HEWLETT PACKARD

RTE Drivers DVR32 and DVA32

Reference Manual

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Table of Contents

Tables

1

General Information

This manual contains information and procedures needed to write FORTRAN or Assembly application programs that call disk drivers DVR32 and DVA32 with the RTE-IVB or RTE-6/VM Operating System. References to RTE pertain to both operating systems.

This chapter lists the components of the driver and describes the operating environment required. Chapter 2 describes the drivers' calling sequences, error conditions, and device timeout processing. Chapter 3 contains information used when incorporating DVA32 or DVR32 (or both) into an RTE operating system.

Appendix A lists performance characteristics and recommended timeout values for disk drives serviced by DVA32 and DVR32.

Components

DVA32 and DVR32 consist of the following components:

a. This manual, part number 92068-90012.

b. The binary relocatable file %DVA32, part number 92067-16553, or %DVR32, part number 92067-16330 (revision 2001 or later).

Operating Environment

The operating environment must include:

a. HP 1000 M/E/F-Series computer.

b. RTE-6/VM or RTE-IVB Operating System.

c. For DVA32: HP 12821A Integrated Controller Disk (ICD) card.

   For DVR32: HP 13175A/B Controller Interface Card and HP 13037B/C Multiple Access Controller.

d. For DVA32: Any of the following disk drives connected to the HP 12821A interface. Up to four of any combination is allowable.

   9895 7906H 7920H 7925H

   For DVR32: Any of the following disk drives connected to the HP 13037B/C controller. Up to eight of any combination is allowable.

   7905 7906 7920 7925

2

Application Information

DVA32 provides the software interface between RTE user programs and Integrated Controller Disk (ICD) disk drives (listed in Chapter 1). DVR32 performs the same function for Multiple Access Controller (MAC) drives. DVA32 communicates with the disk via the HP 12821A ICD card. The card communicates with individual controllers contained in each HP 79xxH and HP 9895 disk drive.

The driver accesses a specific disk drive by means of an address number between 0 and 7 assigned to the drive during the initialization phase of generation and set with a switch on the drive.

DVR32 communicates with the HP 79xx drives via the HP 13175A/B Controller Interface Card and the HP 13037B/C Multiple Access Controller. A specific drive is accessed by means of a unit number between 0 and 7 assigned during generation and set with a switch on the drive. MAC disk drives and DVR32 support multiple-CPU configurations. Information about this capability is included in the appropriate appendix of the System Manager's Manual for your operating system.

All disk drives accessed by DVR32 and DVA32 have 128-word physical sectors. Both drivers, however, operate using 64-word logical sectors. The specification of sector number in an RTE read or write operation refers to a logical 64-word sector, not a 128-word physical sector. For most efficient usage, all operations (particularly write operations) should start on an even numbered logical sector and end on an odd numbered logical sector.

DVA32 is compatible with DVR32 (programs that use DVR32 will run with DVA32) with the exception that ICD drives and DVA32 do not support the multiple-CPU capability. Also, ICD drives and DVA32 do not have error correction capability, although they do have complete error detection capability.

This section describes read, write, and status requests for both drivers. A control request (EXEC 3) may be used as a LOCK or UNLOCK function for DVR32 in a multiple-CPU environment. For information about this feature refer to the appropriate appendix of your System Manager's Manual. The drivers will handle a control request from the system if the calling program is aborted during an I/O operation.

READ and WRITE Requests

Table 2-1 shows the calling sequences used in FORTRAN and Assembler to read and write data.

Table 2-1. READ and WRITE Calling Sequences

Assembly:

```
EXT EXEC
    .
    .
JSB EXEC
DEF RTRN

DEF ICODE
DEF ICNWD
DEF IBUFR
DEF IBUFL

DEF ITRAK
DEF ISECT
```

where:

RTRN = Return address
ICODE = Request code
1 = Read
2 = Write
ICNWD = Control word
Bits 0−5 = LU number of disk subchannel
Bit 10: 1 = verify after write
0 = do not verify after write
IBUFR = Starting address of buffer
IBUFL = Length of buffer; positive number of words or negative number of characters
ITRAK = Track number (decimal)
ISECT = Sector number (decimal)

FORTRAN:

```
CALL EXEC(ICODE,ICNWD,IBUFR,IBUFL,ITRAK,ISECT)
```

If bit 10 in the control word (ICNWD) is set, the driver performs a data verification routine after the write. If an error is detected, the driver again attempts the write and verification. This process is repeated until successful data transfer is verified or until ten write attempts have been made, at which point a track error is reported (refer to the Error Conditions section later in this chapter).

During a read, DVR32 executes an error detection and correction routine. If an error is detected and cannot be corrected by this routine, DVR32 attempts the read again. A track error is reported after ten read attempts. DVA32 follows the same procedure except that it does not perform error correction, but retries the read up to 10 times before reporting a track error.

Upon return the B-Register contains the transmission log. This is the positive number of words or characters transferred, depending on which the user specified. The A-Register contains status information explained in the following section of this chapter.

If a request is made in which the track number (ITRAK) is greater than the size of the subchannel, or if track number = −1, the driver returns after setting the B-Register to the number of tracks on the subchannel and setting bit 5 in EQT word 5 to 1 (refer to the I/O Status Word Format description in your Programmer's Reference Manual). If the request was a read, the driver also returns the number of 64-word sectors per track in IBUFR(1).

A read or write request causes an IO07 error (“Driver has rejected call”) and program abortion under the following conditions:

a. The subchannel number corresponding to the LU number in ICNWD was larger than the number of subchannels defined in the initialization phase of generation.

b. The sector number was larger than the number of sectors per track on the drive.

c. The sector or track number was negative (except for track number = −1, explained above).

d. The length of the requested transfer (IBUFL) was larger than the length of the track, or the operation would go beyond the end of the subchannel.

Status Request

Table 2-2 shows FORTRAN and Assembly calling sequences for a status request. Table 2-3 describes the information returned in ISTA1 from EQT word 5. For more information about EQT words 4 and 5, and DRT word 2, refer to the appropriate appendix of your Programmer’s Reference Manual.

Table 2-2. Status Request Calling Sequence

Assembly:

```
JSB EXEC
DEF RTRN
DEF ICODE
DEF ICNWD
DEF ISTA1
DEF ISTA2
DEF ISTA3
```

where:

RTRN = Return address
ICODE = Request code: 13 decimal
ICNWD = Logical unit number
ISTA1 = Status word 1 (word 5 of EQT entry)
ISTA2 = Status word 2 (optional − EQT word 4)
ISTA3 = Status word 3 (optional − word 2 of DRT entry)

FORTRAN: `CALL EXEC(ICODE,ICNWD,ISTA1[,ISTA2][,ISTA3])`

Table 2-3. Status Word 1 (ISTA1) Information

Bit	Meaning
0	ANY ERROR. Set if any bit marked * is true.
1*	BUSY. Set if drive is busy (seek incomplete).
2*	NOT READY. Set if drive is not ready.
3*	SEEK CHECK. Set if a seek check condition (illegal track address, head malfunction, and so on) has occurred.
4	PROTECT. Set if the track is flagged as protected.
5*	FAULT. Set if any of a number of hardware failures has occurred. Refer to the appropriate hardware manual.
6	FORMAT. Set if the Format switch of the drive is “on”.
7	PROTECTED. Set if the “Protected” switch of the accessed disk is “on”.

In addition to the EXEC 13 status request, another request is available that returns the two controller status words from the previous operation as well as the two current status words. Table 2-4 shows the calling sequence for this status request.

Table 2-4. Full Status Read Calling Sequence

Assembly:

```
JSB EXEC
DEF RTRN
DEF ICODE
DEF ICNWD
DEF IBUFR
DEF IBUFL
DEF ITRAK
DEF ISECT
```

where:

RTRN = Return address
ICODE = 1 (Read)
ICNWD = Bits 0−5 = LU number
Bits 6−10 = 23 octal (function code)
IBUFR = Starting address of buffer
IBUFL = Length of buffer; 2 or 4 words
ITRAK is not used
ISECT is not used

FORTRAN:

```
CALL EXEC(ICODE,ICNWD,IBUFR,IBUFL,ITRAK,ISECT)
```

For DVA32, if the buffer length is 2, only the previous operation status words are returned in IBUFR(1) and IBUFR(2), respectively. If the buffer length is 4, the two status words of the previous operation are returned in IBUFR(1) and IBUFR(2), and the current status words are returned in IBUFR(3) and IBUFR(4).

For a description of DVR32 controller status codes, see the Controller Instruction Set section of the *HP 13037 Controller Installation and Service Manual*, part number 13037-90006. For a description of DVA32 controller status codes, see the *HP 13365 Controller Programming Guide*, part number 13365-90901.

For DVR32, IBUFR(1) contains the unit from which status is requested. If the buffer length is 2, the driver returns the previous status in IBUFR(2) and IBUFR(3). If the buffer length is 4, the driver returns the previous status in IBUFR(2) and IBUFR(3) and the current status in IBUFR(4) and IBUFR(5).

Error Conditions

This section describes DVR32 and DVA32 error conditions.

IO07 Error

Driver rejects call, program aborted.

a. DMA not assigned for the device. DMA can be assigned during system generation in RTE.

b. Requested subchannel number is out of range. Check LU number.

c. Requested length of transfer is too large. Length + starting sector# * 64 was larger than the track size (number of sectors/track * 64).

d. Requested negative track or sector number (except track = −1, described earlier in this chapter).

Track Error

Parity error exit.

Format: `TR` *nn* `EQT` *xx* `U` *yy* `S(or U)`

where:

nn	Logical track number (track number relative to subchannel).
xx	EQT entry number.
yy	Subchannel number.
`S` (or `U`)	The request was from System (or User).

This error occurs in the following situations:

a. Verify after write or error detection after read indicates that an error occurred after ten attempts.

b. “Seek check” error condition detected after six write attempts. Check if disk is formatted.

c. Controller status indicates illegal access to spare track.

d. Attempted to write on protected track with the format switch “off”.

e. Overrun exists after ten read attempts. Detected by disk controller whenever instantaneous data transfer rate of the controller exceeds that of DMA.

f. Attempted to write when the protect switch on the drive is “on”.

I/O Not Ready

Format: `IONR L`*nn* `E`*xx* `S`*yy zzz*

where:

nn	LU number.
xx	EQT entry number.
yy	Subchannel number.
zzz	Status word, see Table 2-3.

a. Disk controller indicates drive not ready.

b. Disk controller returns status indicating hardware malfunction exists.

c. Drive is busy.

d. DVA32 only. Drive timed out because:

1. Device address is invalid or nonexistent.
2. Power is down on the specified device.
3. Disk did not respond within the time specified in EQT14, or within 2 seconds if the user has not specified the timeout length (refer to Device Timeout Processing later in this chapter).

Immediate Completion

Driver executes a normal exit without doing any I/O to the disk controller. This occurs when the requested track number is −1 or is larger than the number of tracks on the subchannel. As previously explained, the B-Register is set to the number of tracks on the subchannel, bit 5 in EQT 5 is set, and if the request was a read, the number of 64-word sectors per track is returned in IBUFR(1).

Return Codes

Below is an explanation of the information returned in the A- and B-Registers upon return from the Initiation and Continuation/Completion sections of DVA32 and DVR32. For more information about standard driver structure and functions, see the *RTE Operating System Driver Writing Manual*, part number 92200-93005.

Initiation Section

Return codes from this section are as follows:

A = 0 Operation initiated.

A = 1 Illegal write or read. Caused by:

1. Negative track number (except −1) was specified.
2. Requested length of transfer was too large.
3. Requested sector number larger than number of sectors per track on drive.

A = 3 Equipment malfunction exists or equipment is not ready.

A = 4 Indicates immediate completion has occurred. Caused by:

1. Requested track number was too large or = −1.
2. Received control request with a nonzero subfunction code. (For example, subfunction code of 22 for call from disk library routine, 23 for full status read.)

Continuation/Completion Section

A = 0 Successful completion.

A = 1 Equipment malfunction or drive not ready.

A = 3 One of the following data transmission errors:

1. Error detected during write verification.
2. Data overrun occurred during read.
3. Transfer incomplete.

B = Transmission log. This is the positive number of words or characters transmitted, depending on which the user requested. B = 0 for timeout during request from a disk library routine; refer to the following section.

Device Timeout Processing

It is strongly recommended that you set the timeout value for DVA32 at generation time or by using the RTE "TO" command. If it is not set at generation time or is set to 0 with the TO command, the default timeout value of two seconds is assumed by DVA32. Refer to Appendix A for recommended timeout values for specific disk drives.

DVR32 does not process its own timeouts (they are processed by the system). It is not necessary to set a timeout value because the driver has access to device status information as long as the 13037 controller is powered on and functional. If a timeout value is set for DVR32 the system, processes it as follows:

When a timeout occurs the system issues an "IOTO" message and the LU of the I/O request is set down. The program that called the driver resumes and the value of the transmission log (from the B-Register) returned to it is zero. Because DVR32 has access to device status information, it is able to detect if a drive is down. In this case, the driver returns from the initiation section to RTE I/O control module (RTIOC) after setting the A-Register = 3. The system then issues an "IONR" message.

For a timeout during a call from a disk library routine, the action taken by DVR32 is the same as that taken by DVA32, explained below.

DVA32 processes timeouts in the following manner:

For a normal timeout (the call was not from a disk library routine), the driver clears the interface card and returns from the continuation section to RTIOC after setting the A-Register = 1, indicating "device malfunction". The system issues an "IONR" error. Because the interface card does not have access to device status information, the message issued upon timeout is always "IONR", rather than "IOTO".

Note Disk library routines are used by SWTCH, FORMT, and the disk backup utilities. They reside in the libraries:

$DSCLB	92067-12002	ICD/MAC Disk Utilities Library
$DKULB	92067-12003	ICD/MAC Disk Backup Library

For a timeout during a request from a disk library routine, the driver returns from the continuation section to RTIOC after setting the A- and B-Registers = 0, indicating "disk library timeout". No error message is issued by the system, and the timeout should be handled by the program that called the disk library routine.

3

Configuration Information

This Chapter contains configuration information for DVA32 and DVR32.

For more information, refer to the following manuals as appropriate for your system:

- *RTE-IVB Online Generator Reference Manual*, part number 92068-90007
- *RTE-IVB System Manager's Manual*, part number 92068-90006
- *RTE-IVB Programmer's Reference Manual*, part number 92068-90004
- *RTE-IVB Utility Programs Reference Manual*, part number 92068-90010

or

- *RTE-6/VM Online Generator Reference Manual*, part number 92084-90010
- *RTE-6/VM System Manager's Manual*, part number 92084-90009

Follow the procedures below to configure the appropriate driver into the RTE system at generation time.

The examples below use DVA32. The procedure is the same for both drivers, with the exception that the timeout value does not need to be set for DVR32.

Program Input Phase

Load the driver along with the other I/O drivers by making the following entry:

```
PROG INPUT PHASE:
    .
    .
    .
REL,%DVA32
```

Table Generation Phase

During this phase make the following entries:

1. Equipment Table entry.

```
EQUIPMENT TABLE ENTRY
    .
    .
    .
EQT n?
sc, DVA32,D,T=x
```

   where:

   n is the EQT entry number.
   sc is the octal select code of the ICD card.
   D indicates that DMA is required.

   DVA32 only:

   x is the desired timeout value expressed in tens of milliseconds. Refer to Appendix A.

2. A Device Reference Table (DRT) entry relating the desired LU number for each disk subchannel defined during the initialization phase of generation:

```
DEVICE REFERENCE TABLE
    .
    .
    .
lu = EQT#?
n,m
```

   where:

   lu is an LU number.
   n is the EQT entry number associated with the LU number.
   m is the subchannel number associated with the LU number.

   Note: All disk LUs must be numbered less than 64.

3. An interrupt table entry for the ICD card (or MAC card for DVR32):

```
INTERRUPT TABLE:
    .
    .
    .
sc,EQT,n
```

   where:

   sc is the octal select code of the ICD card (or MAC card for DVR32).
   n is the EQT entry number from step 1 above.

Multiple Disk Interfaces

This section explains procedures used when configuring additional disk interfaces into an RTE system.

Different Interfaces

To configure both an ICD and a MAC interface into your RTE system, follow the procedure in the above section for both drivers. In addition, you must provide your own relocatable track map table module during the Program Input Phase to accompany the peripheral disk driver (that driver that does not support the system disk subchannel on LU 2). A track map table contains your disk subchannel definitions. The system disk track map table is defined interactively during the initialization phase of generation and thus need not be supplied by the user.

The track map table used by DVR32 is $TB32, and that used by DVA32 is $TA32. Both track map tables must exist if both DVR32 and DVA32 are included in your system. If DVR32 supports the system disk ($TB32 was constructed during generation), then you must supply the track map table $TA32 to be used by DVA32. If DVA32 supports the system disk, then $TB32 must be supplied by the user. Directions for building and assembling a track map table module are included in the appropriate appendix of your System Manager's Manual. A sample source and relocatable file for each table is distributed with your RTE system in the following files:

&$TB32/%$TB32 relocatable part number 92067-16509
&$TA32/%$TA32 relocatable part number 92067-16507

Identical Interfaces

To configure two interfaces of the same type into your system, follow the procedure in the above section. The standard driver DVR32 or DVA32 is used, and the corresponding track map table is defined by the generator.

For the second interface and driver, however, special provisions must be made. Because a driver cannot service more than one interface, a separate driver and track map table must be included for the second interface. To avoid duplicate module and entry point names at generation time, the names of the driver, its entry points, and its track map table must be unique. For this reason, the following drivers are distributed with your RTE system:

File Name	Part Number	Driver Name	Track Map Table Used	Interface Type
%DVC32	92067-16506	DVC32	$TC32	ICD (HP 12821A)
%DVP32	92067-16508	DVP32	$TP32	MAC (HP 13175A/B)

The track map tables $TC32 and $TP32 can be built by modifying the source files &$TA32 and &$TB32, respectively, and assembling the new source file. The resulting relocatable module must be included along with the driver during the Program Input Phase of generation. The track map table subchannel definition format is shown in Appendix B of this manual. For more information about creating a track map table, refer to the appropriate appendix of your System Manager's Manual.

A

Recommended Disk Timeout Values

Table A-1. Disk Performance Characteristics and Recommended Timeout Values

	HP 9895	HP 7905	HP 7906(H)	HP 7920(H)	HP 7925(H)
Tracks/Cylinder	2	3	4	5	9
No. of Cylinders	77	411	411	823	823
Sectors/Track (64-word sectors)	60	96	96	96	128
Track-to-Track Seek Time	3 ms/track + 15 ms track settling	5 ms	5 ms	5 ms	5.4 ms
Maximum Seek Time	231 ms	45 ms	45 ms	45 ms	48.5 ms
Average Latency	83.3 ms	8.33 ms	8.33 ms	8.33 ms	11.11 ms
Capacity per Drive (MBytes)	1	15	20	50	121.4
Recommended Timeout Value (seconds)	see below	2	2	2	2

For the HP 79xxH drives, the default timeout value of 2 seconds is sufficient in most cases. This value can be decreased, however, if the user's application requires faster detection of timeout conditions.

The timeout value for DVA32 should be set to the largest recommended timeout value among all devices serviced by the driver in your configuration.

In the case of the HP 9895 flexible disk (DVA32 only), the appropriate timeout value will vary according to how the sectors have been organized by the disk utility program FORMT. This program "interleaves" sectors on the HP 9895 according to the number of "fill" sectors specified by the user. For detailed information, see the Utility Programs Reference Manual for your system. A good rule for determining the timeout value for the HP 9895 is:

Timeout value (in seconds) = (fill# + 2) * 0.2

The formula is valid for fill values between 1 and 28. A fill value of 1 is the smallest recommended value and will result in the fastest transfer rate. A fill value of 0 is not recommended.

B

Track Map Table Entry Format

Disk subchannel definitions in track map tables defined by the user follow the formats shown below.

Table B-1. $TB32 Entry Format (DVR32)

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
word 0	No. of 64-word sectors/track															
1	First cylinder number															
2	No. of surfaces								Starting head no.					Unit no.		
3	No. of tracks															
4									No. of spares							

Table B-2. $TA32 Entry Format (DVA32)

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
word 0	No. of 64-word sectors/track															
1	First cylinder number															
2	No. of surfaces								Starting head no.					Address no.		
3	No. of tracks															
4	1	0	0	Unit no.						No. of spares						

C

Summary of DVR32 and DVA32 Features

Table C-1. DVR32 and DVA32 Features

	DVR32	DVA32
Supported Disks	HP 7905 HP 7906 HP 7920 HP 7925	HP 9895 HP 7906H HP 7920H HP 7925H
Interface	HP 13175A/B	HP 12821A
Multiple CPU Access	Yes	No
Error Detection	Yes	Yes
Error Correction	Yes	No
Device Timeout Detection	No	Yes
Online Sparing and Initialization	Yes	Yes