Advanced Graphics Package

Version 2.0

Supplement for HP 1000 Systems

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PREFACE

Who needs to use this manual?

This Supplement complements the *AGP Reference Manual* and is intended for users of Hewlett-Packard's Advanced Graphics Package (AGP). The Supplement presents AGP reference information which is specific to the HP 1000 operating systems.

How is it organized?

There are four parts to this Supplement plus an Appendix. Part I contains HP 1000 Operating System topics such as programming requirements, user-modifiable graphics tables, and other HP 1000 system-specific topics. Part II describes the AGP programs (User Program, Work Station Program and Monitor Program). Part III describes calls which are operating system dependent. Part IV describes AGP installation procedures and Appendix A summarizes the changes in the AGP Subroutine Parameters from Version 1.0.

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Table of Contents

Part I
System-Dependent Topics

Part II
Advanced Topics

List of Tables

AGP SUBROUTINES AND PARAMETERS FOR HP 1000 SYSTEMS

J2DRW (X,Y)
J2MOV (X,Y)
J2MRK (X,Y,MARKNO)
J2PGN (NPOLY,NVEC,XVEC,YVEC)
J2PLY (NPNTS,XVEC,YVEC)
J3DRW (X,Y,Z)
J3MOV (X,Y,Z)
J3MRK (X,Y,Z,MARKNO)
J3PGN (NPOLY,NVEC,XVEC,YVEC,ZVEC)
J3PLY (NPNTS,XVEC,YVEC,ZVEC)
JALPH (ID,NCHARS,STRING)
JASPK (XSIZE,YSIZE)
JBATC {no parameters}
JBEGN {no parameters}
JBUTN (ID,ECHO,BUTTON)
JCLOS {no parameters}
JCLPD (HITHR,YON)
JCLPW (OPCODE)
JCLR {no parameters}
JCMOD (OPCODE)
JCOLM (ID, MODEL)
JCOLR (COLOR)
JCORI (XBAS,YBAS,ZBAS,XPLN,YPLN,ZPLN)
JCSIZ (WIDTH,HEIGHT,GAP)
JDCOL (ID,COLOR,COLP 1,COLP 2,COLP 3)
JDDEV (ID,CLASS)
JDFNT (FONT,SLANT,FNLEN,FNAME,CONTRL)
JDINT (ID,WSPLEN,WSPNAM,LU,CONTRL)
JDLIM (ID,XMIN,XMAX,YMIN,YMAX)
JDMOD (MATRIX)
JDPMM (ID,VX,VY,XMM,YMM)
JDPST (ID,PINDEX,DENSTY,ORIENT,EDGE,DIDDF)
JDPTH (HDIST,YDIST)
JEDEV (ID,CLASS,LU)
JEND {no parameters}
JFONT (FONT)
JGDET (OPCODE)
JGHI (OPCODE)
JGVIS (OPCODE)
JHAND (OPCODE)
JI 1IN (OPCODE,VALUE)
JI 1RE (OPCODE,VALUE)
JI 2RE (OPCODE,VAL 1,VAL 2)
JI 3RE (OPCODE,VAL 1,VAL 2,VAL 3)
JI 4RE (OPCODE,VAL 1,VAL 2,VAL 3,VAL 4)
JICOL (ID,COLOR,COLP 1,COLP 2,COLP 3)
JICP (X,Y,Z)
JIERR (ERRNUM,LEVNUM,SUBNUM,INFO)
JIESC (ID,OPCODE,iSIZE,RSIZE,ILIST,RLIST)
JIMAT (OPCODE,MATRIX)
JIPST (ID,INDEX,DENSTY,ORIENT,EDGE,DIDDF)
JISGA (NAME,VALUE)
JISGW (SEGNAM,MAXNAM,COUNT,IDARRY)
JITSZ (NCHARS,STRING,SHIGH,SWIDE)
JIVOF {no parameters}
JIVON {no parameters}
JIWND (XARRAY,YARRAY,ZARRAY)
JIWS (ID,OPCODE,ISIZE,RSIZE,ILIST,RLIST)
JJUST (BASE,UP)
JKYBD (ID,ECHO,MAX,ACTUAL,STRING)
JLLIM (ID,XMIN,XMAX,YMIN,YMAX)
JLOCP (ID,VX,VY)
JLPMM (ID,VX,VY,XMM,YMM)
JLSTL (LSTYLE)
JLWID (LWIDTH)
JMCUR {no parameters}
JNEWF {no parameters}
JOESC (ID,OPCODE,ISIZE,RSIZE,ILIST,RLIST)
JOPEN (NAME)
JPICK (ID,ECHO,BUTTON,NAME,PICKID)
JPICL (COLOR)
JPIKP (ID,VX,VY)
JPILS (LSTYLE)
JPKID (PICKID)
JPLIM (ID,XMIN,XMAX,YMIN,YMAX)
JPPMM (ID,VX,VY,XMM,YMM)
JPROJ (OPCODE,DU,DV,DN)
JPSTL (PINDEX)
JPURG (NAME)
JR2DR (DX,DY)
JR2MK (DX,DY,MARKNO)
JR2MV (DX,DY)
JR2PG (NPOLY,NVEC,DXVEC,DYVEC)
JR2PL (NPNTS,DXVEC,DYVEC)
JR3DR (DX,DY,DZ)
JR3MK (DX,DY,DZ,MARKNO)
JR3MV (DX,DY,DZ)
JR3PG (NPOLY,NVEC,DXVEC,DYVEC,DZVEC)
JR3PL (NPNTS,DXVEC,DYVEC,DZVEC)
JRNAM (OLDNAM,NEWNAM)
JRSET {no parameters}
JSDET (NAME,OPCODE)
JSDF (ID,NAMLEN,NAME,SIZE,CONTRL)
JSERR (RLU,RLEVEL,ALEVEL)
JSHI (NAME,OPCODE)
JSLOC (ID,ECHO,VX,VY)
JSVAL (ID,ECHO,SUBVAL,VALUE)
JSVIS (NAME,OPCODE)
JTEXH (NCHARS,STRING)
JTEXL (NCHARS,STRING)
JTEXM (NCHARS,STRING)
JUPDT {no parameters}
JVDIS (DIST)
JVIEW (VPXMIN,VPXMAX,VPYMIN,VPYMAX)
JVPLN (XNRM,YNRM,ZNRM,XUP,YUP,ZUP)
JVREF (X,Y,Z)
JVSAL (OPCODE)
JVTOW (VX,VY,X,Y,Z)
JWEND (ID)
JWIND (DWUMIN,DWUMAX,DWVMIN,DWVMAX)
JWLOC (ID,ECHO,BUTTON,VX,VY)
JWOFF (ID)
JWON (ID)
JWTOV (X,Y,Z,VX,VY)
JWVAL (ID,ECHO,SUBVAL,BUTTON,VALUE)

Part I
System-Dependent Topics

OPERATING ENVIRONMENT

AGP is supported on the following HP 1000 processors and RTE operating systems:

Processor	Operating System
HP 1000 E,F	RTE-6/VM
HP 1000 A600,A700,A900	RTE-A
	RTE-A Virtual Code (VC+)

Note: *Any reference within this manual to RTE-A applies equally to RTE-A with VC+ unless otherwise stated. The term 'CDS' in this manual refers to Code and Data Separation, available exclusively under the RTE-A Operating System with the VC+ System Extension Package. CDS is not available under any other HP operating system, and the programs compiled for other systems should always be non-CDS.*

LOGICAL UNITS

DGL supports a logical unit number (LU) in the range of 0 to 63. For information regarding LUs, refer to the *RTE-A User's Manual*, the *RTE-A Utilities Manual* or the *RTE-6/VM CI User's Manual*.

PROGRAMMING LANGUAGES

AGP is designed to have a multi-language interface. This means, it is possible for the user to access AGP from different programming languages using identical functions. The multi-language interface can be called from FORTRAN, Pascal and MACRO.

FORTRAN

Application programs written in FORTRAN 7X must pass parameters to AGP in the form AGP requires. All integers must be 16-bit integers. All reals must be 32-bit reals.

Characters must be passed to AGP and are returned from AGP in integer arrays. The following example illustrates how characters may be used in an integer array:

```
INTEGER TEXT(8)
DATA TEXT/2HAB,2HCD,2HEF,2HGH/
```

All parameters passed to AGP must have one word addresses and must not reside in EMA/VMA.

The programming examples of this manual are written in FORTRAN, however, they are not complete programs. Care should be exercised when combining them into programs which are to be executed, because many calls which must be used (but are not related to the topic being presented) are not shown.

The FORTRAN example shown on the following page is complete. It may be typed into the computer and executed, or it may be modified to include many of the other program fragments.

```
C
C..Delete the C in column 1 of the following CDS directive when
C  linking with the CDS version of UPLIB in the VC+ environment.
C$CDS ON
      PROGRAM USER
C
C..AGP User Program to draw a line.
C
C..Set up variables.
C
      INTEGER WSPLEN, WSPNAM(4), LU, CNTRL
      DATA    WSPLEN /8/
      DATA    WSPNAM /2HWS,2HP1,2H.R,2HUN/
C
C..Initialize the graphics system.
C
      CALL JBEGN
C
C..Initialize a work station program: work station 1,WSPNAM =
C  'WSP1.RUN' at LU = 1 with no control bits set.
C  Enable it for graphics output.
C
      LU    = 1
      CNTRL = 0
      CALL JDINT(1,WSPLEN,WSPNAM,LU,CNTRL)
      CALL JWON(1)
C
C..Everything between the comment lines may be changed as needed.
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C..Use default attributes and viewing transformation to draw a line
C  diagonally across the display.
C
      CALL J2MOV(-1.0,-1.0)
      CALL J2DRW( 1.0, 1.0)
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C..Disable the work station, terminate it, end the AGP system, and
C  terminate this program.
C
      CALL JWOFF(1)
      CALL JWEND(1)
      CALL JEND
C
      END
```

Pascal

In general, the considerations which must be made when accessing AGP routines are the same as when accessing any non-Pascal routine from a Pascal program. Therefore, a review of that topic in the *Pascal Language Manual* may be useful.

Parameters (param1, param2, ...) passed to AGP routines must be declared VAR, or call-by-reference. Note that any external routine may modify the actual parameters passed to it when declared VAR in Pascal. However, AGP does not modify input parameters. All AGP routines should be declared as external procedures as follows:

```
PROCEDURE AGP_routine
   $ALIAS 'Jxxxx'$
   (VAR param1 : type1;
    VAR param2 : type2;
           :
           :
    VAR paramN : typeN);
EXTERNAL;
```

where Jxxxx is the true name of the AGP routine, and AGP_routine is a convenient alias.

The following files are supplied with AGP:

```
PAGP1.PASI
PAGP2.PASI
PAGP3.PASI
```

These files provide standard data types and external declarations for inclusion in all application programs. The contents of these files may be copied to a local directory and modified as needed.

The application program must use the data types and format which AGP requires. As a Pascal user, you should declare and use appropriate data types for both the formal and actual parameters of AGP routines. One example of a data type where considerations must be made is the data type INTEGER. The Pascal data type INTEGER represents integers in 32 bits, while AGP's code always assumes them to be 16 bits.

The following declarations cause the variable graphics_id to be stored in a 16-bit integer:

```
TYPE
     INT = -32768..32767;

VAR
     graphics_id : INT;
```

Characters must also be formatted appropriately. Pascal data type CHAR is stored as one character per 16-bit word, while AGP requires two characters

in 16 bits. The application program must declare all parameters containing characters to be PACKED ARRAYs of the appropriate size. If an application program were going to pass an array of 40 characters, the variable "text_string" should be declared as follows:

```
TYPE
    CHAR40      = PACKED ARRAY [1..40] of CHAR;

VAR
    text_string : CHAR40;
```

Some AGP routines pass back information through parameters which could be interpreted as different Pascal data types, depending on the use of the AGP routine. JIWS is an example of such a routine. For opcodes that inquire device information (5050, 5051, 6050, 6051, 7050 and 7051) the ILIST array parameter to the JIWS routine returns information which, for part of the array, is interpreted as characters. The remainder of the array, is interpreted as integers.

If the JIWS routine is declared from a Pascal program, as it is from a FORTRAN program, code is dedicated to the translation of the character from the integer array. This is done in Pascal by either computationally extracting the high and low order bytes of each integer to get the corresponding character, or by using a variant record structure that automatically maps the necessary integers to a packed array of characters. An example follows:

```
TYPE
   SINT       = -32768..32767;   [Single Word Integer]
   LET_NUM    = (Alpha, Numeric);

   AGP_STRING = RECORD
                  CASE LET_NUM OF
                    Alpha   : (letters : PACKED ARRAY[1..2] OF CHAR):
                    Numeric : (num     : SINT);
                  END;
                END;
```

Using this example, each element in the ILIST array is of the type AGP_STRING (i.e., VAR ILIST) : ARRAY [1..6] OF AGP_STRING;). If the first element of the array passed back by JIWS contained characters, they could be accessed in the following manner:

```
first_letter  :=ILIST[1].letters[1];
second_letter :=ILIST[1].letters[2];
```

A more straightforward solution to this mapping problem is to define a special AGP routine, aliasing to JIWS, with the mapping done transparently. The following type declarations and procedure declaration could be used for the JIWS call with OPCODES of 5050, 5051, 6050, 6051, 7050 and 7051. *(Note that in this example, device_status is the more descriptive variable name for ILIST).*

```
TYPE
   SINT       = -32768..32767;    {Single Word Integer}
   DEV_STATUS = RECORD
                  name  : PACKED ARRAY [1..6] OF CHAR;
                  state : ARRAY [1..4] OF SINT;
                END;
   REAL_LIST  = ARRAY [1..4] OF REAL;

PROCEDURE inquire_device_status $ALIAS "JIWS"$
       (VAR opcode,       { inquiry opcode                 }
            isize         { size of the integer array      }
            rsize : SINT; { size of the real array         }
        VAR device_status : DEV_STATUS;                    }
        VAR dummy         : REAL_LIST;
        VAR ierr          : SINT       );
```

It is also possible (as for JOESC and JIESC) that an AGP routine could pass either character or integer information through the same parameter, depending on the desired interpretation of the call. The Pascal program could define the AGP routine in a variety of ways to gain the desired amount of flexibility. Variant records, as presented in the first solution, could also be used to achieve the desired results.

Table 1 summarizes correspondences between AGP parameters and matching Pascal data types. A file containing standard data-type declarations for Pascal is supplied with the AGP product.

Table 1. AGP and Pascal Data Type Correspondence

AGP expects	Pascal data type
Integer	-32768..32767
Character string of n characters	PACKED ARRAY[1..n] OF CHAR
Real	REAL
Array of n integers	ARRAY [1..n] of -32768..32767
Array of n reals	ARRAY [1..n] of real

Another consideration when accessing AGP from Pascal, is the type of heap used. The heap is a memory area that may be allocated at run time. Its location, relative to the program code, is determined by the HEAP compiler option. The heap may exist within the program's logical address space (HEAP 1), in Extended Memory Area (HEAP 2), or may not exist at all (HEAP 0). Only HEAP 2 requires special consideration by AGP users.

When HEAP 2 is used, the heap is in EMA. The address of format parameters are two words long. AGP routines require their parameters have a single word address. However, the program may force Pascal to use only one word for those parameter's address via another compiler option: HEAPPARMS OFF. HEAPPARMS OFF should be set before the declaration of the formal parameters of AGP routines. This tells the compiler to give them a single word address. It also prevents the actual parameters from residing in EMA, which is necessary when accessing AGP.

```
$HEAP 2$

PROGRAM agp;

TYPE
    INT= -32768..32767;

PROCEDURE get button
    $ALIAS "JBUTN"$
    ($HEAPPARMS OFF$
    VAR echo_type,
    button : INT
    $HEAPPARMS ON$);
EXTERNAL;
                    :
                    :
```

A Pascal version of program USER follows:

```
{ Delete the comment delimiters from around the $CDS ON directive     }
{ when linking the following program with the CDS version of UPLIB    }
{ in the VC+ environment.                                             }
{$CDS ON}

PROGRAM user; {AGP user program to draw a line }
{ constant and type declarations }
{ the pagp1.inc include file is part of the AGP product }
$INCLUDE 'pagp1.pasi'$
VAR
   id, wsplen, lu, control : int;
   wspnam : string63;
   xmin, xmax, ymin, ymax : real;

{ external procedure declarations }
{ the pagp2.inc and pagp3.inc include files are part of the AGP }
{ product.                                                      }
$INCLUDE 'pagp2.pasi'$
$INCLUDE 'pagp3.pasi'$

BEGIN {Main of user }
{ Initialize variables }
   id := 1;
   wsplen := 8;
   wspnam := 'WSP1.RUN';
   lu := 1;
   control := 0;
   xmin := -1.0;
   xmax :=  1.0;
   ymin := -1.0;
   xmin :=  1.0;
{ Initialize the graphics system }
   jbegn;

{ Initialize a work station program: work station 1, wspnam =         }
{ 'WSP1.RUN' at lu = 1 with no control bits set.                      }
{ Enable it for graphics output                                       }
  jdint (id, wsplen, wspnam, lu, control);
  jwon (id);
{ Everything between the dashes may be changed as needed.            }
{---------------------------------------------------------------------}
{ Use default attributes and viewing transformation to draw a         }
{ line diagonally across the display                                  }
   j2mov (xmin, ymin);
   j2drw (xmax, ymax);
{---------------------------------------------------------------------}
{ Disable the work station, terminate it, and end the AGP system.     }
   jwoff (id);
   jwend (id);
   jend;
END. { Main of user }
```

MACRO/1000

Application programs written in MACRO/1000 must pass parameters to AGP in the form AGP requires. All integers must be 16-bit integers. All reals must be 32-bit reals. Characters must be packed into contiguous 16-bit words, one character per byte, and left-justified. All parameters passed to AGP must have a one word address and must not reside in EMA/VMA.

For additional assistance, refer to the *MACRO/1000 Manual* section on calling subroutines and CDS programming. Two MACRO/1000 versions of the program USER, (non-CDS and CDS) are shown in the following examples:

Non-CDS Version:

```
MACRO,R,Q
      NAM USER       ;AGP User Program to draw a line
      EXT JBEGN,JDINT,JWON,J2MOV,J2DRW,JWOFF,JWEND,JEND,EXEC
*
*..Constants:
*
ID    DEC 1          ;work station id
WSPLEN DEC 8         ;work station name length
WSPNAM ASC 8,WSP1.RUN ;work station program name
GLU   DEC 1          ;graphics output LU
CNTRL DEC 0          ;display initialization control word
M1.0  DEC-1.0        ;X and Y values of the beginning of the line
D1.0  DEC 1.0        ;X and Y values of the line's endpoint
D6    DEC 6          ;exec code for program termination
*
*..Main routine
*
USER NOP
*
      JSB JBEGN      ;initialize the graphics system
       DEF *+1       ;  return address
*
      JSB JDINT      ;initialize the work station
       DEF *+6
       DEF ID        ;  work station 1
       DEF WSPLEN    ;  work station name length = 8
       DEF WSPNAM    ;  name = 'WSP1.RUN'
       DEF GLU       ;  LU of the graphics display device (LU = 1)
       DEF CNTRL     ;  no control bits set
*
      JSB JWON       ;enable the work station for graphics output
       DEF *+2
       DEF ID        ;  work station 1
*
*..Everything between the asterisks may be changed as needed.
*************************************************************************
*..Using default attributes and viewing transformation to
*  draw a line diagonally across the display.
```

```
*
*
      JSB J2MOV      ;absolute move
       DEF *+3
       DEF M1.0      ;  x = -1.0
       DEF M1.0      ;  y = -1.0
*
      JSB J2DRW      ;absolute draw
       DEF *+3
       DEF D1.0      ;  x = 1.0
       DEF D1.0      ;  y = 1.0
*************************************************************************
*
      JSB JWOFF      ;disable the work station
       DEF *+2
       DEF ID        ;  work station 1
*
      JSB JWEND      ;terminate it
       DEF *+2
       DEF ID        ;  work station 1
*
      JSB JEND       ;end the AGP system
       DEF *+1
*
      JSB EXEC       ;terminate this program
       DEF *+2
       DEF D6
*
      END USER
```

CDS Version:

```
MACRO,R,Q
      NAM USER      ;AGP User Program to draw a line
      CDS ON        ;enable code and data separation for use with
*                   ;CDS versions of AGP libraries
      EXT JBEGN,JDINT,JWON,J2MOV,J2DRW,JWOFF,JWEND,JEND,EXEC
*
*..Constants:
*                   ;placed into data space
      RELOC DATA
ID    DEC 1         ;work station id
WSPLEN DEC 8        ;work station name length
WSPNAM ASC 8,WSP1.RUN ;work station program name
GLU   DEC 1         ;graphics output LU
CNTRL DEC 0         ;display initialization control word
M1.0  DEC -1.0      ;X and Y values of the beginning of the line
D1.0  DEC 1.0       ;X and Y values of the line's endpoint
D6    DEC 6         ;exec code for program termination
*
*..Main routine
*                   ;placed into code space
      RELOC CODE
```

```
USER  NOP
*
      PCAL JBEGN,0,0,0 ;initialize the graphics system
*
      PCAL JDINT,5,0,0 ;initialize the work station
       DEF ID          ;  work station 1
       DEF WSPLEN      ;  work station name length=8
       DEF WSPNAM      ;  name = 'WSP1.RUN'
       DEF GLU         ;  LU of the graphics display device (LU = 1)
       DEF CNTRL       ;  no control bits set
*
       PCAL JWON,1,0,0 ;enable the work station for graphics output
        DEF ID         ;  work station 1
*
*..Everything between the asterisks may be changed as needed.
*********************************************************************
*..Using default attributes and viewing transformation to
*  draw a line diagonally across the display.
*
*
       PCAL J2MOV,2,0,0 ;absolute move
        DEF M1.0        ;  x = -1.0
        DEF M1.0        ;  y = -1.0
*
       PCAL J2DRW,2,0.0 ;absolute draw
        DEF D1.0        ;  x = 1.0
        DEF D1.0        ;  y = 1.0
*********************************************************************
*
       PCAL JWOFF,1,0,0 ;disable the work station
        DEF ID          ;  work station 1
*
       PCAL JEND,1,0,0  ;terminate it
        DEF ID          ;  work station 1
*
       PCAL JEND,0,0,0  ;end the AGP system
*
       PCAL EXEC,1,0,0  ;terminate this program
        DEF D6
*
       END USER
```

NAMING CONVENTIONS

Library File Names

This supplement refers to libraries by their filenames, or by the name they would be referred to if they were in the working directory.

Files containing device handlers in AGP are named so that the first character of the file name correlates with the logical function performed by the handler and the next four characters correlate with the physical device. For example, files beginning with "D" refer to a graphics display handler and files ending with "0019" refer to the HP 2623 Graphics Terminal. Specifically, the file named "D0019.LIB" contains the graphics display handler for the HP 2623A Graphics Terminal. For a complete list of device handlers supported by AGP and their corresponding numbers, refer to the *Device Handlers Manual*.

Table 2 shows the first character used for each logical device handler.

Table 2. Device Handler File Naming Conventions

First Character	Logical Device
D	Display (Graphics)
A	Alphanumeric
L	Locator
P	Pick
B	Button
K	Keyboard
V	Valuator

Internal User Routines begin with "J", "I", "Q", "M", and "F". Internal Common Blocks begin with "JO", "IO", "QO" and "MO". To avoid naming conflicts, do not name common blocks, subroutines or functions beginning with these letters.

The DGL device-independent library name is DIDD. The file containing this library is DIDD.LIB.

Libraries using code and data separation in the VC+ environment are suffixed by _CDS.LIB. The CDS library for D0019.LIB would then be D0019_CDS.LIB.

LINKING AGP PROGRAMS

AGP is divided into two separate programs, with a monitor program (ZMNTR) running concurrently. Only one monitor program is needed to handle multiple AGP users.

PROGRAM	ADVANTAGES
1) **User Program (UP)**	Device independent. Can control any supported graphics configuration by initializing the appropriate WSP. Increased user code space.
2) **Work Station Program (WSP)**	Configuration can be changed to include various peripherals without relinking the user program.
3) **Monitor Program (ZMNTR)**	Cleans up the system resources and performs some WSP initialization tasks.

The User Program, Work Station Program and the Monitor are loaded separately and execute using class I/O to communicate. LINK is the loader used for RTE-6/VM and RTE-A. On the RTE-6/VM operating system, when the UP and ZMNTR are loaded, DECAR.LIB (the Decimal and String Arithmetic Library) must be searched. It is also recommended that link be sized as large as possible. This provides maximum space for relocation of all the external modules required to run AGP programs.

The following sections describe link procedures for UP, WSP, and ZMNTR and large user programs.

The User Program

The UP is loaded by relocating the application program in the standard manner and searching the AGP User Library (UPLIB.LIB). The following link command sequence is typical:

```
RE,<program>     Relocate a user program
SE,UPLIB.LIB     Search the AGP User Program Library
EN               Implicitly search the system library
                 and end
```

The Work Station Program

Linking the WSP requires that some decisions be made first. The steps in

the process for a typical WSP are as follows:

1) Determine the WSP program name.

2) Determine the functions and graphics logical devices included, and

3) Link the WSP.

In addition, it is possible to configure the WSP for particular applications.

The following steps are required to link a WSP:

a) Relocate the WSP main program module, (i.e., WSP.REL or WSP_CDS.REL for applications using CDS).

   Note: *If WSP_CDS.REL is used, the CDS versions of graphics libraries must be searched.*

b) Search the AGP WSP library (WSPLB.LIB). This step appends the SDA (Segment Display Area), their management routines and other AGP routines.

c) Search one physical device handler file for each graphics logical function chosen (e.g., B0001.LIB for the HP 2623A Button). It is possible for one physical device to contain several logical graphics devices. The alpha, button, keyboard, locator, valuator and pick library may be searched in any order. However, the graphics display handler library must be the last library searched (e.g., D0019.LIB for the HP 2623A Graphics Display).

d) Search the DGL library (DIDD.LIB). This appends all the DGL routines necessary to support the handlers. It also adds dummy handlers for any logical functions not explicitly searched in the previous step.

e) Search the system library to pick up necessary system support routines.

In the following example, a non-CDS WSP is used. The WSP supports the graphics display, keyboard, and locator logical functions. The HP 2623 terminal is used for the graphics display and keyboard, and the HP 9111 tablet is the locator.

```
RE,WSP.REL          Relocate the standard WSP main program
SE,WSPLB.LIB        Search the WSP library
SE,K0001.LIB        Search the HP 2623 keyboard input handler file
SE,L0004.LIB        Search the HP 9111 locator input handler file
                    Display handler must be searched last
SE,D0019.LIB        Search the HP 2623 graphics display handler file
SE,DIDD.LIB         Search the DGL library
EN                  Implicitly search the operating system libraries
                    and end
```

EMA/VMA Device Handlers

Some device handlers use EMA/VMA as indicated in the *Device Handlers Manual*. Refer to the following manuals for additional information on EMA/VMA:

RTE-A Programmer's Reference Manual
RTE-6/VM Programmer's Reference Manual
RTE-A Link Reference Manual
RTE-6/VM Line Reference Manual

Two link examples are listed below.

The following is a sample link procedure for a WSP which accesses the HP 2932 printer with an EMA space of 400K words:

```
CI>LINK
   EM,400          EMA space of 400K words required by D0053
   RE,WSP.REL      Relocate the standard WSP main
   SE,WSPLB.LIB    Search the WSP library
   SE,D0053.LIB    Search the display handler for the HP 2932 printer
   SE,DIDD.LIB     Search the DGL library
   EN
```

The following is a sample link procedure for a WSP which accesses the HP 2932 printer using VMA and an in-memory working set of 100K words:

```
CI>LINK
   VM              VMA space
   WS,100          Working set size of 100K words
   RE,WSP.REL      Relocate the standard WSP main
   SE,WSPLB.LIB    Search the WSP library
   RE,PROG1.REL    Relocate the application program
   SE,D0053.LIB    Search the display handler for the HP 2932 printer
   SE,DIDD.LIB     Search DGL library
   EN
```

Depending on the operating system, computer and handler library used, it is possible that the default WSP program is too large to link. If this happens, there are several options available, any combination of which can be used to decrease the WSP size:

- Use CDS versions of the WSP software.
- Use EMA instead of VMA since VMA includes more system code into the program than EMA.
- Reduce the size of the SDA.
- Reduce the size of user-modifiable tables (e.g., the hash table size).
- Remove unnecessary functionality (e.g., use the dummy SDA or dummy polygons).

Minimum options resulting in no loss of functionality are:

- Use EMA.
- Reduce the SDA size to 512 words.
- Reduce the hash table size to 102 words.

The Monitor Program

It is recommended that the monitor program be linked onto the system in order to prevent it from being removed by another user. The following link command sequence can be used to link the monitor program in RTE-A.

```
*
* Specify a system utility
*
SU
*
* Relocate the file ZMNTL.REL (for RTE-A only)
*
RE,ZMNTL.REL
*
* End the linker and output the ZMNTR on directory/PROGRAMS
*
EN,/PROGRAMS/ZMNTR.RUN
```

For the RTE-6 operating systems, use ZMNTR.REL instead of ZMNTL.REL.

Large User Programs (Non-CDS Environment)

Without CDS, some AGP user application programs are so large that the user program must be segmented. In segmenting AGP user programs, it is necessary that all common blocks be relocated with the main. COM.REL contains all the AGP common blocks. Relocating COM.REL makes AGP common blocks available to all segments so they can act on the same data.

The following is a typical link command sequence for a segmented user program with AGP graphics calls in the main program and in each segment.

```
RE,MAIN.REL       Relocate the Main Program
RE,COM.REL        Relocate the Common Block Module
SE,UPLIB.LIB      Search the AGP User Library if
**                 there are AGP calls in the main
SE                Search system library
*
RE,SEG1.REL       Relocate first segment
SE,UPLIB.LIB      Search the AGP User Library if
**                 there are AGP calls in the segment
SE                Search system library
*
RE,SEG2.REL       Relocate second segment
SE,UPLIB.LIB      Search the AGP User Library
**                there are AGP calls in the segment
EN                Implicitly search the system library
                  and end.
```

SPOOLING

General

AGP allows the user to spool graphics commands, but does not perform the actual spooling operations. See the appropriate operating system manual for a discussion of spooling.

Spooling is enabled by setting bit 0 of the control word in the JDINT call. When bit 0 in the control word is not set, the initialization of the device includes verifying the range of the LU specified, making sure that the correct system driver is attached to the LU and finally making sure that the device requested is at the LU value (if possible). If spooling is enabled (bit 0 in control is set), AGP does not perform any of these checks. Note that when bit 0 is set, AGP is forced to be in immediate visibility mode.

By configuring the operating system to perform spooling and then enabling spooling in a AGP application program, an application program can insure that graphics commands will be sent to a graphics device or a disc file without interruption. Two applications can benefit from spooling graphics. First, when several users are attempting to send graphics commands to a device at the same time, this can be used to restrict the use of the device to one user at a time. With this mechanism the graphics device can be treated similar to a spooled line printer. Spooling can also be used to save graphics commands in a file. This file can then be sent to the graphics device at a later time without having to rerun the application program.

If the alphanumeric device and the graphics display device are identical, alphanumeric and graphics data can be spooled simultaneously; but it is necessary to enable the graphics display before enabling the alphanumeric display.

Device Output

When several programmers are sending graphics commands to one device, for example, a plotter, spooling can be used to lock the device so that only one user can access it at a time. In many non-graphics environments, spooling is commonly used in this manner to control the use of line printers. Spooling can only be performed to the device supported by the device handler linked with the AGP program. For example, if an HP 7470A device handler is used, the device at the spooled LU must be an HP 7470A plotter.

The steps required to run a AGP application program on RTE-A are as follows:

```
CI>SP,ON,GLU
CI>PRGRAM,GLU
CI>SP,OF,GLU
```

where GLU is the graphics LU

On RTE-6/VM, the sequence is:

```
:SL,GLU,,,GLU        *Set up GLU (graphics LU) to be spooled
:RU,PRGRAM,GLU       *Outspool graphics to GLU.  The application
                     * must enable spooling in JDINT
:CS,GLU              *Close spool file.  The file will be sent
                     * to the graphics device when it is
                     * available for use.
```

File Output

AGP output can be spooled to a disc file which can later be sent to the graphics/alphanumeric device. This is useful when a picture may need to be generated several times. It avoids having to rerun the application program each time to generate the picture.

To be used for spooling, an LU must be configured for spooling using the Batch Spool Monitor. RTE-A users should refer the *Users Manual* and RTE-6/VM users to the *Batch Spool Monitor Manual* for the specific steps required.

The steps required to run a AGP program on RTE-6/VM which spools to a file are as follows:

```
:CR,filename:SC:LU:3          *Create a file if one doesn't exist.
:SL,GLU,filename:sec:LU,BO    *Set up the file to be associated with
                              * GLU on RTE-6, for both reading and writin
:RU,PRGRAM,GLU                *Run the AGP program.  JDINT must
                              * specify spooling.
:CS,GLU                       *Close the spool file.
```

On RTE-A, the corresponding sequence is:

```
CI>SP,ON,GLU,filename
CI>PRGRAM,GLU
CI>SP,OF,GLU
```

Once created, the file can only be sent to a physical device which is the same type supported by the device handler linked with the application program. For example, if a file was created using an HP 7470A device handler, the file can only be sent to an HP 7470A plotter.

The spooled output is transferred from the file created to the destination device in a different manner for each destination device. Spooled files can only be sent to a graphics/alphanumeric display by using the FMGR "ST" command or the CI "CO" command together with a device-dependent binary code.

Using Graphics Terminals

To send the graphics output created by the device handler for a specific graphics terminal from a disc file, use one of the following:

```
CI>CO,namr,LU of the graphics terminal
or
FMGR:ST,namr,cntrl
```

where cntrl = 3000B + the LU of the graphics terminal. Note that cntrl cannot be an expression. CI should be used where available.

Using HP Plotters or Translators

To send the graphics output created by the device handler for a specific HP Plotter from a disc file, use one of the following:

```
CI>CO,namr,LU of the plotter
or
FMGR:ST,namr,cntrl
```

where cntrl = 2100B + the LU of the HP Plotter. Note that cntrl cannot be an expression. CI should be used where available.

Part II
Advanced Topics

Description of AGP Programs

USER PROGRAM

The user program (UP) is a program written by the user to specify the graphics task. It contains the following components:

1) The *User Written Code* is code written in the host language that contains calls to AGP subroutines that specify the graphics task.

2) The *AGP Command Modules* generate virtual coordinate data from the user-specified world coordinate data. Only those routines referenced by user-specified AGP calls and their support routines are loaded into the user program.

3) The *AGP Communication Module* handles communications between the AGP modules in the user program and those in the WSP.

The UP can communicate with up to eight WSPs simultaneously in AGP. Each WSP drives its own set of devices.

WORK STATION PROGRAM

The work station program (WSP) is a program that receives commands and virtual coordinate data from the AGP command modules and performs the graphics tasks specified in the commands. It can be thought of as a logical graphics device that performs graphics tasks as requested by the user program.

The work station program:

1) maintains the necessary data structures to perform all actions that may be requested of it by the user program.

2) contains a set of device handlers that perform all I/O functions to a specified set of physical graphics devices.

The devices supported by a fully equipped WSP are:

1) Alphanumeric display

2) Button

3) Graphics display

4) Keyboard

5) Locator

6) Pick

7) Valuator

The WSP contains the following components:

1) The *WSP communication and control module* communicates with the AGP modules in the user program and calls the appropriate AGP modules in the WSP to process all requests from the user program.

2) The *segment display area* is a data structure used to store information about graphics segments (e.g., the primitives comprising a segment).

3) The *segment display area manager* consists of all AGP code used to process and inquire about the segment display area (e.g., the code used to perform software picking and to redraw the picture.

4) The *device handler code* consists of one device handler for each logical AGP device.

MONITOR PROGRAM

The Monitor (ZMNTR) performs several actions as part of the WSP initialization process and also as a monitor for cleaning-up system resources. The program performs the following functions:

1. Allocates all the class numbers that AGP uses.

2. "Clones" a WSP from a type 6 file or a permanently loaded program and schedules it as part of the WSP initialization process.

3. Removes the ID segment of the WSP(s) it has RP'd after it terminates on the RTE-6/VM system. (On RTE-A, this action is performed by the operating system.)

4. Cleans up class resources after a user program or work station program terminates abnormally. (On RTE-A, this action is performed by the operating system.)

Abnormal Program Termination

In most cases, if an AGP user program is terminated without a call to JEND (i.e. OF'ed) all the work station programs associated with that user program are terminated.

The segment display area extension, if one exists, may remain open. Any font files which were open at the time will remain open.

If a work station program is abnormally terminated (i.e. OF'ed), the segment display area extension remains open, if one exists. AGP will generate an error of level 4 "Graphics aborted".

On RTE-6/VM, ZMNTR assumes a program has been terminated if it no longer exists, or it is in state 0 (dormant) and is not on the time list.

On RTE-A, the operating system determines when a program has been terminated and performs the clean-up. If, however, the user program is terminated while a work station program is waiting on a read from a device, the operating system does not clean up the work station program.

CONCURRENT WSP SCHEDULING

Frequently, two or more user programs may wish to use the same WSP concurrently or a user program may wish to use the same WSP for multiple work stations. AGP accomplishes this by cloning copies of the WSP as needed. Cloning is the process of making a copy of a program with a different name. AGP does the cloning of the WSP transparently to the user so the user need not worry about making copies of the same WSP. To allow AGP to make a clone, one of the following procedures must be used:

1) Load the WSP as a permanent program (RTE-6/VM only), or

2) Save the WSP as a type 6 file.

Assuming one of these procedures is used, AGP can make renamed copies of the WSP available to all AGP user programs. AGP has a renaming convention for the WSP. AGP will try 12 times as follows to generate a name for the WSP that is not already in use:

1) AGP will try to make the last two characters the true LU from which the program was run (i.e "WSPXX" will be transformed to "WSPLU"

where LU is the last two digits of the logical unit that is running the program). If the work station program name is less than three letters, periods will be used to fill in the blank spaces (i.e. "AB" will change to "AB.LU" and "A" will change to "A..LU").

2) If the name from step one is already in use, the next try is to put a period in the third character of the WSP name if this was not done previously in step one.

3) Finally, if there is still a naming conflict, AGP will try changing the third character to the following values in order until an unused name is found: "/", "0" ,"1" ,"2" , "3", "4", "5", "6", "7", "8", "9". Since exactly 12 tries will be made, the "9" will only be tried in the case of a one, two or three character name where step 2 above was skipped.

For example, if the work station program name is "WSPXX" and the LU is 12, the following names will be tried: "WSP12", "WS.12", "WS/12", "WS012", "WS112", ... "WS812". If the work station program name is "A" and the LU is 15 the following names will be tried: "A..15", "A./15", "A.015", "A.115", ... "A.915".

Problems may occur due to the automatic cloning of WSPs by AGP. For example, if the program is scheduled from LU 48, the WSP could end up with the name "WSP48" and could be confused for another program with a type 6 file of the same name.

AGP Program-to-Program Communications

The user program and the work station program must be able to communicate with each other when they are running concurrently. In RTE this program-to-program communication is done through class I/O. AGP's use of class I/O is transparent to the user since the subroutines handle the allocation of class numbers and all class I/O communication.

AGP ensures that all system resources it uses are properly returned to the system upon program termination. Normally, the user program and the WSP return all the resources they use as part of their termination process. If a user program or WSP is terminated abnormally, the monitor program on RTE-6/VM or the operating system on RTE-A performs the class I/O clean-up.

CLASS I/O ALLOCATION

Two class numbers are allocated each time a WSP is initialized. The values of these class numbers are passed to the user program and the WSP. The user program uses one class number to transmit all messages to the WSP, and the

WSP uses the other class number to transmit messages to the user program. Normally, these class numbers are returned when the user written code requests that the WSP be terminated through a JWEND call.

The Segment Display Area

The Segment Display Area (SDA) is the AGP data structure used for maintaining segments. Whenever a new segment is created (JOPEN), a segment entry is made in the SDA. As output primitives and primitive attribute changes are incorporated into the segment, a virtual coordinate representation of these primitives and attributes are recorded in the SDA. Closing a segment (JCLOS) closes the entry in the SDA.

Along with output primitives and attributes, the SDA entry maintains information on the segment attributes. This information is updated as the application program changes the segment attributes.

Once a segment is closed, it cannot be reopened. Primitives may not be added to or changed in the closed segment. The only operations that can be made to a closed segment are segment deletion, or changing the dynamic segment attributes of highlighting, visiblility, and detectablity.

Each work station has its own SDA space. The SDA space for a work station is located in memory and can be extended to a disc file if necessary, using the JSDF call.

A segment remains in the SDA until:

1) It is explicitly deleted (JPURG)
2) All segments are deleted (JCLR)
3) The last work station on which it appears is terminated (JWEND)
4) The currently open segment overflows and therefore becomes too large to remain in the SDA.

Output primitives which are created within a segment are stored in the SDA. Output primitives created outside of a segment will not be stored in the SDA except in a batch-of-updates (see JBATC).

For applications using little or no segments, the reservation and allocation of SDA file space will not normally be of concern to the AGP application programmer. However, if the application programmer requires too many segments or any very large segments, the program may request additional space be reserved for the SDA by using the JSDF call to open a disc file (see JSDF). The programmer will also need to reserve additional space if a large number of primitives are issued outside of segments while in batch-of-updates (see JBATC).

SEGMENT DISPLAY AREA OVERFLOW

During the construction of a segment, a segment display area overflow may occur. The overflow error will not be reported until the segment is closed (JCLOS). To inquire if the open segment has overflowed on a work station, the inquiry JIWS (Opcode 1002) may be used. This test will only work while the segment is open.

Before JCLOS, which actually closes the overflowed segment, any calls which affect that segment (JRNAM, JSVIS, JSDET, JSHI, JVSAL) will generate errors and will be ignored on that work station. None of the mentioned calls will cause a new-frame-action on the overflowed work station.

When a segment overflows, the segment is removed from the SDA of the work station on which it overflowed. This is done without generating a new-frame-action. The remaining image on the display becomes primitives outside of a segment.

After a segment overflows and is still open, it is treated similarly to primitives outside of a segment on the work station where the overflow occurred. The primitives may still retain characteristics of the segment, (e.g. if the segment was invisible, the primitives may be invisible, if the segment was highlighted, the primitives may be highlighted). At the first occurrence of a new-frame-action the primitives that were specified as part of the overflowed segment will be removed from the display as if they were primitives outside of a segment. An overflowed segment is not pickable. It should be noted that attempting to change an attribute of an overflowed segment will not generate a new-frame-action since the segment is not treated as a segment in the data base.

The current attributes assigned to the open segment will be applied to any primitives added to a segment once it has overflowed. However, the primitives will not be added to the SDA.

An SDA overflow can also occur during a batch-of-updates. When this happens there is no room left in the SDA for new batched data and the "batched" output is sent to the graphics display device. Subsequent data is then sent to the graphics display device as if there were no batching in effect on that work station. All other work stations will remain unaffected.

CHANGING THE SIZE

To increase performance when using segments or batch-of-updates the user may increase the size of the "in-memory" segment display area at the load time of a WSP. Also at load time the user has control over the maximum size that the Segment Display Area may be (which may include a segment display area disc extension). To control these sizes, the user must edit

and compile block data subroutines shipped with AGP and then relocate the modified version before searching the WSP library (WSPLB).

The block data subroutine K0SDF (shipped as source in K0SDF.FTN) holds the data area for the SDA buffer. This data area is used by the WSP to hold part of the SDA. The default value (the value obtained when not modified by the user) is 2048 words which is 16 FMGR blocks (128 words each).

When K0SDF.FTN is modified, the following rules must be followed:

1) Only the dimension of the buffer (SDFBUF) and the DATA statement for the word containing this buffer dimension (SDFDIM) should be changed. If they are changed, they must both be changed so SDFDIM has the same value as the dimension of the buffer (SDFBUF).

2) SDFBUF's dimension (and SDFDIM's value) must be a multiple of 512 words which is 4 FMGR blocks of 128 words each.

There are no checks to verify that user editing was done correctly. If the rules above are not followed, unpredictable results may occur.

A WSP's maximum possible SDA size (including the disc extension) is determined by the block subroutine K0PAG (shipped as source in K0PAG.FTN). K0PAG is used as an array of pointers and flags which contain information about the SDA. For each 512 words (4 FMGR blocks) in the SDA, 3 words of information are stored in K0PAG. The default size for K0PAG (the size obtained when not modified by the user) is 510 words. This allows the maximum SDA to be (510/3)*4 or 680 blocks of 128 words each, using the default K0PAG.FTN.

When modifing K0PAG.FTN the following rules must be followed:

1) Only the dimension of the buffer (BUFFER) and the DATA statement for the word containing this buffer's dimension (BUFDIM) should be changed. If they are changed, they must both be changed so BUFDIM has the same value as the dimension of the buffer (BUFFER).

2) BUFFER's dimension must be a multiple of 3. For each 3 words of BUFFER, the SDA maximum size is increased by 4 blocks.

3) The maximum SDA size must be less then 8188 blocks so BUFFER size must be less than 6141 words.

4) The maximum SDA size set by K0PAG must not be less than the "in memory" SDA buffer size set in K0SDF, that is:

$$\frac{\text{BUFDIM}*512.}{3} \geq \text{SDFDIM}.$$

It is recommended that the "in memory" SDA size (as determined by K0SDF) be set as large as possible if increased performance is desired. The maximum

size possible for K0SDF depends on the size that a WSP can load in. Thus, it is recommended that CDS versions of the relocatables and libraries be used on VC+ operating systems.

The following is a sample CDS linker file sequence for relocating the new modules when changing the segment display area size in the VC+ environment:

```
RE,WSP_CDS.REL     Relocate the WSP main program
RE,K0SDF_CDS.REL   Relocate the new SDA buffer size (compiled w/$CDS on)
RE,K0PAG_CDS.REL   Relocate the new maximum SDA size (compiled w/$CDS on)
SE,WSPLB_CDS.LIB   Search the WSP library (CDS version)
SE,D0019_CDS.LIB   Search the HP 2623 Graphics Display handler (CDS version)
SE,DIDD_CDS.LIB    Search the DGL library (CDS version)
EN                 Implicitly search the system library and end
```

LINKING A WSP WITHOUT A SEGMENT DISPLAY AREA

A module called SDUM.REL (SDUM_CDS.REL for CDS use in VC+ operating systems) can be relocated during the loading of the WSP which will satisfy the requirements of the WSP and provide a dummy segment display area manager.

This is very useful when writing interactive programs which do not use segments and need to run in a smaller partition because of memory limitations.

If the user program attempts to open a segment, or start a batch-of-updates, an error will occur telling the user that segment operations are not possible in the WSP.

The following is a typical linker command sequence when linking the WSP without a segment display area manager.

```
RE,WSP.REL     Relocate the WSP program
RE,SDUM.REL    Relocate the Dummy SDA module
SE,WSPLB.LIB   Search the WSP library
SE,D0019.LIB   Search the HP 2623 graphics display handler file
SE,DIDD.LIB    Search the DGL library
EN             Implicitly search the system library and end
```

The Segment Hashing Table

AGP uses hashing to access segments by name (JOPEN, JRNAM, JPURG, JSVIS, etc.). The segment name is hashed to an entry in a "segment hashing table" (or "hashing table"), and from there AGP searches a linked list of segments in the SDA.

CHANGING THE SIZE

The user can control the performance of AGP segment hashing by altering the size of the segment hashing table. It is the nature of the hashing algorithm that for a given number of segments a larger hashing table usually means shorter linked lists and quicker access by name.

Changing the hashing table size is done via a mechanism similar to that provided for changing the SDA size. That is, the user must edit a special FORTRAN common block which defines the hashing table, changing its dimensions to the desired size. The user must then compile the common block, and relocate it into a new WSP.

The hashing table common block is KONTB (shipped as source in KONTB.TFN). It contains a variable, NTABSZ, and an array NTABLE. NTABLE provides the actual space for the hashing table, and NTABSZ gives AGP a way of knowing the size of NTABLE. The user should edit KONTB.FTN and change both the DATA statement for NTABSZ and the DIMENSION statement for NTABLE. Currently the default for NTABSZ is 202.

AGP requires two words (i.e., two spaces in NTABLE) for each entry in its hashing table. Therefore, the dimensioned size of NTABLE and NTABSZ must be an even number. The number of entries in the AGP hashing table will be NTABSZ/2. Hashing runs most efficiently with no more than one segment per hashing table entry, and efficiency decreases as more segments are created for each hashing table entry.

The user should abide by the following rules in changing KONTB:

1) NTABSZ must be an even number, greater than zero; if it is not, the work station will abort at run-time with error 37.

2) NTABSZ must be equal to the dimensioned size of NTABLE. Errors are not reported if it is not equal, and results in this case are unpredictable.

3) For fastest hashing, a) NTABSZ should be about twice the expected total number of segment names and b) NTABSZ should be twice a prime number. While neither is necessary, each contributes to efficiency.

4) If the user expects to create a large number of segments, it may also be necessary to change the size of the SDA.

   For example, if NTABSZ=202 and NTABLE(202) were specified, a hashing table with 101 entries would be provided. NTABSZ is twice a prime number (101) and would be most efficient if no more than 101 segments were created. Increasing the number of segments to more than 101 would decrease efficiency somewhat, as would sizing NTABSZ at twice a non-prime number, such as 200, instead of 202.

The following is a typical link command sequence for linking a new KONTB:

```
RE,WSP.REL      Relocate the WSP program
RE,KONTB.REL    Relocate the new KONTB
SE,WSPLB.LIB    Search the WSP library
SE,D0019.LIB    Search the HP 2623 graphics display handler file
SE,DIDD.LIB     Search the DGL library
EN              Implicitly search the system library and end
```

Polygon Set Efficiency Considerations

There are four ways to modify polygon set functionality in order to enhance the efficiency of AGP:

- o Change the size of the polygon style table.
- o Change the size of the intercept buffer.
- o Change the size of the vertex buffer.
- o Suspend polygon set functionality (to reduce the WSP size).

CHANGING THE SIZE OF THE POLYGON STYLE TABLE

The default polygon style table for each device contains 16 entries defining 16 different styles. The size of the table can be changed to accomodate more (or fewer) than 16 styles. To change the size of the polygon style table, the user must edit and compile the source block data subroutine Z1PTB.FTN which is shipped with DGL, and relocate the modified version before searching the DGL libraries at WSP load time.

The example below shows the link file sequence for relocating the module:

```
RE,WSP.REL      Relocate the WSP main program
SE,WSPLB.LIB    Search the WSP library
RE,Z1PTB.REL    Relocate the polygon style table
SE,D0019.LIB    Search the 2623 Graphics Display handler
SE,DIDD.LIB     Search the DGL library
EN              Implicitly search the system library and end
```

The maximum number of indices should not exceed 255, and the minimum must be at least 1.

Upon initialization of the WSP, the default table is initialized. Any new entry beyond the sixteenth is defined to represent the same polygon style as index 1. These entries can then be re-defined with JDPST.

If the table contains less than 16 entries, only those indices in the table are initialized; that is, the table is initialized as a strict, ordered subset of the default table.

NOTE: This table should never be sized to zero.

CHANGING THE SIZE OF THE INTERCEPT BUFFER

As each interior fill line is computed, the intersections of the fill line with the polygon set boundary are stored in the DGL part of the WSP; in other words, intersection coordinates are stored in an intercept buffer. The default maximum number of intersections which can be stored for each fill line is 100. If a fill line produces more than this maximum number of intersections, it cannot be drawn. Other lines within the same polygon set can still be drawn, however, as long as the number of their intersections are within range. The size of the intercept buffer can be changed to accommodate a wider range of intersections per fill line. It should never be reduced to hold the coordinates of less than two intersections.

If the application program uses only concave polygons, and thus generates fill lines which intersect the boundary only twice, the buffer could be reduced to hold only two intersections per fill line. This would save a substantial amount of program space for the WSP.

If, on the other hand, the application program uses extremely complex polygon sets, it might be necessary to enlarge the buffer. (The maximum number of boundary intersections for any fill line never exceeds the number of vertices of the clipped polygon set.)

To change the size of the intercept buffer, the user must edit and recompile the source block data subroutine T1INT.FTN shipped with DGL and relocate the modified version before the DGL libraries are searched at WSP load time. The example below shows the link file sequence for relocating the module:

```
RE,WSP.REL      Relocate the WSP main program
SE,WSPLB.LIB    Search the WSP library
RE,T1INT.REL    Relocate the intercept buffer
SE,D0019.LIB    Search the 2623 Graphics Display handler
SE,DIDD.LIB     Search the DGL library
EN              Implicitly search the system library and end
```

CHANGING THE SIZE OF THE VERTEX BUFFER

The vertices of a clipped polygon set are stored in the vertex buffer of the WSP. The default WSP vertex buffer holds up to 100 vertices.

If, after clipping, more vertices are generated than a work station's vertex buffer can hold, Error 57 is generated, and the polygon set is not filled on that work station.

The size of the vertex buffer can be changed to accommodate a wide range of vertices. It should never be reduced to hold less than one vertex.

To change the size of the vertex buffer, the user must edit and recompile the source block data subroutine K1FIL.FTN shipped with AGP and relocate the modified version before the WSP library is searched at WSP load time. The example below shows the link file sequence for relocating the module:

```
RE,WSP.REL      Relocate the WSP main program
RE,K1FIL.REL    Relocate the WSP vertex buffer
SE,WSPLB.LIB    Search the WSP library
SE,D0019.LIB    Search the 2623 Graphics Display handler
SE,DIDD.LIB     Search the DGL library
EN              Implicitly search the system library and end
```

LOADING DUMMY POLYGON SET MODULES

The user can partially or totally suspend polygon set functionality (that is, replace the polygon set modules with dummy modules) to reduce the amount of program code space used in the WSP.

PARTIAL SUSPENSION AT THE DGL LEVEL. For AGP users, suspension of polygon set functionality at the DGL level suspends the filling capability only. An outline of the boundary of the clipped polygon set is generated.

To suspend polygon set functionality at this level the user must relocate the source block data subroutine PGNDM.REL (PGNDM_CDS.REL for CDS use in VC+ operating systems) shipped with DGL before the DGL libraries are searched at WSP link time. The following example shows the loader file sequence for relocating the module:

```
RE,WSP.REL      Relocate the WSP main program
RE,PGNDM.REL    Relocate the polygon set module
SE,WSPLB.LIB    Search the WSP library
SE,D0019.LIB    Search the 2623 Graphics Display handler
SE,DIDD.LIB     Search the DGL library
EN              Implicitly search the system library and end
```

Polygon set calls are affected by the suspension as follows:

CALLS	EFFECT
J2PGN, J3PGN, JR1PG, JR3PG	Error 57 is reported. An outline of the boundary of the clipped polygon is generated.
JDPST	Error 60 is reported. The call is ignored.
JPICL,JPILS	Error 60 is reported. The call is ignored.

The following information is returned for the inquiry call JIWS:

Opcode 1065	No polygon calls supported.
Opcode 1066	Default polygon style.
Opcode 1067	Default polygon interior color. in hardware.
Opcode 1069	No immediate retroactive change of polygon style.
Opcode 1070	No hardware generation of polygons.

FULL SUSPENSION AT THE WSP LEVEL. For full suspension, polygon set functionality must be suspended at the WSP level. To suspend polygon set functionality at this level the user must relocate the source block data subroutine WPGDM.REL (WPGDM_CDS.REL for CDS use in VC+ operating systems) before searching the WSP library at WSP load time.

The following example shows the link file sequence for relocating the module.

Full suspension means no polygon set functionality will be available. This should only be used when polygons are not going to be used by the user program.

```
RE,WSP.REL     Relocate the WSP main program
RE,WPGDM.REL   Relocate the polygon set dummy modules
SE,WSPLB.LIB   Search the WSP library
SE,D0019.LIB   Search the 2623 Graphics Display handler
SE,DIDD.LIB    Search the DGL library
EN             Implicitly search the system library and end
```

Polygon set calls are affected by the suspension as follows:

CALLS	EFFECT
J2PGN, J3PGN, JR2PG, JR3PG	Error 57 is reported. No polygon is generated.
JDPST	Error 60 is reported. The call is ignored.

The following information is returned for the inquiry call JI1IN:

Opcode 20	Normal results.
Opcode 21	Normal results.
Opcode 22	Normal results.

The following information is returned for the inquiry call JIWS:

Opcode 1065	No polygon calls supported.
Opcode 1066	Default polygon style.
Opcode 1067	Default polygon interior color.
Opcode 1068	No polygon points supported in hardware.
Opcode 1069	No immediate retroactive change of polygon style.
Opcode 1070	No hardware generation of polygons.

Color Modelling Efficiency Considerations

CHANGING THE SIZE OF THE COLOR TABLE

Any graphics output device with a color table has a default color table, which is loaded whenever the corresponding device handler is loaded in an AGP program. The default tables of specific devices are given in the *Device Handlers Manual*.

To change the size of the color table, the user must edit and recompile the source block data subroutine Z1CTB.FTN and relocate the modified version before the DGL libraries are searched at WSP load time. The example below shows the link file sequence for relocating the module:

```
RE,WSP.REL     Relocate the WSP main program
SE,WSPLB.LIB   Search the WSP library
RE,Z1CTB.REL   Relocate the relocatable file
SE,D0019.LIB   Search the 2623 Graphics Display handler
SE,DIDD.LIB    Search the DGL library
EN             Implicitly search the system library and end
```

For most devices with color tables, the number of colors in the default table can be increased or decreased at load time. This number should be greater than zero and less than 32767 (the system limit). (Each table includes color 0, the background color.) Note that for devices that allow redefinition of the background color the number must be greater than one.

If the number of entries in the color table is increased, then each new entry has the same default parameters as entry 1. For example, if the default table has 10 entries, and its size is increased by five, then entries 11-15 have the same color definition as entry 1. Therefore, the

effect of referencing entry 12, for instance, will be the same with the modified table as with the default table. To redefine the contents of new entries, use JDCOL.

If the size of the default table is decreased by n entries, then the last n entries are deleted.

LOADING DUMMY COLOR MODELLING ROUTINES

If the color modelling capabilities of AGP are not needed, dummy color modelling routines can be loaded; this frees most of the memory space in which the real routines would otherwise be loaded and stored.

To link dummy color modelling routines, the user must relocate the source block data subroutine COLDM.REL (COLDM_CDS.REL for use in VC+ operating systems) shipped with DGL before the DGL libraries are searched at WSP load time. The following example shows the link file sequence for relocating the module.

```
RE,WSP.REL     Relocate the WSP main program
SE,WSPLB.LIB   Search the WSP library
RE,COLDM.REL   Relocate the color modelling module
SE,D0019.LIB   Search the 2623 Graphics Display handler
SE,DIDD.LIB    Search the DGL library
EN             Implicitly search the system library and end
```

If this is done, all color modelling capabilities are gone, including the ability to redefine color tables; but the ability to choose colors from the (default) color table of the graphics output device, using JCOLR or JPICL, remains. The calls that assume color modelling, JCOLM, JDCOL and JICOL are ignored. A call to JIWS (Opcode 1075) returns a zero. This does not mean that the color table has no entries, but that none of them can be changed; this gives the program a way to find out whether color modelling capabilities are available.

Calls to JIWS, with the opcodes specific to color modelling, return appropriate information:

Opcode 1071	No retroactive color change.
Opcode 1072	No change of background color.
Opcode 1073	No color change.
Opcode 1074	Default color model: RGB.
Opcode 1075	Color modelling unavailable.

Fonts

The following is a listing of the file names representing the font style for each of the six high quality text fonts (stored on disc) which are supplied with AGP:

File Name	Font Style
FONT1	Eurostyle
FONT2	Simplex Roman
FONT3	Triplex Roman
FONT4	Script
FONT5	Mathematical
FONT6	Gothic

Refer to the *AGP Reference Manual* for a detailed description of each font style.

Part III
System-Dependent Calls

INTRODUCTION

The calls described in this supplement contain system-dependent information. These descriptions, together with the (system-independent) call descriptions in the *AGP Reference Manual* provide complete information for AGP subroutines.

The format of the following pages is the same as the format in the Reference Manual. You may insert these call descriptions in the *AGP Reference Manual* (in alphabetical order) or use the system-specific manual as is.

JDFNT

PURPOSE: To associate a font number with a font file for use with high quality text.

CALLING SEQUENCE: CALL JDFNT (FONT,SLANT,FNLEN,FNAME,CONTRL)

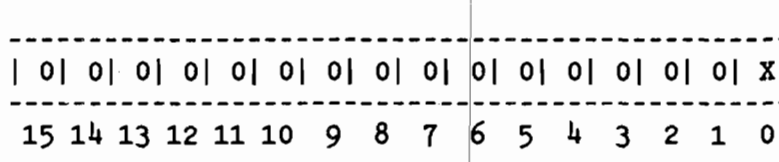
FONT — [INTEGER; Input]
FONT number to be associated with the FONT file specified. Used in the JFONT call to select a desired font.
(1 <= FONT <= 16)

SLANT — [REAL; Input]
Angle in radians specifying the character slant. Range is from -PI/2.0 to +PI/2.0 with a value of 0.0 specifying straight up.
(-PI/2.0 <= SLANT <= PI/2.0).

FNLEN — [INTEGER; Input]
The number of characters from FNAME to be used as the name of the font file.

FNAME — [INTEGER; Array; Input]
The name of the file containing the desired font, in Packed ASCII format.

CONTRL — [INTEGER; Input]
Used to control the characteristics of the character production or font file. Bits should be set according to the following bit map. All unused bits are reserved for future use and should be set to zero.



BIT 0 = 0 AGP will leave the disc font file open as much as possible, closing it only when necessary. At most, one font file will be open at any time. This is the most efficient method of accessing the font file, since the number of disc accesses (for font file opens and closes) is limited.

= 1 AGP will close the font file after every call which accesses it. This mode of operation is much more inefficient and uses more system resources than would otherwise be needed. This mode of operation will limit the possibility of the FONT file being left open upon abnormal termination of the user program.

BIT 1-15 - Currently unused. Should be set to 0.

JDFNT associates FONT with the specified slant and filename. If FONT was previously associated with a font file, JDFNT will associate the new font file specified with the specified font number.

Whenever the font number is referenced for subsequent high quality text output, the character data in the specified font file will be used. Note that a font must be set to the current font (JFONT) and defined (JDFNT) before it can be used for high quality text.

The current font has a disc font file associated with it via the JDFNT call. Typically this disc file is left open by AGP as much as possible to increase performance, with the restriction that at most one font file, (the one associated with the current font) is open at any one time. If it is important that the font file not be left open there are two ways of assuring it is closed. If BIT 0 is set, the particular disc font file will be closed after every AGP routine that accesses it. Alternatively, if BIT 0 is not set any open font file can be closed at any time via the JFONT call (see JFONT for details). The FONT files are not opened exclusively and therefore may be accessed by concurrent user programs.

SLANT is used to generate slanted text. The major use of this parameter is to generate italicized text. The angle specified must be between -PI/2.0 and +PI/2.0. A value of 0.0 for SLANT will generate characters that are not slanted.

For more information on high quality text font files, see Part I of this supplement.

ERROR CONDITIONS:

064 Level 0: AGP was not initialized by JBEGN.

INFO: Undefined.
ACTION: An implicit call to JBEGN is made.

123 Level 3: Incorrect number of parameters specified for the call.

INFO: Number of parameters passed.
ACTION: Call ignored.

090 Level 3: The font number specified is out of range. Possibly a non-positive number or real number was passed.

INFO: The font requested.
ACTION: Call ignored.

125 Level 3: The character count in FNLEN is less than one, or greater than 63. Possibly a negative or real number was passed.

INFO: Character count specified.
ACTION: Call ignored.

089 Level 2: The slant is out of range. The slant must be in the range -PI/2.0 to +PI/2.0.

INFO: Undefined.
ACTION: A value of 0.0 is used.

-2XXX Level 3: FMP error number -XXX. The FMP error is due to a problem with the font file.

INFO: Undefined.
ACTION: Call ignored.

088 Level 3: Specified file is not a font file.

INFO: Undefined.
ACTION: Call ignored.

JDINT

PURPOSE: To initialize a work station.

CALLING SEQUENCE: CALL JDINT(ID,WSPLEN,WSPNAM,LU,CONTRL)

ID [INTEGER; Input]
The ID used to refer to this work station in subsequent AGP calls.
(1 <= ID <= 8.)

WSPLEN [INTEGER; Input]

The number of characters from WSPNAM to be used as the name of the work station program.

WSPNAM [INTEGER; Array; Input]
The name of the work station program to be scheduled, in Packed ASCII format.

LU [INTEGER; Input]
The logical unit to be associated with the graphics display of the work station. If a graphics display is not explicitly loaded, this parameter is ignored. The LU cannot be mapped to a file with FORTRAN file I/O commands.

CONTRL [INTEGER; Input]
Used to control the characteristics of the work station. Bits should be set according to the following bit map. All unused bits should be set to 0.

0	0	0	0	0	0	0	0	0	0	0	0	X	X	0	X
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BIT 0 = 0 - No system spooling will be possible to the LU.
= 1 - LU may be outspooled using system spooling.

As part of the work station initialization process, AGP verifies (if possible) that the device at the LU is of the proper type for the work station program. To do this it sends an inquiry to which the device responds with its particular identification sequence. Setting bit 0 inhibits the inquiry process. AGP does

not perform spooling. A LU must be configured to be outspooled using system spooling routines. Input will not be possible when outspooling is in use. Setting this bit causes all subsequent attempts to enable an input device at LU to be flagged with errors and ignored. Not all graphics displays can be spooled. Refer to the *Device Handlers Manual* to determine if a particular graphics display device can be spooled.

BIT 1 = 0 - Currently unused.
Set to 0.

BIT 2 = 0 - LU will not be locked by AGP.
= 1 - LU will be locked by AGP. Setting Bit 2 will lock the LU of the graphics display device. This will prevent any I/O, not from this work station, and some operating system prompts, from reaching the LU.

When this feature is used some operating system commands may not function correctly, since they may not be able to send their I/O to the LU. Locking the LU uses some system resources. See the appropriate operating system manual for additional information on LU locking.

The LU is not locked by the AGP system until after the graphics output device is initialized. If two programs try to initialize a device simultaneously, unpredictable results may occur even though one or both may set bit 2.

BIT 3 = 0 - Simulated raster erase will not be enabled.
= 1 - Simulated raster erase will be enabled.
Some graphics output devices have the ability to erase images. AGP will use this feature when the simulated raster erase bit is set in the JDINT call. This feature allows AGP to do such things as remove purged segments without clearing the graphics display device, and redraw all visible segments. Note: Erasing is done by redrawing the image in the background color. Therefore, lines crossing the image to be purged may also have parts of them erased thus leaving "holes". See the *Device Handlers Manual* for the effect of bit 3 on a particular device.

BITS 4-6 - Currently unused. Set to 0.

BIT 7 = 0 - Immediate erase. AGP will clear the graphics display during initialization.

= 1 - No erase. Whatever was on the display stays there. This action is device-dependent. See the *Device Handlers Manual* for the effect of bit 7 on a particular device.

BITS 8-15 - Currently unused. Set to 0.

JDINT initializes a work station. A work station must be initialized before the application program can reference it for any purpose. During this call an attempt will be made to ensure that the device at the LU specified is really the type of display device that is loaded into the specified WSP. In some cases it is impossible to determine whether or not the device is the correct type (e.g., the HP 1350 Graphics Translator). Therefore, the errors that refer to whether the device is the correct one may not be reported. Furthermore, when the spooling bit is set, no checks are made as to the validity of the LU.

Unpredictable results may occur if there is no device at the LU, if the device is not the intended graphics device, or if the device is turned off or in a local mode.

If the graphics output device is a dummy device handler the control word CONTRL will be ignored.

If the graphics device is not outspooled, the device name is set to the name of the device as specified in the *Device Handlers Manual*. If the graphics output device has the outspooling bit set, then the name is set to the last four characters of the display library followed by two blanks. For example, the name for the HP 2623 graphics display device handler would be "0001 ".

AGP cannot verify that the program specified is a work station program. If it is not, AGP errors will occur when the user program attempts to communicate with it.

No other work station or program should send any I/O to the LU while it is initialized by this work station. There is no AGP error check for the above condition and unpredictable results may occur if it is violated.

Note that AGP makes an implicit call to JMCUR as part of this call.

Before an application program can use one of AGP's logical devices, it must first be enabled. Each logical device can be enabled and disabled independently of the others. A call to JWON enables graphics output, and a call to JWOFF disables graphics output. Similarly, a call to JEDEV selectively enables one of AGP's other logical devices, and a call to JDDEV disables it.

A user program may initialize up to eight work stations at any one time. For some operating systems there is also a limit to the number of active work station programs on the system at one time (see Part III of this supplement for more information regarding system resources.)

If the Work Station Program (WSP) has been loaded permanently or saved as a type 6 file, AGP schedules a copy of the WSP. In this way, one or more user programs can use copies of the same WSP.

The following example demonstrates initialization and termination of a work station. It also shows how one enables an input device, in this case the locator.

```
    CALL JDINT(1,9,9HW2623.RUN,LU,0)      *Initialize the work station
    CALL JWON(1)                          *Enable graphical output
          :
    CALL JEDEV(1,4,LOCLU)                 *Initialize the locator
          :
    {do locator input}
          :
    CALL JDDEV(1,4)                       *Terminate the locator
    CALL JWOFF(1)                         *Disable graphical output
    CALL JWEND(1)                         *Terminate the work station
```

ERROR CONDITIONS:

064 Level 0: AGP was not initialized by JBEGN.

INFO: Undefined.
ACTION: An implicit call to JBEGN is made.

123 Level 3: Incorrect number of parameters specified for the call.

INFO: Number of parameters passed.
ACTION: Call ignored.

074 Level 3: Work station ID out of range.

INFO: ID of the work station.
ACTION: Call ignored.

127 Level 3: The character count in WSPLEN is less than one or greater than 63. Possibly a negative or real numer was passed.

INFO: Character count specified.
ACTION: Call ignored.

096 Level 3: The ID number specified has been used previously for another work station.

INFO: ID number specified.
ACTION: Call ignored.

009 Level 2: This routine should not be called while a segment is open. Possibly a call to JCLOS was omitted.

INFO: Name of the open segment.
ACTION: An implicit call is made to JCLOS.

003 Level 3: This routine should not be called during a batch of updates. Possibly missing a JUPDT.

INFO: Undefined.
ACTION: An implicit call is made to JUPDT.

116 Level 4: The monitor program ZMNTR could not be found. ZMNTR must have an ID segment to be scheduled.

INFO: ID of the work station.
ACTION: Graphics aborted.

153 Level 4: The monitor program ZMNTR terminated abnormally.

INFO: ID of the work station.
ACTION: Graphics aborted.

154 Level 4: Incorrect ZMNTR for this system. Reload the proper ZMNTR for the operating system.

INFO: Undefined.
ACTION: Graphics aborted.

109 Level 3: Illegal WSP name.

INFO: ID of the work station.
ACTION: Call ignored.

-3XXX Level 3: FMP error -XXX. The FMP error occurred while trying to access the work station program specified.

INFO: ID of the specified work station.
ACTION: Call ignored.

119 Level 3: Checksum error in WSP type 6 file (probably the type 6 program was loaded on another system), or the file is not a type 6.

INFO: ID of the work station.
ACTION: Call ignored.

114 Level 3: No more ID segments available to clone the specified WSP.

INFO: ID of the work station.
ACTION: Call ignored.

113 Level 3: All the available cloning names for the WSP are already in use.

INFO: ID of the work station.
ACTION: Call ignored.

115 Level 3: Specified WSP program not found. It has no ID segment and no type 6 file.

INFO: ID of the work station.
ACTION: Call ignored.

117 Level 1: No copy bit set in WSPs ID segment. The specified WSP cannot be cloned. Possibly the WSP program is currently executing.

INFO: ID of the work station.
ACTION: Call ignored.

079 Level 3: No class number is available.

INFO: ID of the work station.
ACTION: Call ignored.

093 Level 3: The maximum number of work stations for a given CPU have already been initialized. Some other work station must be terminated through a call to JWEND before the specified work station can be initialized.

INFO: ID of the work station.
ACTION: Call ignored.

092 Level 3: The specified work station program cannot be scheduled.

INFO: ID of the work station.
ACTION: Call ignored.

149 Level 3: Revision code mismatch between the UP and the WSP (e.g., the UP was loaded with new software and the WSP was loaded with old software).

INFO: ID of the work station.
ACTION: Call ignored.

037 Level 4: NTABSZ, in common block KONTB of the work station program, is not an even, positive number. Possibly the user has incorrectly modified the common block. (NTABSZ defines the number of entries in the hashtable for access of segments by name.)

INFO: ID of the specific work station.
ACTION: AGP aborted.

094 Level 3: The LU specified does not match the device driver in the WSP, the device at the LU is down, the LU is not in the user's session LU table, or the EQT associated with the LU is down. Possibly the wrong driver was loaded upon creation of the WSP or the incorrect LU was specified.

INFO: LU specified.
ACTION: Call ignored.

135 Level 3: There are no resource numbers available to lock the output device.

INFO: The output LU.
ACTION: Call ignored.

136 Level 3: The attempt to lock the output LU has failed.

INFO: The output LU.
ACTION: Call ignored.

148 Level 3: The requested work station program is not an AGP work station program.

INFO: ID of the work station.
ACTION: Call ignored.

JEDEV

PURPOSE: To enable a logical device (other than the graphics display).

CALLING SEQUENCE: CALL JEDEV (ID,CLASS,LU)

ID [INTEGER; Input]
The ID of the work station whose logical device is to be enabled.
(1 <= ID <= 8)

CLASS [INTEGER; Input]
The class of the logical device which is being enabled:

CLASS = 1 - Alphanumeric device
= 2 - Button device
= 3 - Keyboard device
= 4 - Locator device
= 5 - Valuator device
= 6 - Pick device

LU [INTEGER; Input]
The logical unit of the device. The LU must represent a physical device. The LU cannot be mapped to a file with FORTRAN file I/O commands.

JEDEV enables a logical device on a particular work station. The logical device should be enabled before it is used (e.g., the pick device must be enabled (JEDEV) before it can be used for input (JPICK)). A logical device is terminated through a call to JDDEV. The work station on which the logical device is being enabled, should be initialized (see JDINT). A logical device is enabled and disabled independently of the graphics output being enabled and disabled (see JWON, JWOFF).

When enabling the locator or pick device, the locator or pick echo reference position is set to its default value (see JLOCP or JPIKP).

No logical input device will be enabled if the LU is the same logical unit as a graphics display device which is being outspooled (see JDINT).

If the specified locator/pick is not the same LU as that of an initialized graphics display device, then the logical locator/pick limits will be set to the default values for the particular locator used. If the LU specified is the same as that of an initialized graphics display device, then the logical locator/pick limits are set to the current view surface limits.

Not all logical devices are available on all work stations. The actual logical devices that are available on a particular work station are determined at the time the Work Station Program (WSP) is loaded. JIWS can be used to inquire if a logical device is supported by a particular work station. The LU and the device will also be verified by AGP and the name of the device will be set accordingly. This information is also available to the user program through the JIWS call.

No other work station or program should send any I/O to the LU while it is initialized by this work station. There is no AGP error check for the above condition and unpredictable results may occur if it is violated.

Example:

```
CALL JDINT(3,9,9HW2623.RUN,LU,0)      *initialize work station #3
CALL JWON(3)                          *enable graphical output
      :
CALL JWOFF(3)                         *disable graphical output
      :
CALL JEDEV(3,4,LOCLU)                 *enable the locator
CALL JWLOC(3,1,BUTTN,VX,VY)           *do input
      :
CALL JWON(3)                          *enable graphical ouput
      :
CALL JWLOC(3,1,BUTTN,VX,VY)           *do input
CALL JDDEV(3,4)                       *terminate the locator
      :
CALL JWOFF(3)                         *disable graphical output
CALL JWEND(3)                         *terminate work station
```

ERROR CONDITIONS:

064 Level 0: AGP was not initialized by JBEGN.

INFO: Undefined.
ACTION: An implicit call to JBEGN is made.

123 Level 3: Incorrect number of parameters specified for the call.

INFO: Number of parameters passed.
ACTION: Call ignored.

074 Level 3: Work station ID out of range.

INFO: ID of the work station.
ACTION: Call ignored.

012 Level 3: The logical class is out of range.

INFO: Logical class requested.
ACTION: Call ignored.

071 Level 3: The work station specified has not been initialized by JDINT. Possibly there is a call to JDINT missing, or the ID is not identical to that used in the JDINT call.

INFO: ID of the work station.
ACTION: Call ignored.

003 Level 3: This routine should not be called during a batch of updates. Possibly missing a JUPDT.

INFO: Undefined.
ACTION: An implicit call is made to JUPDT.

121 Level 2: Attempt to enable a logical device that is already enabled at ID.

INFO: ID of the work station.
ACTION: Previously enabled logical device is disabled with an implicit call to JDDEV.

005 Level 3: The work station specified has a dummy device handler loaded for that logical device. An inquiry (see JIWS) of the work station may be made to determine its capabilities.

INFO: ID of the work station.
ACTION: Call ignored for that work station.

080 Level 3: Attempt to enable an input function on an outspooled LU. Input can only be performed from an LU rather than that of an outspooled graphical display.

INFO: ID of the work station.
ACTION: Call ignored.

094 Level 3: The LU specified does not match the device driver in the WSP, the device at the LU is down, the LU is not in the user's session LU table, or the EQT associated with the LU is down. Possibly the wrong driver was loaded upon creation of the WSP or the incorrect LU was specified.

INFO: LU specified.
ACTION: Call ignored.

JIWS

PURPOSE: To inquire about some characteristic of a specific work station.

CALLING SEQUENCE: CALL JIWS(ID,OPCODE,ISIZE,RSIZE,ILIST,RLIST)

ID — [INTEGER; Input]
The ID of the work station to which the inquiry is to be directed.
(1 <= ID <= 8)

OPCODE — [INTEGER; Input]
The code specifying which characteristic of the work station is to be queried. The supported values of OPCODE are listed below.

ISIZE — [INTEGER; Input]
The number of integer parameters to be returned in ILIST by the inquiry function.

RSIZE — [INTEGER; Input]
The number of real parameters to be returned in RLIST by the inquiry function.

ILIST — [INTEGER; Array; Output]
An array of INTEGER characteristics of the work station returned as a function of OPCODE. All strings are returned in Packed ASCII format.

RLIST — [REAL; Array; Output]
An array of REAL characteristics of the work station returned as a function of OPCODE.

JIWS allows the application programmer to inquire several characteristics about the specified work station. All characters returned are in Packed ASCII format.

The thousands digit of the OPCODE parameter specifies the number of integer values returned in ILIST; the hundreds digit specifies the number of real values returned in RLIST. It is the responsibility of the application program to insure that ILIST is dimensioned at least as large as specified by ISIZE, and that RLIST is dimensioned at least as large as specified by RSIZE. If ISIZE or RSIZE is not the exact size required by a particular inquiry function then the call is ignored and an error is reported. An exception to these rules is found in OPCODE 15001, where a variable length SDF extension file pathname is returned in ILIST. For this opcode, the fifth integer returned is really a pathname. Therefore, ILIST should be

dimensioned to be 36 elements long (4 integers plus up to a 63 character pathname, packed 2 characters per word). The ILIST value passed for this opcode is 5.

JIWS implicitly makes the picture current before making the inquiry. JIWS may only be called if the work station is initialized.

The following codes are available:

OPCODE DESCRIPTION

201 Virtual coordinates of last PICK point (Returns (0.,0.) if no PICK has been performed)

RLIST(1) = X virtual coordinate
RLIST(2) = Y virtual coordinate

247 Resolution of pick device

RLIST(1) = Resolution in X direction (points/mm)
RLIST(2) = Resolution in Y direction (points/mm)

248 Maximum dimensions of pick device

RLIST(1) = Maximum size in X direction (mm)
RLIST(2) = Maximum size in Y direction (mm)

249 Current pick echo position

RLIST(1) = X virtual coordinate
RLIST(2) = Y virtual coordinate

250 For internal use only

251 Marker size in virtual coordinates.

RLIST(1) = Marker width in virtual coordinates
RLIST(2) = Marker height in virtual coordinates

252 Resolution of graphics display.

RLIST(1) = Resolution X direction (points/mm)
RLIST(2) = Resolution Y direction (points/mm)

253 Maximum dimensions of graphics display

RLIST(1) = Maximum size in X direction (mm)
RLIST(2) = Maximum size in Y direction (mm)

254 Aspect ratios

RLIST(1) = Aspect ratio of the virtual coordinate system RLIST(2) = Aspect ratio of the logical display limits

255 Resolution of locator device

RLIST(1) = Resolution in X direction (points/mm)
RLIST(2) = Resolution in Y direction (points/mm)

256 Maximum dimensions of locator device

RLIST(1) = Maximum size in X direction (mm)
RLIST(2) = Maximum size in Y direction (mm)

257 Current locator echo position

RLIST(1) = X virtual coordinate
RLIST(2) = Y virtual coordinate

258 For internal use only.

259 For internal use only.

450 For internal use only.

451 For internal use only.

1001 Does the work station have an SDA?

ILIST(1) = 0 - No, the dummy SDA was loaded.
ILIST(1) = 1 - Yes

1002 Has the open segment overflowed?

ILIST(1) = -1 no open segment
ILIST(1) = 0 SDA has not overflowed
ILIST(1) = 1 the open segment has overflowed

Can the graphics device do simulated raster erase?

ILIST(1) = -1 - No
ILIST(1) = 0 - Yes, but it is not enabled
ILIST(1) = 1 - Yes, and it is enabled

1050 Does the graphics display device support hardware clipping at physical limits?

ILIST(1) = 0 - No
ILIST(1) = 1 - Yes, at the view surface boundaries.
2 - Yes, but only to the physical limits of the device.

1051 Justification of view surface within the logical display limits.

ILIST(1) = 0 - View surface is centered within logical display limits.
ILIST(1) = 1 - View surface is positioned in the lower-left corner of the logical display limits.

1052 For internal use only

1053 Number of distinct colors supported on the graphics display.

ILIST(1) = Number of distinct colors supported.

1054 Maximum number of distinct colors that can appear on graphics display at one time.

ILIST(1) = Number of distinct colors that can appear on display device at one time.

1055 For internal use only.

1056 Linestyles supported by the graphics display

ILIST(1) = Number of hardware linestyles supported

1057 Linewidths supported by the graphics display.

ILIST(1) = Number of linewidths supported.

1058 Hardware character sizes supported by the graphics display.

ILIST(1) = Number of character sizes supported.
ILIST(1) = -1 continuous character sizes.

1059 Number of markers supported by graphics display.

ILIST(1) = Number of distinct markers supported.

1060 For internal use only.

1061 For internal use only.

1062 For internal use only.

1063 For internal use only.

1064 For internal use only.

1065 Number of polygon styles supported on the graphics display.

```
ILIST(1) > 0  - Number of polygon styles.
         = 0  - No polygon manipulation capabilities available
                (i.e., polygon routines were suspended at the DGL
                level).
         =-1  - No polygon manipulation capabilities available
                (i.e., polygon routines were suspended at the WSP
                level).
```

1066 For internal use only.

1067 For internal use only.

1068 Number of polygon vertices supported by the display device.

```
ILIST(1) = Number of vertices.
ILIST(1) = 0       - no hardware support.
ILIST(1) = MAXINT - no hardware limit on number of vertices.
```

NOTE: MAXINT is the maximum integer size (CPU dependent).

1069 Indicates whether or not the display device supports immediate retroactive change of polygon style.

```
ILIST(1) = 0 - No
         = 1 - Yes
```

1070 Indicates whether or not the display device supports hardware generation of polygons.

```
ILIST(1) = 0 - No hardware support.
         = 1 - Approximate hardware support.
         = 2 - Exact hardware support.
```

1071 Indicates whether or not the device supports immediate retroactive color change.

```
ILIST(1) = 0 - No
           1 - Yes
```

1072 Indicates whether or not background color can be redefined.

```
ILIST(1) = 0 - No
         = 1 - Yes
```

1073 Indicates whether or not the device supports modification to color table.

ILIST(1) = 0 - No
= 1 - Yes

1074 Indicate which color model is in use.

ILIST(1) = 1 - RGB
= 2 - HSL

1075 Indicates size of color table.

ILIST(1) = Size

1076 Current polygon interior linestyle.

ILIST(1) = Current polygon interior linestyle index.

2050 For internal use only.

3001 WSP name

ILIST(1)-ILIST(3) = Six character WSP name as restored (RP'd).

5050 Graphics display device information

ILIST(1)-ILIST(3) = Six character string containing device name
ILIST(4) = status
= -1 if there is no graphics display device handler loaded
= 0 not enabled for graphics output
= 1 enabled for graphics output

ILIST(5) = LU of graphics display device
= 0 if a dummy display device is loaded

5051 Keyboard device information

ILIST(1)-ILIST(3) = Six character string containing device name.
ILIST(4) = status
= -1 if there is a dummy keyboard device loaded
= 0 disabled
= 1 enabled

ILIST(5) = LU of keyboard device
= 0 if keyboard device is not enabled

6049 Pick device information

ILIST(1)-ILIST(3) = Size character string containing device name.
ILIST(4) = status
= -1 if there is a dummy pick device loaded
= 0 disabled
= 1 enabled.
ILIST(5) = LU of pick device
= 0 if no pick device is loaded
= 0 if no pick device is loaded

6050 Locator device information

ILIST(1)-ILIST(3) = Six character string containing the device name.
ILIST(4) = status
= -1 if there is a dummy locator device loaded
= 0 disabled.
= 1 enabled.
ILIST(5) = LU of locator device
= 0 if no locator device is enabled
ILIST(6) = Number of associated buttons
= 0 if no locator device handler is loaded

6051 Button device information

ILIST(1)-ILIST(3) = Six character string containing device name
ILIST(4) = status
= -1 if there is a dummy button device loaded
= 0 disabled
= 1 enabled
ILIST(5) = LU of button device
= 0 if not button device enabled
ILIST(6) = Number of buttons on the button device
= 0 if no button device handler is loaded

7050 Alphanumeric device information

ILIST(1)-ILIST(3) = Six character string containing device name.
ILIST(4) = status
= -1 if there is a dummy alphanumeric device loaded
= 0 disabled
= 1 enabled
ILIST(5) = LU of alphanumeric device
= 0 if no alphanumeric device enabled
ILIST(6) = maximum number of lines displayable
= -1 if undeterminable (i.e. line printer)
ILIST(7) = maximum number of characters per line

7051 Valuator device information

ILIST(1)-ILIST(3) = Six character string containing device name.
ILIST(4) = status
= -1 if there is a dummy valuator device loaded
= 0 disabled
= 1 enabled
ILIST(5) = LU of valuator device
= 0 if no valuator device enabled
ILIST(6) = Number of associated buttons
= 0 if no valuator device handler loaded
ILIST(7) = Number of subvaluators
= 0 if no valuator device handler loaded

15001 Segment display area and extension

ILIST(1) = Disc file size in blocks (128 words)
ILIST(2) = Usable memory resident SDA size in blocks (128 word)
ILIST(3) = Number of unused blocks (128 word) (in memory and/or on disc)
ILIST(4) = Number of characters in the disc file name. A zero is returned if there is no extension file.
ILIST(5) = Character string containing the disc file name.

ERROR CONDITIONS:

064 Level 0: AGP was not initialized by JBEGN.

INFO: Undefined.
ACTION: An implicit call to JBEGN is made.

123 Level 3: Incorrect number of parameters specified for the call.

INFO: Number of parameters passed.
ACTION: Call ignored.

023 Level 1: ID out of range.

INFO: ID of the work station.
ACTION: Call ignored.

070 Level 1: The work station specified has not been initialized. Possibly a call to JDINT is missing, or the ID is not identical to that used in the JDINT call.

INFO: ID of the work station.
ACTION: Call ignored.

055 Level 1: The requested opcode is not available. Possibly negative or real number was passed.

INFO: Opcode requested.
ACTION: Call ignored.

054 Level 1: ISIZE is not equal to the number of integer parameters to be returned. Possibly a negative or real number was passed.

INFO: ISIZE given.
ACTION: Call ignored.

059 Level 1: RSIZE is not equal to the number of real parameters to be returned. Possibly a negative or real number was passed.

INFO: RSIZE given.
ACTION: Call ignored.

JSDF

PURPOSE: To create a disc file to be used as an extension to the segment display area.

CALLING SEQUENCE: CALL JSDF(ID,NAMLEN,NAME,SIZE,CONTRL)

ID — [INTEGER; Input]
The ID of the work station to which this call applies.

NAMLEN — [INTEGER; Input]
The number of characters from NAME to be used as the name of the file.

NAME — [INTEGER; Array, Input]
The name of the file used for the extension, in Packed ASCII format.

SIZE — [INTEGER; Input]
The size in blocks (128 words each) of the file that is to be created. If size = 0, the AGP system default of 100 blocks will be used.

CONTRL — [INTEGER; Input]
Used to control characteristics of the segment display file extension. Bits should be set according to the following bit map. All unused bits should be set to zero.

0	0	0	0	0	0	0	0	0	0	0	0	X	0	0	0
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

BIT 0 - 2 - Currently unused.

BIT 3 = 0 - Give error if disc file specified exists.
= 1 - Purge and recreate the file if it exists.

BIT 4 -15 - Currently unused.

JSDF creates a (FMGR type 1) disc file that AGP uses as an extension to the segment display area. If the file already exists and bit 3 of the CONTRL parameter is set, AGP purges it and recreates the file with the file size specified.

JSDF may only be called while the specifed work station is initialized. JSDF may be called only once for each work station.

If AGP uses up all the memory space it has in the segment display area and no extension is available, all further actions requiring SDA storage generate errors until the situation is remedied.

The file size given in the JSDF call should be a multiple of 4. AGP will reduce the size given to a multiple of 4 if a non-multiple is given. No errors will be given for this condition.

The file area that is defined with the JSDF call should be larger than the "in memory" SDA size by at least 4 FMGR blocks. If the requested file size is smaller than that in core it will not be used and an error will be generated. The "in memory" SDA size can be inquired through a call to JIWS with an opcode of 15001. The default "in memory" SDA size (used unless a special module is relocated with the WSP) is 2048 words or 16 blocks.

The file size given in the JSDF call cannot be larger than the maximum allowed by that work station. If the requested size is larger than the maximum, the file size will be set to the maximum and an error will be given. The default maximum SDA disc file size (used unless a special module is relocated with the WSP) is 680 FMGR blocks. For more information regarding the segment display area see Part I of this supplement.

A remedy for an SDA overflow may be to call JSDF if it has not been previously called for that work station.

The SDA extension file is closed and purged by the AGP system, when the work station is terminated (JWEND).

ERROR CONDITIONS:

064 Level 0: AGP was not initialized by JBEGN.

INFO: Undefined.
ACTION: An implicit call to JBEGN is made.

123 Level 3: Incorrect number of parameters specified for the call.

INFO: Number of parameters passed.
ACTION: Call ignored.

074 Level 3: Work station ID out of range.

INFO: ID of the work station.
ACTION: Call ignored.

071 Level 3: The work station specified has not been initialized by JDINT. Possibly there is a call to JDINT missing, or the ID is not identical to that used in the JDINT call.

INFO: ID of the work station.
ACTION: Call ignored.

129 Level 3: The character count in NAMLEN is less than one or greater than 63. Possibly a negative or real number was passed.

INFO: Character count specified.
ACTION: Call ignored.

026 Level 3: The SDF size given is less than zero. Only non-negative integer numbers should be passed.

INFO: The size given.
ACTION: Call ignored.

035 Level 3: An enabled work station does not support segment or batch-of-update operations.

INFO: The ID of the work station which does not support the needed operation.
ACTION: Call ignored.

091 Level 3: JSDF can only be called once for each work station. Once the segment display area extension is set up, its size cannot be changed.

INFO: ID of the work station.
ACTION: Call ignored.

156 Level 3: The file size given in the JSDF call is smaller than this work station can use. The file must be at least 4 blocks larger than the portion of the SDF that is in memory.

INFO: Minimum SDF size that could be used by the work station.
ACTION: Call ignored.

-4XXX Level 3: FMP error number -XXX. The FMP error is due to a problem with the segment display area.

INFO: ID of the work station.
ACTION: Call ignored.

157 Level 2: The file size given in the JSDF call is larger than this work station can use.

INFO: Maximum SDF disc file size that could be used by the work station.

ACTION: The SDF disc file size is set to the maximum that the work station can use.

JSERR

PURPOSE: To set the error handling conditions.

CALLING SEQUENCE: CALL JSERR (RLU,RLEVEL,ALEVEL)

RLU	[INTEGER; Input] The LU number to which error output is sent (i.e. the error log LU).
RLEVEL	[INTEGER; Input] The minimum severity error level that will be reported. (0 <= RLEVEL <= 4)
ALEVEL	[INTEGER; Input] The minimum severity error level that results in "aborting" AGP. (0 <= ALEVEL <= 4).

JSERR sets the error handling conditions of reporting and AGP termination and implicitly makes the picture current.

JSERR allows the application program to determine which errors will be reported to the "error log LU" (RLU). All errors of severity level greater than or equal to the error report level (RLEVEL) will be reported. Initially the error report level equals 0, (i.e., all errors will be logged on the RLU). If the error report level is set to 4, only level 4 errors will be logged. If this feature is used before a program is completely debugged, important information may be missed because the error messages will not be printed.

At AGP initialization the RLU is set to the LU from which the program was scheduled.

Setting ALEVEL allows the application program to recover from certain AGP detected errors that do not exceed the specified severity level. Errors greater than or equal to ALEVEL will terminate graphics. ALEVEL = 0 implies all errors and warnings are fatal; ALEVEL = 4 implies no recoverable errors are fatal. At AGP initialization ALEVEL is set to 4.

After AGP has aborted graphics, due to an error equal to or exceeding ALEVEL, all AGP calls will be ignored except for JBEGN, JIERR, and JEND.

The last AGP error can be inquired at any time by the JIERR call.

JSERR is useful when the application program is using programmatic error recovery.

The severity level and recovery action (if any) for each error is discussed under the "Error Conditions" subheading of each subroutine description. Appendix A of the *AGP Reference Manual* lists all errors, their severity levels, the subroutines where they are reported, and the recovery performed when that error occurs. The RLU is specified as a valid LU number. It cannot be mapped to a file with FORTRAN file I/O commands.

The RLU is not checked to verify that it is a valid LU. If an error occurs that should be reported, AGP attempts to report it on the RLU. If this fails, AGP attempts to report the error message on the LU from which the program was run (the default error LU). If that attempt fails the error is not reported; however, the error can still be inquired via a call to JIERR.

ERROR CONDITIONS:

064 Level 0: AGP was not initialized by JBEGN.

INFO: Undefined.
ACTION: An implicit call to JBEGN is made.

123 Level 3: Incorrect number of parameters specified for the call.

INFO: Number of parameters passed.
ACTION: Call ignored.

043 Level 1: The report level is out of range. Possibly a real or negative number was passed.

INFO: Level requested.
ACTION: Call ignored.

044 Level 1: The abort level is out of range. Possibly a real or negative number was passed.

INFO: Level requested.
ACTION: Call ignored.

Part IV
AGP Installation

SYSTEM PREREQUISITES FOR INSTALLATION

There are certain system requirements for installing the AGP programs onto your system. Information regarding these requirements are listed below:

- **ID Segment** — One ID segment available for each User Program, Work Station Program and Monitor program.

- **Class Numbers** — All operating systems require two class numbers for a UP/WSP pair. The system will hang when AGP attempts to perform I/O functions if class numbers are not available.

- **SAM** — (System Available Memory) 256 words required by the user program:

  6 words - header information
  11*n where n is the number of WSPs

  Example: *(with 2 WSPs)*

  6 + 2 * 11=28

  ZMNTR - One class number is required to store information with a class read/write.

  An error will be generated if more than 22 active WSPs are on one CPU at a time.

- **User Libraries** — UPLIB may be generated into the system to avoid the need to specify it directly in the load process.

  You must not generate the device handler files D0001, WSPLB and DIDD into the system.

- **Memory Partitions** — Most efficiency is gained from separate memory partitions for the UP, ZMNTR and WSP. Beneficial when the system disc is a mini-floppy or floppy disc.

INSTALLATION PROCEDURE

Follow the steps listed below to install AGP, Version 2.0, from the distribution media onto your system.

1. Insert the first microfloppy disc, mag tape, or CS/80 cartridge tape into the tape drive. Determine the LU (or CRN for microfloppies) of the drive. This is referred to as the <*source LU*>. Mount the cartridge for microfloppies.

   Note: *The tape media you have received is in the TF (Tape Filer) format. You may wish to consult your HP 1000 System Utilities Manual for more detailed instructions on TF usage.*

2. *For mag tapes and CS/80 cartridges only:*

   Enter the Command Interpreter and run TF. The following TF command replaces any graphics software you presently have under the <destination mask> from your media and verifies that the software was copied.

   ```
   CI> TF
   TF: co <source LU> <destination mask> dv
   ```

   Examples:

   Graphics software is copied into the current working directory from the mag tape drive at LU 8.

   ```
   TF: co 8 @.@ dv
   ```

   Graphics software is copied into the /GRAPHICS directory from the CS/80 cartridge tape drive at LU 24.

   ```
   TF: co 24 /graphics/@.@ dv
   ```

3. *For microfloppies only:*

   The software on microfloppies is shipped under the /GRAPHICSV2 directory. After entering CI and mounting the volume for the microfloppy, enter the following command to extract the graphics software from the microfloppy to the <destination mask> you specify. This command replaces any graphics software you presently have at your <destination mask> and verifies the transfer.

   ```
   ci> co/graphicsv2/@.@ <destination mask> d
   ```

   Dismount the microfloppy volume, remove the microfloppy, insert the next microfloppy and repeat the process until all the microfloppies have been copied.

   Examples:

Graphics software is copied from the microfloppy to the present working directory.

```
CI> co,/graphicsv2/@.@,@.@,dv
```

Graphics software is copied from the microfloppy to the directory /graphics.

```
CI> co,/graphicsv2/@.@,/graphics/@.@,dv
```

4. *For all media:*

The software numbering file: A92862, shipped with the graphics product, contains a list of all of the product's modules and a short one line description of each. Since the graphics product includes software for both CDS and non-CDS operating systems, this software number file is useful if you want to be selective about the modules you put on your disc.

The convention used in the graphics products is an _CDS suffix for compiled modules for use in the VC+ operating system environment. Sources and font files shipped with the product can be used in either environment.

Appendix A
AGP Subroutine Changes

Summary of AGP Subroutine Changes

Changes in the format of the graphics calls from AGP Version 1.0 to AGP Version 2.0 are due to changes in the file system. The table below catagorizes the calls that are impacted.

Category	AGP Call	Reason for Change
Initialization	JDINT	Work station program names may exceed 5 characters.
Font File Selection	JDFNT	Font file names may exceed 6 characters. The security and LU parameters no longer exist with the hierarchial file system.
Segment Display Area Extension	JSDF	The disc file extension to the segment display area exceed 6 characters.
Inquiry	JIWS	Opcode 8001 is replaced by opcode 15001.

Specific Changes

Presented below are the calls and parameter changes that accompany the AGP port from the non-hierarchial HP 1000 file systems (e.g., RTE-IVB, RTE-A.1) to the hierarchial file systems on RTE-A and RTE-6/VM (revision C.83 and later). For a comprehensive discussion of the routines, refer to the *AGP Reference Manual* and the *AGP Version 2.0 Supplement for HP 1000 Systems*.

1. **JDINT**

   Version 1.0 (ID,WSPNAM,LU,CONTRL)

   Version 2.0 (ID,WSPLEN,WSPNAM,LU,CONTRL)

Parameter additions: WSPLEN=character length of WSP name

Parameter changes: WSPNAM=wsp name
name extensions are not assumed.

2. JDFNT

Version 1.0 (FONT,SLANT,FNAME,SEC,CRN,CONTRL)

Version 2.0 (FONT,SLANT,FNLEN,FNAME,CONTRL)

Parameter additions: FNLEN=font file name length

Parameter deletions: SEC=security code of font file
CRN=cartridge reference LU

Parameter changes: FNAME=font file name - name extension are not assumed

3. JSDF

Version 1.0 (ID,NAME,SIZE,CONTRL)

Version 2.0 (ID,NAMLN,NAME,SIZE,CONTRL)

Parameter additions: NAMLN=file name length

Parameter changes: NAME=segment display area file name - name extensions are not assumed

4. JIWS

Version 1.0 (ID,OPCODE,ISIZE,RSIZE,ILIST,RLIST)

Version 2.0 OPCODE changed

Parameter changes: OPCODE of 15001 returns the name of the segment display extension area file name. OPCODE 8001 should not be used.

READER COMMENT SHEET

Advanced Graphics Package
Version 2.0
Supplement for HP 1000 Systems

92862-90001 May 1984

We welcome your evaluation of this manual. Your comments and suggestions help us to improve our publications. Please use additional pages if necessary.

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Empresa Técnica de Equipamentos
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Telex: 42133
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FYSHWICK, A.C.T. 2609
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Telex: 31-024
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Perth, Western Australia Office
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Telex: 93859
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Sydney, New South Wales Office
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A-8052 **GRAZ**
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A-1222 **VIENNA**
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A,CH,CM,CS,E,MS,P

BAHRAIN
Green Salon
P.O. Box 557
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BAHRAIN
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P

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Tel: 256123
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E,C,M

BELGIUM
Hewlett-Packard Belgium S.A./N.V.
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Woluwedal
B-1200 **BRUSSELS**
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Telex: 23-494 paloben bru
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BRAZIL
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Telex: (011) 33872 HPBR-BR
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Hewlett-Packard (Canada) Ltd.
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SANTIAGO 9
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Casilla 256-V
SANTIAGO 21
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Cable: Olympiachile Santiagochile
CH,CS,P

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BOGOTA 1, D.E.
Tel: 212-1466
Telex: 44400 INST CO
Cable: AARIS Bogota
CM,E,M

Casa Humboldt Ltda.
Carrera 14, No. 98-60
Apartado Aereo 51283
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A

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Microprog S.A.
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Telex: 4510 ARENTA DR (RCA) P

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Telex: 2485 HOSPTL ED
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M

EGYPT

International Engineering Associates
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Hewlett-Packard France
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F-25026 **BESANCON**
28 rue de la Republique
F-25000 **BESANCON**
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Hewlett-Packard France
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F-29000 **BREST**
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Hewlett-Packard France
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F-69130 **ECULLY** Cedex (Lyon)
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Hewlett-Packard France
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F-91035 **EVRY** Cedex
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Telex: 692315F
E

Hewlett-Packard France
Parc d'Activite du Bois Briard
Ave. du Lac
F-91040 **EVRY** Cedex
Tel: 16 6 077-8383
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E

Hewlett-Packard France
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F-38320 **EYBENS** (Grenoble)
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Bâtiment Ampère 5 étage
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Boite Postale 300
F-93153 **LE BLANC MESNIL**
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Hewlett-Packard France
Parc d'Activités Cadera
Quartier Jean Mermoz
Avenue du Président JF Kennedy
F-33700 **MERIGNAC** (Bordeaux)
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Immueble "Les 3 B"
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ZAC de Bois Briand
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F-64000 **PAU**
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F-35100 **RENNES**
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F-76100 **ROUEN**
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Hewlett-Packard France
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F-57640 **VIGY** (Metz)
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199-203 Hennessy Rd.
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CM

Schmidt & Co. (Hong Kong) Ltd.
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A,M

ICELAND

Elding Trading Company Inc.
Hafnarnvoli-Tryggvagotu
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M

INDIA

Computer products are sold through Blue Star Ltd. All computer repairs and maintenance service is done through Computer Maintenance Corp.

Blue Star Ltd.
Sabri Complex II Floor
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***BANGALORE** 560 025*
Tel: 55660
Telex: 0845-430
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A,CH,CM,CS*,E*

Blue Star Ltd.
Band Box House
Prabhadevi
***BOMBAY** 400 025*
Tel: 422-3101
Telex: 011-3751
Cable: BLUESTAR
A,M

Blue Star Ltd.
Sahas
414/2 Vir Savarkar Marg
Prabhadevi
***BOMBAY** 400 025*
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Telex: 011-4093
Cable: FROSTBLUE
A,CH,CM,CS*,E,M*

Blue Star Ltd.
Kalyan, 19 Vishwas Colony
*Alkapuri, **BORODA**, 390 005*
Tel: 65235
Cable: BLUE STAR
A

Blue Star Ltd.
7 Hare Street
***CALCUTTA** 700 001*
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A,M

Blue Star Ltd.
133 Kodambakkam High Road
***MADRAS** 600 034*
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Telex: 041-379
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A,M

Blue Star Ltd.
Bhandari House, 7th/8th Floors
91 Nehru Place
***NEW DELHI** 110 024*
Tel: 682547
Telex: 031-2463
Cable: BLUESTAR
A,CH,CM,CS*,E,M*

Blue Star Ltd.
15/16:C Wellesley Rd.
***PUNE** 411 011*
Tel: 22775
Cable: BLUE STAR
A

Blue Star Ltd.
2-2-47/1108 Bolarum Rd.
***SECUNDERABAD** 500 003*
Tel: 72057
Telex: 0155-459
Cable: BLUEFROST
A,E

Blue Star Ltd.
T.C. 7/603 Poornima
Maruthankuzhi
***TRIVANDRUM** 695 013*
Tel: 65799
Telex: 0884-259
Cable: BLUESTAR
E

Computer Maintenance Corporation Ltd.
115, Sarojini Devi Road
***SECUNDERABAD** 500 003*
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Arranged alphabetically by country

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P

BERCA Indonesia P.T.
P.O.Box 2497/Jkt
Antara Bldg., 17th Floor
Jl. Medan Merdeka Selatan 17
JAKARTA-PUSAT
Tel: 21-344-181
Telex: BERSAL IA
A,CS,E,M

BERCA Indonesia P.T.
P.O. Box 174/SBY.
Jl. Kulei No. 11
SURABAYA
Tel: 68172
Telex: 31146 BERSAL SB
Cable: BERSAL-SURABAYA
A,E,M,P*

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Hewlett-Packard Trading S.A.
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Telex: 212-455 HEPAIRAQ IK
CH,CS

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A,CH,CM,CS,E,M,P

Cardiac Services Ltd.
Kilmore Road
Artane
DUBLIN 5
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M

ISRAEL

Eldan Electronic Instrument Ltd.
P.O.Box 1270
***JERUSALEM** 91000*
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***JERUSALEM** 94467*
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A

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Tel: 3 88 388
Telex: 33569 Motil IL
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CH,CM,CS,E,M,P

ITALY

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Hewlett-Packard Italiana S.p.A.
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C,P

Hewlett-Packard Italiana S.p.A.
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I-20063 **CERNUSCO SUL NAVIGLIO**
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A,CH,CM,CS,E,MP,P

Hewlett-Packard Italiana S.p.A.
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I-20090 **TREZZANO SUL NAVIGLIO**
(Milano)
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C,M

Hewlett-Packard Italiana S.p.A.
Via Nuova San Rocco a
Capodimonte, 62/A
I-80131 **NAPOLI**
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A,CH,E

Hewlett-Packard Italiana S.p.A.
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I-16156 **GENOVA PEGLI**
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E,C

Hewlett-Packard Italiana S.p.A.
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