```
DDDDDDDDDDD     EEEEEEEEEEEEEEE  BBBBBBBBBBB      UUU         UUU     GGGGGGGGGGG
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 EEEEEEEEEEE      BBBBBBBBBBBB     UUU         UUU GGG
DDD         DDD EEEEEEEEEEE      BBBBBBBBBBBB     UUU         UUU GGG
DDD         DDD EEEEEEEEEEE      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      UUUUUUUUUUUUUUUUU     GGGGGGGGG
DDDDDDDDDDDD    EEEEEEEEEEEEEEE  BBBBBBBBBBBB      UUUUUUUUUUUUUUUUU     GGGGGGGGG
DDDDDDDDDDDD    EEEEEEEEEEEEEEE  BBBBBBBBBBBB      UUUUUUUUUUUUUUUUU     GGGGGGGGG
```

```
DDDDDDDD    BBBBBBBB      GGGGGGGG  EEEEEEEEEE  XX      XX  TTTTTTTTTT
DDDDDDDD    BBBBBBBB      GGGGGGGG  EEEEEEEEEE  XX      XX  TTTTTTTTTT
DD      DD  BB      BB  GG          EE          XX      XX      TT
DD      DD  BB      BB  GG          EE          XX      XX      TT
DD      DD  BB      BB  GG          EE            XX  XX        TT
DD      DD  BB      BB  GG          EE            XX  XX        TT
DD      DD  BBBBBBBB    GG          EEEEEEEE        XX          TT
DD      DD  BBBBBBBB    GG          EEEEEEEE        XX          TT
DD      DD  BB      BB  GG  GGGGGG  EE            XX  XX        TT
DD      DD  BB      BB  GG  GGGGGG  EE            XX  XX        TT
DD      DD  BB      BB  GG      GG  EE          XX      XX      TT          ....
DD      DD  BB      BB  GG      GG  EE          XX      XX      TT          ....
DDDDDDDD    BBBBBBBB      GGGGGG    EEEEEEEEEE  XX      XX      TT          ....
DDDDDDDD    BBBBBBBB      GGGGGG    EEEEEEEEEE  XX      XX      TT          ....


RRRRRRRR    EEEEEEEEEE    QQQQQQ
RRRRRRRR    EEEEEEEEEE    QQQQQQ
RR      RR  EE          QQ      QQ
RR      RR  EE          QQ      QQ
RR      RR  EE          QQ      QQ
RR      RR  EE          QQ      QQ
RRRRRRRR    EEEEEEEE    QQ      QQ
RRRRRRRR    EEEEEEEE    QQ      QQ
RR  RR      EE          QQ  QQ  QQ
RR  RR      EE          QQ  QQ  QQ
RR    RR    EE          QQ    QQ
RR    RR    EE          QQ    QQ
RR      RR  EEEEEEEEEE    QQQQ  QQ
RR      RR  EEEEEEEEEE    QQQQ  QQ
```

```
! DBGEXT.REQ
!
! Version:      'V04-000'
```



```
! WRITTEN BY
!       Rich Title              October 1983
!
! MODIFIED BY
!
!       Robert Conti            November 2, 1983
!       Edward Freedman         December 12, 1983
!
! MODULE FUNCTION
!
!       This module contains the definitions for the control blocks
!       that are used in communications between DEBUG and the
!       ADA multi-tasking run-time system. These same definitions will be
!       extended for use in communication with the PPA multi-tasking
!       system and other run-time systems, at a future time.
```

E X T E R N A L C O N T R O L B L O C K

An "External Control Block" is a data structure that can be used when DEBUG needs to call a routine that is not linked in as part of the DEBUG image.

For example, DEBUG will have commands to support ADA multi-tasking. However, DEBUG has no knowledge of the workings of the ADA mutli-tasking system and the data structures that describe tasks. Instead, DEBUG will call a routine in the ADA multitasking system in the course of processing SHOW TASK, SET TASK, or any other command that requires knowledge about tasks.

There will be a single entry point, ADA$DBGEXT, in the ADA multitasking system which is called by DEBUG. The External Control Block is the only parameter. Similarly, other multitasking run-time systems will have a single entry point, of the form <facility>$DBGEXT, with the entry point taking an External Control Block as its single parameter. In general, the External Control Block can be used as a means of communication with run-time systems that are not part of DEBUG. For example, in debugging the language SCAN we may want to allow the user to set breakpoints on events such as a SCAN pattern-match. The External Control Block will be the data structure that we use to communicate with the SCAN run-time system.

The DBGEXT$V_FACILITY_ID field identifies which run-time system is being called. The VAX/VMS facility code is used. Thus, it is assumed that there will be at most one DBGEXT entry point in the run-time code of any facility. Currently, legal values are the facility codes for ADA, PPA, and SCAN. This field may not actually be looked at (if desired, the run-time system may do a sanity check for the right value).

Since there are several functions we want each run-time system to perform for us, there is a DBGEXT$W_FUNCTION_CODE field which specifies which function is to be performed.

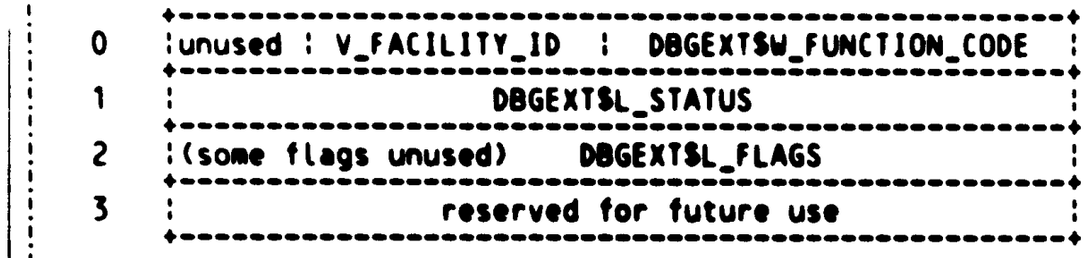
All functions return a status code in the DBGEXT$L_STATUS field. For all functions, there is a DBGEXT$L_FLAGS field which can be used as a bitvector of flags. The exact use of these flags depends on the function.

The use of the remaining fields of the data structure depends upon the "FACILITY_ID" field and upon the "FUNCTION_CODE" field.

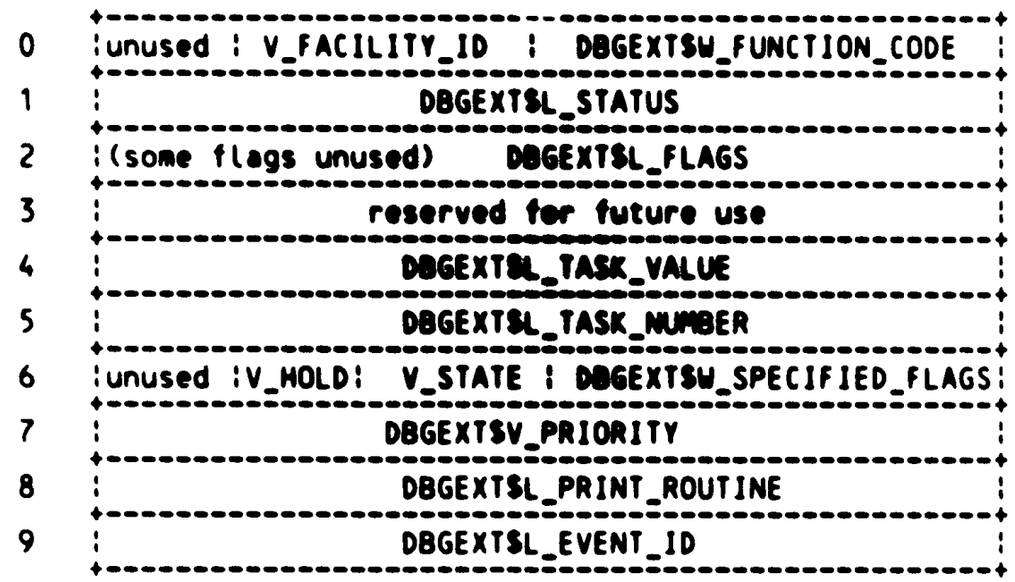
NOTE: DEBUG makes these calls with ASTs disabled. It is required that the run-time code not reenable ASTs during its execution.

The following illustrates the header of an External Control Block.
The fields of an External Control Block are then illustrated
for the case where the "FACILITY_ID" is "ADA".

The following header is common to all External Control Blocks:



The following illustrates the control block when the FACILITY_ID field is "ADA". This control block is used for most functions (some functions, e.g. GET_REGISTERS and SET_REGISTERS use a longer control block, displayed later).



The following fields are present when the "FACILITY_ID" field is "ADA" and the function code is
DBGEXT$K_GET_REGISTERS,
DBGEXT$K_SET_REGISTERS,
DBGEXT$K_SET_ACTIVE.
For all other functions, the smaller block (without the register fields) is passed in.

0	unused			V_FACILITY_ID				DBGEXT$W_FUNCTION_CODE								
1	DBGEXT$L_STATUS															
2	(some flags unused)							DBGEXT$L_FLAGS								
3	reserved for future use															
4	DBGEXT$L_TASK_VALUE															
5	DBGEXT$L_TASK_NUMBER															
6	unused			V_HOLD		V_STATE				DBGEXT$W_SPECIFIED_FLAGS						
7	DBGEXT$V_PRIORITY															
8	DBGEXT$L_PRINT_ROUTINE															
9	DBGEXT$L_EVENT_ID															
10	DBGEXT$L_R0															
11	DBGEXT$L_R1															
12	DBGEXT$L_R2															
13	DBGEXT$L_R3															
14	DBGEXT$L_R4															
15	DBGEXT$L_R5															
16	DBGEXT$L_R6															
17	DBGEXT$L_R7															
18	DBGEXT$L_R8															
19	DBGEXT$L_R9															
20	DBGEXT$L_R10															
21	DBGEXT$L_R11															
22	DBGEXT$L_AP															

```
!  23  !                    DBGEXT$L_FP                    !
      +---------------------------------------------------+
!  24  !                    DBGEXT$L_SP                    !
      +---------------------------------------------------+
!  25  !                    DBGEXT$L_PC                    !
      +---------------------------------------------------+
!  26  !                    DBGEXT$L_PSL                   !
      +---------------------------------------------------+
```

```
!+
!                       CONTROL BLOCK FIELDS
!-

FIELD DBGEXT$HEADER_FIELDS =
    SET
    DBGEXT$W_FUNCTION_CODE      = [ 0,  0, 16, 0],
    DBGEXT$V_FACILITY_ID        = [ 0, 16, 12, 0],
    ! reserved                  = [ 0, 28,  4, 0],
    DBGEXT$L_STATUS             = [ 1,  0, 32, 0],

    DBGEXT$L_FLAGS              = [ 2,  0, 32, 0],
        DBGEXT$V_ALL            = [ 2,  0,  1, 0],%((WHAT WILL ALL DO?-tbs))%
        DBGEXT$V_FULL           = [ 2,  1,  1, 0],%((explain FULL -tbs))%

        DBGEXT$V_PSEUDO_GO      = [ 2,  2,  1, 0],
        ! Pseudo-go is set by the run-time system on return to DEBUG to
        ! indicate that DEBUG must do a pseudo-GO to accomplish the function.
        ! Used only for function SET_ACTIVE (see discussion under SET_ACTIVE).

        DBGEXT$V_NO_HEADER      = [ 2,  3,  1, 0]
        ! Suppresses output of headers on a SHOW_TASK, SHOW_STATISTICS,
        ! or SHOW_DEADLOCKS.

        ! reserved              = [ 0,  4, 28, 0],
        ! reserved              = [ 4,  0, 32, 0],
    TES;


FIELD DBGEXT$ADA_FIELDS =
    SET
    DBGEXT$L_TASK_VALUE                 = [ 4,  0, 32, 0],
    DBGEXT$L_TASK_NUMBER                = [ 5,  0, 32, 0],
    DBGEXT$W_SPECIFIED_FLAGS            = [ 6,  0, 16, 0],
        DBGEXT$V_HOLD_SPECIFIED         = [ 6,  0,  1, 0],
        DBGEXT$V_STATE_SPECIFIED        = [ 6,  1,  1, 0],
        DBGEXT$V_PRIORITY_SPECIFIED     = [ 6,  2,  1, 0],
        ! reserved                     = [ 6,  3, 13, 0],
    DBGEXT$V_STATE                      = [ 6, 16,  4, 0],
        DBGEXT$V_STATE_RUNNING          = [ 6, 16,  1, 0],
        DBGEXT$V_STATE_READY            = [ 6, 17,  1, 0],
        DBGEXT$V_STATE_SUSPENDED        = [ 6, 18,  1, 0],
        DBGEXT$V_STATE_TERMINATED       = [ 6, 19,  1, 0],
    DBGEXT$V_HOLD                       = [ 6, 20,  1, 0],
    ! reserved                         = [ 6, 21, 11, 0],
    DBGEXT$L_PRIORITY                   = [ 7,  0, 32, 0],
        DBGEXT$V_PRIORITY_00            = [ 7,  0,  1, 0],
        DBGEXT$V_PRIORITY_01            = [ 7,  1,  1, 0],
        DBGEXT$V_PRIORITY_02            = [ 7,  2,  1, 0],
        DBGEXT$V_PRIORITY_03            = [ 7,  3,  1, 0],
        DBGEXT$V_PRIORITY_04            = [ 7,  4,  1, 0],
        DBGEXT$V_PRIORITY_05            = [ 7,  5,  1, 0],
        DBGEXT$V_PRIORITY_06            = [ 7,  6,  1, 0],
        DBGEXT$V_PRIORITY_07            = [ 7,  7,  1, 0],
        DBGEXT$V_PRIORITY_08            = [ 7,  8,  1, 0],
        DBGEXT$V_PRIORITY_09            = [ 7,  9,  1, 0],
```

```
        DBGEXT$V_PRIORITY_10            = [ 7, 10,  1, 0],
        DBGEXT$V_PRIORITY_11            = [ 7, 11,  1, 0],
        DBGEXT$V_PRIORITY_12            = [ 7, 12,  1, 0],
        DBGEXT$V_PRIORITY_13            = [ 7, 13,  1, 0],
        DBGEXT$V_PRIORITY_14            = [ 7, 14,  1, 0],
        DBGEXT$V_PRIORITY_15            = [ 7, 15,  1, 0],
        DBGEXT$V_PRIORITY_16            = [ 7, 16,  1, 0],
        DBGEXT$V_PRIORITY_17            = [ 7, 17,  1, 0],
        DBGEXT$V_PRIORITY_18            = [ 7, 18,  1, 0],
        DBGEXT$V_PRIORITY_19            = [ 7, 19,  1, 0],
        DBGEXT$V_PRIORITY_20            = [ 7, 20,  1, 0],
        DBGEXT$V_PRIORITY_21            = [ 7, 21,  1, 0],
        DBGEXT$V_PRIORITY_22            = [ 7, 22,  1, 0],
        DBGEXT$V_PRIORITY_23            = [ 7, 23,  1, 0],
        DBGEXT$V_PRIORITY_24            = [ 7, 24,  1, 0],
        DBGEXT$V_PRIORITY_25            = [ 7, 25,  1, 0],
        DBGEXT$V_PRIORITY_26            = [ 7, 26,  1, 0],
        DBGEXT$V_PRIORITY_27            = [ 7, 27,  1, 0],
        DBGEXT$V_PRIORITY_28            = [ 7, 28,  1, 0],
        DBGEXT$V_PRIORITY_29            = [ 7, 29,  1, 0],
        DBGEXT$V_PRIORITY_30            = [ 7, 30,  1, 0],
        DBGEXT$V_PRIORITY_31            = [ 7, 31,  1, 0],
    DBGEXT$L_PRINT_ROUTINE              = [ 8,  0, 32, 0],
    DBGEXT$L_EVENT_ID                   = [ 9,  0, 32, 0]
    TES;

FIELD DBGEXT$REG_FIELDS =
    SET
    DBGEXT$L_R0                 = [10,  0, 32, 0],
    DBGEXT$L_R1                 = [11,  0, 32, 0],
    DBGEXT$L_R2                 = [12,  0, 32, 0],
    DBGEXT$L_R3                 = [13,  0, 32, 0],
    DBGEXT$L_R4                 = [14,  0, 32, 0],
    DBGEXT$L_R5                 = [15,  0, 32, 0],
    DBGEXT$L_R6                 = [16,  0, 32, 0],
    DBGEXT$L_R7                 = [17,  0, 32, 0],
    DBGEXT$L_R8                 = [18,  0, 32, 0],
    DBGEXT$L_R9                 = [19,  0, 32, 0],
    DBGEXT$L_R10                = [20,  0, 32, 0],
    DBGEXT$L_R11                = [21,  0, 32, 0],
    DBGEXT$L_AP                 = [22,  0, 32, 0],
    DBGEXT$L_FP                 = [23,  0, 32, 0],
    DBGEXT$L_SP                 = [24,  0, 32, 0],
    DBGEXT$L_PC                 = [25,  0, 32, 0],
    DBGEXT$L_PSL                = [26,  0, 32, 0]
    TES;

LITERAL
    DBGEXT$K_HEADER_SIZE        = 4,    ! Size of header in longwords
    DBGEXT$K_ADA_SIZE1          = 10,   ! Size of block for ADA (without regs)
    DBGEXT$K_ADA_SIZE2          = 27,   ! Size of block for ADA (with regs)
    DBGEXT$K_MAX_SIZE           = 27;   ! Max of above sizes

MACRO
    DBGEXT$CONTROL_BLOCK = BLOCK [DBGEXT$K_MAX_SIZE]
                        FIELD ( DBGEXT$HEADER_FIELDS,
```

```
DBGEXT$ADA_FIELDS,
DBGEXT$REG_FIELDS ) %;
```

```
!+
!   Generally, multiple priorities and states are valid as input when calling
!   the ADA run time system but are not valid as output values on return from
!   the call.  Therefore, the following constants are provided for convenience
!   in setting and testing the contents of the fields DBGEXT$V_STATE and
!   DBGEXT$V_PRIORITY.  They define the only possible values of the respective
!   fields when multiple priorities and states are not allowed.
!   Constants for DBGEXT$V_HOLD are provided for completeness.
!-

LITERAL
!    DBGEXT$K_MIN_STATE          = ,     %((superfluous? -tbs))%
!    DBGEXT$K_MAX_STATE          = ,

    DBGEXT$S_STATE              = 4,            ! size of DBGEXT$V_STATE
    DBGEXT$K_STATE_RUNNING      = 1 ^ 0,        ! values for DBGEXT$V_STATE
    DBGEXT$K_STATE_READY        = 1 ^ 1,
    DBGEXT$K_STATE_SUSPENDED    = 1 ^ 2,
    DBGEXT$K_STATE_TERMINATED   = 1 ^ 3,

    DBGEXT$S_HOLD               = 1,            ! size of DBGEXT$V_HOLD
    DBGEXT$K_HOLD               = 1 ^ 0,        ! values for DBGEXT$V_HOLD

    DBGEXT$S_PRIORITY           = 32,           ! size of DBGEXT$V_PRIORITY
    DBGEXT$K_PRIORITY_00        = 1 ^  0,       ! values for DBGEXT$V_PRIORITY
    DBGEXT$K_PRIORITY_01        = 1 ^  1,
    DBGEXT$K_PRIORITY_02        = 1 ^  2,
    DBGEXT$K_PRIORITY_03        = 1 ^  3,
    DBGEXT$K_PRIORITY_04        = 1 ^  4,
    DBGEXT$K_PRIORITY_05        = 1 ^  5,
    DBGEXT$K_PRIORITY_06        = 1 ^  6,
    DBGEXT$K_PRIORITY_07        = 1 ^  7,
    DBGEXT$K_PRIORITY_08        = 1 ^  8,
    DBGEXT$K_PRIORITY_09        = 1 ^  9,
    DBGEXT$K_PRIORITY_10        = 1 ^ 10,
    DBGEXT$K_PRIORITY_11        = 1 ^ 11,
    DBGEXT$K_PRIORITY_12        = 1 ^ 12,
    DBGEXT$K_PRIORITY_13        = 1 ^ 13,
    DBGEXT$K_PRIORITY_14        = 1 ^ 14,
    DBGEXT$K_PRIORITY_15        = 1 ^ 15,
    DBGEXT$K_PRIORITY_16        = 1 ^ 16,
    DBGEXT$K_PRIORITY_17        = 1 ^ 17,
    DBGEXT$K_PRIORITY_18        = 1 ^ 18,
    DBGEXT$K_PRIORITY_19        = 1 ^ 19,
    DBGEXT$K_PRIORITY_20        = 1 ^ 20,
    DBGEXT$K_PRIORITY_21        = 1 ^ 21,
    DBGEXT$K_PRIORITY_22        = 1 ^ 22,
    DBGEXT$K_PRIORITY_23        = 1 ^ 23,
    DBGEXT$K_PRIORITY_24        = 1 ^ 24,
    DBGEXT$K_PRIORITY_25        = 1 ^ 25,
    DBGEXT$K_PRIORITY_26        = 1 ^ 26,
    DBGEXT$K_PRIORITY_27        = 1 ^ 27,
    DBGEXT$K_PRIORITY_28        = 1 ^ 28,
    DBGEXT$K_PRIORITY_29        = 1 ^ 29,
    DBGEXT$K_PRIORITY_30        = 1 ^ 30,
    DBGEXT$K_PRIORITY_31        = 1 ^ 31;
```

FACILITY CODES

The following are the possible values of the DBGEXT$V_FACILITY_ID field.
These correspond to the different run-time system we are
communicating with.

ADA$_FACILITY
PPA$_FACILITY
SCN$_FACILITY

QUES %((-tbs))%
Do PPA and SCAN have facility mnemonics and codes? Are the
above guesses correct?

```
!+
!                       FUNCTION CODES
!
!   The following are the possible values of the DBGEXT$W_FUNCTION_CODE field
!   when the contents of the FACILITY_ID field is ADA$FACILITY.  These
!   correspond to the functions that the ADA run-time system will be asked to
!   perform.
!
!   Summary of the defined Function codes
!
!    DBGEXT$K_MIN_FUNCT          = 1,    ! For CASE bounds
!
! These are used to obtain and convert task values
!    DBGEXT$K_CVT_VALUE_NUM      = 1,
!    DBGEXT$K_CVT_NUM_VALUE      = 2,
!    DBGEXT$K_NEXT_TASK          = 3,
!
! These are used to ask ADA to display task information
!    DBGEXT$K_SHOW_TASK          = 4,
!    DBGEXT$K_SHOW_STATISTICS    = 5,
!    DBGEXT$K_SHOW_DEADLOCK      = 6,
!
! These are used to get and set various attributes of one or more tasks
!       Task state
!    DBGEXT$K_GET_STATE          = 7,
!    DBGEXT$K_GET_ACTIVE         = 8,
!    DBGEXT$K_SET_ACTIVE         = 9,
!    DBGEXT$K_SET_TERMINATE      = 10,
!    DBGEXT$K_SET_HOLD           = 11,
!
!       Task priority
!    DBGEXT$K_GET_PRIORITY       = 12,
!    DBGEXT$K_SET_PRIORITY       = 13,
!    DBGEXT$K_RESTORE_PRIORITY   = 14,
!
!       Task registers
!    DBGEXT$K_GET_REGISTERS      = 15,
!    DBGEXT$K_SET_REGISTERS      = 16,
!
! These are used to control definable events
!    DBGEXT$K_ENABLE_EVENT       = 17,
!    DBGEXT$K_DISABLE_EVENT      = 18,
!
!    DBGEXT$K_MAX_FUNCT          = 18;    ! For CASE bounds
!-
```

```
LITERAL

    ! A minimum task code is defined for CASE statement bounds.
    DBGEXT$K_MIN_FUNCT          = 1,

    !  CVT_VALUE_NUM  takes a task value and converts it to a task number.
    ! INPUT      - The task value is placed in the DBGEXT$L_TASK_VALUE field.
    ! OUTPUT     - The task number is returned in the DBGEXT$L_TASK_NUMBER field.
    !              (If the task does not exist, this function returns
    !              status STS$K_SEVERE).%((TASK DOES NOT EXIST CODE? -tbs))%
    !              %((VALUE IS NOT LEGAL OR ACCVIO? -tbs))%
    DBGEXT$K_CVT_VALUE_NUM      = 1,

    !  CVT_NUM_VALUE  takes a task number and converts it to a task value.
    ! INPUT      - The task number is placed in the DBGEXT$L_TASK_NUMBER field.
    ! OUTPUT     - The task value is returned in the DBGEXT$L_TASK_VALUE field.
    !              (If the task does not exist, this function returns
    !              status STS$K_SEVERE).%((TASK DOES NOT EXIST CODE? -tbs))%
    DBGEXT$K_CVT_NUM_VALUE      = 2,

!  NEXT_TASK  gives a task value and asks ADA to specify the "next" task.
! The ordering of tasks is up to the ADA run-time system.  The only
! requirement on order is that if we start with any task, and repeatedly
! ask for the "next" without giving the user program control in between,
! then we will cycle through all the tasks and return to the task we
! started with.  If selection criteria are imposed, then we will cycle
! through all tasks which match that criteria.
!
! INPUTS     - The task value is placed in the DBGEXT$L_TASK_VALUE field.
!
!              If the TASK_VALUE field is zero (implying the NULL task) the
!              next task will be the main task of the program.
!
!              The ALL flag is ignored, ADA will consider it on by default.
!
!              The set of tasks to cycle through can be restricted by
!              imposing a selection criteria.  The PRIORITY, and/or STATE,
!              and/or HOLD fields can contain values which a task must match
!              to be part of the set (e.g. SHOW TASK/PRI=3/HOLD/STATE=READY).
!              When such a restriction is desired, the DBGEXT$V_xxx_SPECIFIED
!              bits must be set accordingly.  If no restriction is desired,
!              the _SPECIFIED bits must be zero.  A task must match all the
!              criteria which are specified to be part of the set.
```

```
    !%((Multiple PRI and STATE can be given as these are bit fields -tbs))%
    !
    ! OUTPUT    - The "next" task value is returned in DBGEXT$L_TASK_VALUE.
    !
    DBGEXT$K_NEXT_TASK          = 3,

    !  SHOW_TASK  is used to request that ADA display information about a
    ! specified task.
    !
    ! INPUTS    - The task value is placed in the DBGEXT$L_TASK_VALUE field.
    !
    !             The address of a print routine that ADA is to call, to display
    !             the information, is placed in the field DBGEXT$L_PRINT_ROUTINE
    !             (see DBG$PRINT_ROUTINE below).
    !
    !             If the DBGEXT$V_FULL bit is set, more detailed information
    !             is displayed.
    !
    ! OUTPUT    - none.
    !
    DBGEXT$K_SHOW_TASK          = 4,

    !  SHOW_STATISTICS  requests that the ADA run-time system display
    ! statistics about the overall state of the multitasking system.
    !
    ! INPUTS    - The address of a print routine is given in the field
    !             DBGEXT$L_PRINT_ROUTINE.
    !
    !             If the DBGEXT$V_FULL bit is set, more detailed information
    !             is displayed.
    !
    ! OUTPUT    - none.
    !
    DBGEXT$K_SHOW_STAT          = 5,

    !  SHOW_DEADLOCK  requests that the ADA run-time system display information
    ! about deadlocks within the multitasking system.
    !
    ! INPUTS    - The address of a print routine is given in the field
    !             DBGEXT$L_PRINT_ROUTINE.
    !
    !             If the DBGEXT$V_FULL bit is set, more detailed information
    !             is displayed.
    !
    ! OUTPUT    - none.
    !
    DBGEXT$K_SHOW_DEADLOCK      = 6,

    !  GET_STATE  inquires about the "state" and HOLD condition of a task.  The
    ! "state" can be one of RUNNING, READY, SUSPENDED, TERMINATED.
    ! The state codes are defined below.
    !
```

```
!  INPUT      - The task value is placed in the DBGEXT$L_TASK_VALUE field.
!
!  OUTPUTS    - A code representing the state is returned in thex %((V_STATE -tbs))%
!               DBGEXT$W_STATE field.
!
!               The DBGEXT$V_HOLD field is also set if the task is on HOLD.

DBGEXT$K_GET_STATE          = 7,


!  GET_ACTIVE  obtains the task value of the active task.
!  (The active task is that task in whose context (stack and register set)
!  DEBUG is executing.  This is contrasted with the "visible task" --
!  the task whose register set is temporarily in use by DEBUG
!  as a default for the purposes of SHOW CALLS, EXAMINE, etc.).
!
!  INPUTS     - none
!
!  OUTPUT     - The task value of the active task is returned
!               in DBGEXT$L_TASK_VALUE.
!
!  %(( Can the active task be the null task? -tbs))%

DBGEXT$K_GET_ACTIVE         = 8,


!  SET_ACTIVE  requests the run-time system to switch the active
!  task to that given in DBGEXT$L_TASK_VALUE.  The "long form" DBG
!  control block is used.   The registers provided by DEBUG in the control
!  block are those of the (currently) active task.  The run-time
!  system uses these to save the registers of the active task.  It
!  may also modify this register set, (currently only the PC and PSL).
!  When this call returns, DEBUG should use the possibly-modified
!  register values as the active register set.  If the PSEUDO_GO bit
!  is set, DEBUG should then perform the actions of a normal GO,
!  except that ASTs are left disabled.  This "pseudo-GO"
!  will enter special run-time code that will switch-out the
!  currently active task, switch-in the requested active task, and
!  reinvoke DEBUG in that task.   (A special event code is assigned
!  to this "reinvoke DEBUG event".  The reinvokation event signifies
!  to DEBUG that certain components of its state are to be
!  gotten from values saved from DEBUG's prior incarnation, not those
!  at the reinvokation event.  One such saved state component is
!  the "AST enablement" status - whether ASTs were enabled when
!  DEBUG was invoked.)
!  Despite these gyrations, to the user typing
!  DBG> SET TASK/ACTIVE T1, it appears he has entered a simple command
!  immediately followed by a DBG> prompt.
!
!  INPUTS     - The task value of the to-become-active task is set
!               in DBGEXT$L_TASK_VALUE.
!
!               The registers of the (currently) active task are stored in
!               fields DBGEXT$L_R0 through DBGEXT$L_PSL.
!
!  OUTPUTS    - The register set of the new active task, as
```

```
!             modified by the run-time system, in DBGEXT$L_RO
!             through DBGEXT$L_PSL.
!
!             The DBGEXT$V_PSEUDO_GO flag may be set, in which case,
!             DEBUG should perform a "pseudo go" operation.
!
DBGEXT$K_SET_ACTIVE         = 9,

!  SET_TERMINATE  is used to cause ADA to terminate a task.  It is used
! to implement the command SET TASK/TERMINATE.
!
! INPUTS     - The task value is placed in the DBGEXT$L_TASK_VALUE field.
!
!              If the TASK_VALUE field is zero and the ALL flag
!              is set, then the function is done for all tasks.
!
! OUTPUT     - none
!
DBGEXT$K_SET_TERMINATE      = 10,

!  SET_HOLD  is used to put a task on hold or to release a task that was
! previously put on hold.  It is used to implement the command
! SET TASK/HOLD which leaves the state of a task as-is, except that each
! task is marked HOLD.
!
! INPUTS     - The task value is placed in the DBGEXT$L_TASK_VALUE field.
!
!              If the TASK_VALUE field is zero and the ALL flag
!              is set, then the function is done for all tasks.
!
!%(( Will the /ALL selection criteria be used for th' SET_xxx codes? -tbs))%
!
!              The desired status of HOLD is placed into the
!              DBGEXT$V_HOLD field.  (1 => HOLD, 0 => RELEASE)
!
!%((Is the request 1=>1 or 0=>0 legal? -tbs))%
!
! OUTPUT     - none
!
DBGEXT$K_SET_HOLD           = 11,

!  GET_PRIORITY  inquires about the priority of a specified task.
!
! INPUT      - The task value is placed in the DBGEXT$L_TASK_VALUE field.
!
! OUTPUT     - The priority is returned in the DBGEXT$W_PRIORITY field.
!
DBGEXT$K_GET_PRIORITY       = 12,

!  SET_PRIORITY  is used to set the priority of a specified task.
!
! INPUTS     - The task value is placed in the DBGEXT$L_TASK_VALUE field.
```

```
!
!               If the TASK_VALUE field is zero and the ALL flag
!               is set, then the function is done for all tasks.
!
!               The desired priority is placed in the DBGEXT$W_PRIORITY field.
!
!   OUTPUT      - none.
!
    DBGEXT$K_SET_PRIORITY       = 13,

!
!    RESTORE_PRIORITY  is used to restore the priority of a task back
!   to its normal value (as it would be without DEBUG intervention).
!
!   INPUTS      - The task value is placed in the DBGEXT$L_TASK_VALUE field.
!
!               If the TASK_VALUE field is zero and the ALL flag
!               is set, then the function is done for all tasks.
!
!   OUTPUT      - none.
!
    DBGEXT$K_RESTORE_PRIORITY   = 14,

!
!    GET_REGISTERS  is used to obtain the register set of a task.
!
!   INPUT       - The task value is placed in the DBGEXT$L_TASK_VALUE field.
!
!   OUTPUTS     - The register values are returned in the DBGEXT$L_R0
!                 through DBGEXT$L_PSL fields.
!
!   NOTE:       Only DEBUG knows the register set of the active task
!               hence, this call is invalid for the active task.
!               A return status of STS$K_SEVERE is returned.
!
    DBGEXT$K_GET_REGISTERS      = 15,

!
!    SET_REGISTERS  is used to change the register values of a task.
!   This may be needed, for example, in SET TASK T;DEPOSIT R5 = 0;GO
!
!   INPUTS      - The task value is placed in the DBGEXT$L_TASK_VALUE field.
!
!               The register values are placed in the DBGEXT$L_R0
!               through DBGEXT$L_PSL fields.
!
!   OUTPUT      - none.
!
!   NOTE:       Only DEBUG knows the register set of the active task
!               hence, this call is invalid for the active task.
!               A return status of STS$K_SEVERE is returned.
!
    DBGEXT$K_SET_REGISTERS      = 16,

!
!    ENABLE_EVENT  is used during processing of a "SET BREAK/EVENT=" or
```

```
!  "SET TRACE/EVENT=" command to enable reporting of a given kind of event.
!
!  INPUTS     - The DBGEXT$L_EVENT_ID field contains a code identifying
!               the event being enabled. The possible values of this
!               code are defined below.
!
!               The DBGEXT$L_TASK_VALUE field contains a task value further
!               qualifying the event being enabled. This may be zero
!               if the "ALL" flag is lit.
!
!               For example,
!               if we are enabling "task termination" and we supply a
!               task value, then we only want to break on termination of
!               that task. If we enable "task termination" events and
!               set the ALL flag, we want to be notified of any
!               task termination.
!
!  OUTPUT     - none
    DBGEXT$K_ENABLE_EVENT       = 17,

!  DISABLE_EVENT is used during processing of a "CANCEL BREAK/EVENT=" or
!  "CANCEL TRACE/EVENT=" command to disable reporting of a given kind of
!  event.
!
!  INPUTS     - The DBGEXT$L_EVENT_ID field contains a code identifying
!               the event being disabled. The possible values of this
!               code are defined below.
!
!               The DBGEXT$L_TASK_VALUE field contains a task value further
!               qualifying the event being disabled. This may be zero
!               if the "ALL" flag is lit.
!
!  OUTPUT     - none
    DBGEXT$K_DISABLE_EVENT      = 18,

!  A maximum task code is defined for CASE statement bounds.
!
    DBGEXT$K_MAX_FUNCT          = 18;
```

```
!+
                        COMPLETION STATUS

    The run time system has two means of providing a completion status -- the
    return value of the function and the contents of DBGEXT$L_STATUS.

    Function Return Value --

    The run time system should, as its first action, attempt to read and verify
    the field DBGEXT$V_FACILITY_ID in DBGEXT$CONTROL_BLOCK.  Optionally, it may
    also PROBE the control block for read/writability.  If the FACILITY_ID is
    correct, the run time system should eventually return:

        STS$K_SUCCESS                   - service successfully completed

    Otherwise, the run time system should immediately return:

        STS$K_SEVERE                    - service failed

    This helps to insure that an incorrect External Control Block will be
    detected before it is written to.


    Contents of DBGEXT$L_STATUS --

    All other status and error conditions will be placed in the STATUS field of
    the control block.  The possible values of the STATUS field are a composite
    of severity level and message number.  Only two severity values are used.
    They are given by STS$V_SEVERITY:

        STS$K_SUCCESS                   - service successfully completed
    In this case the message number (STS$V_MSG_NO) is zero.

        STS$K_ERROR                     - service failed
    In this case the message number (STS$V_MSG_NO) is one of the following:
!-
LITERAL

    DBGEXT$K_FUNCTION_NOT_IMP   = 0,
    !
    ! The function requested is not implemented by the facility.
    !
    DBGEXT$K_TASK_NOT_EXIST     = 1,
    !
    ! Task number cannot be translated to a task value because the task does
    ! not exist.  Or task value does not point to a currently existing task
    ! (this cannot always be detected).
    !
    DBGEXT$K_TASK_IS_ACTIVE     = 2,
    !
    ! Returned on a SET_REGISTER or GET_REGISTER function for the active task.
    ! The run time system cannot access the registers of teh active task.
    !
    DBGEXT$K_TASK_IS_NULL       = 3;
```

!
! Returned on a SET_ACTIVE function for the null task.

```
!+
!                       PRINT ROUTINE INTERFACE
!
!   The following defines how to use the DEBUG print routine whose address
!   is given in the DBGEXT$L_PRINT_ROUTINE field.
!
!   BIND
!       DBG$PRINT_ROUTINE = .control_block [ DBG$L_PRINT_ROUTINE ];
!
!   DBG$PRINT_ROUTINE ( NEW_LINE,
!                       STRING_TO_PRINT,
!                       FAO_ARG_1,
!                       FAO_ARG_2,...
!                       FAO_ARG_n) : NOVALUE
!
!   NEW_LINE     - this can have one of two values:
!
!                0 - Place the given string in the output buffer.
!                1 - If the given string is non-zero, first place it in the
!                    buffer.  In all cases, output the buffer to the screen.
!
! STRING_TO_PRINT
!                - this is a pointer to a counted ascii string
!                  E.g., UPLIT (%ASCIC 'Output this text')
!                  This may be zero if the ACTION_CODE is "NEWLINE".
!
!                  There may be FAO arguments following the string.
!                  The string thus may contain embedded FAO commands
!                  such as '!AC', '!SL', and so on.
!
!%((FIXUP - THIS EXTENSION IS NOT GOOD!! -tbs))%
!
!                  In addition, there will be a DEBUG-specific extension
!                  to FAO which can be used for symbolizing addresses.
!                  There will be a new command '!SA' for "symbolize address".
!                  This indicates that the corresponding FAO argument
!                  is an address. It's symbolization is to be embedded into
!                  the string.
!
! FAO_ARG1 through FAO_ARGn - optional parameters for FAO arguments.
!
! Example: suppose FOO\L is located at address 200. Then:
!
! DBG$PRINT_ROUTINE (DBGEXT$K_NEWLINE,
!                    UPLIT (%ASCIC 'Task switch at location !SA'),
!                    200);
!
! This would output:
!
! "Task switch at location FOO\L"
!-
```

```
!                                EVENT ID
!
! The following define the possible values of the DBGEXT$L_EVENT_ID field.
! These are the predefined events that we can break or trace on.
!
LITERAL
    DBGEXT$K_MIN_EVENT_CODE     = 0,

    DBGEXT$K_INVOKE_DEBUG       = 0,    ! Unconditional DEBUG invokation


    DBGEXT$K_TASK_ACTIVATION    = 1,    ! First transition of a task to RUNNING
    DBGEXT$K_TASK_SUSPENSION    = 2,    ! Transition from RUNNING to SUSPENDED
    DBGEXT$K_TASK_SWITCH_FROM   = 3,    ! Transition from RUNNING to some state
    DBGEXT$K_TASK_SWITCH_TO     = 4,    ! Transition from some state to RUNNING
    DBGEXT$K_TASK_TERMINATION   = 5,    ! Any kind of termination

    ! Ada specific tasking codes:
    !
    DBGEXT$K_TASK_ABORT_TERM    = 6,    ! Termination by abort
    DBGEXT$K_TASK_EXCEP_TERM    = 7,    ! Termination by unhandled exception
    DBGEXT$K_TASK_EXCEP_REND    = 8,    ! Exception propagating out of rendezvous
    DBGEXT$K_TASK_ENTRY_CALL    = 9,    ! Executing an entry call
    DBGEXT$K_TASK_ACCEPT        = 10,   ! Executing an accept
    DBGEXT$K_TASK_SELECT        = 11,   ! Executing a select

    DBGEXT$K_MAX_EVENT_CODE     = 11;
```

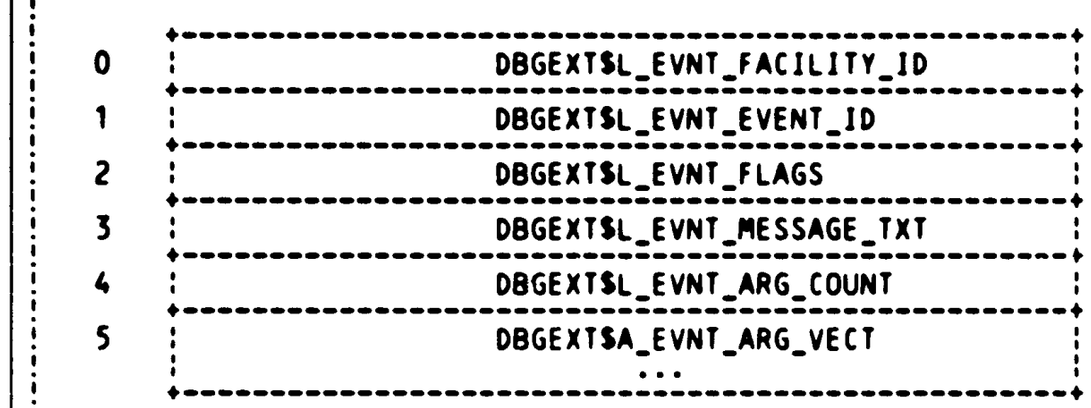
E V E N T C O N T R O L B L O C K

The Event Control Block is the data structure that the ADA (or other) facility passes to DEBUG when it signals that a given event has occured.

For example, if you do a SET BREAK/ADAEVENT=TASK_SWITCH_TO, then when a task switch occurs, the ADA run-time system will signal the special signal DBG$_EVENT. A pointer to an "Event Control Block" is passed as the "FAO argument" of DBG$_EVENT. (E.g., LIB$SIGNAL (DBG$_EVENT, 1, .EVENT_CONTROL_BLOCK). (Note that this condition cannot properly be an S3$ condition because they are not allowed to have FAO arguments other than PC and PSL (except for the hardware conditions). Hence, the facility DBG was chosen. This condition is a DEBUG-defined condition that anyone can signal. The FAO count of 1 is required so that the message conforms to a legal format for a message vector.) Through proper use of the SEVERITY field and the NOMESSAGE bit in the condition, the signaller can be assured that events will be "reflected" by Traceback should DEBUG not be mapped into the image (for some reason). So there really are no restrictions on when this condition can be signalled.

The control block contains a code indicating the facility that has originated the event and another code to indicate what event has occurred. It also contains message text to be output announcing the event.

The following illustrates the Event Control Block:




```
FIELD DBGEXT$EVNT_FIELDS =
    SET
    DBGEXT$L_EVNT_FACILITY_ID   = [0, 0, 32, 0],
    DBGEXT$L_EVNT_EVENT_ID      = [1, 0, 32, 0],
    DBGEXT$L_EVNT_FLAGS         = [2, 0, 32, 0],
    DBGEXT$V_EVNT_MORE_TEXT     = [2, 0,  1, 0],        ! Flag bit 0
    DBGEXT$V_EVNT_REENTRY       = [2, 1,  1, 0],        ! Flag bit 1

    DBGEXT$L_EVNT_MESSAGE_TXT   = [3, 0, 32, 0],
    DBGEXT$L_EVNT_ARG_COUNT     = [4, 0, 32, 0],
    DBGEXT$A_EVNT_ARG_VECT      = [5, 0,  0, 0]
    TES;
```

```
LITERAL
    DBGEXT$K_EVNT_BASE_SIZE     = 5;

MACRO
    DBGEXT$EVENT_CONTROL_BLOCK(NUM_ARGS) =
        BLOCK [DBGEXT$K_BASE_SIZE + NUM_ARGS ,LONG]
        FIELD (DBGEXT$EVNT_FIELDS)%;
```

Explanation of fields:

FACILITY_ID field:	The code for the facility signaling the event. If the CUST_DEF bit is set the event is a "user event". Otherwise, the only supported codes are ADA, PPA, and scan.
EVENT_ID field:	This field contains the event code. Event codes are numbered from 1 within each facility. Event code 0 is reserved in all facilities. It represents the unconditional event, that is, unconditional DEBUG entry. If the EVENT_ID field is zero, the REENTRY bit is checked.
MESSAGE_TXT field:	This is a pointer to a counted ascii string. The string represents a message to be printed when the event occurs and is fomatted as an "fao control string". The string may take FAO arguments. The string may also contain the DEBUG extension to FAO, '!SA', in order to symbolize an address. This extension is described above. NOTE: if this field is 0, it indicates that there is no message.
ARG_COUNT field:	Count of the number of FAO arguments that go with the text.
ARG_VECT field:	A vector of FAO arguments.
MORE_TEXT flag:	If this flag is TRUE, it indicates that DEBUG is to return control at the point of the signal after displaying the message. This is to be used for output of multi-line messages. (I.e., the run-time system should then resignal the event with the next line of message text in the MESSAGE_TXT field).
REENTRY flag:	If this flag is TRUE, then this event is a DEBUG-reetnry event that has occurred after a PSEUDO_GO. DEBUG is thereby instructed to restore certain components of its state from the values they had at DEBUG's last incarnation (e.g. AST enablement).

For this flag to be checked by DEBUG, the
EVENT_ID field MUST BE ZERO, thus indicating
unconditional entry to DEBUG.

REGISTERING EVENTS WITH DEBUG

DEBUG's event handling feature is available to user programs as well as Digital software. DEBUG maintains an event table for each facility that chooses to register its events with DEBUG.

Registering an event with DEBUG is very simple. The facility need only signal the following signal after DEBUG has been invoked in an image:

```
LIB$SIGNAL(DBG$_REGISTER_EVENTS,
        first_event_condition,
        second_event_condition,
        etc.
```

A list of event conditions is chained below a master condition of DBG$_REGISTER_EVENTS. This signal may be raised as many times as desired to add more events to DEBUG's event table. Since DEBUG derives the facility number from the event condition, events for different facilities may be registered with the same signal.

The event conditions appearing in the message vector must be defined in the facilities message file. The string defined in the message file is the string that DEBUG will use to name the event.

For example, suppose we wish to add an event of PLI$_TASK_SWITCH. The following would do it:

1. Add to PLI's message file:
```
        PLI$_FACILITY   = xxx
        TASK_SWITCH     "TASK_SWITCH"
```

2. Register the event with DEBUG
```
        LIB$SIGNAL(DBG$_REGISTER_EVENTS, PLI$_TASK_SWITCH)
```

After the registration, any user can then type
```
        SET BREAK/EVENT=PLI$_TASK_SWITCH
```

A command SET EVENT/FACILITY="PLI$_" can be used so the facility prefix can be omitted, e.g. SET BREAK/EVENT=TASK_SWITCH This will then not be confused with an Ada task switch. SET EVENT/NOFACILITY will eliminate the automatic prfixing of event names.

To simplify the registration of events by facilities, any facility should provide an entry point that users can call from the DEBUGGER to load the events of that facility. To load PLI's events, then, a user would merely type

```
   DBG> CALL PLI$_LOAD_EVENTS
```

** Obviously, Ada's events should be registered with this same general mechanism

S0DEBUG
MAP

DBGLIB
REQ

DEBUG

DEBUG
MAP

DBGSSISHR
MAP

DBGEXT
REQ

DBGMSG
MDL

DBGGEN
REQ