRONMENT:
0000    ;       VAX/VMS User mode : Mapped and entered initially from the CLI. From
0000    ;       then on DEBUG runs as a (very complex) exception handler.
0000    ;
0000    ; VERSION:      4.00
0000    ;
```

```
0000  ; REVISION HISTORY:
0000  ;
0000  ;
0000  ;       MODIFIED BY:
0000  ;               John Francis, 30 Nov-mber 1981
0000  ;               V. Holt, 2 June 1982
0000  ;               P. Sager, Oct. 1982
0000  ;               P. Sager, Aug. 1983
0000  ;+
0000  ; 1.01  05-OCT-78       DAR     Fixed bug in the way WINDOW_2 returns to VMS.
0000  ; 1.02  20-OCT-78       MCC     Changed size of writable storage to be
0000  ;                               calculated at link time.
0000  ; 1.03  24-OCT-78       DAR     PROBER transfer address before initializing
0000  ;                               the PSL's IV and DV bits.
0000  ; 1.04  10-NOV-78       DAR     Added routine DBG$THREAD_BPT for threaded BPT's.
0000  ; 1.05  07-DEC-78       DAR     Fixed exit handler to exit if SS$_CLIFRCEXT.
0000  ; 1.06  18-DEC-78       DAR     Added global label to threaded breakpoint routine
0000  ;                               to enable "GO %line x" to work in threaded code.
0000  ; 1.07  23-MAR-79       MCC     Modified dbg$out_message to write error messages
0000  ;                               to the LOG file
0000  ; 1.08   6-AUG-79       MCC     Modified dbg$final_handl to check for error msgs
0000  ;                               from shared msg file, before signaling "internal
0000  ;                               DEBUG coding error"
0000  ; 1.09   5-SEP-79       MCC     Made a fix to toggle system service failure
0000  ;                               mode when user program has set it and DEBUG
0000  ;                               gets control
0000  ; 1.10   7-APR-81       JF      Signal DBG$_SUPERDEBUG if testable debugger
0000  ;                               and any unexpected errors are encountered
0000  ; 3.00  30-NOV-81       JF      Tidy up entry and exit sequences to fix bugs
0000  ;                               with AST's and user termination handlers.
0000  ; 3.10   2-Jun-82       VJH     Removed all references to DBG$FAO_PUT and
0000  ;                               DBG$OUT_PUT, as these routines are now obsolete.
0000  ;                               Replaced them with calls to DBG$PRINT and
0000  ;                               DBG$NEWLINE, respectively.
0000  ; 3.B0   12-Oct-82      PS      Added some code to DBG$PSEUDO_HANDLER to
0000  ;                               release all the memory blocks for CALL command
0000  ; 3.B1  18-Jan-83       JF      Added DBG$GV_CONTROL state vector and modified
0000  ;                               handling of 'SS$_DEBUG' exception.
0000  ; 4.0   31-Aug-83       PS      Fixed a read error infinite loop reported by
0000  ;                               user through SPR.  Set up a count in
000C  ;                               DBG$COMMAND_PROC (DBGEXC), If we get bad
0000  ;                               status from $GET/Key Pad input, after 20
0000  ;                               tries, we'll force the DEBUG to take EXIT.
0000  ;                               (See code added in DBG$FINAL_HANDL, label
0000  ;                                FINAL_7).
0000  ; 4.0   01-Feb-84       PS      Added SSI for watch pointing
0000  ;--
```

```
                 0000          .SBTTL  DECLARATIONS
                 0000
                 0000    ; *****SSI
                 0000    ; SSI_USS is a privileged shareable image to set up system service
                 0000    ; interception for watch pointing.  It must be installed in SYS$LIBRARY.
                 0000    ; DEBUG can link with/without SSI_USS on VMS V4, indicated by link flag
                 0000    ; DBG$GL_3B_SYSTEM and DBG$GL_SETSSI.  DBG$GL_3B_SYSTEM must be set to 1
                 0000    ; to indicate VMS V4 system, DBG$GL_SETSSI must be set to 1 to indicate to
                 0000    ; link with SSI_USS, set to 0 to indicate to link without SSI_USS.  On VMS
                 0000    ; V3 system, DBG$GL_3B_SYSTEM must be set to 0, there is no SSI_USS active.
                 0000    ; In this way, DEBUG will work both ways on VMS V4 and VMS V3.  Declare
                 0000    ; SSI_USS to be weak reference, so that we won't get linker warnings at
                 0000    ; link time.
                 0000          .WEAK    SSI_USSK
                 0000          .WEAK    SSI_USSU
                 0000          .EXTRN   DBG$GL_3B_SYSTEM,DBG$GL_SETSSI
                 0000          .EXTRN   DBG$GL_INPRAB,DBG$GL_OUTPRAB,DBG$RUNFRAME,DBG$GV_CONTROL
                 0000          .EXTRN   DBG$GB_CALL_NORMAL_RET,DBG$SCR_SCREEN_TERM,PRT$C_UW
                 0000          .EXTRN   DBG$END_OF_LINE,DBG$EXC_HANDLER,DBG$PRINT,DBG$RST_INIT
                 0000          .EXTRN   DBG$REL_MEMORY,DBG$INIT_DEBUG,DBG$OUT_NUM_VAL,DBG$NEWLINE
                 0000          .EXTRN   DBG$PUTMSG,DBG$INS_OPCODES,LIB$SIGNAL,SYS$DCLEXH,SYS$EXIT
                 0000          .EXTRN   SYS$GETMSG,SYS$PUT,SYS$SETAST,SYS$SETPRT,SYS$UNWIND
                 0000          .EXTRN   DBG$GL_LOGRAB,DBG$GB_DEF_OUT,DBG$FLUSHBUF,DBG$GB_UNHANDLED_EXC
                 0000          .EXTRN   EVENT$PAGE_QUEUE
                 0000
                 0000    ;
                 0000    ; invoke data definitions
                 0000    ;
                 0000          $CHFDEF                     ; Condition handler mnemonics
                 0000          $CLIDEF                     ; CLI status bit definitions
                 0000          $DBGDEF                     ; Debug definitions
                 0000          $IFDDEF                     ; Image file definitions
                 0000          $PSLDEF                     ; Processor Status Longword bits
                 0000          $RABDEF                     ; RAB definitions
                 0000          $SFDEF                      ; Stack Frame offset definitions
                 0000          $SHRDEF                     ; Shared error messages
                 0000          $SSDEF                      ; System error codes
                 0000          $STSDEF                     ; Status code fields
                 0000    ;
                 0000    ; Equated symbols
                 0000    ;
       00000100  0000          buf_siz         = 256            ; length of getmsg, FAO, and $PUT buffers
       00000002  0000          dbg_facility    = 2              ; DEBUG facility code.
```

```
                    0000   ; *****SSI
                    0000   ; SSI_USS can be called by the user, or by the DBG (TDBG), or by the SDBG.
                    0000   ; Each level (user, DBG/TDBG, SDBG) delcares a interception routine which
                    0000   ; runs at a priority (user - priority 1, 2, DBG/TDBG - priority 3, SDBG -
                    0000   ; priority 4).  This vector is used to indicate which priority is active
                    0000   ; at the moment.
                    0000   ;
                    0000   ;          Definitions of bits in DBG$GV_SSI_CONTROL running state vector
                    0000   ;
        00000000    0000              dbg$v_ssi_routine_1 = 0          ; Set if user declared prio. 1 routine
                    0000                                               ;  is running
        00000001    0000              dbg$m_ssi_routine_1 = 1@dbg$v_ssi_routine_1
                    0000
        00000001    0000              dbg$v_ssi_routine_2 = 1          ; Set if user declared prio. 2 routine
                    0000                                               ;  is running
        00000002    0000              dbg$m_ssi_routine_2 = 1@dbg$v_ssi_routine_2
                    0000
        00000002    0000              dbg$v_ssi_routine_3 = 2          ; Set if user declared prio. 3 routine
                    0000                                               ;  is running
        00000004    0000              dbg$m_ssi_routine_3 = 1@dbg$v_ssi_routine_3
                    0000
        00000003    0000              dbg$v_ssi_routine_4 = 3          ; Set if user declared prio. 4 routine
                    0000                                               ;  is running
        00000008    0000              dbg$m_ssi_routine_4 = 1@dbg$v_ssi_routine_4
                    0000
                    0000
                    0000   ;          Definitions of bits in DBG$GV_CONTROL state vector
                    0000   ;          ****   THESE MUST MATCH DEFINITIONS IN DBGLIB   ****
                    0000
        00000000    0000              dbg$v_control_tdbg =  0          ; Set if this is a testable DEBUG
        00000001    0000              dbg$m_control_tdbg =  1@dbg$v_control_tdbg
                    0000
        00000001    0000              dbg$v_control_sdbg =  1          ; Set if this is SUPERDEBUG
        00000002    0000              dbg$m_control_sdbg =  1@dbg$v_control_sdbg
                    0000
        00000002    0000              dbg$v_control_kdbg =  2          ;
        00000004    0000              dbg$m_control_kdbg =  1@dbg$v_control_kdbg
                    0000
        00000003    0000              dbg$v_control_urun =  3          ; Set if user program has been run
        00000008    0000              dbg$m_control_urun =  1@dbg$v_control_urun
                    0000
        00000004    0000              dbg$v_control_exit =  4          ; Set if DEBUG is about to EXIT
        00000010    0000              dbg$m_control_exit =  1@dbg$v_control_exit
                    0000
        00000005    0000              dbg$v_control_fail =  5          ; Set by DEBUG internal errors
        00000020    0000              dbg$m_control_fail =  1@dbg$v_control_fail
                    0000
        00000006    0000              dbg$v_control_done =  6          ; Set if user program completed
        00000040    0000              dbg$m_control_done =  1@dbg$v_control_done
                    0000
        00000007    0000              dbg$v_control_allocate  =  7     ; Set if OK to allocate more memory
                    0000                                               ;        (e.g., SET MODULE/ALLOCATE)
        00000080    0000              dbg$m_control_allocate = 1@dbg$v_control_allocate
                    0000
        00000008    0000              dbg$v_control_user =  8          ; Set if user program is running
        00000100    0000              dbg$m_control_user =  1@dbg$v_control_user
                    0000
```

```
                00000009  0000   190          dbg$v_control_stop =  9          ; Set by ^Y,DEBUG sequence
                00000200  0000   191          dbg$m_control_stop =  1@dbg$v_control_stop
                          0000   192
                0000000A  0000   193          dbg$v_control_tbit =  10         ; Set during un-interruptable TBITs
                00000400  0000   194          dbg$m_control_tbit =  1@dbg$v_control_tbit
                          0000   195
                0000000B  0000   196          dbg$v_control_screen = 11        ; Set if screen displays must be updated
                          0000   197                                           ;       because user program has run
                00000800  0000   198          dbg$m_control_screen = 1@dbg$v_control_screen
                          0000   199
                0000000C  0000   200          dbg$v_control_version_4 = 12     ; Set if VMS 3B or 4.0 is running
                00001000  0000   201          dbg$m_control_version_4 = 1@dbg$v_control_version_4
                          0000   202
                          0000   203
                0000   205 ;+
                0000   206 ; Special vector that contains the beginning and end addresses of DEBUG's
                0000   207 ; writable storage area.  The third address in the vector is the transfer
                0000   208 ; address of DEBUG that is in this module.
                0000   209 ;-
            00000000   210         .PSECT  DBG$ABS_ZERO LONG, PIC, SHR, NOWRT, EXE
                0000   211 virtual_zero:
      00000000  0000   212         .LONG   0       ;.ADDRESS writable_stor ; lowest writable location
      00000000  0004   213         .LONG   0       ;.ADDRESS end_write_stor; highest writable location
      00000002' 0008   214         .LONG   <beginhere+2> - virtual_zero    ; start address of mapped DEBUG
                000C   215
                000C   216
            00000000   217         .PSECT  DBG$GLOBAL LONG, PIC, NOSHR, NOEXE
                0000   218
                0000   219 writable_stor:                                  ; Define lowest writable address
      00000004  0000   220 dbg$gl_runframe::       .BLKL   1
                0004   221
            00000000   222         .PSECT  ZZZ$ZZZZZZ LONG, PIC, NOSHR, NOEXE
                0000   223
                0000   224 end_write_stor:                                 ; Define highest writable address
```

```
   00000000            .PSECT  DBG$SSI  PIC, NOSHR, NOEXE, PAGE
       0000            .ALIGN  PAGE
       0000    ; *****SSI
       0000    ; Allocate one page of storage for the following variables.  These variables
       0000    ; are DEBUG variables, pass in SSI_USS as parameters, values are returned
       0000    ; from SSI_USS.  If we set the watch point on these variables (page is
       0000    ; write protected) will cause SSI_USS to fail (kernal mode accvio, PROBEW).
       0000    ; Any DEBUG variables is on the same page will be affected.  So, we put
       0000    ; these variables on a page all by themself, away from the other DEBUG
       0000    ; variables.  Restriction has to be set: NO WATCH POINT CAN BE SET ON THESE
       0000    ; VARIABLES.
       0000    ;
       0000    SSI_VAR_BEG::
00000200  0000    DATA:   .BLKB   512
       0200    SSI_VAR_END::
       0200
00000000  0200    DBG_ROUTINE_ID==SSI_VAR_BEG                ; An ID returned from SSI_USS to
       0200                                               ;  indicate TDBG/DBG has declared its
       0200                                               ;  interception routine
00000004  0200    SDBG_ROUTINE_ID==SSI_VAR_BEG+4             ; An ID returned from SSI_USS to
       0200                                               ;  indicate SDBG has declared its
       0200                                               ;  interception routine
00000008  0200    SAVE_STATE==SSI_VAR_BEG+8                  ; An important communication state
       0200                                               ;  variable to keep the interception
       0200                                               ;  flow going between all the levels
0000000C  0200    DUMMY=SSI_VAR_BEG+12                       ; Dummy arg.
       0200
       0200    ;
       0200    ; OWN STORAGE
       0200    ;
   00000000            .PSECT  DBG$OWN LONG, PIC, NOSHR, NOEXE
       0000
       0000    ; *****SSI
       0000    ; Variables are used in DEBUG to make SSI work.
       0000    DBG_SSI_CNT::                          ; A count to keep track how many SSV are seen
00000000  0000            .LONG   0                      ;  by DBG/TDBG, or SDBG
       0004    DBG_ONCE_ONLY_CNT::                    ; Debug is highly re-entriant, is also hard
00000000  0004            .LONG   0                      ;  to identify re-entriant point.  So we use
       0008                                           ;  this count to keep track of the entry point
       0008    DBG_SETUP::                            ; An important state flag to control SSI's
00000000  0008            .LONG   0                      ;  activities for DBG/TDBG
       000C    SDBG_SETUP::                           ; An important state flag to control SSI's
00000000  000C            .LONG   0                      ;  activities for SDBG
       0010    PAGE_ENTRY::                           ; Pointer to watch variable's page list
00000000  0010            .LONG   0
       0014    DBG$GB_SET_SSI_CNT::                   ; A flag to indicate watch pointing is active
      00  0014            .BYTE   0                      ;  DEBUG only intecepts if watch pointing is
       0015                                           ;  trigged
       0015    DBG$GV_SSI_CONTROL::                   ; A state vector to control which interception
      00  0015            .BYTE   0                      ;  routine is active at the moment
       0016    SAVE_SSI_STATE::                       ; A state vector is used in helping to set the
      00  0016            .BYTE   0                      ;  above state vector.  It serves the
       0017                                           ;  communication gap between TDBG and SDBG
```

```
                      0017  ;
                      0017  ; OWN STORAGE
                      0017  ;
                      0017  term_reason:
           00000000   0017          .LONG   0               ; Location for termination reason
                      001B
                      001B  term_block_one:
           00000000   001B          .LONG   0               ; Forward link
           000002F7'  001F  fix_1:  .ADDRESS term_handler   ; Address of termination handler
           00000001   0023          .LONG   1               ; Argument count
           00000017'  0027  fix_2:  .ADDRESS term_reason    ; Address of termination reason
                      002B
                      002B  term_block_two:
           00000000   002B          .LONG   0               ; Forward link
           000002B1'  002F  fix_3:  .ADDRESS restore_context; Address of termination handler
           00000001   0033          .LONG   1               ; Argument count
           00000017'  0037  fix_4:  .ADDRESS term_reason    ; Address of termination reason
```

```
                    003B  ; **************** saved_AP and saved_FP must be contiguous ***************
                    003B  ; **************** saved_R0 and saved_R1 must be contiguous ***************
                    003B
          00000000  003B  saved_AP:.LONG  0                ; Original AP
          00000000  003F  saved_FP:.LONG  0                ; Original FP
          00000000  0043  saved_R0:.LONG  0                ; R0 and R1 are saved contiguously so that
          00000000  0047  saved_R1:.LONG  0                ;  they can be preserved across $EXIT_S
                    004B
                    004B  faobufdesc:
          00000100  004B          .LONG   buf_siz          ; length of FAO buffer
          00000000  004F          .LONG   0                ; address of FAO buffer
                    0053  msg_length:
              0000  0053          .WORD   0                ; holds temporary buffer lengths
                    0055  fao_buf:
          00000155  0055          .BLKB   buf_siz          ; buffer for FAO messages
                    0155  log_buf:
          00000255  0155          .BLKB   buf_siz          ; buffer for LOG file
                    0255  term_buf:
          00000355  0255          .BLKB   buf_siz          ; buffer for EXIT reason messages
                    0355
          00000000  0355  const_0:.LONG   0
                    0359  const_1:
          00000001  0359  param_0:.LONG   1                ; Parameter count
          00000361  035D  param_1:.BLKL   1                ; Actual parameter value
                    0361
          00000365  0361  user_pc:.BLKL   1                ; Saved PC for fake LIB$SIGNAL entry
          00000369  0365  user_fp:.BLKL   1                ; Saved FP for fake LIB$SIGNAL entry
          0000036D  0369  handler:.BLKL   1                ; Address of user handler (or zero)
          00000001  036D  dbg$gl_exit_status::.LONG 1      ; Status to be returned to DCL on exit
```

```
                                 00000000    328          .PSECT  DBG$PLIT BYTE, PIC, SHR, NOWRT, EXE
                                     0000    329
                                     0000    330 routine_value:
72 75 74 65 72 20 65 75 6C 61 76 00' 0000    331          .ASCIC \value returned is \
            20 73 69 20 64 65 6E  000C
                               12  0000
```

```
    0013           .SBTTL  BEGINHERE       - called by DCL via DBGBOOT
00000000           .PSECT  DBG$CODE BYTE, PIC, SHR, NOWRT, EXE
    0000  ;++
    0000  ; FUNCTIONAL DESCRIPTION:
    0000  ;
    0000  ;         Routine "beginhere" is where DEBUG is given control from the CLI,
    0000  ;        either at the start of program execution or in response to the DCL
    0000  ;        "DEBUG" command (in the case of RUN/NODEBUG).
    0000  ;        The routine first resolves the two separate ways that DEBUG can be
    0000  ;        entered from the CLI, and coerces them to a common format. It then
    0000  ;        performs once-only DEBUG initialization, and finally it enters the
    0000  ;        exception handler that initiates command processing.
    0000  ;
    0000  ;        AP ---> --------------------------
    0000  ;                !                      6 !
    0000  ;                --------------------------
    0000  ;                ! transfer vector address  ! (Exception args if RUN/NODEBUG)
    0000  ;                --------------------------
    0000  ;                ! parsing information      !
    0000  ;                --------------------------
    0000  ;                ! image header information !
    0000  ;                --------------------------
    0000  ;                !  image file information  !
    0000  ;                --------------------------
    0000  ;                ! LINK status bits         !
    0000  ;                --------------------------
    0000  ;                !  CLI status bits         !
    0000  ;                --------------------------
    0000  ;
    0000  ;        The transfer vector has three or less transfer addresses in it.
    0000  ;        They are ordered as in the picture below:
    0000  ;
    0000  ;                --------------------------
    0000  ;                ! DEBUG transfer address   !
    0000  ;                --------------------------
    0000  ;                ! OTS transfer address     !
    0000  ;                --------------------------
    0000  ;                ! user transfer address    !
    0000  ;                --------------------------
    0000  ;
    0000  ;        If the DEBUG or OTS transfer addresses are absent, the subsequent
    0000  ;        addresses are moved upward in the list.
```

```
                               0000   ; *****SSI
                               0000   ; Since DEBUG is highly re-entriant, (ie, signal back to DEBUG via SS$_NORMAL,
                               0000   ; Error message, build call frame stack on the fly, or via Branch, JMP etc.),
                               0000   ; to be safe, at each label in this module (potential entry point) we DISABLE
                               0000   ; SSI, so we won't intercept DEBUG'S own System Service calls.  DBG/TDBG
                               0000   ; watches user program's system service, SDBG watches TDBG and user program's
                               0000   ; system service calls.  But at each level DBG, TDBG or SDBG, one never
                               0000   ; intercepts its own system service calls.
                               0000   ;
                         0000  0000           .ENTRY  BEGINHERE,^M<>           ; Null entry mask
      00000B0E'EF    00    FB  0002           CALLS   #0,DISABLE_SSI
      00000000'EF    10    88  0009           BISB2   #dbg$m_control_exit,dbg$gv_control; Exit on startup errors
              09B6         30  0010           BSBW    fix_up_addresses         ; [TEMP] until VMS bug is fixed
      0000003B'EF    5C    7D  0013           MOVQ    AP,saved_AP              ; Save pointer to CLI parameters
         2F 18 AC    10    E1  001A           BBC     #cli$v_dbgexcp,24(AP),3$; Branch if normal entry to DEBUG
                               001F   ;
                               001F   ; DEBUG has been entered after user program has been started. Find the
                               001F   ; call frame on the stack which will resturn control to SYS$IMGSTA and
                               001F   ; change the return address to point to dbg$user_exit so that DEBUG is
                               001F   ; given control if the user program exits via a RETURN.
                               001F   ;
            5C    04 AC    D0  001F           MOVL    4(AP),AP                 ; Get pointer to exception parameters
            50    08 AC    D0  0023           MOVL    chf$l_mcharglst(AP),R0   ; Get address of MECHANISM arguments
            50    04 A0    D0  0027           MOVL    chf$l_mch_frame(R0),R0   ; Get FP of establisher (SYS$IMGSTA)
      0000003F'EF    50    D0  002B           MOVL    R0,saved_FP              ; Save for last-chance handler
                51   5D    D0  0032           MOVL    FP,R1                    ; Get current frame pointer
            51    0C A1    D0  0035 1$:       MOVL    sf$l_save_fp(R1),R1      ; Step back to previous frame
         61    14    00    0C  0039           PROBER  #0,#20,(R1)              ; Can this stack frame be read ?
                     0C    13  003D           BEQL    2$                       ; No  - stack is corrupted ?
            50    0C A1    D1  003F           CMPL    sf$l_save_fp(R1),R0      ; Do we point back to SYS$IMGSTA ?
                     F0    12  0043           BNEQ    1$                       ; No  - go look at earlier frames
       10 A1    018A'CF    9E  0045           MOVAB   W^dbg$user_exit,sf$l_save_pc(R1); Yes - change return PC
                   00A1    31  004B 2$:       BRW     setup                    ; Go perform common initialization
                               004E   ;
                               004E   ; DEBUG has been given control directly at start of program execution.
                               004E   ; We need to build a fake call-frame on the stack,  so that it appears
                               004E   ; to the user as though DEBUG had been given control after the CALL of
                               004E   ; his program but before execution of any user instructions.
                               004E   ;
   04 00000000'EF    01    E0  004E 3$:       BBS     #dbg$v_control_sdbg,dbg$gv_control,4$;Use this vector if SDBG
            04 AC    04    C0  0056           ADDL2   #4,4(AP)                 ; Otherwise step to OTS or USER entry
         50    01    10    78  005A 4$:       ASHL    #16,#1,R0                ; Get all-zero default entry mask
            51    04 BC    D0  005E           MOVL    @4(AP),R1                ; Get address of user transfer vector
         61    02    00    0C  0062           PROBER  #0,#2,(R1)               ; Can transfer address be read ?
                     03    13  0066           BEQL    5$                       ; If not, don't try to read it !
               50    61    3C  0068           MOVZWL  (R1),R0                  ; Get user entry mask bits in R0
      00000043'EF    50    D0  006B 5$:       MOVL    R0,saved_R0              ; Save entry-mask and flag bit
   00000047'EF    51    02    C1  0072           ADDL3   #2,R1,saved_R1           ; Save transfer address as well
      51    5E    02    00    EF  007A           EXTZV   #0,#2,SP,R1              ; Get low two bits of stack pointer
               5E    03    CA  007F           BICL2   #3,SP                    ; Force stack to longword alignment
         50    F000 8F    AA  0082           BICW2   #^XF000,R0               ; Mask to just bits 0-11 (registers)
                     50    BB  0087           PUSHR   R0                       ; Save registers given in entry mask
                018A'CF    9F  0089           PUSHAB  W^dbg$user_exit          ; Set up fake return address
                3000 8F    BB  008D           PUSHR   #^M<FP,AP>               ; Save current context registers
      7E    51    FE 8F    9C  0091           ROTL    #-2,R1,-(SP)             ; Set stack alignment bits
            02 AE    50    A8  0096           BISW2   R0,2(SP)                 ; Include register save mask
                     7E    D4  009A           CLRL    -(SP)                    ; Initialize stack exception handler
       6D    B1'AF   9E  009C   433        MOVAB   B^one_shot_handler,(FP) ; Establish handler in outer frame
          5D    5E   D0  00A0   434        MOVL    SP,FP                   ; Frame established - set pointer
 7E   00028001 8F    D0  00A3   435        MOVL    #dbg$_normal,-(SP)      ; Stack special exception code
 00000000'GF    01   FB  00AA   436        CALLS   #1,G^LIB$SIGNAL         ; SIGNAL into exception handler
                         00B1   437 ;
                         00B1   438 ;      Never returns here - PC changed within handler !
```

```
                                      00B1   one_shot_handler:
                               0FFC   00B1             .WORD   ^M<R2,R3,R4,R5,R6,R7,R8,R9,R10,R11>     ; Full save entry mask
        00000B0E'EF      00      FB   00B3             CALLS   #0,DISABLE_SSI
             50   04 AC          D0   00BA             MOVL    chf$l_sigarglst(AP),R0  ; Get address of SIGNAL arg list
         04 A0    046C 8F        3C   00BE             MOVZWL  #ss$_debug,4(R0)        ; Change exception name to SS$_DEBUG
             51   60    01       C3   00C4             SUBL3   #1,chf$l_sig_args(R0),R1; Get offset to saved PC value
              50   6041          DE   00C8             MOVAL   (R0)[R1],R0             ; Get address of saved PC parameter
           80   00000047'EF      D0   00CC             MOVL    saved_R1,(R0)+          ; Change to user program start address
   51    00000043'EF   01   0F   EF   00D3             EXTZV   #15,#1,saved_R0,R1      ; Get entry-mask decimal enable bit
           60   01   07     51   F0   00DC             INSV    R1,#psl$v_dv,#1,(R0)    ; Set decimal overflow bit in saved PSL
   51    00000043'EF   01   0E   EF   00E1             EXTZV   #14,#1,saved_R0,R1      ; Get entry-mask integer enable bit
           60   01   05     51   F0   00EA             INSV    R1,#psl$v_iv,#1,(R0)    ; Set integer overflow bit in saved PSL
                                      00EF   ;
                                      00EF   ; fall through into common DEBUG once-only initialization code
                                      00EF   ;
                                      00EF   setup:
                        0125     30   00EF             BSBW    save_user_context       ; Establish known state of the world
             50   08 AC          D0   00F2             MOVL    chf$l_mcharglst(AP),R0  ; Get address of MECHANISM array
             51   04 A0          D0   00F6             MOVL    chf$l_mch_frame(R0),R1  ; Get frame of our establisher
             61   065B'CF        DE   00FA             MOVAL   W^dbg$final_handl,(R1)  ; Establish final exception handler
                                      00FF
             6D   0640'CF        DE   00FF             MOVAL   W^window_handler,(FP)   ; Establish local exception handler
                        00D0     30   0104             BSBW    setup_exit_handler      ; Establish DEBUGs final exit handler
                       3C 50     E9   0107             BLBC    R0,1$                   ; Go EXIT with error-status on failure
        00000000'EF      00      FB   010A             CALLS   #0,dbg$init_debug       ; initialize DEBUG context.
                                      0111             $SETEXV_S VECTOR=#2,ADDRES=last_chance; Declare last chance handler
                       1F 50     E9   0124             BLBC    R0,1$                   ; Go EXIT with error-status on failure
   50    00000000'EF   01   00   EF   0127             EXTZV   #dbg$v_control_tdbg,#1,dbg$gv_control,R0 ; Get TEST DEBUG flag
                                      0130             $SETEXV_S VECTOR=R0,ADDRES=primary_handler; Declare 'primary' handler
                       0E 50     E8   0143             BLBS    R0,2$                   ; Carry on if declaration successful
        50   03   00   04        F0   0146   1$:       INSV    #4,#0,#3,R0             ; Otherwise make this a fatal error
                                      014B             $EXIT_S R0                      ;  and report status via SYS$EXIT
                                      0154
             50   04 AC          D0   0154   2$:       MOVL    chf$l_sigarglst(AP),R0  ; Get address of SIGNAL arg list
             51   60    01       C3   0158             SUBL3   #1,chf$l_sig_args(R0),R1; Get offset to saved PC value
                        6041     DD   015C             PUSHL   (R0)[R1]                ; Stack PC value for dbg$rst_init
          50    0000003B'EF      D0   015F             MOVL    saved_AP,R0             ; Get address of CLI vector
                       0C A0     DD   0166             PUSHL   cli$a_imghdadr(R0)      ; Push address of image header info.
             50   10 A0          D0   0169             MOVL    cli$a_imgfiled(R0),R0   ; Get the address of the image file
             51   02 A0          3C   016D             MOVZWL  ifd$w_filnamoff(R0),R1  ; get offset to file name
          7E   51   50           C1   0171             ADDL3   R0,R1,-(SP)             ; Push address onto stack
             7E   08 A0          3C   0175             MOVZWL  ifd$w_chan(R0),-(SP)    ; Push channel number onto stack
        00000000'EF      04      FB   0179             CALLS   #4,dbg$rst_init         ; Initialize the symbol tables.
        00000000'EF      10      8A   0180             BICB2   #dbg$m_control_exit,dbg$gv_control ; Turn off exit flag
                        041B     31   0187             BRW     prim_4                  ; Act as though its a normal exception
```

```
                                  018A      ;
                                  018A      ;       When the user program runs to completion, then control runs back
                                  018A      ;       to the label dbg$user_exit, and DEBUG forces a SYS$EXIT with the
                                  018A      ;       user's value of R0. Our termination handler then reports this R0
                                  018A      ;       as a system message.  The rest of this routine  (which starts at
                                  018A      ;       beginhere_2) is jumped to from within the termination handler.
                                  018A      ;       It recreates the original argument list with a new R0,R1 pair to
                                  018A      ;       preserve them across $EXIT_S, and moves back through the restart
                                  018A      ;       logic to the command processor.
                                  018A
                                  018A      dbg$user_exit::
00000B0E'EF     00    FB          018A              CALLS   #0,disable_ssi
0000036D'EF     50    D0          0191              MOVL    R0,dbg$gl_exit_status   ; Save user program's return status
00000043'EF     50    7D          0198              MOVQ    R0,saved_R0             ; Stuff away for later restoration.
                                  019F              $EXIT_S R0                      ; Force SYS$EXIT with user's R0 value.
                      04          01A8              RET                             ; Don't need to set R0 here !
                                  01A9
                                  01A9
                                  01A9      reset_debug:
         50     8E    D0          01A9              MOVL    (SP)+,R0                ; Get back return address
5C    0000003B'EF     7D          01AC              MOVQ    saved_AP,AP             ; Restore saved AP and FP
         5E     5D    D0          01B3              MOVL    FP,SP                   ; Restore SP to be the saved FP
       FFD0     CF    9F          01B6              PUSHAB  W^dbg$user_exit         ; Set up fake return address
       3000     8F    BB          01BA              PUSHR   #^M<FP,AP>              ; Save current context registers
                7E    D4          01BE              CLRL    -(SP)                   ; Set register save mask & PSW
7E    000003FF'EF     9E          01C0              MOVAB   term_window_handler,-(SP);Establish temporary window handler
         5D     5E    D0          01C7              MOVL    SP,FP                   ; Point to current frame
                50    DD          01CA              PUSHL   R0                      ; Stack return address again
         7E     01    CE          01CC              MNEGL   #1,-(SP)                ; Replace all BPT's with their real
00000000'EF     01    FB          01CF              CALLS   #1,dbg$ins_opcodes      ;  opcodes, and unprotect all pages
                      05          01D6              RSB                             ; Return to caller with a new frame
                                  01D7
                                  01D7      setup_exit_handler:
                                  01D7              $DCLEXH_S DESBLK=term_block_one ; Declare a termination handler
         2F 50        E9          01E4              BLBC    R0,3$                   ; Return error-status to caller
   28 00000000'EF     E8          01E7              BLBS    dbg$gv_control,3$       ; No re-arranging if TEST DEBUG
51    0000001B'EF     D0          01EE      1$:     MOVL    term_block_one,R1       ; Get link to first USER exit handler
                1F    13          01F5              BEQL    3$                      ; Zero link means we are the last one
                51    DD          01F7              PUSHL   R1                      ; Save address of control block
                                  01F9              $CANEXH_S DESBLK=(R1)           ; Un-declare user exit handler
         02 50        E9          0202              BLBC    R0,2$                   ; Return error status to caller
                E7    10          0205              BSBB    1$                      ; Repeat for all user exit handlers
         51     8E    D0          0207      2$:     MOVL    (SP)+,R1                ; Get back address of control block
         09 50        E9          020A              BLBC    R0,3$                   ; Report error-status to caller
                                  020D              $DCLEXH_S DESBLK=(R1)           ; Re-establish handlers in LIFO order
                      05          0216      3$:     RSB                             ; Return status in R0
```

```
                             0217                .SBTTL  DEBUG entry and exit routines - save/restore state of user
                             0217       ;
                             0217       ;  This routine is called on entry to DEBUG to save the user's registers
                             0217       ; and sundry other user context in the current RUNFRAME,  and to set the
                             0217       ; context of DEBUG to a known state (AST's disabled, etc.).
                             0217       ;
                             0217       save_user_context:
    01 00000001'EF      E8   0217               BLBS    dbg$gv_control+1,save_user_context_always
                             021E                                                    ; Only do this if user was 'in control'
                        05   021E               RSB                                  ; Otherwise return immediately
                             021F       save_user_context_always:
          01FF 8F       BB   021F               POSHR   #^M<R0,R1,R2,R3,R4,R5,R6,R7,R8> ; Save all registers we use
   00000B0E'EF    00    FB   0223               CALLS   #0,disable_ssi
                             022A               $SETAST_S #0                         ; Disable AST interrupts
  56    00000000'EF     9E   0233               MOVAB   dbg$runframe,R6              ; Get pointer to current RUNFRAME
        57     04 AC    7D   023A               MOVQ    4(AP),R7                     ;  and to SIGNAL & MECHANISM arrays
    48 A6    0820 8F    AA   023E               BICW2   #dbg$m_enab_fex+dbg$m_enab_ast,dbg$w_run_stat(R6)
 05 00000000'EF   0A    E4   0244               BBSC    #dbg$v_control_tbit,dbg$gv_control,2$; (set if ASTs held off)
             50   01    D1   024C               CMPL    #ss$_wasclr,R0               ; Were ASTs enabled?
             04   13         024F               BEQL    3$                           ; No - flag is already clear
       48 A6      20    A8   0251       2$:     BISW2   #dbg$m_enab_ast,dbg$w_run_stat(R6) ; Yes - remember to reenable
                             0255       3$:     $SETSFM_S #0                         ; Disable sys service failure exception
             50   01    D1   025E               CMPL    #ss$_wasclr,R0               ; Was it enabled?
             06   13         0261               BEQL    4$                           ; No - flag is already clear
    48 A6    0800 8F    A8   0263               BISW2   #dbg$m_enab_fex,dbg$w_run_stat(R6) ; Yes - remember to reenable
              04 A7     DD   0269       4$:     PUSHL   chf$l_sig_name(R7)           ; Stack actual exception code
   00000000'EF    01    FB   026C               CALLS   #1,dbg$exception_is_fault;Get type of exception (fault/trap)
 48 A6   01   0D   50   F0   0273               INSV    R0,#dbg$v_at_fault,#1,dbg$w_run_stat(R6) ; Remember exc type
        53     04 A6    DE   0279               MOVAL   dbg$l_user_regs(R6),R3       ; Get address for user's registers
        83     0C A8    7D   027D               MOVQ    chf$l_mch_savr0(R8),(R3)+;Copy R0,R1 from MECHANISM array
    63   14 AD    28    28   0281               MOVC3   #40,20(FP),(R3)              ; Save user registers R2 - R11
        83     08 AD    7D   0286               MOVQ    sf$l_save_ap(FP),(R3)+       ; Save user AP - FP
      50   01     67    C1   028A               ADDL3   (R7),#1,R0                   ; Get signal arg count plus 1
         50     6740    DE   028E               MOVAL   (R7)[R0],R0                  ; Calculate value of user SP
             83   50    D0   0292               MOVL    R0,(R3)+                     ; Save user SP in RUNFRAME
             83   70    7D   0295               MOVQ    -(R0),(R3)+                  ; Save last 2 SIGNAL args (PC & PSL)
                             0298               $DCLEXH_S DESBLK=term_block_two ; Declare temporary exit handler
   00000001'EF    01    8A   02A5               BICB2   #dbg$m_control_user@-8,dbg$gv_control+1 ; DEBUG is in control
          01FF 8F       BA   02AC               POPR    #^M<R0,R1,R2,R3,R4,R5,R6,R7,R8> ; Restore all used registers
                        05   02B0               RSB                                  ; Return with user context save'
                             02B1
                             02B1       restore_context:
                      0004   02B1               .WORD   ^M<R2>                       ; Save contents of register R2
00000000'EF     0108 8F  A8  02B3               BISW2   #dbg$m_control_user+dbg$m_control_urun,dbg$gv_control
     52    00000000'EF   9E  02BC               MOVAB   dbg$runframe,R2              ; Get base of current run frame
      09 48 A2    0B    E1   02C3               BBC     #dbg$v_enab_fex,dbg$w_run_stat(R2),1$    ; Was SFM enabled ?
                             02C8               $SETSFM_S #1                         ; Yes - reenable exceptions
      11 48 A2    05    E1   02D1       1$:     BBC     #dbg$v_enab_ast,dbg$w_run_stat(R2),2$    ; Were AST's enabled ?
  11 00000000'EF  0A    E0   02D6               BBS     #dbg$v_control_tbit,dbg$gv_control,3$    ;  and not postponed ?
                             02DE               $SETAST_S #1                         ; Yes - reenable ASTs
 00 00000000'EF   0A    E5   02E7       2$:     BBCC    #dbg$v_control_tbit,dbg$gv_control,3$    ; No ASTs postponed !
                             02EF       ; *****SSI
                             02EF       ; Time to leave DEBUG, ENABLE SSI, This is the only place we enable SSI.
                             02EF       ;
   000009FD'EF    00    FB   02EF       3$:     CALLS   #0,enable_ssi
                        04   02F6               RET                                  ; User context reset - return
```

```
                                 02F7        .SBTTL  DEBUG Termination  and last-chance handlers
                                 02F7
                                 02F7  TERM_HANDLER:
                           0000  02F7          .WORD   ^M<>                    ; Null entry mask
                                 02F9  DBG$TERM_HANDLR::
     00000B0E'EF   00      FB    02F9          CALLS   #0,disable_ssi
       07 00000000'EF      E9    0300          BLBC    DBG$GL_SCREEN_MODE,2$   ; Set up screen refresh and set scrol-
     00000000'EF   00      FB    0307          CALLS   #0,DBG$SCR_SCREEN_TERM  ;       ling region back to normal
  0D 00000000'EF   04      E0    030E  2$:     BBS     #DBG$V_CONTROL_EXIT,DBG$GV_CONTROL,3$    ; Exit if exit flag set
00000017'EF   00000980 8F  D1    0316          CMPL    #SS$_CLIFRCEXT,TERM_REASON               ; Check the exit status
                     2D    12    0321          BNEQ    5$                      ; Continue unless "CLI forced exit"
                                 0323  ; Before we return to CLI, we check for this special case.
  24 00000000'EF   06      E0    0323  3$:     BBS     #DBG$V_CONTROL_DONE,DBG$GV_CONTROL,4$
                                 032B  ; In testable debugger, if the user program does not run to an end, if we
                                 032B  ; reach here via DBG>EXIT, if there are break points set along the path
                                 032B  ; such as PRIMARY_HANDLER, DBG$EXCEPTION_HANDLER in SDBG, causing super
                                 032B  ; debugger goes into an infinite loop.  ($EXIT calls all user declared
                                 032B  ; handler after we reach RET instruction here, one of the user declared
                                 032B  ; handler is the DBG$TERM_HANDLR in Super Debugger, Super debugger signals
                                 032B  ; exit status, then causing break point faults to take place, note: at this
                                 032B  ; point super debugger is no longer available).  So before we RET, we do
                                 032B  ; some cleaning work.
0000036D'EF   00000017'EF  D0    032B          MOVL    TERM_REASON,DBG$GL_EXIT_STATUS  ; Save the $EXIT status code
     00000001'EF   01      8A    0336          BICB2   #dbg$m_control_user@-8,dbg$gv_control+1 ; DEBUG is in control
  00000000'EF   40 8F      88    033D          BISB2   #dbg$m_control_done,dbg$gv_control      ; User program complete
                   FE61    30    0345          BSBW    reset_debug             ; Re-establish a known context
       50   00000017'EF    D0    0348          MOVL    TERM_REASON,R0
                     04          034F  4$:     RET                             ; Don't intercept - return to CLI
                                 0350
0000036D'EF   00000017'EF  D0    0350  5$:     MOVL    TERM_REASON,DBG$GL_EXIT_STATUS  ; Save the $EXIT status code
00000017'EF   10000000 8F  CA    035B          BICL2   #sts$m_inhib_msg,term_reason            ; Clear 'inhibit' bit
     00000001'EF   01      8A    0366          BICB2   #dbg$m_control_user@-8,dbg$gv_control+1 ; DEBUG is in control
  00000000'EF   40 8F      88    036D          BISB2   #dbg$m_control_done,dbg$gv_control      ; User program complete
                   FE31    30    0375          BSBW    reset_debug             ; Re-establish a known context
                   FE5C    30    0378          BSBW    setup_exit_handler      ; Re-establish final exit handler
   0000004B'EF   00FF 8F   3C    037B          MOVZWL  #buf_siz-1,faobufdesc   ; Try to convert the status
0000004F'EF   00000256'EF  9E    0384          MOVAB   term_buf+1,faobufdesc+4 ; to a system message
                                 038F          $GETMSG_S MSGID=term_reason,MSGLEN=msg_length,BUFADR=faobufdesc
00000255'EF   00000053'EF  90    03AC          MOVB    msg_length,term_buf     ; Make counted string in TERM_BUF
              00000255'EF  9F    03B7          PUSHAB  term_buf                ; Address of counted string
                     01    DD    03BD          PUSHL   #1                      ; One FAO parameter for SIGNAL
            0002806B 8F    DD    03BF          PUSHL   #dbg$_exitstatus        ; Message number
     00000000'GF   03      FB    03C5          CALLS   #3,G^LIB$SIGNAL         ; SIGNAL exit status back to DEBUG
                                 03CC
                                 03CC  last_chance:
                           0000  03CC          .WORD   ^M<>                    ; Null entry mask
     00000B0E'EF   00      FB    03CE          CALLS   #0,DISABLE_SSI
     00000001'EF   01      8A    03D5          BICB2   #dbg$m_control_user@-8,dbg$gv_control+1 ; DEBUG is in control
     00000000'EF   6C      FA    03DC          CALLG   (AP),dbg$putmsg         ; Output signal message text
         50   08 AC        D0    03E3          MOVL    chf$l_mcharglst(AP),R0  ; Get address of MECHANISM array
   00000043'EF   0C A0     7D    03E7          MOVQ    chf$l_mch_savr0(R0),saved_R0 ; Save contents of user registers
                   FDB7    30    03EF          BSBW    reset_debug             ; Reset stack to a known state
            00028258 8F    DD    03F2          PUSHL   #dbg$_lastchance        ; Message number
     00000000'GF   01      FB    03F8          CALLS   #1,G^LIB$SIGNAL         ; SIGNAL back in to DEBUG
                                 03FF
                                 03FF  term_window_handler:
                           0FFC  03FF          .WORD   ^M<R2,R3,R4,R5,R6,R7,R8,R9,R10,R11>     ; Full entry mask
```

```
        00000B0E'EF    00   FB  0401     647          CALLS   #0,DISABLE_SSI
              52   04 AC    7D  0408     648          MOVQ    chf$l_sigarglst(AP),R2  ; Get SIGNAL & MECHANISM addresses
   0C A3    00000043'EF     7D  040C     649          MOVQ    saved_R0,chf$l_mch_savr0(R3)     ; Set contents of user R0,R1
                   04 B3    D4  0414     650          CLRL    @chf$l_mch_frame(R3)     ; Remove link to this handler
        00000000'EF    6C   FA  0417     651          CALLG   (AP),dbg$putmsg          ; Output signal message text
           51    62    01   C3  041E     652          SUBL3   #1,(R2),R1               ; Get offset to saved PC value
                     8241   D4  0422     653          CLRL    (R2)+[R1]                ; Clear PC to make restart difficult
           62   046C 8F     3C  0425     654          MOVZWL  #ss$_debug,(R2)          ; Change signal name to 'SS$_DEBUG'
        000000C1'EF    01   88  042A     655          BISB2   #dbg$m_control_user@-8,dbg$gv_control+1 ; User was in control
                     016E   31  0431     656          BRW     prim_3                   ; Go save context & issue DEBUG prompt
```

```
                                   0434         .SBTTL  DBG$PSEUDO_PROG - Structure to implement CALL
                                   0434
                                   0434  dbg$pseudo_prog::
  00000052'FF   0000004E'FF    FA  0434         CALLG   @dbg$runframe+dbg$l_frame_ptr,@dbg$runframe+dbg$l_call_addr
                                   043F
                                   043F  dbg$pseudo_exit::: Label to detect STEPping off the end of the CALLed routine.
          00000B0E'EF    00    FB  043F         CALLS   #0,disable_ssi
          00000043'EF    50    7D  0446         MOVQ    R0,saved_R0                ; Save return value from user procedure
                                   044D         $SETAST_S #0                       ; Disable AST interrupts
                                   0456         $DCLEXH_S DESBLK=term_block_two ; Declare temporary exit handler
          00000001'EF    01    8A  0463         BICB2   #dbg$m_control_user@-8,dbg$gv_control+1 ; DEBUG is in control
                   5C    6D    D0  046A         MOVL    (FP),AP                    ; Get pointer to current handler
             6D    7E'AF       3E  046D         MOVAW   B^pseudo_handler,(FP)      ; Get handler to bootstrap into DEBUG
             00028001 8F       DD  0471         PUSHL   #dbg$_normal               ; Get phony exception value
          00000000'GF    01    FB  0477         CALLS   #1,G^LIB$SIGNAL            ; SIGNAL back to proper context
                                   047E  ;      point of no return !
                                   047E
                             0FFC  047E  pseudo_handler: .WORD   ^M<R2,R3,R4,R5,R6,R7,R8,R9,R10,R11> ; Full save mask
                                   0480
             5A    04 AC       7D  0480         MOVQ    chf$l_sigarglst(AP),R10 ; Get pointers to SIGNAL & MECHANISM
          04 BB    08 AD       D0  0484         MOVL    sf$l_save_ap(FP),@chf$l_mch_frame(R11)  ; Restore handler
          00000000'EF    00    FB  0489         CALLS   #0,dbg$flushbuf            ; Initialize print buffer.
             00000000'EF       DF  0490         PUSHAL  routine_value              ; Report the value returned
          00000000'EF    01    FB  0496         CALLS   #1,dbg$print               ; Insert text in buffer
             00000043'EF       DD  049D         PUSHL   saved_R0                   ;  call of DBG$OUT_NUM_VAL
          00000000'EF    01    FB  04A3         CALLS   #1,dbg$out_num_val         ; Insert returned numeric value
          00000000'EF    00    FB  04AA         CALLS   #0,dbg$newline             ; Output buffer contents
          5B    00000000'EF    9E  04B1         MOVAB   dbg$runframe,R11           ; Get address of routine's runframe
                   56    6B    D0  04B8         MOVL    dbg$l_next_link(R11),R6 ;  and address of previous runframe
             55    4E AB       D0  04BB         MOVL    dbg$l_frame_ptr(R11),R5 ; get address of routine argument list
                   54    65    D0  04BF         MOVL    (R5),R4                    ; Get number of parameters passed
                         25    13  04C2         BEQL    3$                         ; No data structure if no parameters !
             53    61 BB44     DE  04C4         MOVAL   @dbg$l_save_fld(R11)[R4],R3     ; Otherwise get MEMUSE vector
          0000035D'EF    73    D0  04C9  1$:    MOVL    -(R3),param_1              ; Get memory used for this parameter
                         0B    13  04D0         BEQL    2$                         ; Zero means none allocated !
  00000000'GF   00000359'EF    FA  04D2         CALLG   param_0,G^dbg$rel_memory; Otherwise release memory again
                      E9 54    F5  04DD  2$:    SOBGTR  R4,1$                      ; Loop for all parameters
                         53    DD  04E0         PUSHL   R3                         ; Then point to MEMUSE vector area
          00000000'GF    01    FB  04E2         CALLS   #1,G^dbg$rel_memory        ;  and release that space as well
                         55    DD  04E9  3$:    PUSHL   R5                         ;  Push address of block.
          00000000'GF    01    FB  04EB         CALLS   #1,G^dbg$rel_memory        ; Free space used for argument list
        6B   66    0065 8F     28  04F2         MOVC3   #dbg$k_runfr_len,(R6),(R11); Restore previous context
                         56    DD  04F8         PUSHL   R6                         ; Push address of runframe
          00000000'GF    01    FB  04FA         CALLS   #1,G^dbg$rel_memory        ; Free this storage too
                         52    D4  0501         CLRL    R2                         ; Pop "unhandled exc" stack
 00000000'EF42  00000001'EF42  90  0503  4$:    MOVB    DBG$GB_UNHANDLED_EXC+1[R2],DBG$GB_UNHANDLED_EXC[R2]
                EF 52    08    F3  0510         AOBLEQ  #8,R2,4$
          00000000'EF    01    91  0514         CMPB    #1,DBG$GB_CALL_NORMAL_RET; Set CALL flag to indicate a normal
                         06    12  051B         BNEQ    5$                         ;        return from a CALL command call
             00000000'EF       96  051D         INCB    DBG$GB_CALL_NORMAL_RET     ;        (used to suppress screen update)
             51    6A    01    C3  0523  5$:    SUBL3   #1,(R10),R1                ; Get offset to saved SIGNAL PC
                51    6A41     DE  0527         MOVAL   (R10)[R1],R1               ; Get actual address for PC & PSL
           04 AA    046C 8F    3C  052B         MOVZWL  #ss$_debug,4(R10)          ; Change signal name to 'SS$_DEBUG'
                61    40 AB    7D  0531         MOVQ    dbg$l_user_pc(R11),(R1) ; Restore PC & PSL to SIGNAL array
                         6E    11  0535         BRB     prim_4                     ; Rejoin common exception flow
```

```
0537          .SBTTL  PRIMARY_HANDLER
0537  ;++
0537  ; FUNCTIONAL DESCRIPTION:
0537  ;       Exception handler declared in the primary vector. Simply resignals
0537  ;       if the exception occurred during the execution of a debug command.
0537  ;       If the exception occurred in the user program being debugged, this
0537  ;       routine disables ASTs (if they were enabled),  saves the registers
0537  ;       from the user program at the time of the exception, and then calls
0537  ;       a routine to handle the exception.
0537  ;       When the called routine returns, the registers are restored,  ASTs
0537  ;       are re-enabled (if they were disabled),  and the exception handler
0537  ;       returns with the resignal value received from the called routine.
0537  ;
0537  ; CALLING SEQUENCE:
0537  ;       4(AP)   - Address of SIGNAL ARRAY
0537  ;       8(AP)   - Address of MECHANISM ARRAY
0537  ;
0537  ; IMPLICIT INPUTS:
0537  ;       The global flag dbg$v_control_user, which indicates whether the
0537  ;       user program was running, or DEBUG was executing a debug command.
0537  ;
0537  ; IMPLICIT OUTPUTS:
0537  ;       The "dbg$v_enab_ast" flag indicates whether asts were enabled
0537  ;       at the time of the interrupt
0537  ;
0537  ; ROUTINE VALUE:
0537  ;       SS$_RESIGNAL or the value returned by DBG$EXC_HANDLER
0537  ;
0537  ; SIDE EFFECTS:
0537  ;       The user may get control under DEBUG
0537  ;--
```

```
                              0FFC  0537    746              .ENTRY  PRIMARY_HANDLER,^M<R2,R3,R4,R5,R6,R7,R8,R9,R10,R11>
                                    0539    747 prim_handl_2::
        00000B0E'EF   00      FB    0539    748              CALLS   #0,disable_ssi
             50   0918 8F     3C    0540    749              MOVZWL  #ss$_resignal,R0           ; We usually want to resignal exception
                51   04 AC    D0    0545    750              MOVL    chf$l_sigarglst(AP),R1     ; Get address of SIGNAL argument list
      04 A1    00028001 8F    D1    0549    751              CMPL    #dbg$_normal,4(R1)         ; Fake DEBUG-generated signal ?
                         36   13    0551    752              BEQL    2$                         ; Yes - just resignal it at once
      04 A1    0000046C 8F    D1    0553    753              CMPL    #ss$_debug,4(R1)           ; Generated by ^Y,DEBUG sequence ?
                         25   12    055B    754              BNEQ    1$                         ; No  - pass on to next handler
                    50   01   3C    055D    755              MOVZWL  #ss$_continue,R0           ; Get ready to ignore 'SS$_DEBUG'
          22 00000000'EF      E8    0560    756              BLBS    dbg$gv_control,2$          ; Always ignore if testable debugger
      13 00000000'EF   09     E3    0567    757              BBCS    #dbg$v_control_stop,dbg$gv_control,1$    ; Set STOP flag
          14 00000001'EF      E8    056F    758              BLBS    dbg$gv_control+1,3$        ; Continue unless DEBUG was running
        00000000'EF    20     88    0576    759              BISB2   #dbg$m_control_fail,dbg$gv_control ; and the STOP flag was set
             50   0918 8F     3C    057D    760              MOVZWL  #ss$_resignal,R0           ;  when we resignal to final handler
          01 00000001'EF      E8    0582    761 1$:          BLBS    dbg$gv_control+1,3$        ; Are debug commands being executed?
                              04    0589    762 2$:          RET                                ; Yes - return to exception dispatch
                                    058A    763
      10 00000000'EF   01     E1    058A    764 3$:          BBC     #dbg$v_control_sdbg,dbg$gv_control,prim_3 ; If SUPERDEBUG,
      04 A1    00028352 8F    D1    0592    765              CMPL    #dbg$_superdebug,4(R1)     ; See if this SUPERDEBUG signal
                         06   12    059A    766              BNEQ    prim_3                     ; Some other signal - look at it
         04 A1    046C 8F     3C    059C    767              MOVZWL  #ss$_debug,4(R1)           ; SUPERDEBUG gets changed to DEBUG
                       FC72   30    05A2    768 prim_3: BSBW     save_user_context          ; Establish known state of the world
               6D   0640'CF   DE    05A5    769 prim_4: MOVAL    W^window_handler,(FP)      ; Establish temporary exception handler
        00000000'EF    6C     FA    05AA    770              CALLG   (AP),dbg$exc_handler       ; Call inner exception handler
                      24 50   E9    05B1    771              BLBC    R0,return_to_user          ; Just return if re-signalling
      1C 00000000'EF   0A     E0    05B4    772              BBS     #dbg$v_control_tbit,dbg$gv_control,return_to_user; Single-Step ?
      14 00000000'EF   09     E1    05BC    773              BBC     #dbg$v_control_stop,dbg$gv_control,return_to_user; ^Y, DEBUG ?
  00000361'EF   00000040'EF   D0    05C4    774              MOVL    dbg$runframe+dbg$l_user_regs+60,user_pc          ; Yes - save PC
     00000040'EF    0862'CF   9E    05CF    775              MOVAB   W^Pseudo_Signal,dbg$runframe+dbg$l_user_regs+60  ;  & set new PC
                                    05D8    776 return_to_user:
               5A    04 AC    7D    05D8    777              MOVQ    4(AP),R10                  ; Get address of SIGNAL & MECHANISM
                         01   BB    05DC    778              PUSHR   #^M<R0>                    ; Save resignal value
        51    00000004'EF     DE    05DE    779              MOVAL   dbg$runframe+dbg$l_user_regs,R1 ; Get address of user regs
               0C AB    81    7D    05E5    780              MOVQ    (R1)+,12(R11)              ; And restore R0 - R1,
            14 AD    61    28 28    05E9    781              MOVC3   #40,(R1),20(FP)            ;  user R2 - R11
               08 AD    81    7D    05EE    782              MOVQ    (R1)+,8(FP)                ;   and user AP - FP
            52    6A    01    C3    05F2    783              SUBL3   #1,(R10),R2                ; Get offset to saved SIGNAL PC
                52    6A42    DE    05F6    784              MOVAL   (R10)[R2],R2               ; Get actual address for PC & PSL
               62    04 A1    7D    05FA    785              MOVQ    4(R1),(R2)                 ; Restore PC & PSL to SIGNAL array
                         6D   D4    05FE    786              CLRL    (FP)                       ; Remove stack-frame exception handler
                                    0600    787              $CANEXH_S DESBLK=term_block_two    ; Un-declare temporary exit handler
           FC9F CF    00      FB    060D    788              CALLS   #0,restore_context         ; Go reset user AST/SFM enables
                         01   BA    0612    789              POPR    #^M<R0>                    ; Get the resignal value back
                              04    0614    790              RET                                ;  and return
```

```
                        0615            .SBTTL  DBG$THREAD_BPT  - Entry to DEBUG for threaded BPT's
                        0615      ;++
                        0615      ; FUNCTIONAL DESCRIPTION:
                        0615      ;         This routine is called by a "JMP @(R11)+" instruction when the "thread"
                        0615      ;         processor encounters the thread where the user has set a breakpoint.
                        0615      ;         An exception frame is built on the stack to describe the breakpoint
                        0615      ;         using R11 -4 as the address of the "PC".  The PRIMARY_HANDLER is called
                        0615      ;         which will announce the breakpoint and process user commands.
                        0615      ;
                        0615      ;         When the user issues a GO or STEP command the actual thread is moved
                        0615      ;         onto the stack from R11 and the exception frame is removed.  The user
                        0615      ;         program is then restarted by an REI to the next thread.
                        0615      ;
                        0615      ; CALLING SEQUENCE:
                        0615      ;         R11     - Contains the address after the thread where the breakpoint
                        0615      ;                   was set.
                        0615      ;
                        0615      ; IMPLICIT INPUTS:
                        0615      ;         The routine was called with a JMP @(R11)+ instruction.
                        0615      ;
                        0615      ; IMPLICIT OUTPUTS:
                        0615      ;         R11 is still the thread pointer.
                        0615      ;
                        0615      ; ROUTINE VALUE:
                        0615      ;         None.
                        0615      ;
                        0615      ; SIDE EFFECTS:
                        0615      ;         None.
                        0615      ;
                        0615      ;--
                        0615
                        0615    dbg$thread_bpt::
            7E    DC    0615            MOVPSL  -(SP)                           ; Save the current PSL
            7B    DF    0617            PUSHAL  -(R11)                          ; Treat R11 as the PC, and set it to
                        0619                                                    ; the address of the thread.
   00000414 8F    DD    0619            PUSHL   #ss$_break                      ; This is a breakpoint exception.
            03    DD    061F            PUSHL   #3                              ; Exception frame has 3 longwords
       7E   50    7D    0621            MOVQ    R0,-(SP)                        ; Save R0,R1
            7E    7C    0624            CLRQ    -(SP)                           ; next 2 longwords of mechanism array
            04    DD    0626            PUSHL   #4                              ; Mechanism array has 4 longwords.
            6E    DF    0628            PUSHAL  (SP)                            ; Build arg list for primary handler
         18 AE    DF    062A            PUSHAL  24(SP)                          ;
   FF05 CF   02   FB    062D            CALLS   #2,primary_handler              ; Call primary handler
                        0632    dbg$thread_ret::                                ; Label where threaded breakpoint returns
    1C AE   8B    D0    0632            MOVL    (R11)+,28(SP)                   ; Save user's actual thread in case
                        0636                                                    ; he changed it during the breakpoint
       5E   0C    C0    0636            ADDL2   #12,SP                          ; Get address of new R0,R1
       50   8E    7D    0639            MOVQ    (SP)+,R0                        ; Restore R0,R1
       5E   08    C0    063C            ADDL2   #8,SP                           ; Remove all but new PC - PSL pair
                  02    063F            REI                                     ; Transfer control to "thread" routine
```

```
                          0640   843         .SBTTL  WINDOW_HANDLER  - Call frame exception handler
                          0640   844 ;++
                          0640   845 ; FUNCTIONAL DESCRIPTION:
                          0640   846 ;       This handler is put up by the primary handler to be used during the
                          0640   847 ;       "window" during the processing of an exception and before the DEBUG
                          0640   848 ;       prompt is output. SS$_DEBUG signals are ignored (we are trying hard
                          0640   849 ;       to get back to DEBUG command level). everything else causes a jump
                          0640   850 ;       to FINAL_HANDLER to report the error.
                          0640   851 ;
                          0640   852 ; CALLING SEQUENCE:
                          0640   853 ;       4(AP)   - Address of SIGNAL ARRAY
                          0640   854 ;       8(AP)   - Address of MECHANISM ARRAY
                          0640   855 ;
                          0640   856 ; IMPLICIT INPUTS:
                          0640   857 ;       NONE
                          0640   858 ;
                          0640   859 ; IMPLICIT OUTPUTS:
                          0640   860 ;       NONE
                          0640   861 ;
                          0640   862 ; ROUTINE VALUE:
                          0640   863 ;       NONE
                          0640   864 ;
                          0640   865 ; SIDE EFFECTS:
                          0640   866 ;       Errors reported by FINAL_HANDLER
                          0640   867 ;--
                          0640   868 window_handler:
                    0FFC  0640   869         .WORD   ^M<R2,R3,R4,R5,R6,R7,R8,R9,R10,R11>
   00000B0E'EF   00   FB  0642   870         CALLS   #0,DISABLE_SSI
         50   04 AC   D0  0649   871         MOVL    4(AP),R0                ; Get address of SIGNAL ARRAY
0000046C 8F   04 A0   D1  064D   872         CMPL    4(R0),#ss$_debug        ; Is this the DEBUG exception ?
                 06'  12  0655   873         BNEQ    dbg$final_handl+2       ; No  - transfer to the final handler
            50   01   3C  0657   874         MOVZWL  #ss$_continue,R0        ; Yes - load CONTINUE code
                      04  065A   875         RET                             ; Ignore extra 'SS$_DEBUG' signals
```

```
                               065B         .SBTTL  DBG$FINAL_HANDL - Call frame exception handler
                               065B     ;
                               065B     ; Functional description:
                               065B     ;       This handler is the ultimate exception handler for exceptions
                               065B     ;       that occur under DEBUG control or during execution of the user
                               065B     ;       program. Any exception that gets here has already passed thru
                               065B     ;       primary handlers, secondary handlers, and user-declared
                               065B     ;       stack handlers. This handler stops the exception from causing
                               065B     ;       an exit to the operating system, and drops the user back at
                               065B     ;       DEBUG command level.
                               065B     ;
                               065B     ;       This routine first determines whether it was called because of
                               065B     ;       a hard/software exception condition, or because of a software
                               065B     ;       generated SIGNAL. The identification of the error is from the
                               065B     ;       signal-arg-list.
                               065B     ;
                               065B     ;       The handler outputs DEBUG generated messages and operating
                               065B     ;       system generated conditions in distinct manners. The latter
                               065B     ;       conditions are reported, analyzed for source of error, and
                               065B     ;       then the user regains control. DEBUG messages are output, and
                               065B     ;       control is returned to the user or to CLI according to the
                               065B     ;       severity of the message.
                               065B     ;
                               065B     ; Calling sequence:
                               065B     ;       4(AP)   - Address of SIGNAL ARRAY for an exception. Contains the
                               065B     ;                 exception name, the PC of the exception, and the PSL
                               065B     ;                 and any additional FAO arguments required by the
                               065B     ;                 particular message to be generated.
                               065B     ;       8(AP)   - Address of MECHANISM ARRAY for an exception. Contains
                               065B     ;                 R0 and R1.
                               065B     ;
                               065B     ; Implicit inputs:
                               065B     ;       The global flag DBG$V_CONTROL_USER says whether DEBUG or the user
                               065B     ;       was running when the exception occurred. The severity of the error
                               065B     ;       is determined by the low three bits in the error identifier.
                               065B     ;
                               065B     ; Implicit outputs:
                               065B     ;       The name of the exception is changed if PRIMARY_HANDLER is
                               065B     ;       called.
                               065B     ;
                               065B     ; Routine value:
                               065B     ;       SS$_RESIGNAL is returned when the exception was SS$_UNWIND.
                               065B     ;       SS$_CONTINUE is returned when the exception occurred in DEBUG
                               065B     ;               code (unless the error was fatal).
                               065B     ;       Otherwise, this code JMPs to primary_handler and the return is
                               065B     ;               dependent upon many subsequent things.
                               065B     ;
                               065B     ; Side effects:
                               065B     ;       An error message is output to the terminal.
                               065B     ;
                               065B
                         0FFC  065B         .ENTRY  DBG$FINAL_HANDL,^M<R2,R3,R4,R5,R6,R7,R8,R9,R10,R11>
      00000B0E'EF   00   FB    065D         CALLS   #0,disable_ssi
              52    04 AC  D0  0664         MOVL    CHF$L_SIGARGLST(AP),R2  ; Get address of signal argument list
   00000920 8F      04 A2  D1  0668         CMPL    4(R2),#SS$_UNWIND       ; Is this a SYSTEM unwind exception ?
                    06   12    0670         BNEQ    1$                      ; If not unwind, look at it further.
        50    0918 8F    3C    0672         MOVZWL  #SS$_RESIGNAL,R0        ; if unwind, just resignal condition
```

```
                             04  0677     934           RET
                                 0678     935
             6D    E0 AF     9E  0678     936 1$:       MOVAB   B^DBG$FINAL_HANDL,(FP)  ; Establish ourselves as a handler
        53   00000001'EF     9A  067C     937           MOVZBL  DBG$GV_CONTROL+1,R3     ; Save current state of DEBUG/USER flag
                    FB91     30  0683     938           BSBW    SAVE_USER_CONTEXT       ; Establish known state of the world
  00000004'EF   80000000 8F  C8  0686     939           BISL2   #RAB$M_CCO,DBG$GL_OUTPRAB+RAB$L_ROP ; Cancel control-O
      0000046C 8F    04 A2   D1  0691     940           CMPL    4(R2),#SS$_DEBUG        ; Is this the DEBUG exception ?
                        27   13  0699     941           BEQL    2$                      ; Yes - suppress message output
      00028001 8F    04 A2   D1  069B     942           CMPL    4(R2),#DBG$_NORMAL      ; Special DEBUG initialization ?
                        23   13  06A3     943           BEQL    3$                      ; Yes - suppress message output
         00000000'EF    6C   FA  06A5     944           CALLG   (AP),DBG$PUTMSG         ; Write system message to DBG$OUTPUT
    02    04 A2    0C   10   ED  06AC     945           CMPZV   #STS$V_FAC_NO,#STS$S_FAC_NO,4(R2),#DBG_FACILITY ;
                        0E   12  06B2     946           BNEQ    2$                      ; Skip if facility is not DEBUG
          1000 8F    04 A2   B1  06B4     947           CMPW    4(R2),#SHR$_APPENDEDB   ; Not DEBUG if bit 15 is clear unless
                        06   1F  06BA     948           BLSSU   2$                      ;       this is a "shared" message
             0000074E'EF     17  06BC     949           JMP     FINAL_2
                                 06C2     950
                                 06C2     951 ; Come here if not a DEBUG-specific exception (System or User generated).
                                 06C2     952 ; If the user was running, jump into the register saving exception handler.
                                 06C2     953 ; If DEBUG was running, output a message saying that DEBUG caused the error.
                                 06C2     954 ;
                     03 53   E8  06C2     955 2$:       BLBS    R3,3$                   ; Report error if DEBUG was running
                      00B3   31  06C5     956           BRW     FINAL_3                 ;       by branching to FINAL_3
            54    62    01   C3  06C8     957 3$:       SUBL3   #1,(R2),R4              ; Get address of saved PC
                   FD6F CF   9F  06CC     958           PUSHAB  DBG$PSEUDO_EXIT         ; Get address of DBG$PSEUDO_EXIT
                 8E   6244   D1  06D0     959           CMPL    (R2)[R4],(SP)+          ; See if CALLed routine has finished
                        36   13  06D4     960           BEQL    4$                      ; If so, just return CONTINUE
                  32 04 A2   E8  06D6     961           BLBS    4(R2),4$                ; Continue if INFORMATION or SUCCESS
      00000361'EF     6244   D0  06DA     962           MOVL    (R2)[R4],USER_PC        ; Save actual user PC for error
      0000036D'EF    04 A2   D0  06E2     963           MOVL    4(R2),DBG$GL_EXIT_STATUS; Remember error status (for EXIT)
    04    04 A2    03   00   ED  06EA     964           CMPZV   #0,#3,4(R2),#4          ; Check for severe error
                        07   12  06F0     965           BNEQ    35$                     ; If not, don't fill in global
         00000000'EF    01   90  06F2     966           MOVB    #1,DBG$GB_UNHANDLED_EXC ; Remember that an unhandled exception
                                 06F9     967                                           ;       has occured in the user program
                                 06F9     968 35$:      $UNWIND_S  DEPADR=CONST_0,NEWPC=PSEUDO_SIGNAL   ; Unwind the stack
                                 070C     969 ;
                                 070C     970 ; After the UNWIND, return to the user, but do so without restoring the
                                 070C     971 ; registers.  The Exception-Handling Facility requires that we not change
                                 070C     972 ; the saved PC, and in any event there is no need to restore any registers
                                 070C     973 ; since they cannot be changed (via DEPOSIT, etc.) in the Final Handler.
                                 070C     974 ;
                  50    01   3C  070C     975 4$:       MOVZWL  #SS$_CONTINUE,R0        ; Return status "CONTINUE"
                     23 53   E8  070F     976           BLBS    R3,6$                   ; Restore registers on user exit
             00000000'EF     D5  0712     977           TSTL    DBG$GL_SCREEN_ERROR     ; Do not purge type-ahead if error msg
                        0F   12  0718     978           BNEQ    5$                      ;       went to a screen display
                  0B 04 A2   E8  071A     979           BLBS    4(R2),5$                ; Do not purge type-ahead if severity
  00000004'EF   20000000 8F  C8  071E     980           BISL2   #RAB$M_PTA,DBG$GL_INPRAB+RAB$L_ROP   ;       is INFO or SUCCESS
  00000004'EF   80000000 8F  CA  0729     981 5$:       BICL2   #RAB$M_CCO,DBG$GL_OUTPRAB+RAB$L_ROP     ; Un-cancel Ctrl-O
                             04  0734     982           RET                             ; Return to exception mechanism
                        01   BB  0735     983 6$:       PUSHR   #^M<R0>                 ; Save resignal value
                        6D   D4  0737     984           CLRL    (FP)                    ; Remove stack-frame exception handler
                                 0739     985           $CANEXH_S DESBLK=TERM_BLOCK_TWO ; Un-declare temporary exit handler
          FB66 CF       00   FB  0746     986           CALLS   #0,RESTORE_CONTEXT      ; Go reset user AST/SFM enables
                        01   BA  074B     987           POPR    #^M<R0>                 ; Get the resignal value back and
                             04  074D     988           RET                             ;       return from the Final Handler
                                 074E     989 ;
                                 074E     990 ; Arrive here because the error was generated by a DEBUG signal.
```

```
                              074E     ;
                              074E     FINAL_2:
       1F 00000000'EF   E9   074E             BLBC    DBG$GV_CONTROL,6$            ; Only SIGNAL if testable DEBUG
   04   04 A2   03  00   ED   0755             CMPZV   #STS$V_SEVERITY,#STS$S_SEVERITY,4(R2),#STS$K_SEVERE ; Fatal ?
                    0A   13   075B             BEQL    5$                           ; If so, signal condition
    00028362 8F   04 A2   D1   075D             CMPL    4(R2),#DBG$_INTERR           ; Check for either of the two
                    0D   12   0765             BNEQ    6$                           ;  'DEBUG internal coding error'
         00028352 8F     DD   0767     5$:      PUSHL   #DBG$_SUPERDEBUG             ; Get special signal for SUPERDEBUG
      00000000'GF   01   FB   076D             CALLS   #1,G^LIB$SIGNAL              ; Alert the superdebugger
            44 04 A2     E9   0774     6$:      BLBC    4(R2),FINAL_4                ; Exit, but allow DEBUG to continue
                  008D   31   0778             BRW     FINAL_5                      ;       if message is 'INFORMATION'
                              077B
                              077B     FINAL_3:
    0000046C 8F   04 A2   D1   077B             CMPL    4(R2),#SS$_DEBUG             ; Is this the DEBUG exception ?
                    37   13   0783             BEQL    FINAL_4                      ; Yes -  UNWIND to DEBUG command level
       1B 00000000'EF   05   E2   0785             BBSS    #DBG$V_CONTROL_FAIL,DBG$GV_CONTROL,8$    ; Set failure flag
         00028322 8F     DD   078D             PUSHL   #DBG$_DBGERR                 ; Message blaming DEBUG for the error
                    01   DD   0793             PUSHL   #1                           ; Number of parameters
                    00   DD   0795             PUSHL   #0                           ; No facility string
              08CE'CF    9F   0797             PUSHAB  W^DBG$OUT_MESSAGE            ; Action routine name to output message
                 08 AE   9F   079B             PUSHAB  8(SP)                        ; Address of argument list
      00000000'GF   03   FB   079E             CALLS   #3,G^SYS$PUTMSG              ; Get message formatted and output
                 5E   08  C0   07A5             ADDL2   #8,SP                        ; Remove temporary argument list
       0D 00000000'EF     E9   07A8     8$:      BLBC    DBG$GV_CONTROL,FINAL_4       ; Are we a testable DEBUG ?
         00028352 8F     DD   07AF             PUSHL   #DBG$_SUPERDEBUG             ; Yes - get special signal
      00000000'GF   01   FB   07B5             CALLS   #1,G^LIB$SIGNAL              ; Alert the superdebugger
                              07BC     ;
                              07BC     ; The messages are all out. Unless the exit flag is set, do end-of-command
                              07BC     ; proces_ing and unwind the stack to the caller of the command processor,
                              07BC     ; (or whoever established DBG$FINAL_HANDL as the exception handler)
                              07BC     ; and return a continue code.
                              07BC     ;
                              07BC     FINAL_4:
    70 00000000'EF   04   E0   07BC             BBS     #DBG$V_CONTROL_EXIT,DBG$GV_CONTROL,FINAL_6 ; EXIT if flag is set
  50   00010000 8F   02   C5   07C4             MULL3   #2, #65536, R0               ; Get DEBUG facility code in R0
     50   000010B0 8F     C0   07CC             ADDL2   #SHR$_READERR, R0            ; Change SHR$_READERR to DBG$_READERR
               50   04    C8   07D3             BISL2   #^X0004, R0                  ; Set the fatal bit on.
            50   04 A2    D1   07D6             CMPL    4(R2), R0                    ; If the message is DBG$_READERR
                    0A   13   07DA             BEQL    FINAL_4_1
    00028138 8F   04 A2   D1   07DC             CMPL    4(R2), #DBG$_INPREADERR      ; Keypad input error?
                    09   12   07E4             BNEQ    FINAL_4_2                    ; No, continue
                              07E6     FINAL_4_1:
       14    00000000'EF  D1   07E6             CMPL    DBG$GL_READERR_CNT, #20      ; Tried 20 times, get the same error
                    57   18   07ED             BGEQ    FINAL_7                      ; Yes, force exit
                              07EF     FINAL_4_2:
      00000000'EF   00   FB   07EF             CALLS   #0,DBG$END_OF_LINE           ; Clean up DEBUG internal status
            50   08 AC    D0   07F6             MOVL    8(AP),R0                     ; Get address of mechanism array
                 0C A0    D4   07FA             CLRL    CHF$L_MCH_SAVR0(R0)          ; Make sure returned value is 0 !!
                              07FD             $UNWIND_S                            ; Unwind to caller of the routine
                              0808                                                  ;       that declared this handler
                              0808     FINAL_5:
                 50   01  3C   0808             MOVZWL  #SS$_CONTINUE,R0             ; Return status "CONTINUE"
                 23 53    E8   080B             BLBS    R3,12$                       ; Restore registers on user exit
         00000000'EF      D5   080E             TSTL    DBG$GL_SCREEN_ERROR          ; Do not purge type-ahead if error msg
                    0F   12   0814             BNEQ    11$                          ;       went to a screen display
              0B 04 A2    E8   0816             BLBS    4(R2),11$                    ; Do not purge type-ahead if severity
 00000004'EF    20000000 8F  C8   081A             BISL2   #RAB$M_PTA,DBG$GL_INPRAB+RAB$L_ROP    ;   is INFO or SUCCESS
```

```
    00000004'EF    80000000 8F    CA  0825   1048 11$:    BICL2    #RAB$M_CCO,DBG$GL_OUTPRAB+RAB$L_ROP     ; Un-cancel Ctrl-O
                                  04  0830   1049         RET                                  ; Return to exception mechanism
                         FDA4     31  0831   1050 12$:    BRW      RETURN_TO_USER              ; Go restore user context
                                      0834   1051
                                      0834   1052
                                      0834   1053 FINAL_6:
                  50     04 A2    D0  0834   1054         MOVL     4(R2),R0                    ; Unrecoverable error - get code
             50    03     00   04 F0  0838   1055         INSV     #4,#0,#3,R0                 ; Change severity to FATAL
                                      083D   1056         $EXIT_S  R0                          ;  and take an exit.
                                      0846   1057
                                      0846   1058 FINAL_7:
              00000000'EF    10   88  0846   1059         BISB2    #DBG$M_CONTROL_EXIT,DBG$GV_CONTROL; Set Exit bit on
              50   00028128 8F    D0  084D   1060         MOVL     #DBG$_READERR, R0           ; Set the exit status
             50    03     00   04 F0  0854   1061         INSV     #4,#0,#3,R0                 ; Change severity to FATAL
                                      0859   1062         $EXIT_S  R0                          ;  and take an exit.
```

```
                                    0862   1064 PSEUDO_SIGNAL:
        00000B0E'EF     00     FB   0862   1065          CALLS   #0,disable_ssi
00000004'EF   20000000 8F      C8   0869   1066          BISL2   #RAB$M_PTA,DBG$GL_INPRAB+RAB$L_ROP      ; Purge type-ahead
        00000365'EF     5D     D0   0874   1067          MOVL    FP,USER_FP                 ; Save user's frame pointer
        00000369'EF     6D     D0   087B   1068          MOVL    (FP),HANDLER               ; Save pointer to stack handler
        50   00000000'EF       9E   0882   1069          MOVAB   DBG$RUNFRAME,R0            ; Restore
              50    04 A0      DE   0889   1070          MOVAL   DBG$L_USER_REGS(R0),R0     ;  user registers
                    50  60     7D   088D   1071          MOVQ    (R0),R0                    ;  R0 and R1.
              6D    A1'AF      9E   0890   1072          MOVAB   B^LOCAL_HANDLER,(FP)       ; Set up a one-shot handler
              00028001 8F      DD   0894   1073          PUSHL   #DBG$_NORMAL               ; Get special exception value
        00000000'GF     01     FB   089A   1074          CALLS   #1,G^LIB$SIGNAL            ; SIGNAL back to DEBUG context
                                    08A1   1075
                                    08A1   1076 LOCAL_HANDLER:
                              0FFC  08A1   1077          .WORD   ^M<R2,R3,R4,R5,R6,R7,R8,R9,R10,R11>
        00000B0E'EF     00     FB   08A3   1078          CALLS   #0,disable_ssi
00000365'FF   00000369'EF      D0   08AA   1079          MOVL    HANDLER,@USER_FP           ; Restore user's original handler
              50    04 AC      D0   08B5   1080          MOVL    CHF$L_SIGARGLST(AP),R0     ; Get address of signal argument list
        04 A0     046C 8F      3C   08B9   1081          MOVZWL  #SS$_DEBUG,4(R0)           ; Change signal name to SS$_DEBUG
            51    60    01     C3   08BF   1082          SUBL3   #1,(R0),R1                 ; Get offset to PC in SIGNAL args
     6041   00000361'EF        D0   08C3   1083          MOVL    USER_PC,(R0)[R1]           ; Restore actual User Error PC
                     FCD4      31   08CB   1084          BRW     PRIM_3                     ; Go save context & issue DEBUG prompt
```

```
                                          08CE         .SBTTL  DBG$OUT_MESSAGE - Write SYS$PUTMSG output to DBG$OUTPUT
                                          08CE
                                          08CE  ;++
                                          08CE  ; FUNCTIONAL DESCRIPTION:
                                          08CE  ;      This routine is called as an action routine from EXE$PUTMSG to output
                                          08CE  ;      the string that EXE$PUTMSG has just formatted.  The string is output
                                          08CE  ;      to the logical device DBG$OUTPUT, and a value of zero is returned to
                                          08CE  ;      EXE$PUTMSG preventing it from outputing the message also.
                                          08CE  ;
                                          08CE  ; CALLING SEQUENCE:
                                          08CE  ;      4(AP)   - Address of a quadword string descriptor
                                          08CE  ;
                                          08CE  ; IMPLICIT INPUTS:
                                          08CE  ;      The output RAB for DBG$OUTPUT at location DBG$GL_OUTPRAB
                                          08CE  ;
                                          08CE  ; ROUTINE VALUE:
                                          08CE  ;      R0 = 0  - To inhibit further typing of the message
                                          08CE  ;
                                          08CE  ;--
                                          08CE
                                   0000   08CE         .ENTRY  DBG$OUT_MESSAGE,^M<>
                                          08D0
                  50     04 BC      9E    08D0         MOVAB   @4(AP),R0                     ; Get address of string descriptor
            00000022'EF     60      B0    08D4         MOVW     (R0),dbg$gl_outprab+rab$w_rsz  ; Load string length into RAB
         00000028'EF     04 A0      D0    08DB         MOVL    4(R0),dbg$gl_outprab+rab$l_rbf  ; Load address of string
               3F 00000000'EF       E9    08E3         BLBC    dbg$gb_def_out,1$             ; Check if LOG file being written
            00000155'EF     21      90    08EA         MOVB    #^A"!",log_buf                ; Put "!" into first byte of LOG buf
20    00000028'FF    00000022'EF    2C    08F1         MOVC5   dbg$gl_outprab+rab$w_rsz,@<dbg$gl_outprab+rab$l_rbf>, -
         00000156'EF     00FF 8F          08FD
                                          0905                 #^A" ",#buf_siz-1,log_buf+1      ; Copy message to LOG buffer
00000022'EF    00000022'EF     01   A1    0905         ADDW3   #1,dbg$gl_outprab+rab$w_rsz,dbg$gl_lograb+rab$w_rsz ; Length
      00000028'EF    00000155'EF    9E    0911         MOVAB   log_buf,dbg$gl_lograb+rab$l_rbf ; Load address of string
                                          091C         $PUT    RAB = dbg$gl_lograb           ; Write string to LOG file
                 00000000'EF        D5    0929    1$:  TSTL    dbg$gl_screen_error           ; If errors are redirected to a screen
                          10        13    092F         BEQL    2$                            ;      display, call screen WRITE_ERROR
                 00000000'EF        9F    0931         PUSHAB  dbg$gl_outprab                ;      routine instead of $PUT to out-
            00000000'EF     01      FB    0937         CALLS   #1,dbg$scr_write_error        ;      put the message
                       10 50        E8    093E         BLBS    R0,3$                         ; On success, skip the $PUT call
                                          0941    2$:  $PUT    RAB = dbg$gl_outprab          ; Write string to DBG$OUTPUT
                       03 50        E9    094E         BLBC    R0,4$                         ; Exit if we encountered an error
                          50        D4    0951    3$:  CLRL    R0                            ; Otherwise return 0
                                    04    0953         RET                                   ;
          50    03    00    04      F0    0954    4$:  INSV    #4,#0,#3,R0                   ; Change severity to FATAL
                                          0959         $EXIT_S R0                            ;  and take an exit.
```

```
                        0962  1130          .SBTTL  DBG$CHECK_PROT  - Makes page writable
                        0962  1131  ;++
                        0962  1132  ; FUNCTIONAL DESCRIPTION:
                        0962  1133  ;        Probes a single byte to see whether it can be written.  If it can,
                        0962  1134  ;       the value dbg$k_no_reset is returned.  Otherwise, the SETPRT system
                        0962  1135  ;       service is called to change the protection of the page in which the
                        0962  1136  ;       byte is located to user read/write and we return dbg$k_reset_prt as
                        0962  1137  ;       the value of this routine.  If the system service returns an error,
                        0962  1138  ;       zero is returned.
                        0962  1139  ;
                        0962  1140  ; CALLING SEQUENCE:
                        0962  1141  ;       4(AP)   - The address of the byte to make writeable
                        0962  1142  ;       8(AP)   - The address of a byte in which the system service can put
                        0962  1143  ;                 the previous protection of the page
                        0962  1144  ;
                        0962  1145  ; IMPLICIT INPUTS:
                        0962  1146  ;       NONE
                        0962  1147  ;
                        0962  1148  ; IMPLICIT OUTPUTS:
                        0962  1149  ;       NONE
                        0962  1150  ;
                        0962  1151  ; ROUTINE VALUE:
                        0962  1152  ;       dbg$k_no_reset  - Protection was already writeable, no change made
                        0962  1153  ;       dbg$k_reset_prt - Protection changed, old protection stored
                        0962  1154  ;       0               - Error in system service call
                        0962  1155  ;
                        0962  1156  ; SIDE EFFECTS:
                        0962  1157  ;       NONE
                        0962  1158  ;--
                        0962  1159
                  0000  0962  1160          .ENTRY  DBG$CHECK_PROT,^M<>
                        0964  1161
04 BC    01    00    0D 0964  1162          PROBEW  #0,#1,@4(AP)            ; See if this byte can be written
               04    13 0969  1163          BEQL    1$                      ; No, must change protection
         50    01    D0 096B  1164          MOVL    #dbg$k_no_reset,R0      ; Yes, set return value
                     04 096E  1165          RET                             ;  to no change, and return
                        096F  1166
            04 AC    DD 096F  1167  1$:     PUSHL   4(AP)                   ; Get address passed as argument
            04 AC    DD 0972  1168          PUSHL   4(AP)                   ; Same address for end of area
         50    5E    D0 0975  1169          MOVL    SP,R0                   ; Save stack address
                        0978  1170          $SETPRT_S INADR=(R0),PROT=#prt$c_uw,PRVPRT=@8(AP); Change protection
            04 50    E9 098E  1171          BLBC    R0,2$                   ; Return error if service failed
         50    02    D0 0991  1172          MOVL    #dbg$k_reset_prt,R0     ; Service succeeded, set return value
                     04 0994  1173          RET                             ; And return
                        0995  1174
               50    D4 0995  1175  2$:     CLRL    R0                      ; Set error return value
                     04 0997  1176          RET
                        0998  1177
```

```
                         0998            .SBTTL  DBG$REDO_PROT   - Sets page to read only
                         0998      ;++
                         0998      ; FUNCTIONAL DESCRIPTION:
                         0998      ;       Sets the protection of a page to a specified protection.
                         0998      ;
                         0998      ; CALLING SEQUENCE:
                         0998      ;       4(AP)   - Address of byte whose protection must be changed
                         0998      ;       8(AP)   - Address of byte which contains the new protection
                         0998      ;
                         0998      ; IMPLICIT INPUTS:
                         0998      ;       NONE
                         0998      ;
                         0998      ; OUTPUTS:
                         0998      ;       NONE
                         0998      ;
                         0998      ; IMPLICIT OUTPUTS:
                         0998      ;       NONE
                         0998      ;
                         0998      ; ROUTINE VALUE:
                         0998      ;       NONE
                         0998      ;
                         0998      ; SIDE EFFECTS:
                         0998      ;       SIGNAL "DBG$_NOWPROT" if page cannot be write protected.
                         0998      ;--
                         0998
                   0000  0998            .ENTRY  DBG$REDO_PROT,^M<>        ; Null entry mask
                         099A
            04 AC    DD  099A            PUSHL   4(AP)                     ; Get address passed as argument
            04 AC    DD  099D            PUSHL   4(AP)                     ; Same address for end of area
         50    5E    D0  09A0            MOVL    SP,R0                     ; Save stack address
      51    08 BC    9A  09A3            MOVZBL  @8(AP),R1                 ; Get protection of this page
                         09A7            $SETPRT_S INADR=(R0),PROT=R1      ; Reset protection
            0D 50    E8  09B8            BLBS    R0,1$                     ; Return if service succeeded
        000284C4 8F  DD  09BB            PUSHL   #dbg$_nowprot             ; If not, tell user that protection
   00000000'GF   01  FB  09C1            CALLS   #1,G^LIB$SIGNAL           ; Resetting did not work
                     04  09C8      1$:   RET                               ; And return
```

```
                                09C9  1216 fix_up_addresses:
     0000001F'EF    F92A CF   9E 09C9  1217         MOVAB   term_handler,fix_1        ; [TEMP]
  00000027'EF   00000017'EF   9E 09D2  1218         MOVAB   term_reason,fix_2         ; [TEMP]
     0000002F'EF    F8D0 CF   9E 09DD  1219         MOVAB   restore_context,fix_3     ; [TEMP]
  00000037'EF   00000017'EF   9E 09E6  1220         MOVAB   term_reason,fix_4         ; [TEMP]
  00000000'EF   00000000'EF   9E 09F1  1221         MOVAB   dbg$runframe,dbg$gl_runframe
                              05 09FC  1222         RSB
                                 09FD  1223
```

```
09FD  ; *****SSI
09FD  ;
09FD  ; Abstract:
09FD  ;
09FD  ; In VAX DEBUG, watchpoints are implemented by write-protecting the page
09FD  ; containing the watched variable.  An access violation on that page signals
09FD  ; to DEBUG that the watched variable may be changed.  The problem with this
09FD  ; implementation is that it can cause system services that write to locations
09FD  ; on the write-protected page to fail.
09FD  ;
09FD  ; The way we have solved this problem is to intercept system services.  We have
09FD  ; changed the System Service vector to jump into intercept code, which then
09FD  ; calls a interception DEBUG routine.  In the DEBUG routine, we unprotect the
09FD  ; write-protected page and set bit 15 of the saved PSW in the system service
09FD  ; call frame on the stack. The system service then executes.  When the system
09FD  ; service returns, the bit in the saved PSW caused a reserved operand fault
09FD  ; which DEBUG catches.  DEBUG can then check for changes to the watched
09FD  ; variables and reset the page protections.
09FD  ;
09FD  ; In DEBUG, the code itself to take to implement this scheme is not much.
09FD  ; The difficulty is to put all the interactions together and make it all to
09FD  ; work properly.  Both DEBUG and System Service Intercept code are highly
09FD  ; re-entriant in an unpredicatable way.  System service can originated
09FD  ; from user program, from DBG/TDBG or from SDBG. System service can call
09FD  ; system service.  DEBUG has it own events (Break points, Stepping, Go,
09FD  ; RET, etc.) at DBG/TDBG and SDBG levels.  The communication between the levels
09FD  ; is important (in the past, TDBG/SDBG acts quite seperately), the orderring of
09FD  ; the instruction sequences is important.  It is likely things are working
09FD  ; fine in 2 levels' interactions (user and DBG), one should really test
09FD  ; 3 levels interactions by hand (user, TDBG and SDBG).
09FD  ;
09FD  ; DBGSSISHR.EXE is a priveleged shareable image at the moment which sets up
09FD  ; the system service interception.  This is the communication path between
09FD  ; user program, DBG/TDBG, and SDBG.  It is important to call this image
09FD  ; to find out what are the others doing at the moment and to tell the others
09FD  ; what am I doing at the moment.  It is not necessary to activate the
09FD  ; interception each time this image is called.  This image is intended to be
09FD  ; an unsupported system service in the future (or never will be).
09FD  ; In the meantime, this image is part of the DEBUG source.  This image runs
09FD  ; in kernal mode, so any changes made to this image should be tested on
09FD  ; stand alone machine.
09FD  ;
09FD  ;
09FD  ; There are things still not working correctly:
09FD  ;
09FD  ; 1. If one sets watch points in both TDBG and SDBG (interceptions are
09FD  ;    active), system service is originated from user:
09FD  ;
09FD  ;    user          dbg_ssi_routine          sdbg_ssi_routine
09FD  ;    sys$xxx  --> sees it (set bit 15)  --> sees it (bit 15 set)  -->:
09FD  ;                                                                   :
09FD  ;             <-- RET     (bit 15 off,  <-- RET     (bit 15 set)  <--V
09FD  ;                          t-bit over)
09FD  ;
09FD  ;    At each level, normal DEBUG interactions are going on.  The problem
09FD  ;    here is after sdbg_ssi_routine is called, bit 15 is off (where it
09FD  ;    should have been set), SDBG went into a loop.
```

```
                                    09FD  ;
                                    09FD  ;  2. If one sets same watch point on a user variable from both TDBG and SDBG.
                                    09FD  ;     This variable is changed by a system service originated from user.
                                    09FD  ;     Because the problem I mentioned above, I have changed the picture
                                    09FD  ;     a bit, so the SDBG won't go into a loop:
                                    09FD  ;
                                    09FD  ;    user          dbg_ssi_routine            sdbg_ssi_routine
                                    09FD  ;    sys$xxx  --> sees it (set bit 15)  --> sees it (pass)        -->|
                                    09FD  ;                                                                    |
                                    09FD  ;             <-- RET      (bit 15 off,  <-- RET      (pass)       <--V
                                    09FD  ;                           t-bit over)
                                    09FD  ;
                                    09FD  ;      Now the problem is not be able to report the watched variable correctly
                                    09FD  ;      in this case.  (I consider this is a feature for now).
                                    09FD  ;
                                    09FD  ;  3. One can step into user program from SDBG level, this can confuse the
                                    09FD  ;     things.
                                    09FD  ;
                                    09FD  ;  4. Unknown problems?
                                    09FD  ;
                                    09FD
                                    09FD  ; Main interface to enable the intercept system service.
                                    09FD  ;
                              0000  09FD        .ENTRY  ENABLE_SSI,^M<>
          00000000'8F     01   D1   09FF        cmpl    #1,#dbg$gl_3b_system     ; VMS 4 system? (link flag check)
                          01   13   0A06        beql    enable_ssi_3b            ; Yes, next check
                               04   0A08        ret                              ; No, simply return
                                    0A09  enable_ssi_3b:
          00000000'8F     01   D1   0A09        cmpl    #1,#dbg$gl_setssi        ; VMS 4 system linked with
                                    0A10                                         ;  DBGSSISHR.EXE? (link flag check)
                          01   13   0A10        beql    enable_start             ; Yes, things start to happen
                               04   0A12        ret                              ; No, simply return
                                    0A13  ENABLE_START:
                          01   BB   0A13        PUSHR   #^M<R0>                  ; R0 is used randomly in DBGSTART
                                    0A15                                         ;  for purpose, save it to be safe
               00000004'EF     D4   0A15        CLRL    DBG_ONCE_ONLY_CNT        ; Since we are leaving DEBUG, clear
                                    0A1B                                         ;  this re-entriant count
               00000BC9'EF     16   0A1B        JSB     TRIGGER_SSI              ; Is any watch point active?
       6C 00000000'EF     01   E0   0A21        BBS     #DBG$V_CONTROL_SDBG,DBG$GV_CONTROL,2$; If SDBG is running
                                    0A29
                                    0A29  ; DBG/TDBG is running now.
                                    0A29  ;
  00000008'EF    03000300 8F   D0   0A29        MOVL    #^X03000300,DBG_SETUP    ; Initialize the variable, from
                                    0A34                                         ;  left to right, user mode, not
                                    0A34                                         ;  active, priority 3, SSI disabled.
               00000000'EF     D5   0A34        TSTL    DBG_SSI_CNT              ; Have we intercepted before?
                                    0A3A                                         ;  (DBG_SSI_ROUTINE called?)
                          0B   13   0A3A        BEQL    1$                       ; No
  00000015'EF    00000016'EF   88   0A3C        BISB2   SAVE_SSI_STATE,DBG$GV_SSI_CONTROL; Yes, merge (OR) running
                                    0A47                                         ;  status from intercept code in P0,
                                    0A47                                         ;  we got to make sure the info. has
                                    0A47                                         ;  flowed through all levels during
                                    0A47                                         ;  one service call, regardless the
                                    0A47                                         ;  interactions happen in the back.
  0000000A'EF    00000015'EF   88   0A47  1$:   BISB2   DBG$GV_SSI_CONTROL,DBG_SETUP+2; Merge (OR) again into state
                                    0A52                                         ;  vector 3rd byte now
          09 00000014'EF       E8   0A52        BLBS    DBG$GB_SET_SSI_CNT,11$   ; Any watch pointing active at this
```

```
                                 0A59                                            ;  level?
        0000000A'EF     04   8A  0A59          BICB2   #DBG$M_SSI_ROUTINE_3,DBG_SETUP+2; No, Tell the 3rd bit in 3rd
                                 0A60                                            ;  byte in state vector that priority
                                 0A60                                            ;  3 is not active
                        07   11  0A60          BRB     12$
        0000000A'EF     04   88  0A62     11$: BISB2   #DBG$M_SSI_ROUTINE_3,DBG_SETUP+2; Yes, Tell the 3rd bit in 3rd
                                 0A69                                            ;  byte in state vector that priority
                                 0A69                                            ;  3 is active
   00000008'EF    00000014'EF    88  0A69     12$: BISB2   DBG$GB_SET_SSI_CNT,DBG_SETUP; Now, finally set the enable/disable
                                 0A74                                            ;  bit depending on whether the watch
                                 0A74                                            ;  point is set or not
                  00000008'EF    9F  0A74          PUSHAB  SAVE_STATE            ; Save old state, not used here
                  00000000'EF    9F  0A7A          PUSHAB  DBG_ROUTINE_ID        ; Must keep this ID around, retunred
                                 0A80                                            ;  ID value from SSI_USS
                  00000C22'GF    9F  0A80          PUSHAB  G^DBG_SSI_ROUTINE     ; user supplied routine to be called
                                 0A86                                            ;  at the time system service is
                                 0A86                                            ;  intercepted
                  00000008'EF    DD  0A86          PUSHL   DBG_SETUP             ; Enable/Disable DEBUG routine
        00000000'GF     04   FB  0A8C          CALLS   #4,G^SSI_USSU         ; Invoke routine in privileged library
                                 0A93                                            ;  to setup intercept system service
                        6A   11  0A93          BRB     4$                    ; Join the common code
                                 0A95
                                 0A95
                                 0A95   ; SDBG is running now.
                                 0A95   ;
                                 0A95   2$:
   0000000C'EF    03000400 8F    D0  0A95          MOVL    #^X03000400,SDBG_SETUP  ; Initialize the variable, from left
                                 0AA0                                            ;   to right, user mode, not active,
                                 0AA0                                            ;   priority 4, SSI disabled
                  00000000'EF    D5  0AA0          TSTL    DBG_SSI_CNT           ; Have intercept before?
                        0B   13  0AA6          BEQL    3$                    ; No
   00000015'EF    00000016'EF    88  0AA8          BISB2   SAVE_SSI_STATE,DBG$GV_SSI_CONTROL; Yes, merge (OR) running
                                 0AB3                                            ;   status from intercept code in P0
   0000000E'EF    00000015'EF    88  0AB3      3$: BISB2   DBG$GV_SSI_CONTROL,SDBG_SETUP+2; Merge (OR) again into state
                                 0ABE                                            ;   vector
               09 00000014'EF    E8  0ABE          BLBS    DBG$GB_SET_SSI_CNT,31$  ; Any watch pointing active at this
                                 0AC5                                            ;   level?
        0000000E'EF     08   8A  0AC5          BICB2   #DBG$M_SSI_ROUTINE_4,SDBG_SETUP+2; No
                        07   11  0ACC          BRB     32$
        0000000E'EF     08   88  0ACE     31$: BISB2   #DBG$M_SSI_ROUTINE_4,SDBG_SETUP+2; Yes
   0000000C'EF    00000014'EF    88  0AD5     32$: BISB2   DBG$GB_SET_SSI_CNT,SDBG_SETUP; Finally, enable/disable SSI
                  00000008'EF    9F  0AE0          PUSHAB  SAVE_STATE            ; Save old state, not used here
                  00000004'EF    9F  0AE6          PUSHAB  SDBG_ROUTINE_ID       ; Must keep this ID around, retunred
                                 0AEC                                            ;  ID value from SSI_USS
                  00000C22'GF    9F  0AEC          PUSHAB  G^DBG_SSI_ROUTINE     ; user supplied routine to be called
                                 0AF2                                            ;  at the time system service is
                                 0AF2                                            ;  intercepted
                  0000000C'EF    DD  0AF2          PUSHL   SDBG_SETUP            ; Enable/Disable SDBG routine
        00000000'GF     04   FB  0AF8          CALLS   #4,G^SSI_USSU         ; Invoke routine in privileged library
                                 0AFF                                            ;  to setup intercept system service
                                 0AFF     4$:
                     09 50   E8  0AFF          BLBS    R0,5$                 ; Test to see if SSI_USS failed
                                 0B02          $EXIT_S R0                    ; Yes, out!!!
                                 0B0B
                                 0B0B     5$:
                        01   BA  0B0B          POPR    #^M<R0>               ; Pop R0, RET
                             04  0B0D          RET
```

```
                                   0B0E  1396
                                   0B0E  1397 ; Main interface to disable the intercept system service.
                                   0B0E  1398 ; NOTE: DEBUG interception routine is always not active.  SSI is enabled
                                   0B0E  1399 ; only if there is a watch point set.
                                   0B0E  1400 ;
                              0000 0B0E  1401         .ENTRY  DISABLE_SSI,^M<>
      00000000'8F    01    D1      0B10  1402         cmpl    #1,#dbg$gl_3b_system     ; VMS 4 system? (link flag check)
                     01    13      0B17  1403         beql    disable_ssi_3b           ; Yes, next check
                     04            0B19  1404         ret                              ; No, simply return
                                   0B1A  1405 disable_ssi_3b:
      00000000'8F    01    D1      0B1A  1406         cmpl    #1,#dbg$gl_setssi        ; VMS 4 system linked with
                                   0B21  1407                                          ;  DBGSSISHR.EXE? (link flag check)
                     01    13      0B21  1408         beql    disable_start            ; Yes, things start to happen
                     04            0B23  1409         ret                              ; No, simply return
                                   0B24  1410 DISABLE_START:
                     03    BB      0B24  1411         PUSHR   #^M<R0,R1>
            00000004'EF    D6      0B26  1412         INCL    DBG_ONCE_ONLY_CNT        ; Keep track of re-entriant times
            00000BC9'EF    16      0B2C  1413         JSB     TRIGGER_SSI              ; Is any watch point active?
    37 00000000'EF   01    E0      0B32  1414         BBS     #DBG$V_CONTROL_SDBG,DBG$GV_CONTROL,2$
                                   0B3A  1415                                          ; If SDBG is running
                                   0B3A  1416
                                   0B3A  1417 ; DBG or TDBG is running
 00000008'EF    03000300 8F    D0  0B3A  1418         MOVL    #^X03000300,DBG_SETUP    ; Initialize the variable, from
                                   0B45  1419                                          ;    left to right, user mode, not
                                   0B45  1420                                          ;    active, priority 3, SSI disabled
 00000008'EF    00000014'EF    88  0B45  1421         BISB2   DBG$GB_SET_SSI_CNT,DBG_SETUP; Enable/Disable SSI depending on
                                   0B50  1422                                          ; whether watch point is set or not
            00000008'EF    9F      0B50  1423         PUSHAB  SAVE_STATE               ; Save the old state, must remember
                                   0B56  1424                                          ;  the state when DEBUG is first time
                                   0B56  1425                                          ;  entered
            00000000'EF    9F      0B56  1426         PUSHAB  DBG_ROUTINE_ID           ; Must keep this ID around, retunred
            00000C22'GF    9F      0B5C  1427         PUSHAB  G^DBG_SSI_ROUTINE        ; user supplied routine to be called
                                   0B62  1428                                          ;  at the time system service is
                                   0B62  1429                                          ;  intercepted
                                   0B62  1430                                          ; ID value from SSI_USS
            00000008'EF    DD      0B62  1431         PUSHL   DBG_SETUP                ; Setup the SSI_USS
      00000000'GF    04    FB      0B68  1432         CALLS   #4,G^SSI_USSU            ; Invoke routine in privileged library
                                   0B6F  1433                                          ;  to setup intercept system service
                     35    11      0B6F  1434         BRB     4$
                                   0B71  1435
                                   0B71  1436 ; SDBG is running
                                   0B71  1437 2$:
 0000000C'EF    03000400 8F    D0  0B71  1438         MOVL    #^X03000400,SDBG_SETUP   ; Initialize the variable, from left
                                   0B7C  1439                                          ;   to right, user mode, not active,
                                   0B7C  1440                                          ;   priority 4, SSI disabled
 0000000C'EF    00000014'EF    88  0B7C  1441         BISB2   DBG$GB_SET_SSI_CNT,SDBG_SETUP; Enable SSI if watch point set
            00000008'EF    9F      0B87  1442         PUSHAB  SAVE_STATE               ; Save the old state, must
            00000004'EF    9F      0B8D  1443         PUSHAB  SDBG_ROUTINE_ID          ; Must keep this ID around, retunred
                                   0B93  1444                                          ;  ID value from SSI_USS
            00000C22'GF    9F      0B93  1445         PUSHAB  G^DBG_SSI_ROUTINE        ; user supplied routine to be called
                                   0B99  1446                                          ;  at the time system service is
                                   0B99  1447                                          ;  intercepted
            0000000C'EF    DD      0B99  1448         PUSHL   SDBG_SETUP               ; Setup the SSI_USS
      00000000'GF    04    FB      0B9F  1449         CALLS   #4,G^SSI_USSU            ; Invoke routine in privileged library
                                   0BA6  1450                                          ;  to setup intercept system service
                                   0BA6  1451 4$:
                  09 50    E8      0BA6  1452         BLBS    R0,5$                    ; Test to see if SSI_USS failed
```

```
                                      0BA9            $EXIT_S RO                    ; Yes, out!!!
                                      0BB2      5$:
          01   00000004'EF       D1   0BB2            CMPL    DBG_ONCE_ONLY_CNT,#1      ; First time enter DEBUG
                            0B   12   0BB9            BNEQ    6$                        ; No
 00000015'EF   00000008'EF       90   0BBB            MOVB    SAVE_STATE,DBG$GV_SSI_CONTROL; Yes, remember its original state
                                      0BC6      6$:
                            03   BA   0BC6            POPR    #^M<R0,R1>
                                 04   0BC8            RET
                                      0BC9
                                      0BC9    ; This routine is used to determine whether a watch point is set or not.
                                      0BC9    ;
                                      0BC9    TRIGGER_SSI::
               00000014'EF       94   0BC9            CLRB    DBG$GB_SET_SSI_CNT        ; Assume there is no watch point active
               00000000'EF       D5   0BCF            TSTL    EVENT$PAGE_QUEUE          ; A list of watched pages is there?
                            4A   13   0BD5            BEQL    3$                        ; No
 00000010'EF   00000000'EF       D0   0BD7            MOVL    EVENT$PAGE_QUEUE,PAGE_ENTRY; Loop through the list
          50   00000000'EF       9E   0BE2      1$:   MOVAB   EVENT$PAGE_QUEUE,R0       ;
          50   00000010'EF       D1   0BE9            CMPL    PAGE_ENTRY,R0             ; End of list?
                            13   13   0BF0            BEQL    2$                        ; Yes
               00000014'EF       96   0BF2            INCB    DBG$GB_SET_SSI_CNT        ; There is one watch point
 00000010'EF   00000010'FF       D0   0BF8            MOVL    @PAGE_ENTRY,PAGE_ENTRY    ; Next
                            DD   11   0C03            BRB     1$
               00000014'EF       95   0C05      2$:   TSTB    DBG$GB_SET_SSI_CNT        ; Any watched page found?
                            14   13   0C0B            BEQL    3$                        ; No
     00000014'EF            01   90   0C0D            MOVB    #1,DBG$GB_SET_SSI_CNT     ; Yes, flag it
               0000000C'EF       9F   0C14            PUSHAB  DUMMY
     00000000'GF            01   FB   0C1A            CALLS   #1,G^SSI_USSK             ; Call the Kernel mode routine to
                                 05   0C21      3$:   RSB                               ;  Set up the interception, if
                                      0C22                                              ;  interception is already setup
                                      0C22                                              ;  call simply returns
                                      0C22
```

```
                                0C22  1485 ; DEBUG Interception routine.
                                0C22  1486 ;
                          0000  0C22  1487         .ENTRY  DBG_SSI_ROUTINE,^M<>
                                0C24  1488 DBG$PSEUDO_SSI::
      6D   00000C61'EF     DE   0C24  1489         MOVAL   DBG_SSI_ROUTINE_HANDLER,(FP)
                                0C2B  1490                                         ; Declare its own stack handler
                                0C2B  1491                                         ;   so primary handler can resignal
                                0C2B  1492                                         ;   DBG$_NORMAL, so stack handler
                                0C2B  1493                                         ;   has a chance to catch this signal
                                0C2B  1494                                         ;   and change it to DBG$_SS_INT
           00000000'EF     D6   0C2B  1495         INCL    DBG_SSI_CNT             ; Mark the fact we see one
  00000016'EF    18 AC     90   0C31  1496         MOVB    24(AP),SAVE_SSI_STATE   ; Get the communication variable
                                0C39  1497                                         ;   at the time this routine is called
                 14 AC     DD   0C39  1498         PUSHL   20(AP)                  ; Pass in Address of the system service
                                0C3C  1499                                         ;   count (this system service may be
                                0C3C  1500                                         ;   nested)
                 10 AC     DD   0C3C  1501         PUSHL   16(AP)                  ; Pass in Address of the system service
                                0C3F  1502                                         ;   RET counc (this system service may
                                0C3F  1503                                         ;   return from SDBG, then TDBG)
                 0C AC     DD   0C3F  1504         PUSHL   12(AP)                  ; FP of the system service
                 08 AC     DD   0C42  1505         PUSHL   8(AP)                   ; AP of the system service
                 04 AC     DD   0C45  1506         PUSHL   4(AP)                   ; System service index
                    05     DD   0C48  1507         PUSHL   #5                      ; # of arguments
           00028001 8F     DD   0C4A  1508         PUSHL   #DBG$_NORMAL            ; A way to get back into DEBUG
      00000000'GF    07    FB   0C50  1509         CALLS   #7,G^LIB$SIGNAL         ; Signal it.
                 50   01   D0   0C57  1510         MOVL    #1,R0                   ; Interception done, return
           00000016'EF     94   0C5A  1511         CLRB    SAVE_SSI_STATE          ; No use for the communication variable
                                0C60  1512                                         ;   clear it, make sure there is no
                                0C60  1513                                         ;   side facts after using it
                           04   0C60  1514         RET
                                0C61  1515
                                0C61  1516 ; DEBUG Interception routine handler
                                0C61  1517 ;
                          0000  0C61  1518         .ENTRY  DBG_SSI_ROUTINE_HANDLER,^M<>
                    F5B9   30   0C63  1519         BSBW    SAVE_USER_CONTEXT_ALWAYS; Save user context
              52   04 AC   D0   0C66  1520         MOVL    CHF$L_SIGARGLST(AP),R2  ; Change DBG$_NORMAL to
  04 A2    00028793 8F     D0   0C6A  1521         MOVL    #DBG$_SS_INT,4(R2)      ; DBG$_SSI_INT
                    F930   31   0C72  1522         BRW     PRIM_4                  ; Act as though its a normal exception
                                0C75  1523
                                0C75  1524         .END    beginhere
```

```
                                                          K 15
DBGSTART                                          15-SEP-1984 23:47:35  VAX/VMS Macro V04-00        Page  39
Symbol table                                       4-SEP-1984 23:59:28  [DEBUG.SRC]DBGSTART.MAR;1        (28)

$$.TMP1                       = 00000001                DBG$L_USER_PSL                  00000044
$$.TMP2                       = 000000EF                DBG$L_USER_R0                   00000004
$$T1                          = 00000000                DBG$L_USER_R1                   00000008
BEGINHERE                       00000000 RG    08       DBG$L_USER_R10                  0000002C
BUF_SIZ                       = 00000100                DBG$L_USER_R11                  00000030
CHF$L_MCHARGLST               = 00000008                DBG$L_USER_R2                   0000000C
CHF$L_MCH_FRAME               = 00000004                DBG$L_USER_R3                   00000010
CHF$L_MCH_SAVR0               = 0000000C                DBG$L_USER_R4                   00000014
CHF$L_SIGARGLST               = 00000004                DBG$L_USER_R5                   00000018
CHF$L_SIG_ARGS                = 00000000                DBG$L_USER_R6                   0000001C
CHF$L_SIG_NAME                = 00000004                DBG$L_USER_R7                   00000020
CLI$A_IMGFILED                = 00000010                DBG$L_USER_R8                   00000024
CLI$A_IMGHDADR                = 0000000C                DBG$L_USER_R9                   00000028
CLI$V_DBGEXCP                 = 00000010                DBG$L_USER_REGS                 00000004
CONST_0                         00000355 R     06       DBG$L_USER_SP                   0000003C
CONST_1                         00000359 R     06       DBG$L_WATCHPT                   00000056
DATA                            00000000 R     05       DBG$L_WATCHPTEN                 0000005A
DBG$B_BPT_INS                   00000060                DBG$M_CONTROL_ALLOCATE        = 00000080
DBG$B_PREV_PRO1                 0000005E                DBG$M_CONTROL_DONE            = 00000040
DBG$B_PREV_PRO2                 0000005F                DBG$M_CONTROL_EXIT            = 00000010
DBG$B_USER_OPCO                 00000040                DBG$M_CONTROL_FAIL            = 00000020
DBG$CHECK_PROT                  00000962 RG    08       DBG$M_CONTROL_KDBG            = 00000004
DBG$C_RUNFR_LEN                 00000065                DBG$M_CONTROL_SCREEN          = 00000800
DBG$END_OF_LINE                 ********    X  00       DBG$M_CONTROL_SDBG            = 00000002
DBG$EXCEPTION_IS_FAULT          ********    X  08       DBG$M_CONTROL_STOP            = 00000200
DBG$EXC_HANDLER                 ********    X  00       DBG$M_CONTROL_TBIT            = 00000400
DBG$FINAL_HANDL                 0000065B RG    08       DBG$M_CONTROL_TDBG            = 00000001
DBG$FLUSHBUF                    ********    X  00       DBG$M_CONTROL_URUN            = 00000008
DBG$GB_CALL_NORMAL_RET          ********    X  00       DBG$M_CONTROL_USER            = 00000100
DBG$GB_DEF_OUT                  ********    X  00       DBG$M_CONTROL_VERSION_4       = 00001000
DBG$GB_SET_SSI_CNT              00000014 RG    06       DBG$M_ENAB_AST                = 00000020
DBG$GB_UNHANDLED_EXC            ********    X  00       DBG$M_ENAB_FEX                = 00000800
DBG$GL_3B_SYSTEM                ********    X  00       DBG$M_SSI_ROUTINE_1           = 00000001
DBG$GL_EXIT_STATUS              0000036D RG    06       DBG$M_SSI_ROUTINE_2           = 00000002
DBG$GL_INPRAB                   ********    X  00       DBG$M_SSI_ROUTINE_3           = 00000004
DBG$GL_LOGRAB                   ********    X  00       DBG$M_SSI_ROUTINE_4           = 00000008
DBG$GL_OUTPRAB                  ********    X  00       DBG$NEWLINE                     ********    X  00
DBG$GL_READERR_CNT              ********    X  08       DBG$OUT_MESSAGE                 000008CE RG    08
DBG$GL_RUNFRAME                 00000000 RG    03       DBG$OUT_NUM_VAL                 ********    X  00
DBG$GL_SCREEN_ERROR             ********    X  08       DBG$PRINT                       ********    X  00
DBG$GL_SCREEN_MODE              ********    X  08       DBG$PSEUDO_EXIT                 0000043F RG    08
DBG$GL_SETSSI                   ********    X  00       DBG$PSEUDO_PROG                 00000434 RG    08
DBG$GV_CONTROL                  ********    X  00       DBG$PSEUDO_SSI                  00000C24 RG    08
DBG$GV_SSI_CONTROL              00000015 RG    06       DBG$PUTMSG                      ********    X  00
DBG$INIT_DEBUG                  ********    X  00       DBG$REDO_PROT                   00000998 RG    08
DBG$INS_OPCODES                 ********    X  00       DBG$REL_MEMORY                  ********    X  00
DBG$K_NO_RESET                = 00000001                DBG$RST_INIT                    ********    X  00
DBG$K_RESET_PRT               = 00000002                DBG$RUNFRAME                    ********    X  00
DBG$K_RUNFR_LEN                 00000065                DBG$SCR_SCREEN_TERM             ********    X  00
DBG$L_BPT_PC                    0000004A                DBG$SCR_WRITE_ERROR             ********    X  08
DBG$L_CALL_ADDR                 00000052                DBG$TERM_HANDLR                 000002F9 RG    08
DBG$L_FRAME_PTR                 0000004E                DBG$THREAD_BPT                  00000615 RG    08
DBG$L_NEXT_LINK                 00000000                DBG$THREAD_RET                  00000632 RG    08
DBG$L_SAVE_FLD                  00000061                DBG$USER_EXIT                   0000018A RG    08
DBG$L_USER_AP                   00000034                DBG$V_AT_FAULT                = 0000000D
DBG$L_USER_FP                   00000038                DBG$V_CONTROL_ALLOCATE        = 00000007
DBG$L_USER_PC                   00000040                DBG$V_CONTROL_DONE            = 00000006
```

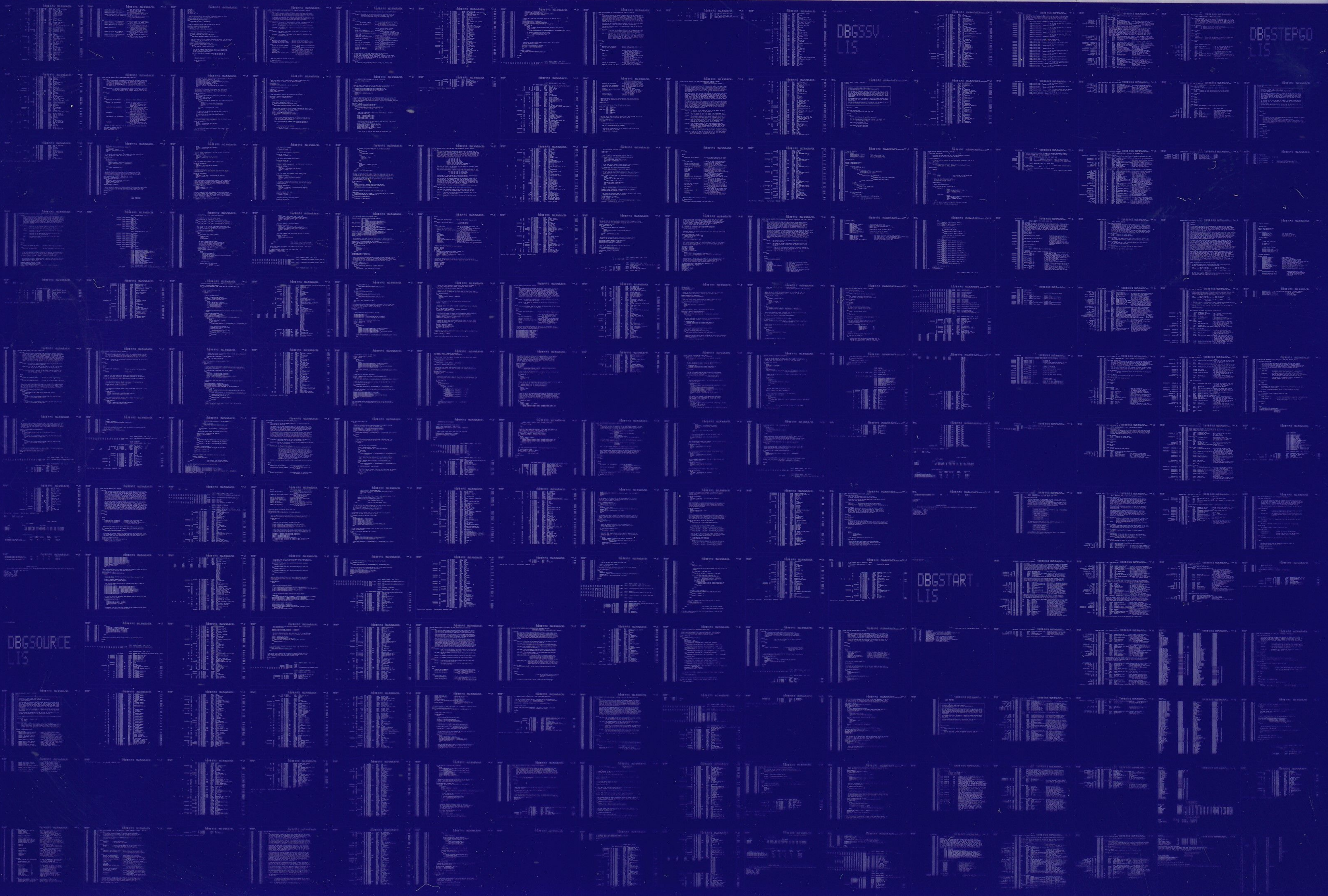
```
                                                       L 15
DBGSTART                                                      15-SEP-1984 23:47:35  VAX/VMS Macro V04-00          Page  40
Symbol table                                                   4-SEP-1984 23:59:28  [DEBUG.SRC]DBGSTART.MAR;1          (28)

DBG$V_CONTROL_EXIT              = 00000004                    FIX_4                             00000037 R     06
DBG$V_CONTROL_FAIL              = 00000005                    FIX_UP_ADDRESSES                  000009C9 R     08
DBG$V_CONTROL_KDBG              = 00000002                    HANDLER                           00000369 R     06
DBG$V_CONTROL_SCREEN            = 0000000B                    IFD$W_CHAN                      = 00000008
DBG$V_CONTROL_SDBG              = 00000001                    IFD$W_FILNAMOFF                 = 00000002
DBG$V_CONTROL_STOP              = 00000009                    LAST_CHANCE                       000003CC R     08
DBG$V_CONTROL_TBIT              = 0000000A                    LIB$SIGNAL                        ********   X   00
DBG$V_CONTROL_TDBG              = 00000000                    LOCAL_HANDLER                     000008A1 R     08
DBG$V_CONTROL_URUN              = 00000003                    LOG_BUF                           00000155 R     06
DBG$V_CONTROL_USER              = 00000008                    MSG_LENGTH                        00000053 R     06
DBG$V_CONTROL_VERSION_4         = 0000000C                    ONE_SHOT_HANDLER                  000000B1 R     08
DBG$V_ENAB_AST                  = 00000005                    PAGE_ENTRY                        00000010 RG    06
DBG$V_ENAB_FEX                  = 0000000B                    PARAM_0                           00000359 R     06
DBG$V_SSI_ROUTINE_1             = 00000000                    PARAM_1                           0000035D R     06
DBG$V_SSI_ROUTINE_2             = 00000001                    PRIMARY_HANDLER                   00000537 RG    08
DBG$V_SSI_ROUTINE_3             = 00000002                    PRIM_3                            000005A2 R     08
DBG$V_SSI_ROUTINE_4             = 00000003                    PRIM_4                            000005A5 R     08
DBG$W_RUN_STAT                    00000048                    PRIM_HANDL_2                      00000539 RG    08
DBG$_DBGERR                     = 00028322                    PRT$C_UW                          ********   X   00
DBG$_EXITSTATUS                 = 0002806B                    PSEUDO_HANDLER                    0000047E R     08
DBG$_INPREADERR                 = 00028138                    PSEUDO_SIGNAL                     00000862 R     08
DBG$_INTERR                     = 00028362                    PSL$V_DV                        = 00000007
DBG$_LASTCHANCE                 = 00028258                    PSL$V_IV                        = 00000005
DBG$_NORMAL                     = 00028001                    RAB$L_RBF                       = 00000028
DBG$_NOWPROT                    = 000284C4                    RAB$L_ROP                       = 00000004
DBG$_READERR                    = 00028128                    RAB$M_CCO                       = 80000000
DBG$_SS_INT                     = 00028793                    RAB$M_PTA                       = 20000000
DBG$_SUPERDEBUG                 = 00028352                    RAB$W_RSZ                       = 00000022
DBG_FACILITY                    = 00000002                    RESET_DEBUG                       000001A9 R     08
DBG_ONCE_ONLY_CNT                 00000004 RG     06          RESTORE_CONTEXT                   000002B1 R     08
DBG_ROUTINE_ID                  = 00000000 RG     05          RETURN_TO_USER                    000005D8 R     08
DBG_SETUP                         00000008 RG     06          ROUTINE_VALUE                     00000000 R     07
DBG_SSI_CNT                       00000000 RG     06          SAVED_AP                          0000003B R     06
DBG_SSI_ROUTINE                   00000C22 RG     08          SAVED_FP                          0000003F R     06
DBG_SSI_ROUTINE_HANDLER           00000C61 RG     08          SAVED_R0                          00000043 R     06
DISABLE_SSI                       00000B0E RG     08          SAVED_R1                          00000047 R     06
DISABLE_SSI_3B                    00000B1A R      08          SAVE_SSI_STATE                    00000016 RG    06
DISABLE_START                     00000B24 R      08          SAVE_STATE                      = 00000008 RG    05
DUMMY                           = 0000000C R      05          SAVE_USER_CONTEXT                 00000217 R     08
ENABLE_SSI                        000009FD RG     08          SAVE_USER_CONTEXT_ALWAYS          0000021F R     08
ENABLE_SSI_3B                     00000A09 R      08          SDBG_ROUTINE_ID                 = 00000004 RG    05
ENABLE_START                      00000A13 R      08          SDBG_SETUP                        0000000C RG    06
END_WRITE_STOR                    00000000 R      04          SETUP                             000000EF R     08
EVENT$PAGE_QUEUE                  ********    X   00          SETUP_EXIT_HANDLER                000001D7 R     08
FAOBUFDESC                        0000004B R      06          SF$L_SAVE_AP                    = 00000008
FAO_BUF                           00000055 R      06          SF$L_SAVE_FP                    = 0000000C
FINAL_2                           0000074E R      08          SF$L_SAVE_PC                    = 00000010
FINAL_3                           0000077B R      08          SHR$_APPENDEDB                  = 00001000
FINAL_4                           000007BC R      08          SHR$_READERR                    = 000010B0
FINAL_4_1                         000007E6 R      08          SS$_BREAK                       = 00000414
FINAL_4_2                         000007EF R      08          SS$_CLIFRCEXT                   = 00000980
FINAL_5                           00000808 R      08          SS$_CONTINUE                    = 00000001
FINAL_6                           00000834 R      08          SS$_DEBUG                       = 0000046C
FINAL_7                           00000846 R      08          SS$_RESIGNAL                    = 00000918
FIX_1                             0000001F R      06          SS$_UNWIND                      = 00000920
FIX_2                             00000027 R      06          SS$_WASCLR                      = 00000001
FIX_3                             0000002F R      06          SSI_USSK                          ********W GX   00
```

```
                                                M 15
DBGSTART                                          15-SEP-1984 23:47:35  VAX/VMS Macro V04-00        Page  41
Symbol table                                       4-SEP-1984 23:59:28  [DEBUG.SRC]DBGSTART.MAR;1         (28)

SSI_USSU                    ********W GX    00
SSI_VAR_BEG                 00000000 RG     05
SSI_VAR_END                 00000200 RG     05
STS$K_SEVERE              = 00000004
STS$M_INHIB_MSG           = 10000000
STS$S_FAC_NO              = 0000000C
STS$S_SEVERITY            = 00000003
STS$V_FAC_NO              = 00000010
STS$V_SEVERITY            = 00000000
SYS$CANEXH                  ********  GX    08
SYS$DCLEXH                  ********  GX    00
SYS$EXIT                    ********  GX    00
SYS$GETMSG                  ********  GX    00
SYS$PUT                     ********  GX    00
SYS$PUTMSG                  ********   X    08
SYS$SETAST                  ********  GX    00
SYS$SETEXV                  ********  GX    08
SYS$SETPRT                  ********  GX    00
SYS$SETSFM                  ********  GX    08
SYS$UNWIND                  ********  GX    00
TERM_BLOCK_ONE              0000001B R      06
TERM_BLOCK_TWO              0000002B R      06
TERM_BUF                    00000255 R      06
TERM_HANDLER                000002F7 R      08
TERM_REASON                 00000017 R      06
TERM_WINDOW_HANDLER         000003FF R      08
TRIGGER_SSI                 00000BC9 RG     08
USER_FP                     00000365 R      06
USER_PC                     00000361 R      06
VIRTUAL_ZERO                00000000 R      02
WINDOW_HANDLER              00000640 R      08
WRITABLE_STOR               00000000 F      03

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

PSECT name                 Allocation            PSECT No.  Attributes
----------                 ----------            ---------  ----------
.  ABS  .                  00000000  (     0.)  00 (  0.)  NOPIC   USR   CON   ABS   LCL NOSHR NOEXE NORD   NOWRT NOVEC BYTE
$ABS$                      00000065  (   101.)  01 (  1.)  NOPIC   USR   CON   ABS   LCL NOSHR   EXE   RD     WRT NOVEC BYTE
DBG$ABS_ZERO               0000000C  (    12.)  02 (  2.)    PIC   USR   CON   REL   LCL   SHR   EXE   RD   NOWRT NOVEC LONG
DBG$GLOBAL                 00000004  (     4.)  03 (  3.)    PIC   USR   CON   REL   LCL NOSHR NOEXE   RD     WRT NOVEC LONG
ZZZ$ZZZZZZ                 00000000  (     0.)  04 (  4.)    PIC   USR   CON   REL   LCL NOSHR NOEXE   RD     WRT NOVEC LONG
DBG$SSI                    00000200  (   512.)  05 (  5.)    PIC   USR   CON   REL   LCL NOSHR NOEXE   RD     WRT NOVEC PAGE
DBG$OWN                    00000371  (   881.)  06 (  6.)    PIC   USR   CON   REL   LCL NOSHR NOEXE   RD     WRT NOVEC LONG
DBG$PLIT                   00000013  (    19.)  07 (  7.)    PIC   USR   CON   REL   LCL   SHR   EXE   RD   NOWRT NOVEC BYTE
DBG$CODE                   00000C75  (  3189.)  08 (  8.)    PIC   USR   CON   REL   LCL   SHR   EXE   RD   NOWRT NOVEC BYTE

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

Phase                  Page faults    CPU Time       Elapsed Time
-----                  -----------    --------       ------------
Initialization                 16     00:00:00.05    00:00:01.23
Command processing             96     00:00:00.82    00:00:03.71
```

```
Pass 1                               499       00:00:17.36    00:00:57.95
Symbol table sort                      8       00:00:02.38    00:00:07.61
Pass 2                               448       00:00:04.56    00:00:14.30
Symbol table output                   31       00:00:00.24    00:00:01.40
Psect synopsis output                  3       00:00:00.03    00:00:00.04
Cross-reference output                 0       00:00:00.00    00:00:00.00
Assembler run totals                1103       00:00:25.46    00:01:26.39

The working set limit was 1950 pages.
95992 bytes (188 pages) of virtual memory were used to buffer the intermediate code.
There were 90 pages of symbol table space allocated to hold 1516 non-local and 63 local symbols.
1524 source lines were read in Pass 1, producing 65 object records in Pass 2.
32 pages of virtual memory were used to define 30 macros.

                                                  +----------------------------+
                                                  ! Macro library statistics !
                                                  +----------------------------+

Macro library name                                 Macros defined
------------------                                 --------------
_$255$DUA28:[DEBUG.OBJ]DBGMSG.MLB;1                       1
_$255$DUA28:[SYS.OBJ]LIB.MLB;1                            1
_$255$DUA28:[SYSLIB]STARLET.MLB;2                        25
TOTALS (all libraries)                                   27

1626 GETS were required to define 27 macros.

There were no errors, warnings or information messages.

MACRO/LIS=LIS$:DBGSTART/OBJ=OBJ$:DBGSTART MSRC$:DBGSTART/UPDATE=(ENH$:DBGSTART)+EXECML$/LIB+LIB$:DBGMSG/LIB
```

0094 AH-BT13A-SE
VAX/VMS V4.0

DIGITAL EQUIPMENT CORPORATION
CONFIDENTIAL AND PROPRIETARY


DBGSSV
LIS

DBGSTEPGO
LIS

DBGSTART
LIS

DBGSOURCE
LIS