

# LibDsk v1.5.9-pre

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## **Abstract**

LibDsk is a library intended to give transparent access to floppy drives and to the “disc image files” used by emulators to represent floppy drives.

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# 1 Introduction

## 1.1 About this document

This document only covers LibDsk – the library – itself. For information on the example utilities supplied with LibDsk (apriboot, dskform, dsktrans, dskid, dskdump, dskscan, dskutil and md3serial) see their respective manual pages.

## 1.2 About LibDsk

LibDsk is a library for accessing floppy drives and disc images transparently. It currently supports the following disc image formats:

- Raw “dd if=foo of=bar” images;
- Raw images in logical filesystem order;
- CPCEMU-format .DSK images (normal and extended);
- MYZ80-format hard drive images;
- CFI-format disc images, as produced by FDCOPY.COM under DOS and used to distribute some Amstrad system discs;
- ApriDisk-format disc images, used by the utility of the same name under DOS.
- NanoWasp-format disc images, used by the eponymous emulator.
- IMD-format disc images, as produced by Dave Dunfield’s ImageDisk utility.
- Yaze ‘ydisk’ disc images, created by the ‘yaze’ and ‘yaze-ag’ emulators.
- JV3-format disc images, used in TRS-80 emulation.
- Compaq Quick Release Sector Transfer (QRST), used for their computers’ BIOS setup floppies.
- Disc images created by the Sydex imaging programs Teledisk and CopyQM (Not supported in the 16-bit Windows version).
- SAP disc images used in emulation of Thomson computers.
- The floppy drive under Linux;
- The floppy drive under Windows. Windows support is a complicated subject - see section 7 below.
- The floppy drive (and hard drive partitions) under DOS.
- LDBS: A disc image format still under development. See LDBS/ldbs.html for more information.

LibDsk also supports compressed disc images in the following formats:

- Squeeze (Huffman coded)
- GZip (Deflate )
- BZip2 (Burrows-Wheeler; support is read-only)
- TeleDisk ‘advanced’ compression (LZH; support is read-only, and confined to TeleDisk disk images)

### 1.3 What's new?

**Important note:** If you have coded against a version of LibDsk prior to 1.5.3, bear in mind that 1.5.3 is a substantial rewrite. The API for your programs remains the same, but there are differences in implementation that may trip you up. In particular, if you are writing to a disc image file it is very important to check the result of `dsk_close()` – there are a lot of drivers which make their changes in memory and don't try to commit them until `dsk_close()` is called.

For full details, see the file `ChangeLog`.

- `dskform` can now format disc images with a blank PCDOS or Apricot MSDOS filesystem.
- Added a new 'sap' driver for SAP-format disc images (thanks to Emulix75 for information).
- When converting to Teledisk TD0 format, attempt to come up with a plausible value for the drive type (3.5" / 5.25").
- The geometry probe has been amended to try and get the correct data rate on disc images that don't include this information as metadata.
- The 'dsk' / 'edsk' driver has been rewritten to support the extensions described at <http://simonowen.com/misc/extextdsk.txt>
- The LDBS file format has been changed to support the above extensions. LDBS files created by LibDsk 1.5.3 and earlier can still be used, but don't support the extensions.
- Added a new 'qrst' driver for Compaq QRST-format disc images.
- Various bugfixes in the IMD driver.
- Added a new 'ldbs' driver for LDBS-format disc images.
- CopyQM and Teledisk are no longer supported in 16-bit Windows builds, because 16-bit Windows does not provide the `sscanf()` function to DLLs.
- Added a new 'complement' option to the drive geometry, allowing for disc image formats where the bytes are stored complemented.
- Added a new 'jv3' driver for JV3-format disc images.
- A bugfix to the automatic geometry probe in the 'imd' driver: HD discs were not being correctly detected.
- Added a new 'imd' driver for IMD-format disc images.
- A new `SIDES_EXTSURFACE` geometry, for disc images where the sector numbers on side 1 follow on from side 0.
- TeleDisk images with 'advanced' (LZH) compression are now supported.
- Added a new 'ydisk' driver for YAZE ydisk-format disc images.
- Some disc image files include filesystem information as part of the disc image metadata. `dskid` and `dsktrans` now display and copy this information.

- Should now compile out of the box on FreeBSD.
- A bugfix to the rcpmfs driver should allow it to simulate a CP/M 2 filesystem as well as CP/M 3.

## 1.4 Terms and definitions

In this document, I use the word `CYLINDER` to refer to a position on a floppy disc, and `TRACK` to refer to the data within a cylinder on one side of the disc. For a single-sided disc, these are the same; for a double-sided disc, there are twice as many tracks as cylinders.

## 2 Supported file formats

The following disc image file formats are supported by LibDsk.

**“dsk”** : Disc image in the DSK format used by CPCEMU. The format of a .DSK file is described in the CPCEMU documentation.

**“edsk”** : Disc image in the extended CPCEMU DSK format.

**“raw”** : Raw disc image - as produced by “`dd if=/dev/fd0 of=image`”. On systems other than Linux, DOS or Windows, this is also used to access the host system’s floppy drive.

**“rawoo”** : Raw disc image, ordered so that all the tracks on side 0 come first, then all the tracks on side 1.

**“rawob”** : Raw disc image, ordered so that all the tracks on side 0 come first, then all the tracks on side 1 in reverse order.

**“logical”** : Raw disc image in logical filesystem order. Early versions of LibDsk could generate such images (for example, by using the now-deprecated `-logical` option to `dsktrans`) but couldn’t then write them back or use them in emulators.

**“floppy”** : Host system’s floppy drive (under Linux, DOS or Windows).

**“int25”** : Hard drive partition under DOS. Also used for the floppy drive on Apricot PCs.

**“ntwdm”** : Enhanced floppy support under Windows 2000 and XP, using an additional kernel-mode driver.

**“myz80”** : MYZ80 hard drive image, which is *nearly* the same as “raw” but has a 256 byte header.

**“cfi”** : Compressed floppy image, as produced by FDCOPY.COM under DOS. Its format is described in `cfi.html`.

**“imd”** : Disc images created by Dave Dunfield’s ImageDisk utility.

**“jv3”** : Disc images used by Jeff Vavasour’s TRS-80 emulators.

**“qm”** : Disc images created by Sydex’s CopyQM.



**“tele”** : Disc images created by Sydex’s TeleDisk.

**“nanowasp”** : Disc image in the 400k Microbee format used by the NanoWasp emulator. This is similar to “raw”, but the tracks are stored in a different order. LibDsk also applies a sector skew so that the sectors are read/written in the logical order. Strictly speaking, it should not do this (when libdsk is used with cpmtools, cpmtools is the one that does the skewing) but cpmtools cannot handle the skewing scheme used by the Microbee format.

**“apridisk”**: Disc image in the format used by the ApriDisk utility. The format is described in [apridisk.html](http://apridisk.html).

**“rcpmfs”**: Reverse CP/M filesystem. A directory is made to appear as a CP/M disk. This is a complex system and should be approached with caution.

**“remote”**: Remote LibDsk server, most likely at the other end of a serial line.

**“ydisk”**: Disc image format used by the yaze and yaze-ag CP/M emulators.

**“qrst”**: Compaq Quick Release Sector Transfer.

**“ldbs”**: LibDsk Block Store.

### 3 Architecture

LibDsk is composed of a fixed core (files named `dsk*.c`) and a number of drivers (files named `drv*.c`). When you open an image or a drive (using `dsk_open()` or `dsk_creat()`) then a driver is chosen. This driver is then used until it’s closed (`dsk_close()`).

Each driver is identified by a name. To get a list of available drivers, use `dsk_type_enum()`. To get the driver that is being used by an open DSK image, use `dsk_drvname()` or `dsk_drvdesc()`.

#### 3.1 Logical and physical sectors

LibDsk has two models of disc geometry. One is as a linear array of “logical” sectors - for example, a 720k floppy appears as 1440 512-byte sectors numbered 0 to 1439. The other locates each sector using a (Cylinder, Head, Sector) triple - so on the 720k floppy described earlier, sectors would run from (0,0,1) to (79,1,9).

Internally, all LibDsk drivers are written to use the Cylinder/Head/Sector model. For those calls which take parameters in logical sectors, LibDsk uses the information in a `DSK_GEOMETRY` structure to convert to C/H/S. `DSK_GEOMETRY` also contains information such as the sector size and data rate used to access a given disc.

Those functions which deal with whole tracks (such as the command to format a track) use logical tracks and (cylinder,head) pairs instead. To initialise a `DSK_GEOMETRY` structure, either:

- call `dsk_getgeom()` to try and detect it from the disc; or
- call `dg_stdformat()` to select one of the “standard” formats that LibDsk knows about; or

- call `dg_dosgeom()` / `dg_cpm86geom()` / `dg_pcwgeom()` / `dg_aprigeom()` to initialise it from a copy of a DOS / CP/M86 / PCW / Apricot boot sector; or
- Set all the members manually.

### 3.1.1 DSK\_GEOMETRY in detail

```
typedef struct
{
    dsk_sides_t dg_sidedness; /* This describes the logical sequence of tracks on
        the disc - the order in which their host system reads them. This will only be used
        if dg_heads is greater than 1 (otherwise all the methods are equivalent) and you
        are using functions that take logical sectors or tracks as parameters. It will be
        one of:

        SIDES_ALT The tracks are ordered Cylinder 0 Head 0; C0H1; C1H0; C1H1;
        C2H0; C2H1 etc. This layout is used by most PC-hosted operating systems,
        including DOS and Linux. Amstrad's 8-bit operating systems also use this
        ordering.

        SIDES_OUTBACK The tracks go out to the edge on Head 0, and then back in
        on Head 1 (so Cylinder 0 Head 0 is the first track, while Cylinder 0 Head
        1 is the last). This layout is used by Freek Heite's 144FEAT driver (for
        CP/M-86 on the PC) but I have not seen it elsewhere.

        SIDES_OUTOUT The tracks go out to the edge on Head 0, then out again on Head
        1 (so the order goes C(last)H0, C0H1, C1H1, ..., C(last)H1). This ordering
        is used by Acorn-format discs.

        SIDES_EXTSURFACE The tracks are arranged in the same way as SIDES_ALT,
        but if the sectors on side 0 are numbered 1-n, the sectors on side 1 are
        numbered n+1 - 2*n (for example, side 0 are numbered 1-9, and side 1 are
        numbered 10-18). This is a new option and should be treated with caution!

        */

    dsk_p cyl_t dg_cylinders; /* The number of cylinders this disc has. Usually 40
        or 80. */

    dsk_p head_t dg_heads; /* The number of heads (sides) the disc has. Usually 1 or
        2. */

    dsk_p sect_t dg_sectors; /* The number of sectors per track. */

    dsk_p sect_t dg_secbase; /* The first physical sector number. Most systems start
        numbering their sectors at 1; Acorn systems start at 0, and Amstrad CPCs start
        at 65 or 193. */

    size_t dg_secsz; /* Sector size in bytes. Note that several drivers rely on this
        being a power of 2. */

    dsk_rate_t dg_datarate; /* Data rate. This will be one of:

        RATE_HD High-density disc (1.4Mb or 1.2Mb)
```

```

    RATE_DD Double-density disc in 1.2Mb drive (ie, 360k disc in 1.2Mb drive)
    RATE_SD Double-density disc in 1.4Mb or 720k drive
    RATE_ED Extra-density disc (2.8Mb) */

dsk_gap_t dg_rwgap; /* Read/write gap length */

dsk_gap_t dg_fmtgap; /* Format gap length */

int dg_fm; /* This is really a dsk_recmode_t, but is declared as an int for backward
compatibility. It contains the recording mode and additional flags. To extract the
recording mode, use (dg_fm & RECMODE_MASK):

    RECMODE_MFM MFM (double density) recording mode.
    RECMODE_FM FM (single density) recording mode. Not all PC floppy controllers
support this mode; the National Semiconductor PC87306 and the Future
Domain TMC series SCSI controllers can at least read FM discs. The BBC
Micro used FM recording for its 100k and 200k DFS formats. The Win-
dows / DOS floppy drivers do not support FM recording.

To extract the flags, use (dg_fm & RECMODE_FLAGMASK). There is cur-
rently one additional flag: RECMODE_COMPLEMENT. If this flag is set,
bytes written on the disc are stored complemented (ie, XORed with 0xFF). */

int dg_nomulti; /* Set to nonzero to disable multitrack mode. This only affects
attempts to read normal data from tracks containing deleted data (or vice versa).
*/

int dg_noskip; /* Set to nonzero to disable skipping deleted data when searching
for non-deleted data (or vice versa). */

} DSK_GEOMETRY;

```

## 4 LibDsk Function Reference

### 4.1 dsk\_open: Open an existing disc image

```
dsk_err_t dsk_open(DSK_PDRIVER *self, const char *filename, const char *type, const c
```

Enter with:

- “self” is the address of a DSK\_PDRIVER variable (treat it as a handle to a drive / disc file). On return, the variable will be non-null (if the operation succeeded) or null (if the operation failed).
- “filename” is the name of the disc image file. On DOS and Windows, “A:” and “B:” refer to the two floppy drives. On Apricot MS-DOS, “0:” and “1:” refer to the floppy drives.
- “type” is NULL to detect the disc image format automatically, or the name of a LibDsk driver to force that driver to be used. See `dsk_type_enum()` below.

- “compress” is NULL to auto-detect compressed files, or the name of a LibDsk compression scheme. See `dsk_comp_enum()`.

Returns: A `dsk_err_t`, which will be 0 (`DSK_ERR_OK`) if successful, or a negative integer if failed. See `dsk_strerror()`. The error `DSK_ERR_NOTME` means either that no driver was able to open the disc / disc image (if “type” was NULL) or that the requested driver could not open the file (if “type” was not NULL).

Standard LibDsk drivers are listed in section 2.

Compression schemes are:

“sq” : Huffman (squeezed). The reason for the inclusion of this system is to support .DQK images (see appendix B).

“gz” : GZip (deflate). This will only be present if libdsk was built with zlib support.

“bz2” : BZip2 (Burrows-Wheeler compression). This support is currently read-only, and will only be present if LibDsk was built with bzip support.

## 4.2 dsk\_creat: Create a new disc image

```
dsk_err_t dsk_creat(DSK_PDRIVER *self, const char *filename, const char *type)
```

In the case of floppy drives, this acts exactly as `dsk_open()`. For image files, the file will be deleted and recreated. Parameters and results are as for `dsk_open()`, except that “type” cannot be NULL (it must specify the type of disc image to be created) and if “compress” is NULL, it means that the file being created should not be compressed.

## 4.3 dsk\_close: Close a drive or disc image

```
dsk_err_t dsk_close(DSK_PDRIVER *self)
```

Pass the address of an opaque pointer returned from `dsk_open()` / `dsk_creat()`. On return, the drive will have been closed and the pointer set to NULL. It is important to check the result of this function; many drivers don’t write their changes back until `dsk_close()` is called.

## 4.4 dsk\_dirty: Read the dirty flag

```
int dsk_dirty(DSK_PDRIVER self)
```

This function returns non-zero if the disc has been modified since it was inserted into the drive, and zero if it has not been modified.

## 4.5 dsk\_pread, dsk\_lread : Read a sector

```
dsk_err_t dsk_pread(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_pcy_t  
dsk_err_t dsk_lread(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_lsect_t
```

These functions read a single sector from the disc. There are two of them, depending on whether you are using logical or physical sector addresses.

Enter with:

- “self” is a handle to an open drive / image file.
- “geom” points to the geometry for the drive.
- “buf” is the buffer into which data will be loaded.
- “cylinder”, “head” and “sector” (dsk\_pread) or “sector” (dsk\_lread) give the location of the sector.

Returns:

- If successful, DSK\_ERR\_OK. Otherwise, a negative DSK\_ERR\_\* value.
- If the driver cannot read sectors, DSK\_ERR\_NOTIMPL will be returned.

#### 4.6 dsk\_pwrite, dsk\_lwrite: Write a sector

```
dsk_err_t dsk_pwrite(DSK_PDRIIVER self, const DSK_GEOMETRY *geom, const void *buf, dsk_
dsk_err_t dsk_lwrite(DSK_PDRIIVER self, const DSK_GEOMETRY *geom, const void *buf, dsk_
```

As dsk\_pread / dsk\_lread, but write their buffers to disc rather than reading them from disc. If the driver cannot write sectors, DSK\_ERR\_NOTIMPL will be returned.

#### 4.7 dsk\_pcheck, dsk\_lcheck: Verify sectors on disc against memory

```
dsk_err_t dsk_pcheck(DSK_PDRIIVER self, const DSK_GEOMETRY *geom, const void *buf, dsk_
dsk_err_t dsk_lcheck(DSK_PDRIIVER self, const DSK_GEOMETRY *geom, const void *buf, dsk_
```

As dsk\_pread / dsk\_lread, but rather than reading their buffers from disc, they compare the contents of their buffers with the data already on the disc. If the data match, the functions return DSK\_ERR\_OK. If there is a mismatch, they return DSK\_ERR\_MISMATCH. In case of error, other DSK\_ERR\_\* values are returned. If the driver cannot read sectors, DSK\_ERR\_NOTIMPL will be returned.

#### 4.8 dsk\_pformat, dsk\_lformat: Format a disc track

```
dsk_err_t dsk_pformat(DSK_PDRIIVER self, DSK_GEOMETRY *geom, dsk_pcyll_t cylinder, dsk_
dsk_err_t dsk_lformat(DSK_PDRIIVER self, DSK_GEOMETRY *geom, dsk_ltrack_t track, const
```

Enter with:

- “self” is a handle to an open drive / image file.
- “geom” points to the geometry for the drive. The formatter may modify this if (for example) it’s asked to format track 41 of a 40-track drive.
- “cylinder” / “head” (dsk\_pformat) or “track” (dsk\_lformat) give the location of the track to format.

- “format” should be an array of (geom->dg\_sectors) DSK\_FORMAT structures. These structures must contain sector headers for the track being formatted. For example, to format the first track of a 720k disc, you would pass in an array of 9 such structures: { 0, 0, 1, 512 }, { 0, 0, 2, 512, } ..., { 0, 0, 9, 512 }
- “filler” should be the filler byte to use. Currently the Win32 driver ignores this parameter. If the driver cannot format tracks, DSK\_ERR\_NOTIMPL will be returned.

Note that when formatting a .DSK file that has more than one head, you must format cylinder 0 for each head before formatting other cylinders.

#### 4.9 dsk\_apform, dsk\_alform: Automatic format

```
dsk_err_t dsk_apform(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_p cyl_t cylinder,
dsk_err_t dsk_alform(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_ltrack_t track,
```

These function calls behave as dsk\_pformat() and dsk\_lformat() above, except that the sector headers are automatically generated. This saves time and trouble setting up sector headers on discs with standard layouts such as DOS, PCW or Linux floppies. If the driver cannot format tracks, DSK\_ERR\_NOTIMPL will be returned.

#### 4.10 dsk\_psecid, dsk\_lsecid: Read a sector ID.

```
dsk_err_t dsk_psecid(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_p cyl_t cylinder,
dsk_err_t dsk_lsecid(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_ltrack_t track,
```

Read a sector ID from the given track. This can be used to probe for discs with oddly-numbered sectors (eg, numbered 65-74). Enter with:

- “self” is a handle to an open drive / image file.
- “geom” points to the geometry for the drive.
- “cylinder” / “head” (dsk\_psecid) or “track” (dsk\_lsecid) give the location of the track to read the sector from.
- “result” points to an uninitialised DSK\_FORMAT structure.

On return:

- If successful, the buffer at “result” will be initialised with the sector header found, and DSK\_ERR\_OK will be returned.
- If the driver cannot provide this functionality (for example, the Win32 driver under NT), DSK\_ERR\_NOTIMPL will be returned.

Note that the DOS, Win16 and Win32 (under Win9x) drivers implement a limited version of this call, which will work on normal DOS / CP/M86 / PCW discs and CPC discs. However it will not be usable for other purposes.

## 4.11 `dsk_ptrackids`, `dsk_ltrackids`: Identify sectors on track.

```
dsk_err_t dsk_ptrackids(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_p cyl_t cylind
dsk_err_t dsk_ltrackids(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_ltrack_t track
```

These functions are intended to read all the sector IDs from a track, in order, and (preferably) starting at the index hole. If they succeed, 'result' will point at an array of `DSK_FORMAT` structures describing the sectors found. This array will have been allocated with `dsk_malloc()` and should be freed with `dsk_free()`.

## 4.12 `dsk_rtread`: Reserved.

```
dsk_err_t dsk_rtread(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_p cyl_t cylind
```

This function is reserved for future expansion. The intention is to use it for diagnostic read commands (such as reading the raw bits from a track). Currently it returns `DSK_ERR_NOTIMPL`.

## 4.13 `dsk_xread`, `dsk_xwrite`: Low-level reading and writing

```
dsk_err_t dsk_xread(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_p cyl_t cylind
dsk_err_t dsk_xwrite(DSK_PDRIVER self, const DSK_GEOMETRY *geom, const void *buf, dsk_p cyl_t cylind
```

`dsk_xread()` and `dsk_xwrite()` are extended versions of `dsk_pread()` and `dsk_pwrite()`. They allow the caller to read/write sectors whose sector ID differs from the physical location of the sector, or to read/write deleted data.. The "cylinder" and "head" arguments specify where to look; the "cyl\_expected" and "head\_expected" are the values to search for in the sector header.

These functions are only supported by the CPCEMU driver, the Linux floppy driver and the NTWDM floppy driver. Other drivers will return `DSK_ERR_NOTIMPL`. Unless you are emulating a floppy controller, or you need to read discs that contain deleted data or misnumbered sectors, it should not be necessary to call these functions.

### 4.13.1 `dsk_xread()`, `dsk_xwrite()`: Deleted data

The "deleted" argument is used if you want to read or write sectors that have been marked as deleted. In `dsk_xwrite()`, this is a simple value; pass 0 to write normal data, or 1 to write deleted data. In `dsk_xread()`, pass the address of an integer containing 0 (read normal data) or 1 (read deleted data). On return, the integer will contain:

- If the requested data type was read: 0
- If the other data type was read: 1
- If the command failed: Value is meaningless.

Passing NULL acts the same as passing a pointer to 0.

The opposite type of data will only be read if you set `geom->dg_noskip` to nonzero. Some examples:

geom->dg_noskip	deleted	Data on disc	Results	*deleted becomes
0	-> 0	Normal	DSK_ERR_OK	0
0	-> 0	Deleted	DSK_ERR_NODATA	??
0	-> 1	Deleted	DSK_ERR_NODATA	??
1	-> 0	Normal	DSK_ERR_OK	0
1	-> 0	Deleted	DSK_ERR_OK	1
1	-> 1	Normal	DSK_ERR_OK	1
1	-> 1	Deleted	DSK_ERR_OK	0

#### 4.14 dsk\_lread, dsk\_ptread, dsk\_xtread

```

dsk_err_t dsk_lread(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_ltrack_t track)
dsk_err_t dsk_ptread(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_p cyl_t cylinder, dsk_head_t head)
dsk_err_t dsk_xtread(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_p cyl_t cylinder, dsk_head_t head, dsk_sector_t sector)

```

These functions read a track from the disc, using the FDC's "READ TRACK" command. There are three of them - logical, physical and extended physical.

If the driver does not support this functionality, LibDsk will attempt to simulate it using multiple sector reads.

Enter with:

- "self" is a handle to an open drive / image file.
- "geom" points to the geometry for the drive.
- "buf" is the buffer into which data will be loaded.
- "cylinder" and "head" (dsk\_ptread, dsk\_xtread) or "track" (dsk\_lread) give the location of the track to read.
- (dsk\_xtread) "cyl\_expected" and "head\_expected" are used as the values to search for in the sector headers.

Returns:

- If successful, DSK\_ERR\_OK. Otherwise, a negative DSK\_ERR\_\* value.
- (dsk\_xtread()) only) If the driver does not support extended sector reads/writes, then DSK\_ERR\_NOTIMPL will be returned.

#### 4.15 dsk\_lseek, dsk\_pseek

```

dsk_err_t dsk_lseek(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_ltrack_t track)
dsk_err_t dsk_pseek(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_p cyl_t cylinder, dsk_head_t head)

```

Seek to a given cylinder. Only the CPCEMU driver, the Linux floppy driver and the NTWDM floppy driver support this; other drivers return DSK\_ERR\_NOTIMPL. You should not normally need to call these functions. They have been provided to support programs that emulate a uPD765A controller.



## 4.16 dsk\_drive\_status

```
dsk_err_t dsk_drive_status(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_phead_t head)
```

Get the drive's status (ready, read-only etc.). The byte "result" will have one or more of the following bits set:

**DSK\_ST3\_FAULT:** Drive fault

**DSK\_ST3\_RO:** Read-only

**DSK\_ST3\_READY:** Ready

**DSK\_ST3\_TRACK0:** Head is over track 0

**DSK\_ST3\_DSDDRV:** Drive is double-sided

**DSK\_ST3\_HEAD1:** Current head is head 1, not head 0. Usually this just depends on the value of the "head" parameter to this function.

Which bits will be "live" depends on which driver is in use, but the most trustworthy will be DSK\_ST3\_READY and DSK\_ST3\_RO. This function will never return DSK\_ERR\_NOTIMPL; if the facility is not provided by the driver, a default version will be used.

## 4.17 dsk\_dirty: Has drive been written to?

```
int dsk_dirty(DSK_PDRIVER self);
```

This returns zero if the disc has not been written to since it was opened, nonzero if it has.

## 4.18 dsk\_getgeom: Guess disc geometry

```
dsk_err_t dsk_getgeom(DSK_PDRIVER self, DSK_GEOMETRY *geom)
```

This attempts to determine the geometry of a disc (number of cylinders, tracks, sectors etc.) by loading the boot sector. It understands DOS, Apricot, CP/M-86 and PCW boot sectors. If the geometry could be guessed, then "geom" will be initialised and DSK\_ERR\_OK will be returned. If no guess could be made, then DSK\_ERR\_BADFMT will be returned. Other values will result if the disc could not be read.

Some drivers (in particular the MYZ80 driver, and the Win32 driver under NT) only support certain fixed disc geometries. In this case, the geometry returned will reflect what the driver can use, rather than what the boot sector says.

## 4.19 dg\_\*geom : Initialise disc geometry from boot sector

```
dsk_err_t dg_dosgeom(DSK_GEOMETRY *self, const unsigned char *bootsect)
dsk_err_t dg_pcwgeom(DSK_GEOMETRY *self, const unsigned char *bootsect)
dsk_err_t dg_cpm86geom(DSK_GEOMETRY *self, const unsigned char *bootsect)
dsk_err_t dg_aprigeom(DSK_GEOMETRY *self, const unsigned char *bootsect)
```

These functions are used by `dsk_getgeom()`, but can also be called independently. Enter them with:

- “self” is the structure to initialise;
- “bootsect” is the boot sector to initialise the structure from.

Returns `DSK_ERR_BADFMT` if the sector does not contain a suitable disc specification, or `DSK_ERR_OK` otherwise.

**dg\_dosgeom** will check for a PC-DOS boot sector.

**dg\_pcwgeom** will check for an Amstrad PCW boot sector.

**dg\_cpm86geom** will check for a CP/M-86 boot sector.

**dg\_aprigeom** will check for an Apricot DOS boot sector.

## 4.20 dg\_stdformat : Initialise disc geometry from a standard LibDsk format.

```
dsk_err_t dg_stdformat(DSK_GEOMETRY *self, dsk_format_t formatid, dsk_cchar_t *fname,
```

Initialises a `DSK_GEOMETRY` structure with one of the standard formats LibDsk knows about. Formats are:

**FMT\_180K:** 180k, 9 512 byte sectors, 40 tracks, 1 side

**FMT\_200K:** 200k, 10 512 byte sectors, 40 tracks, 1 side

**FMT\_CPCSYS:** Amstrad CPC system format - as **FMT\_180K**, but physical sectors are numbered 65-73

**FMT\_CPCDATA:** Amstrad CPC data format - as **FMT\_180K**, but physical sectors are numbered 193-201

**FMT\_720K:** 720k, 9 512 byte sectors, 80 tracks, 2 sides

**FMT\_800K:** 800k, 10 512 byte sectors, 80 tracks, 2 sides

**FMT\_1440K:** 1.4M, 18 512 byte sectors, 80 tracks, 2 sides

**FMT\_160K:** 160k, 8 512 byte sectors, 40 tracks, 1 side

**FMT\_320K:** As **FMT\_160K**, but 2 sides

**FMT\_360K:** As **FMT\_180K**, but 2 sides

**FMT\_720F:** As **FMT\_720K**, but the physical/logical sector mapping is “out-and-back” rather than “alternate sides”. See section 3.1.1 for details.

**FMT\_1200F:** As **FMT\_720F**, but with 15 sectors

**FMT\_1440F:** As **FMT\_720F**, but with 18 sectors

**FMT\_ACORN160:** Acorn 40 track single sided 160k (used by ADFS ‘S’ format)

**FMT\_ACORN320:** Acorn 80 track single sided 320k (used by ADFS 'M' format)

**FMT\_ACORN640:** Acorn 80 track double sided 640k (used by ADFS 'L' format)

**FMT\_ACORN800:** Acorn 80 track double sided 800k (used by ADFS 'D' and 'E')

**FMT\_ACORN1600:** Acorn 80 track high density 1600k (used by ADFS 'F' format)

**FMT\_BBC100** BBC micro 40 track single sided 100k (using FM encoding)

**FMT\_BBC200** BBC micro 80 track single sided 200k (using FM encoding)

**FMT\_MBEE400** Microbee 40 track double sided 400k

**FMT\_MGT800** MGT 80 track double sided 800k (used by MGT +D and Sam Coupé).

If the “fname” is not NULL, it will be pointed at a short name for the format (suitable for use as a program option; see `tools/dskform.c`).

If the “fdesc” is not NULL, it will be pointed at a description string for the format. With these two, it's possible to enumerate geometries supported by the library without keeping a separate list in your program - see `tools/formnames.c` for example code that does this.

If additional formats have been specified in the `libdiskrc` file (section 5.1), they will be returned by this function, using format numbers starting at the last builtin format plus 1.

## 4.21 `dsk_*_forcehead`: Override disc head

```
dsk_err_t dsk_set_forcehead(DSK_PDRIVER self, int force)
dsk_err_t dsk_get_forcehead(DSK_PDRIVER self, int *force)
```

(This function is deprecated; it is equivalent to `dsk_set_option()` / `dsk_get_option()` with “HEAD” as the option name).

Forces the driver to ignore the head number passed to it and always use either side 0 or side 1 of the disc. This is used to read discs recorded on PCW / CPC / Spectrum+3 add-on 3.5" drives. Instead of the system software being programmed to use both sides of the disc, a switch on the drive was used to set which side was being used. Thus discs would end up with both sides saying they were head 0.

Anyway, when using `dsk_set_forcehead`, pass:

**-1:** Normal - the head passed as a parameter to other calls is used.

**0:** Always use side 0.

**1:** Always use side 1.

## 4.22 `dsk_*_option`: Set/get driver option

```
dsk_err_t dsk_set_option(DSK_PDRIVER self, const char *name, int value)
dsk_err_t dsk_get_option(DSK_PDRIVER self, const char *name, int *value)
```

Sets or gets a driver-specific numeric option.

The “name” field is the option name. If the selected driver does not support the appropriate option, then the error DSK\_ERR\_BADOPT will be returned. If the option is valid but the value requested is not, DSK\_ERR\_BADVAL will be returned.

The following driver options are supported by the Linux and NTWDM floppy drivers:

**HEAD** Force the drive always to use one or other side of the disc, ignoring the disc geometry. Valid values are 0 or 1 to force one or other side of the disc, -1 to allow either.

**DOUBLESTEP** To support a 48tpi disc in a 96tpi drive, double all cylinder numbers. Valid values are 1 (enable) or 0 (disable).

**ST0 / ST1 / ST2 / ST3** These are the values of the floppy controller’s 4 status registers returned by the last operation. They cannot be changed, only read.

The ‘remote’ driver supports the following option (plus any options that the remote driver supports):

**REMOTE:TESTING** This disables an optimisation in the remote driver, so that it sends method calls to the remote server even if it has been asked not to. The purpose of this is to ensure that all calls to the remote driver result in RPC packets being sent.

#### 4.22.1 Filesystem driver options

It is possible that as part of its geometry probe, LibDsk will have detected a CP/M or DOS filesystem on a disc image. Alternatively, a disc image may contain filesystem metadata (for example, the YAZE ydsk and RCPMFS drivers both contain CP/M filesystem parameters). These parameters appear as driver options, prefixed with the name FS:. When making a copy, dsktrans enumerates the driver options on the source disc image and sets them to the same values on the destination image. This is necessary to ensure that (for example) when one YDSK is copied to another, its filesystem parameters are transferred. The current filesystem options supported by LibDsk are:

**FS:CP/M:BSH** Block shift - 3 => 1k, 4 => 2k, 5 => 4k...

**FS:CP/M:BLM** Block mask - (block size / 128) - 1

**FS:CP/M:EXM** Extent mask - roughly, how much does a directory entry cover? (0 => 16k, 1 => 32k, 3 => 64k...)

**FS:CP/M:DSM** Number of data and directory blocks, minus 1

**FS:CP/M:DRM** Number of directory entries, minus 1

**FS:CP/M:AL0** Allocation bitmap of directory blocks (first 8 blocks)

**FS:CP/M:AL1** Allocation bitmap of directory blocks (second 8 blocks)

**FS:CP/M:CKS** Checksum vector size (normally (FS:CP/M:DRM + 1) / 4); can be 0x8000 for a fixed disc

**FS:CP/M:OFF** Number of boot tracks

**FS:CP/M:VERSION** Filesystem version (-2 (ISX), 2 (CP/M 2) or 3 (CP/M 3). This is only supported by the 'rcpmfs' driver.)

**FS:FAT:SECCLUS** Number of sectors per cluster

**FS:FAT:RESERVED** Number of reserved sectors

**FS:FAT:FATCOPIES** Number of FAT copies

**FS:FAT:DIRENTRIES** Number of root directory entries

**FS:FAT:MEDIABYTE** Media byte (usually the first byte of the FAT)

**FS:FAT:SECFAT** Number of sectors per FAT

Note that it is theoretically possible for a disc to have FS:CP/M *and* FS:FAT information - for example, a CP/M filesystem saved in a disc image that also contains FAT metadata, or vice versa.

#### 4.23 dsk\_option\_enum: Get list of driver options

```
dsk_err_t dsk_option_enum(DSK_PDRIIVER self, int idx, char **optname)
```

If “idx” is in the range 0 -> number of driver options, (\*optname) is set to the name of the appropriate driver option. If not, (\*optname) is set to NULL.

#### 4.24 dsk\_\*\_comment: Set comment for disc image

```
dsk_err_t dsk_set_comment(DSK_PDRIIVER self, const char *comment)
dsk_err_t dsk_get_comment(DSK_PDRIIVER self, char **comment)
```

Used to get or set the comment (if any) for the current disc. The pointer passed or returned may be NULL (meaning “No comment”). The string returned belongs to LibDsk; don’t alter or free it.

#### 4.25 dsk\_type\_enum

```
dsk_err_t dsk_type_enum(int index, char **drvname)
```

If “index” is in the range 0 -> number of LibDsk drivers, (\*drvname) is set to the short name for that driver (eg: “myz80” or “raw”). If not, (\*drvname) is set to NULL.

#### 4.26 dsk\_comp\_enum

```
dsk_err_t dsk_comp_enum(int index, char **compname)
```

As dsk\_type\_enum(), but lists supported compression schemes.

#### 4.27 **dsk\_drvname, dsk\_drvdesc**

```
const char *dsk_drvname(DSK_PDRIIVER self)
const char *dsk_drvdesc(DSK_PDRIIVER self)
```

Returns the driver name (eg: “myz80”) or description (eg “MYZ80 hard drive driver”) for an open disc image.

#### 4.28 **dsk\_compname, dsk\_compdesc**

```
const char *dsk_compname(DSK_PDRIIVER self);
const char *dsk_compdesc(DSK_PDRIIVER self);
```

Returns the compression system name (eg: “gz”; NULL if the disc image isn’t compressed) or description (eg: “GZip compressed”) for an open disc image.

#### 4.29 **dg\_ps2ls, dg\_ls2ps, dg\_pt2lt, dg\_lt2pt**

Convert between logical sectors and physical cylinder/head/sector addresses. Normally these functions are called internally and you don’t need to use them.

```
dsk_err_t dg_ps2ls(const DSK_GEOMETRY *self, dsk_p cyl, dsk_phead_t head, dsk_ps
```

Converts physical C/H/S to logical sector.

```
dsk_err_t dg_ls2ps(const DSK_GEOMETRY *self, dsk_lsect_t logical, dsk_p cyl, ds
```

Converts logical sector to physical C/H/S.

```
dsk_err_t dg_pt2lt(const DSK_GEOMETRY *self, dsk_p cyl, dsk_phead_t head, dsk_lt
```

Converts physical C/H to logical track.

```
dsk_err_t dg_lt2pt(const DSK_GEOMETRY *self, dsk_ltrack_t logical, dsk_p cyl, d
```

Converts logical track to physical C/H.

#### 4.30 **dsk\_strerror: Convert error code to string**

```
char *dsk_strerror(dsk_err_t err)
```

Converts an error code returned by one of the other LibDsk functions into a printable string.

### 4.31 dsk\_reportfunc\_set / dsk\_reportfunc\_get

```
void dsk_reportfunc_set(DSK_REPORTFUNC report, DSK_REPORTEND repend);  
void dsk_reportfunc_get(DSK_REPORTFUNC *report, DSK_REPORTEND *repend);
```

Used to set callbacks from LibDsk to your own code, for LibDsk to display messages during processing that may take time. The code could be used to set the text on the status line of your program window, for example.

```
typedef void (*DSK_REPORTFUNC)(const char *message);  
typedef void (*DSK_REPORTEND)(void);
```

The first function you provide will be called when LibDsk wants to display a message (such as “Decompressing...”). The second will be called when the processing has finished.

### 4.32 dsk\_set\_retry / dsk\_get\_retry

```
dsk_err_t dsk_set_retry(DSK_PDRIIVER self, unsigned int count);  
dsk_err_t dsk_get_retry(DSK_PDRIIVER self, unsigned int *count);
```

Sets the number of times that a failed read, write, check or format operation will be attempted. 1 means “only try once, do not retry”.

### 4.33 dsk\_get\_psh

```
unsigned char dsk_get_psh(size_t sector_size)
```

Converts a sector size into the sector shift used by the uPD765A controller (eg: 128 -> 0, 256 -> 1, 512 -> 2 etc.) You should not need to use this. The reverse operation is:  $\text{sector\_size} = (128 \ll \text{psh})$ .

### 4.34 dsk\_copy: Copy an entire disk image

```
dsk_err_t dsk_copy(DSK_PDRIIVER source, DSK_PDRIIVER dest, DSK_GEOMETRY *geom);
```

This will copy all data possible from one disk image to another. It only works on disc image files; attempts to use it on floppy drives, remote servers and so forth will return DSK\_ERR\_NOTIMPL.

The 'geom' parameter is usually left as NULL. Most disk image files contain enough metadata that their structure can be determined unambiguously. Raw files (formats 'raw', 'rawoo', 'rawob' and 'logical') do not. If the source or the target is one of these files, the copy may fail with DSK\_ERR\_BADFMT. If so, a 'geom' parameter should be passed, describing the layout to use.

### 4.35 Structure: DSK\_FORMAT

This structure is used to represent a sector header. It has four members:

**fmt\_cylinder:** Cylinder number.

**fmt\_head:** Head number.

**fmt\_sector:** Sector number.

**fmt\_sectsize:** Sector size in bytes.

### 4.36 LibDsk errors

**DSK\_ERR\_OK:** No error.

**DSK\_ERR\_BADPTR:** A null or otherwise invalid pointer was passed to a LibDsk routine.

**DSK\_ERR\_DIVZERO:** Division by zero: For example, a DSK\_GEOMETRY is set to have zero sectors.

**DSK\_ERR\_BADPARAM:** Bad parameter (eg: if a DSK\_GEOMETRY is set up with `dg_cylinders = 40`, trying to convert a sector in cylinder 65 to a logical sector will give this error).

**DSK\_ERR\_NODRVR:** Requested driver not found in `dsk_open()` / `dsk_creat()`.

**DSK\_ERR\_NOTME:** Disc image could not be opened by requested driver.

**DSK\_ERR\_SYSERR:** System call failed. `errno` holds the reason.

**DSK\_ERR\_NOMEM:** `malloc()` failed to allocate memory.

**DSK\_ERR\_NOTIMPL:** Function is not implemented (eg, this driver doesn't support `dsk_xread()`).

**DSK\_ERR\_MISMATCH:** In `dsk_lcheck()` / `dsk_pcheck()`, sectors didn't match.

**DSK\_ERR\_NOTRDY:** Drive is not ready.

**DSK\_ERR\_RDONLY:** Disc is read-only.

**DSK\_ERR\_SEEKFAIL:** Seek fail.

**DSK\_ERR\_DATAERR:** Data error.

**DSK\_ERR\_NODATA:** Sector ID found, but not sector data.

**DSK\_ERR\_NOADDR:** Sector not found at all.

**DSK\_ERR\_BADFMT:** Not a valid format.

**DSK\_ERR\_CHANGED:** Disc has been changed unexpectedly.

**DSK\_ERR\_ECHECK:** Equipment check.

**DSK\_ERR\_OVERRUN:** Overrun.



**DSK\_ERR\_ACCESS:** Access denied.

**DSK\_ERR\_CTRLR:** Controller failed.

**DSK\_ERR\_COMPRESS:** Compressed file is corrupt.

**DSK\_ERR\_RPC:** Error in remote procedure call.

**DSK\_ERR\_BADOPT:** Driver does not support the requested option.

**DSK\_ERR\_BADVAL:** Driver does support the requested option, but the passed value is out of range.

**DSK\_ERR\_UNKNOWN:** Unknown error

## 4.37 Miscellaneous

**LIBDSK\_VERSION** is a macro, defined as a string containing the library version - eg "1.0.0"

## 5 Initialisation files

In addition to its built-in library of formats, LibDsk can also load formats from one or two external files - a systemwide file (**libdiskrc**) and a user-specific file (**.libdiskrc**). The rules for how these files are found differ from platform to platform.

### 5.1 libdiskrc format

The file format is similar to a Windows .INI file. Each format is described in a section, which starts with the format name in square brackets (format names may not start with a hyphen). After the format name, there are a number of lines of the form **variable=value**.

Anything after a semicolon or hash character is treated as a comment and ignored. Blank lines are also ignored.

For each geometry, the entries listed below can be present. If not all the values are present, LibDsk will use default values from its "pcw180" format. As you can see, they correspond to members of the **DSK\_GEOMETRY** structure.

**description=DESC** The description of the format as shown by (for example) **dskform -help**.

**sides=TREATMENT** How a double-sided disk is handled. This can either be *alt* (sides alternate – used by most PC-hosted operating systems), *outback* (use side 0 tracks 0-79, then side 1 tracks 79-0 – used by 144FEAT CP/M disks), *outout* (use side 0 tracks 0-79, then side 1 tracks 0-79 – used by some Acorn formats) or *extsurface* (sectors on side 0 are numbered 1-*n*, sectors on side 1 are numbered *n*+1 - *n*\*2). If the disk is single-sided, this parameter can be omitted.

**cylinders=COUNT** Sets the number of cylinders (usually 40 or 80).

**heads=COUNT** Sets the number of heads (usually 1 or 2 for single- or double- sided).

**sectors=COUNT** Sets the number of sectors per track.

**secbase=NUMBER** Sets the first sector number on a track. Usually 1; some Acorn formats use 0.

**seccsize=COUNT** Sets the size of a sector in bytes. This should be a power of 2.

**datarate=VALUE** Sets the rate at which the disk should be accessed. This is one of *HD, DD, SD or ED*.

**rwgap=VALUE** Sets the read/write gap.

**fmtgap=VALUE** Sets the format gap.

**recmode=FM or MFM** Sets the recording mode - FM or MFM. For backward compatibility, the alternate syntax **FM=Y or N** is also supported.

**complement=Y or N** Sets the complement flag - Y if the format stores data complemented.

**multitrack=Y or N** Sets multitrack mode.

**skipdeleted=Y or N** Sets whether to skip deleted data.

### 5.1.1 libdiskrc example

```
; This is FMT_800K as a libdiskrc entry
[xcf2dd]
Description = 800k XCF2DD format
Sides = Alt
Cylinders = 80
Heads = 2
Sectors = 10
SecBase = 1
SecSize = 512
DataRate = SD
RWGap = 12
FmtGap = 23
RecMode = MFM
[xcf2]
Description = 200k XCF2 format
Cylinders = 40
```

... etc.

The supplied libdiskrc.sample file contains libdiskrc-format definitions of all the built-in disk formats.

## 5.2 Locating libdiskrc

### 5.2.1 UNIX

The systemwide file is located at `${datadir}/LibDsk/libdiskrc`. The `${datadir}` is usually `/usr/local/share`; you can change it with the `-datadir` or `-prefix` arguments to the configure script.

The user-specific file is `$(HOME)/.libdiskrc`.

### 5.2.2 Win32

The systemwide file is in the path specified at

```
HKEY_LOCAL_MACHINE\Software\jce@seasip\LibDsk\ShareDir
```

If this registry key is not found, LibDsk finds the path of the program that called it (using `GetModuleFileName()`), and then uses “/...program path.../share/libdskrc”.

The user-specific file is in the path specified at

```
HKEY_CURRENT_USER\Software\jce@seasip\LibDsk\HomeDir
```

If this registry key is not present, the user’s “My Documents” directory is used. Either way, the file is called `.libdskrc`.

### 5.2.3 Win16

The systemwide file is found from the location of the calling program using `GetModuleFileName()`. There is no user-specific file.

### 5.2.4 DOS

The systemwide file is only searched for if the `LIBDSK` environment variable is set; if it is set, it is assumed to be the name of the directory containing `libdskrc`. There is no user-specific file.

## 6 Reverse CP/M-FS (rcpmfs) backend

The `rcpmfs` backend is designed to present a host directory as a read/write CP/M disk image. This has a number of uses:

- You could construct a CP/M disk image using `dsktrans directory filename`.
- Conversely, you could extract the files from a CP/M disk image using `dsktrans filename directory`.
- It is possible for a CP/M emulator running a genuine copy of CP/M to use LibDsk to access files on the host system, without altering the BDOS or installing additional drivers.

`rcpmfs` does not work with systems that only support “8.3” format filenames; it also needs a system call that can set the size of a file (such as `truncate()` under UNIX). It therefore remains unimplemented in the DOS and Win16 versions of the library.

### 6.1 In Use

To use an `rcpmfs` directory in LibDsk, pass a directory name instead of a filename. Files in the directory which match CP/M naming conventions (8.3 filenames) will appear in the emulated disk image; if there are more files than will fit in the emulated disk, LibDsk will stop when it reaches one that doesn’t fit. Under Windows, the ‘short filename’ is used, so files with names not matching CP/M conventions may also be mapped with names like `README~1.HTM`.

CP/M has 16 user areas (some variants support 32; rcpmfs does not), and files with the same name can exist in each area. rcpmfs represents nonzero user areas by prepending “nn.” to the filename; so if a CP/M program created a file called EXAMPLE.DAT in user 4, this would be saved as “04..example.dat” in the underlying directory. The double dot ensures that the resulting filename is not a valid CP/M name, and therefore won’t conflict with any file in user 0.

rcpmfs can behave as a CP/M 2 or CP/M 3 filesystem. If the latter, it constructs a disc label (based on the name of the directory) and turns on date/time stamping. Update and access stamps are used, because they map nicely to the utime() system call. It can also emulate the filesystem used by the ISX emulator, which stores file sizes slightly differently.

## 6.2 rcpmfs initialisation file

For a directory to be usable by rcpmfs, it should contain a file called .libdisk.ini describing the format to use. This file is in INI format, similar to libdiskrc (section 5.1). It must contain only one section: [RCPMFS]. Within that section, the following variables may be present:

**BlockSize** Size of a CP/M data block. Must be a power of 2, and at least 1024. If there are more than 255 blocks in the CP/M filesystem, this must be at least 2048.

**DirBlocks** Number of blocks containing the CP/M directory.

**TotalBlocks** Total number of data and directory blocks.

**SysTracks** Number of system tracks. These will be stored in a file called .libdisk.boot.

**Version** CP/M version that will be accessing the filesystem. This should be 2, 3 or ISX:

2 CP/M 2 – no time stamps or disk labels.

3 CP/M 3 – time stamps and disk labels are present.

**ISX** Used by the ISX emulator. Similar to CP/M 2, but byte 13 of the CP/M directory entry holds the number of *unused* bytes in the last record, not the number of *used* bytes.

**Format** Name of one of the LibDsk built-in or user-supplied formats, giving the geometry that the simulated disk will have. Alternatively, you can specify the format manually, using the same variable names as in libdiskrc.

If there is no .libdisk.ini file present, LibDsk will assume BlockSize=1024, DirBlocks=2, TotalBlocks=175, SysTracks=1, Version=3, Format=pcw180.

If you call dsk\_option\_set with any of the following options:

- FS:CP/M:BSH
- FS:CP/M:BLM
- FS:CP/M:DSM
- FS:CP/M:DRM
- FS:CP/M:OFF

- FS:CP/M:VERSION

and the value written differs from the one used before, then a new .libdsk.ini file will be written with the revised filesystem parameters and the directory rescanned. This allows a command of the form:

```
dsktrans -otype rcpmfs disc-image directory
```

to stand a reasonable chance of working as long as the source disc image has a CP/M filesystem that LibDsk can detect.

To select ISX format using dsk\_option\_set(), use -2 as the filesystem version:

```
dsk_set_option(dsk, "FS:CP/M:VERSION", -2);
```

### 6.3 Bugs

rcpmfs is not without its bugs and missing features:

- To my knowledge, rcpmfs has only been tested under the dsktrans pattern of usage (which writes the directory and then the file space), and with fairly simple operations in a CP/M emulator. It is not known how well it holds up under heavy use as a live CP/M filesystem.
- The CP/M attributes F1-F4, passwords and permissions are not mapped. The SYS and ARC attributes are only mapped in the Win32 version.
- Formatting (or reformatting) an rcpmfs directory writes out a new .libdsk.ini containing the geometry used to do the format. However, since DSK\_GEOMETRY doesn't contain the CP/M filesystem parameters (block size, block count, etc.) these will be the ones previously used in that directory, and quite possibly completely wrong. If you want to 'format' the directory using LibDsk, call dsk\_set\_option() with the six "FS:CP/M:" options listed above to set up the correct filesystem parameters. Or create the .libdsk.ini by other means.

## 7 LibDsk under Windows

This section mainly deals with the subject of direct floppy drive access. Other aspects of LibDsk remain relatively consistent across Windows versions.

As with so many other aspects of Windows, direct access to the floppy drive is a case of "write once - debug everywhere"<sup>1</sup>. Not only does support vary across different systems, it varies depending on whether LibDsk was compiled with a 16-bit compiler or a 32-bit one. This table shows the different possibilities and the resulting behaviour:

Windows Version	Win16 Subsystem	Win32 Subsystem
3.x	Fairly good	n/a
4.x (95, 98 and ME)	Good but less stable	Limited
NT, 2000, XP	Very limited	
2000, XP + ntwdm driver	Good	

<sup>1</sup>Originally said by Microsoft with respect to Java. Pot. Kettle. Black.

## **7.1 Windows 3.x**

Only the 16-bit build of LibDsk will run. The floppy support in Win16 is pretty much the same as in DOS; there is support for discs with arbitrary numbers of tracks and sectors, and arbitrary sector sizes. This means that LibDsk can, for example, read Acorn ADFS floppies.

## **7.2 Windows 4.x (95, 98 and ME)**

Both the 16-bit and 32-bit versions of LibDsk will run. The 16-bit version is more capable, but less stable; it can read Acorn ADFS floppies, which the 32-bit version cannot. Unfortunately, 32-bit programs can't link to the 16-bit version of LibDsk<sup>2</sup>, but there is a workaround (described below) involving the use of LDSERVER.

## **7.3 Windows NT (NT 3.x, NT 4.x, 2000, XP) without ntwdm driver**

The floppy drive can only read/write formats which are supported by the floppy driver. This is the case using either version of LibDsk.

## **7.4 Windows 2000 and XP with ntwdm driver**

Simon Owen's enhancement to the Windows 2000 floppy driver can be downloaded from <<http://simonowen.com/fdrawcmd/>>. Once it is installed, LibDsk (using its 'ntwdm' driver rather than 'floppy') has pretty much carte blanche regarding floppy formats, and can access discs in many formats including Acorn ADFS.

## **7.5 General comments on programming floppy access for Windows**

LibDsk has four independent drivers for accessing floppies under Windows. They are:

### **7.5.1 The Win16 driver.**

This uses INT 0x13 to do the reads and writes, just as in MSDOS. Again as in MSDOS, there is a diskette parameter table pointed to by INT 0x1E. This table seems not to be documented, which is perhaps why the Win16 subsystem in Windows 2000/XP doesn't implement it. You can, fortunately, tell if this is the case; if the first two bytes are both 0xC4, then what you have is a Windows 2000 trap rather than a diskette parameter table.

### **7.5.2 The Win32c driver.**

This driver uses VWIN32 services to make INT 0x13-style calls under Windows9x. However, there is no VWIN32 call to change the diskette parameter table, which is why the Win16 driver can do things the Win32 drivers can't. It isn't possible to get round this by thunking to a 16-bit DLL either; the INT 0x1E vector is zero for 16-bit DLLs in 32-bit processes.

---

<sup>2</sup>And no, the Generic Thunk isn't good enough. I've tried it.

### 7.5.3 The Win32 driver.

Windows NT gets close (but not close enough) to the UNIX idea that everything is a file. So while in theory it would be enough to use the normal “raw” driver on “\\.\A:”, in practice there are a number of nasty subtleties relating to such things as memory alignment and file locking.

### 7.5.4 The ntwdm driver.

This driver is a wrapper around fdrawcmd.sys, which allows commands to be issued to the floppy controller.

### 7.5.5 Other floppy APIs

Sydex produce a replacement floppy driver for 32-bit versions of Windows (SydexFDD) which is not supported by LibDsk.

## 7.6 LDSERVER

LDSERVER is a program that makes the 16-bit LibDsk DLL available to 32-bit programs. It does this by creating a mailslot (“\\.\mailslot\LibDsk16”) and listening for messages. Each message corresponds to a LibDsk call.

The 32-bit LibDsk library checks for this mailslot and, if it finds it, uses it in preference to its own floppy support.

### 7.6.1 Compiling LDSERVER

A compiled version of LDSERVER is not supplied. You will need to build it yourself from the files in the rpcserv directory; projects are provided for Microsoft Visual C++ 1.5 and Borland C++ 5.0.

LDSERVER calls functions in NETAPI.DLL. If your compiler doesn’t include an import library for this DLL, you will have to generate it using the IMPLIB tool - eg:

```
IMPLIB NETAPI.LIB NETAPI.DLL
```

or the equivalent utility for your compiler.

### 7.6.2 Using LDSERVER

Just run LDSERVER.EXE, and then use a 32-bit LibDsk program. The server window shows a reference count (0 if it is idle, nonzero if LibDsk programs are using it) and the status should change to “Active” when it is performing disc access.

LDSERVER does not shut down automatically.

### 7.6.3 Important Security Warning

LDSERVER is a 16-bit program, written using APIs intended for use on a local area network. These APIs have no security support. It will happily obey commands sent from anywhere on your network. If your computer is connected to the Internet, it will obey commands sent to it over the Internet. A malicious attacker could use LDSERVER to overwrite important system files or read confidential documents.

If you have a firewall, then make sure that the NetBIOS ports 137, 138 and 139 are blocked. If you don't have a firewall, ***do not run LDSERVER while your computer is connected to the Internet!***

## 7.7 LibDsk and COM

If you are building the 32-bit version of LibDsk with Visual C++ 6.0, you can also build the accompanying 'atlibdsk' project, which builds a version of LibDsk that exports its API through COM. This allows relatively easy use of LibDsk from languages that support COM binding, such as Visual BASIC or .NET languages.

### 7.7.1 General points

Where LibDsk functions return a `dsk_err_t`, ATLIBDSK returns a COM HRESULT. This will be `S_OK` for success, a general COM error (such as `E_POINTER` or `E_INVALIDARG`), or a `FACILITY_ITF` error (`0x8004xxxx`). The low word of a `FACILITY_ITF` error is the LibDsk error code, converted to a positive number (eg: `0x8004000C` is `FACILITY_ITF` error 12, so the LibDsk error is -12, `DSK_ERR_SEEKFAIL`).

Sector buffers to be read/written must be passed as variants containing arrays of bytes.

The arrays of `DSK_FORMAT` structures passed to `dsk_lform()` and `dsk_pform()` are replaced by variants containing arrays of bytes - four bytes per sector to format. The last byte is the physical sector shift (0 for 128, 1 for 256 etc.)

ATLIBDSK exports four object classes:

### 7.7.2 Library

This contains LibDsk functions not associated with a particular disk image. Its methods are:

Method	Equivalent LibDsk call	Comments
<code>open</code>	<code>dsk_open</code>	Instantiates a new Disk object.
<code>create</code>	<code>dsk_creat</code>	Instantiates a new Disk object.
<code>get_psh</code>	<code>dsk_get_psh</code>	
<code>dosgeom</code>	<code>dg_dosgeom</code>	Instantiates a new Geometry object.
<code>cpm86geom</code>	<code>dg_cpm86geom</code>	Instantiates a new Geometry object.
<code>pcwgeom</code>	<code>dg_pcwgeom</code>	Instantiates a new Geometry object.
<code>apriggeom</code>	<code>dg_apriggeom</code>	Instantiates a new Geometry object.
<code>stdformat</code>	<code>dg_stdformat</code>	Instantiates a new Geometry object.
<code>stdformat_count</code>		Returns the number of formats supported by <code>stdformat</code>
<code>type_enum</code>	<code>dsk_type_enum</code>	Returns TRUE if the passed index is valid, else FALSE.
<code>comp_enum</code>	<code>dsk_comp_enum</code>	Returns TRUE if the passed index is valid, else FALSE.
<code>reporter</code>	<code>dsk_reportfunc_{set,get}</code>	This is a property of type <code>IReporter</code>

### 7.7.3 Geometry

This corresponds to the `DSK_GEOMETRY` structure. The following properties correspond to the structure members:

- sidedness
- cylinders



- heads
- sectors
- secbase
- datarate
- secsize
- rwgap
- fmtgap
- fm
- nomulti
- noskip

There are also five functions. Four are for logical/physical sector conversions:

- ls2ps
- lt2pt
- ps2ls
- pt2lt

and the last is `stdformat()`, which wraps `dg_stdformat()`.

#### **7.7.4 Disk**

The Disk object corresponds to a LibDsk `DSK_PDRIVER` value. You should not create one yourself (method calls will fail with `E_POINTER`) but call the 'create' or 'open' methods of the Library object.

Functions included are:

- `get_geometry`
- `close`
- `drive_status`
- `pread`
- `lread`
- `xread`
- `pwrite`
- `lwrite`
- `xwrite`
- `pcheck`

- lcheck
- xcheck
- pformat
- lformat
- apform
- alform
- ptread
- ltread
- xtread
- psecid
- lsecid
- lseek
- pseek
- option\_enum

all of which are pretty similar to their LibDsk namesakes. There are also the following properties:

- comment
- option
- retries
- drvname
- drvdesc
- compname
- compdesc

### 7.7.5 IReporter

IReporter is used for the LibDsk message callback. It is an interface that should be implemented by an object in your program. Set the library's "reporter" property to your object; then its report() and endreport() methods will be called.

## 8 LibDsk RPC system

The LibDsk RPC system is designed to make disc drives on remote computers transparently available to LibDsk applications. It operates on a client/server basis; LibDsk contains a driver (called 'remote') that can act as a client, and it can be used to implement a server.

The on-the-wire protocol is described in protocol.txt in the documentation directory.

## 8.1 The 'serial' driver

This is designed for using LibDsk over a serial connection - say from a 3.5" computer to a 5.25" computer. The filename specification to use at the client end is:

```
serial:port,baud,remotename{,remotetype{,remotecompress}}
```

for example:

```
serial:/dev/ttyS0,9600+crtscts,A:
```

The various parts of this filename specification are:

**port** The local serial port to use.

- Under Linux, this is the name of a serial port (eg /dev/ttyS0).
- Under Windows, this is likewise the name of a serial port (eg COM1:).
- Under DOS, you need to have a FOSSIL serial port driver loaded; LibDsk was tested using ADF <[http://ftp.iis.com.br/pub/simtelnet/msdos/fossil/adf\\_150.zip](http://ftp.iis.com.br/pub/simtelnet/msdos/fossil/adf_150.zip)> (or do a web search for adf\_150.zip). The port is then the number assigned by the FOSSIL driver (normally 0). Note also that ADF uses a single fixed baud rate, so you should make sure that the rate on the command line matches the rate that was used when ADF was loaded.

**baud** The speed and handshaking options. LibDsk does not allow the number of bits, the parity or the count of stop bits to be changed; it insists on 8-bit communications with 1 stop bit and no parity. The speed is a number (300, 600, 1200 etc.) and the handshake option is "+crtscts" (to use RTS/CTS handshaking) or "-crtscts" (not to). If neither handshake option is present, "+crtscts" is assumed.

**remotename** The name of the file or drive on the remote computer.

**remotetype** The type of the file/drive ("dsk", "floppy" etc.).

**remotecompress** The compression to use on the remote computer.

### 8.1.1 Servers for the serial driver

One of the sample utilities supplied with LibDsk is called serslave (serslave.exe under DOS / Windows). This is a server using the same serial protocol as above.

Launch serslave with the command:

```
serslave port,baud
```

for example:

```
serslave COM1:,9600+crtscts
```

or in DOS (again, a FOSSIL driver is required):

```
serslave 0,19200
```

I have written a similar server for CP/M systems, called AUXD. This is a separate download from the LibDsk web page.

## 8.2 The 'fork' driver

The 'fork' driver is used (on any system which supports the fork() system call) to send LibDsk requests to a local program using pipes. This driver was written for testing purposes, but may come in handy as a poor man's plugin system. The filename specification is:

```
fork:program,remotename{,remotetype{,remotecompress}}
```

for example:

```
fork:./dskslave,a.dqk,dsk,sq
```

The various parts of this filename specification are:

**program** The name of the program to use; `execvp()` is used to launch it, so if no path is given the user's PATH will be searched. The program must take LibDsk calls from its standard input and send results to its standard output.

**remotename** The name of the file or drive.

**remotetype** The type of the file/drive ("dsk", "floppy" etc.).

**remotecompress** The compression to use.

An example of a server for this protocol is the example 'forkslave' program; this is a very simple wrapper around `dsk_rpc_server()` which reads RPC packets from its standard input and writes them to its standard output.

## 9 Writing new drivers

The interface between LibDsk and its drivers is defined by the `DRV_CLASS` structure. To add a new driver, you create a new `DRV_CLASS` structure and add it to various files.

There are two methods of writing a driver. One is to provide all the functions yourself. The other is to write a driver using LDBS as its internal storage format; in that case, you need only provide `dc_open()`, `dc_creat()` and `dc_close()`. The latter technique is particularly suited to formats that can't be rewritten in place (so you have to parse the whole file on open and rewrite the whole file on close anyway), and is described in section 10.

Assuming you want to create a full driver that rewrites in-place, proceed as follows:

### 9.1 The driver header

Firstly, create a header for this driver, basing it on (for example) `lib/drvposix.h`. The first thing in the header (after the LGPL banner) is:

```
typedef struct
{
    DSK_DRIVER px_super;
    FILE *px_fp;
    int px_readonly;
    long px_filesize;
} POSIX_DSK_DRIVER;
```

This is where you define any variables that your driver needs to store for each disc image. In the case of the “raw” driver, this consists of a FILE pointer to access the underlying disc file, a “readonly” flag, and the current size of the drive image file. The first member of this structure must be of type DSK\_DRIVER.

The rest of this header consists of function prototypes, which I will come back to later.

## 9.2 The driver source file

Secondly, create a .c file for your driver. Again, it’s probably easiest to base this on lib/drvposix.c. At the start of this file, create a DRV\_CLASS structure, such as:

```
DRV_CLASS dc_posix =
{
    sizeof(POSIX_DSK_DRIVER),
    NULL,
    "raw\0rawalt\0",
    "Raw file driver",
    posix_open,
    posix_creat,
    posix_close
};
```

The first four entries in this structure are:

- The size of your driver’s instance data;
- The driver’s superclass. This should be left as NULL.
- Possible names for the driver (each will be matched against the name passed to `dsk_open()` / `dsk_creat()`). Each possible name, including the last, must be followed by `\0`.
- The driver’s description string.

The remainder of the structure is composed of function pointers; the types of these are given in `drv.h`. At the very least, you will need to provide the first three pointers (`*_open`, `*_creat` and `*_close`); to make the driver vaguely useful, you will also need to implement some of the others.

Once you have created this structure, edit:

- `drivers.h`. Add a declaration for your DRV\_CLASS structure, such as

```
extern DRV_CLASS dc_myformat;
```

- `drivers.inc`. Insert a reference to your structure (eg: “&dc\_myformat,”) in the list. Note that order is important; the comments in `drivers.inc` describe how to decide where things go.

Edit “lib/Makefile.am”. Near the top of this file is a list of drivers and their header files; just add your .c and .h to this list.

If your driver depends on certain system headers (as all the floppy drivers do) then you will need to add checks for these to “configure.in” and “lib/drv.h”; then run “autoconf” to rebuild the configure script.

The function pointers in the DRV\_CLASS structure are described in drv.h. The first parameter to all of them (“self”) is declared as a pointer to DSK\_DRIVER. In fact, it is a pointer to the first member of your instance data structure. Just cast the pointer to the correct type:

```
/* Sanity check: Is this meant for our driver? */
if (self->dr_class != &dc_posix) return DSK_ERR_BADPTR;
pxself = (POSIX_DSK_DRIVER *)self;
```

and you’re in business.

## 9.3 Driver functions

### 9.3.1 dc\_open

```
dsk_err_t (*dc_open) (DSK_PDRIVER self, const char *filename)
```

Attempt to open a disc image. Entered with:

- “self” points to the instance data for this disc image (see above); it will have been initialised to zeroes using memset().
- “filename” is the name of the image to open.

Return:

**DSK\_ERR\_OK:** The driver has successfully opened the image.

**DSK\_ERR\_NOTME:** The driver cannot handle this image. Other drivers should be allowed to try to use it.

**other:** The driver cannot handle this image. No other drivers should be tried (eg: the image was recognised by this driver, but is corrupt).

If the file has a comment, record it here using dsk\_set\_comment().

### 9.3.2 dc\_creat

```
dsk_err_t (*dc_creat) (DSK_PDRIVER self, const char *filename)
```

Attempt to create a new disc image. For the “floppy” drivers, behaves exactly as dc\_open. Parameters and results are the same as for dc\_open, except that DSK\_ERR\_NOTME is treated like any other error.

### 9.3.3 dc\_close

```
dsk_err_t (*dc_close) (DSK_PDRIVER self)
```

Close the disc image. This will be the last call your driver will receive for a given disc image file, and it should free any resources it is using. Whether it returns DSK\_ERR\_OK or an error, this disc image will not be used again.

### 9.3.4 dc\_read

```
dsk_err_t (*dc_read)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_p cyl_
```

Read a sector. Note that sector addresses passed to drivers are *always* in C/H/S format. This function has the same parameters and return values as `dsk_pread()`.

You don't need to check the `RECMODE_COMPLEMENT` flag in the geometry structure (this applies to all read and write functions). If the flag is set, the LibDsk core will complement the results from the driver before returning them to the caller. Similarly, any buffer passed for a write will already be complemented if appropriate.

### 9.3.5 dc\_write

```
dsk_err_t (*dc_write)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, const void *buf, ds
```

Write a sector. This function has the same parameters and return values as `dsk_pwrite()`. If your driver is read-only, leave this function pointer NULL.

### 9.3.6 dc\_format

```
dsk_err_t (*dc_format)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_p cyl_t cylinde
```

Format a track. This function has the same parameters and return values as `dsk_pformat()`. If your driver cannot format tracks, leave this function pointer NULL.

### 9.3.7 dc\_getgeom

```
dsk_err_t (*dc_getgeom)(DSK_PDRIVER self, DSK_GEOMETRY *geom)
```

Get the disc geometry. Leave this function pointer as NULL unless either:

1. Your disc image does not allow a caller to use an arbitrary disc geometry. The drivers which currently do this are the Win32 one, because Windows NT decides on the geometry itself and doesn't let programs change it; and the MYZ80 and SIMH ones, which have a single fixed geometry.
2. Your disc image file contains enough information to populate a `DSK_GEOMETRY` completely. The `rcpmfs` and `ydisk` drivers do this.
3. You want to do an extended geometry probe including a call to the default one. The internal function `dsk_defgetgeom()` has been provided for this; it's the same as `dsk_getgeom()` but always uses the standard probe. The `LDBS` driver does this.

Returns `DSK_ERR_OK` if successful; `DSK_ERR_NOTME` or `DSK_ERR_NOTIMPL` to fall back to the standard LibDsk geometry probe; other values to indicate failure.

### 9.3.8 dc\_secid

```
dsk_err_t (*dc_secid)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_p cyl_t cylinder
```

Read the ID of the next sector on a certain track/head, and put it in “result”. Ideally you would simulate a rotating disc, so that the IDs are returned in the same order that they were written when the disc was formatted. This function is also used to test for discs in CPC format (which have oddly-numbered physical sectors); if the disc image can’t support this (eg: the “raw” or Win32 drivers) then leave the function pointer NULL.

### 9.3.9 dc\_xseek

```
dsk_err_t (*dc_xseek)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, dsk_p cyl_t cylinder
```

Seek to a given cylinder / head. For disc images, just return DSK\_ERR\_OK if the cylinder/head are in range, or DSK\_ERR\_SEEKFAIL otherwise. For a floppy driver, only implement this function if your FDC can perform a seek by itself.

### 9.3.10 dc\_xread, dc\_xwrite

```
dsk_err_t (*dc_xread)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_p cyl_t cylinder, dsk_p head, dsk_p sector, dsk_p offset, dsk_p len)  
dsk_err_t (*dc_xwrite)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, const void *buf, dsk_p cyl_t cylinder, dsk_p head, dsk_p sector, dsk_p offset, dsk_p len)
```

Read / write sector whose ID may not match its position on disc, or which is marked as deleted. Only implement this if your disc image emulates sector IDs or your floppy driver exposes this level of functionality. Currently it is implemented in the Linux, NTWDM and CPCEMU drivers, plus those using LDBS as their internal storage (LDBS itself, DSK, EDSK, ApriDisk, CFI, JV3, CopyQM, QRST, Teledisk).

### 9.3.11 dc\_status

```
dsk_err_t (*dc_status)(DSK_PDRIVER self, const DSK_GEOMETRY &geom, dsk_p head_t head, dsk_p cyl_t cylinder, dsk_p head, dsk_p sector, dsk_p offset, dsk_p len)
```

Return the drive status (see dsk\_drive\_status() for the bits to return). “\*result” will contain the value calculated by the default implementation; for most image file drivers, all you have to do is set the read-only bit if appropriate.

### 9.3.12 dc\_tread

```
dsk_err_t (*dc_tread)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_p cyl_t cylinder, dsk_p head, dsk_p sector, dsk_p offset, dsk_p len)
```

Read a track. You need only implement this if your floppy driver exposes the relevant functionality; if you don’t, the library will use multiple calls to dc\_read() instead. This function has the same parameters and return values as dsk\_ptread().



### 9.3.13 dc\_xtread

```
dsk_err_t (*dc_xtread)(DSK_PDRIVER self, const DSK_GEOMETRY *geom, void *buf, dsk_pcy1
```

Read a track, with extended sector matching (sector headers on disc differ from physical location). This function has the same parameters and return values as `dsk_xtread()`. As with `dc_tread()`, you need only implement this function if your floppy driver has a special READ TRACK command.

### 9.3.14 dc\_option\_enum

```
dsk_err_t (*dc_option_enum)(DSK_DRIVER *self, int idx, char **optname);
```

List numerical options which your driver supports. If your driver does not support any, you need not implement this.

### 9.3.15 dc\_option\_set, dc\_option\_get

```
dsk_err_t (*dc_option_set)(DSK_DRIVER *self, const char *optname, int value);  
dsk_err_t (*dc_option_get)(DSK_DRIVER *self, const char *optname, int *value);
```

Get or set the value of a numerical option. Again, if your driver has no numerical options, this need not be implemented.

Note that numerical options can 'belong' either to a driver or to the LibDsk core, with the driver taking priority. For example:

- If LibDsk accesses a FAT-format disc image using the 'dsk' driver, neither LibDsk nor the driver will support the FS:CP/M:BSH option.
- If LibDsk accesses a CP/M-format disc image using the 'dsk' driver, `dsk_get_geometry()` will detect the CP/M filesystem. Since the driver does not support the FS:CP/M:BSH option, it will be handled by the LibDsk core.
- If LibDsk accesses a CP/M-format disc image using the 'ydsk' driver, the driver does support the FS:CP/M:BSH option and so it will be handled by the driver.

It is possible for a driver to rely on the option support in the LibDsk core rather than implement its own. This means a lot less code needs to be written; but it does not allow any validation to be performed on the values an option can hold, nor does it notify the driver when the value of an option is changed. Currently this system is used by the `myz80` driver.

To use this system, create the variables you require with `dsk_isetoption`:

```
dsk_err_t dsk_isetoption(DSK_DRIVER *self, const char *optname, int value, int create
```

The first three parameters are the same as for `dsk_set_option()`. The last should be set to 1 to create the new variable, or 0 to return `DSK_ERR_BADOPT` if the variable is not present.

To read a value back, use `dsk_get_option()` as normal.

### 9.3.16 dc\_trackids

```
dsk_err_t (*dc_trackids)(DSK_DRIVER *self, const DSK_GEOMETRY *geom, dsk_p cyl;
```

Read the IDs of all sectors on the specified track, preferably in the correct order and starting at the index hole. If you leave this function pointer as NULL, LibDsk will use a default implementation.

### 9.3.17 dc\_rtread

```
dsk_err_t (*dc_rtread)(DSK_DRIVER *self, const DSK_GEOMETRY *geom, void *buf, dsk_pcy
```

For future expansion. Leave this function pointer as NULL.

### 9.3.18 dc\_to\_ldbs

```
dsk_err_t (*dc_to_ldbs)(DSK_DRIVER *self, struct ldbs **result, DSK_GEOMETRY *geom);
```

Export the current disk image file as an LDBS blockstore. If this driver is not for a disk image file, there's no need to implement this function.

### 9.3.19 dc\_from\_ldbs

```
dsk_err_t (*dc_from_ldbs)(DSK_DRIVER *self, struct ldbs *source, DSK_GEOMETRY *geom);
```

Replace the entire contents of this disk image with the provided LDBS blockstore. If this driver is not for a disk image file, there's no need to implement this function.

## 10 Writing new drivers (derived from LDBS)

The technique when creating an LDBS-based driver is similar to a standalone driver, with a few important differences. A good example file to look at for this is the QRST driver.

An LDBS-based driver will need to make extensive use of the functions in `lib/ldbs.h`. Currently the best documentation for these functions is in the comments of `ldbs.h` itself.

### 10.1 The driver header

As for a standalone driver, create a header, basing it on (for example) `lib/drvqrst.h`. The first thing in the header (after the LGPL banner) is:

```
typedef struct
{
    LDBSDISK_DSK_DRIVER qrst_super;
    char *qrst_filename;
    /* The following variables hold state when saving, and are only
```

```

        * used within qrst_close() */
        size_t qrst_tracklen;
        unsigned long qrst_bias;
        unsigned long qrst_checksum;
    } QRST_DSK_DRIVER;

```

The major difference here is that the first member of the structure is a `LDBSDISK_DSK_DRIVER` rather than a plain `DSK_DRIVER`.

## 10.2 The driver source file

Secondly, create a `.c` file for your driver. Again, it's probably easiest to base this on `lib/drvqrst.c`. At the start of this file, create a `DRV_CLASS` structure, such as:

```

DRV_CLASS dc_qrst =
{
    sizeof(QRST_DSK_DRIVER),
    &dc_ldbsdisk,
    "QRST",
    "Quick Release Sector Transfer",
    qrst_open,
    qrst_creat,
    qrst_close
};

```

The first four entries in this structure are:

- The size of your driver's instance data;
- The driver's superclass. This needs to be set to `&dc_ldbsdisk`, rather than `NULL` as it would be in a standalone driver.
- The driver's name (as passed to `dsk_open()` / `dsk_creat()` )
- The driver's description string.

The remainder of the structure is composed of function pointers, but you should only need to provide the first three pointers (`*_open`, `*_creat` and `*_close`).

Once you have created this structure, edit:

- `drivers.h`. Add a declaration for your `DRV_CLASS` structure, such as

```
extern DRV_CLASS dc_myformat;
```

- `drivers.inc`. Insert a reference to your structure (eg: `"&dc_myformat,"`) in the list. Note that order is important; the comments in `drivers.inc` describe how to decide where things go.

Edit `"lib/Makefile.am"`. Near the top of this file is a list of drivers and their header files; just add your `.c` and `.h` to this list.

If your driver depends on certain system headers (as all the floppy drivers do) then you will need to add checks for these to `"configure.in"` and `"lib/drv.h"`; then run `"autoconf"` to rebuild the configure script.

The function pointers in the DRV\_CLASS structure are described in drv.h. The first parameter to all of them (“self”) is declared as a pointer to DSK\_DRIVER. In fact, it is a pointer to the first member of your instance data structure. Just cast the pointer to the correct type:

```
/* Sanity check: Is this meant for our driver? */
if (self->dr_class != &dc_qrst) return DSK_ERR_BADPTR;
qrstself = (QRST_DSK_DRIVER *)self;
```

and you’re in business.

## 10.3 Driver functions

### 10.3.1 dc\_open

```
dsk_err_t (*dc_open )(DSK_PDRIVER self, const char *filename)
```

Open a disc image and load it into an LDBS blockstore. Entered with:

- “self” points to the instance data for this disc image (see above); it will have been initialised to zeroes using memset().
- “filename” is the name of the image to open.

Return:

**DSK\_ERR\_OK:** The driver has successfully opened the image.

**DSK\_ERR\_NOTME:** The driver cannot handle this image. Other drivers should be allowed to try to use it.

**other:** The driver cannot handle this image. No other drivers should be tried (eg: the image was recognised by this driver, but is corrupt).

Once you have established that your driver can open and parse the image it was passed, it should initialise the LDBS blockstore in the superclass, using `ldbs_new()`:

```
dsk_err_t ldbs_new(PLDBS *result, const char *filename, const char type[4]);
```

In this case, the first parameter should point to the blockstore in the superclass. The other two should be NULL and LDBS\_DSK\_TYPE respectively:

```
ldbs_new(&qrstself->qrst_super.ld_store, NULL, LDBS_DSK_TYPE);
```

You then need to read in the entire disc image and save it in the blockstore using LDBS functions:

- For each track, use `ldbs_trackhead_alloc()` to create a track header structure.
- For each sector in that track, use `ldbs_encode_secid()` to generate its block ID, then `ldbs_putblock()` to add it to the store. Record the block ID in that sector’s entry in the track header.

- Once all the sectors have been added, use `ldbs_put_trackhead()` to add the completed track header.

If the file has a comment, record it using `ldbs_put_comment()` rather than `dsk_set_comment()`. If your disc image has a fixed geometry you should convert it to a `DSK_GEOMETRY` structure and record it with `ldbs_put_geometry()`. A few disc image formats contain a CP/M Disk Parameter block; if yours is one you should add that with `ldbs_put_dpb()`.

Once the blockstore is completely populated, end with

```
return ldbdisk_attach(self);
```

### 10.3.2 dc\_creat

```
dsk_err_t (*dc_creat)(DSK_PDRIVER self, const char *filename)
```

This should check that the target file can be created, and keep hold of either its filename or file handle. It should then behave as 'open', except that you don't do anything with the blockstore created by `ldbs_new()` before calling `ldbsdisk_attach()`.

### 10.3.3 dc\_close

```
dsk_err_t (*dc_close)(DSK_PDRIVER self)
```

Close the disc image. If it has been changed, you need to write out the contents of the blockstore to a new file, overwriting anything that was there already.

The first thing to do (after basic sanity checks) is to call `ldbsdisk_detach()` to ensure all pending buffers have been written to the blockstore. The next is to check if any changes need to be written back; if `self->dr_dirty` is zero, there's nothing to write back, so you can just close the blockstore and return.

```
return ldbsclose(&qrsself->qrst_super.ld_store);
```

Assuming that changes do need to be written back, you now need to reverse the conversion done by your 'open' method, and write the blockstore out in the your disc image format. Some functions which may be helpful here are:

- `ldbs_max_cyl_head()` will return the number of cylinders and heads necessary to contain this disc image. For example, a 720k DOS disc image would return 80 cylinders, 2 heads.
- `ldbs_get_stats()` will analyse the blockstore and return the maximum and minimum values for cylinder, head, sector, sectors per track and sector size.
- `ldbs_all_tracks()` will iterate over all tracks in the blockstore and, for each track, call a callback function you provide. It can return the tracks in `SIDES_ALT`, `SIDES_OUTOUT` or `SIDES_OUTBACK` order; if you want to process them in a different order you'll need to write your own iteration function. In that case, use `ldbs_max_cyl_head()` to get the range, and then `ldbs_get_trackhead()` for each track you want to process.
- `ldbs_all_sectors()` works on the same principle, but the callback is run for each sector in each track. Note that sectors will be returned in the order they are listed in the track header, which may well be different from their numerical order.

- `ldbs_getblock()` will load a sector using the block ID given for it in the track header.
- `ldbs_get_comment()` will return the comment (if any). Similarly `ldbs_get_dpb()` retrieves the CP/M DPB (if one was written) and `ldbs_get_geom()` returns the DSK\_GEOMETRY last used to format a track. Note that the geometry recorded is advisory; if it conflicts with the values returned by `ldbs_get_stats()`, the values returned by `ldbs_get_stats()` are going to be the accurate ones.
- `ldbs_load_track()` will return a memory buffer containing the data from all the sectors in a particular track, in sector ID order.

`*_close()` will be the last call your driver will receive for a given disc image file, and it should free any resources it is using. Whether it returns `DSK_ERR_OK` or an error, this disc image will not be used again.

## 11 Adding new compression methods

Adding a new compression method is very similar to adding a driver, though you only have to implement four functions.

To add a new driver, you create a new `COMPRESS_CLASS` structure and add it to various files.

### 11.1 Driver header

This is done as for disc drivers. If you don't need any extra variables (for example, `gzip` and `bzip2` compression don't) then you don't have to declare a new structure type - see `lib/compgz.h` for an example.

### 11.2 Driver implementation

Secondly, create a `.c` file for your driver. It's probably easiest to base this on `lib/compgz.c`. At the start of this file, create a `COMPRESS_CLASS` structure, such as:

```
COMPRESS_CLASS cc_gz =
{
    sizeof(COMPRESS_DATA),
    "gz",
    "Gzip (deflate compression)",
    gz_open, /* open */
    gz_creat, /* create new */
    gz_commit, /* commit */
    gz_abort /* abort */
};
```

The first three entries in this structure are:

- The size of your driver's instance data. The GZip driver has no instance data and so just uses `COMPRESS_DATA`. If it had extra data these would be in a struct called `GZ_COMPRESS_DATA`, so the size here would be `sizeof(GZ_COMPRESS_DATA)`.
- The driver's name (as passed to `dsk_open()` / `dsk_creat()`)

- The driver’s description string.

The remainder of the structure is composed of function pointers. The types of these are given in `drv.h`. You must implement all four.

Once you have created this structure, edit:

- `comp.h`. Include your header.
- `compress.inc`. Insert a reference to your structure (eg: “&cc\_myzip,”) in the list. Note that order is important.

Edit “`lib/Makefile.am`”. At the bottom of this file is a list of drivers and their header files; just add your `.c` and `.h` to this list.

If your driver depends on certain system headers (eg, the `gzip` one depends on `zlib.h`) then you will need to add checks for these to “`configure.in`” and “`lib/compi.h`”; then run “`autoconf`” to rebuild the `configure` script.

The function pointers in the `COMPRESS_CLASS` structure are described in `lib/compress.h`. The first parameter to all of them (“`self`”) is declared as a pointer to `COMPRESS_DATA`. In fact, it is a pointer to the first member of your instance data structure. Just cast the pointer to the correct type:

```
/* Sanity check: Is this meant for our driver? */
if (self->cd_class != &cc_sq) return DSK_ERR_BADPTR;
sqself = (SQ_COMPRESS_DATA *)self;
```

and you’re in business.

## 11.3 Compression functions

### 11.3.1 `cc_open`

```
dsk_err_t (*cc_open )(COMPRESS_DATA *self)
```

Attempt to decompress a compressed file.

- “`self`” points to the instance data for this disc image.
- `self->cd_cfilename` is the filename of the file to decompress.

Return:

**DSK\_ERR\_OK:** The file has been decompressed.

**DSK\_ERR\_NOTME:** The file is not compressed using this driver’s method.

**other:** The file does belong to this driver, but it is corrupt or some other error occurred.

Two helper functions may be useful when you are writing `cc_open`:

```
dsk_err_t comp_fopen (COMPRESS_DATA *self, FILE **pfp);
```

Open the file whose name is given at `self->cd_cfilename`. If successful, `*pfp` will be the opened stream. If not, it will be `NULL`. If the file can only be opened read-only, sets `self->cd_readonly` to 1.

```
dsk_err_t comp_mktemp (COMPRESS_DATA *self, FILE **pfp);
```

Create a temporary file and store its name at `self->cd_ufilename`. You should use this to create the file that you decompress into.

### 11.3.2 cc\_creat

```
dsk_err_t (*cc_creat)(COMPRESS_DATA *cd)
```

Warn the compression engine that a disc image file is being created, and when closed it will be compressed. The filename is stored at `self->cd_cfilename`. Normally this just returns `DSK_ERR_OK`.

### 11.3.3 cc\_commit

```
dsk_err_t (*cc_commit)(COMPRESS_DATA *cd)
```

Compress an uncompressed file. `self->cd_ufilename` is the name of the file to compress. `self->cd_cfilename` is the name of the output file.

### 11.3.4 cc\_abort

```
dsk_err_t (*cc_abort)(COMPRESS_DATA *cd)
```

This is used if a file was decompressed and it's now being closed without having been changed. There is therefore no need to compress it again. This normally just returns `DSK_ERR_OK`.

## 12 Adding new remote transports.

Adding a new remote transport is also very similar to adding a driver.

To add a new driver, you create a new `REMOTE_CLASS` structure and add it to various files.

### 12.1 Driver header

This is done as for disc drivers. Create a structure based on `REMOTE_DATA` to hold your class's data – see `lib/rpctios.h` and `lib/rpcfork.h` for examples.

### 12.2 Driver implementation

Create a `.c` file for your driver. It's probably easiest to base this on `lib/rpcfork.c`. At the start of this file, create a `REMOTE_CLASS` structure, such as:

```
REMOTE_CLASS rpc_fork =
{
    sizeof(FORK_REMOTE_DATA),
    "fork",
    "UNIX client using fork",
    fork_open, /* open */
    fork_close, /* close */
    fork_call, /* perform RPC */
};
```

The first three entries in this structure are:



- The size of your driver's instance data – `sizeof(your_REMOTE_DATA)` structure.
- The driver's name. If the filename passed to LibDsk begins with this name followed by a colon, then it's assumed to be using your driver.
- The driver's description string.

The remainder of the structure is composed of function pointers. The types of these are given in `lib/remote.h`. You must implement all three.

Once you have created this structure, edit:

- `lib/remall.h`. Include your header.
- `lib/remote.inc`. Insert a reference to your structure (eg: “&rpc\_fork,”) in the list. The drivers will be tested in the order in which they appear in the file.

Edit “`lib/Makefile.am`”. At the bottom of this file is a list of drivers and their header files; just add your `.c` and `.h` to this list.

If your driver depends on certain system headers (eg, the `termios` one depends on `termios.h`) then you will need to add checks for these to “`configure.in`” and “`lib/drvi.h`”; then run “`autoconf`” to rebuild the `configure` script.

The function pointers in the `REMOTE_CLASS` structure are described in `lib/compres.h`. The first parameter to all of them (“`pDriver`”) is declared as `DSK_PDRIIVER`; you can extract a pointer to your instance data using the `dr_remote` member like this:

```
/* Sanity checks */
self = (FORK_REMOTE_DATA *)pDriver->dr_remote;
if (self == NULL || self->super.rd_class != &rpc_fork)
    return DSK_ERR_BADPTR;
```

## 12.3 Remote communication functions

### 12.3.1 `rc_open`

```
dsk_err_t (*rc_open ) (DSK_PDRIIVER pDriver, const char *name, char *nameout)
```

Connect to a remote server.

- `pDriver` points to a `DSK_DRIVER` containing the pointer to your instance data.
- `name` is the filename as passed to LibDsk, starting with “*driver:*” and containing any connection parameters needed.
- `nameout` is an output buffer with enough space to hold a string of the same length as the input filename. If you are returning `DSK_ERR_OK`, it must be set to the input filename minus any options this driver has used. For example, the “`serial`” driver, given a filename like “`serial:/dev/ttyS1,2400-crtscts,example.ufi,raw`” would extract its own options and return “`example.ufi,raw`” here.

Return:

**DSK\_ERR\_OK:** Connection established.

**DSK\_ERR\_NOTME:** The filename passed is not recognised by this driver.

**other:** An error such as out-of-memory occurred.

### 12.3.2 rc\_close

```
dsk_err_t (*rc_close)(DSK_PDRIVER pDriver)
```

Close the connection to the remote server.

### 12.3.3 rc\_call

```
dsk_err_t (*rc_call)(DSK_PDRIVER pDriver, unsigned char *input, int inp_len, unsigned
```

Perform a remote procedure call to the server.

**input** is the packet LibDsk wants to send.

**inp\_len** is the number of bytes in the packet.

**output** is a buffer for the result packet.

**\*out\_len** (on entry) is the size of the result buffer.

**\*out\_len** (on return) is the number of bytes that were populated in the result buffer.

In general, this call will wrap the input in whatever framing bytes are necessary (usually including the packet length, since packets do not contain their own length), send the packet over the wire, wait for a response, and unpack the response into 'output'. Return DSK\_ERR\_TIMEOUT if the connection timed out (the 'serial' driver waits 30 seconds) and DSK\_ERR\_ABORT if the user deliberately broke the connection.

## A The CopyQM File Format

### A.1 Introduction

This section describes the file format of files created by CopyQM. A lot of the information has been extracted by looking at hex-dumps of the files, so there might be some errors in the description.

### A.2 Header

The CopyQM files consist of a header, an optional comment (if indicated by the header) followed by the tracks of the image encoded with a run length encoding scheme. The header is 133 bytes long, see table. It always starts with {0x43, 0x51, 0x14 }, which can be used for auto-detection of the image. All numbers have little-endian byte ordering. When all bytes in the header are added together in a byte, the result should be zero.

Offset	Size	Comment
0x00	1	Always 0x43 ('C')
0x01	1	Always 0x51 ('Q')
0x02	1	Always 0x14
0x03	2	Sector size (from here to 0x1B inclusive is a DOS BPB)
0x05	1	Sectors per cluster
0x06	2	Number of reserved sectors
0x08	1	FAT copies
0x09	2	Number of root directory entries
0x0b	2	Total number of sectors
0x0d	1	Media byte
0x0e	2	Number of sectors per FAT
0x10	2	Number of sectors per track
0x12	2	Number of heads
0x14	4	Number of hidden sectors
0x18	4	Total sectors if > 65535 (should always be 0 on a floppy image)
0x1c	60?	Description of media (e.g. "720K Double-Sided")
0x58	1	Type of image. 0=DOS, 1=blind, 2=HFS
0x59	1	Density. 0=DD, 1=HD, 2=ED
0x5a	1	Number of tracks used on image
0x5b	1	Total number of tracks for image
0x5c	4	CRC for the used, unpacked tracks
0x60	11	Volume label (DOS/HFS)
0x6b	2	Creation time
0x6d	2	Creation date
0x6f	2	Length of image comment
0x71	1	Number of first sector - 1
0x74	1	Interleave. (0 for older versions of CopyQM)
0x75	1	Skew. Normally 0. Negative number for alt. sides
0x84	1	Header checksum byte

### A.3 CRC

The CRC is calculated for the unpacked data for all tracks that are used in the image. The CRC value is initialized with 0 and then updated using the CRC 32 polynomial 0x104C11DB7, bit reverse algorithm. Due to a feature in CopyQM (8 bit register as an index into a 1024 byte table) all bytes must have their top two bits removed before added to the CRC.

### A.4 Image comment

The image comment follows the header. It has a variable size found in the header. The image comment can contain \0-bytes.

### A.5 Image data

The image data is run length encoded. Each run is preceded by a 16-bit length. If the length is negative, the byte after the length is repeated **-length** times. If the length is positive, it is followed by **length** bytes of unencoded data. It seems like a new run

of repeating or differing data is always started at each new track. Older versions of CopyQM always alternates between runs of differing data and repeating data, even if the length of one of them is zero.

## B DQK Files

A DQK file is a .DSK file compressed using Richard Greenlaw's Squeeze file format (originally from CP/M as SQ.COM, and later built in to NSWP.COM; versions also exist for DOS and UNIX). SQ was used in preference to more efficient compressors such as gzip because it can be readily decoded on 8-bit and 16-bit computers.

The original reason for DQK files was software distribution. A disc image of a 180k disc won't fit on a 180k disc, owing to various overheads. However, the compressed DQK version may fit onto such a disc, and leave room for a tool to write the DQK back out as well.

Such a tool has been included in the "dskwrite" directory in this distribution. It contains the following files:

- dskwrite.com: Program to write .DSK or .DQK files out to a real disc. The .COM file works on PCs, Amstrad PCWs and Sinclair Spectrum +3s.
- dskwrite.txt: Documentation for dskwrite.
- dskwrite.z80: Z80 source for the CP/M version.
- dskwrite.asm: 8086 source for the DOS version.
- dskwrsea.com: The dskwrite distribution file - a self-extracting archive. It will self-extract under CP/M or DOS.

Note that the files in the "dskwrite" directory are not GPLed or LGPLed. They are public domain. You may do whatsoever you please with them.

LibDsk has been given .DQK support (use the "dsk" driver with "sq" compression) so that .DQK files don't have to be created and compressed in a two-state process.

## C LibDsk with cpmtools

cpmtools v1.9 and later <<http://www.moria.de/~michael/cpmtools/>> can be configured to use LibDsk for all disc access, thus allowing CP/M discs and emulator disc images to be read and written.

cpmtools v2.19+ allow a cpmtools disk definition to be associated with a LibDsk geometry, by adding a "libdsk:format" entry to the disk definition. For example, this entry uses "libdsk:format ibm1440" so that the disk image is accessed using the 'ibm1440' geometry rather than the default 'pcw1440'.

```
diskdef cpm86-144feat
    seclen 512
    tracks 160
    sectrk 18
    blocksize 4096
    maxdir 256
    skew 1
```

```

    boottrk 2
    os 3
    libdsk:format ibm1440
end

```

The myz80 and nanowasp drivers use a fixed disk format; here are diskdefs entries which can be used to read them:

```

diskdef myz80
    seclen 1024
    tracks 64
    sectrk 128
    blocksize 4096
    maxdir 1024
    skew 1
    boottrk 0
    os 3
end
diskdef nanowasp
    seclen 512
    tracks 80
    sectrk 10
    blocksize 2048
    maxdir 128
    skew 1
    os 2.2
end

```

In the old diskdefs format with one line per entry, these are:

```

myz80      1024 64 128 4096 1024 1 0 3
microbee   512 80 10 2048 128 1 2 2.2

```

## D DSK / EDSK recording mode extension

This extension was proposed by me on the comp.sys.sinclair and comp.sys.amstrad.8bit newsgroups on 10 January 2004. It was subsequently released in ANNE 2.1.4 and added to the formal EDSK format definition at <http://andercheran.aiind.upv.es/~amstrad/docs/extdsk.html> and <http://andercheran.aiind.upv.es/~amstrad/docs/extdsk.html>.

DSK/EDSK originate on the Amstrad CPC, which ordinarily writes all its diskettes in MFM recording mode and at the Double Density rate. However, ANNE emulates the PcW16, which also supports the High Density rate; and the system software depends on DD discs not being readable at the HD rate.

The extension gives meanings to two unused bytes of the DSK/EDSK “Track-Info” block:

### Byte 12h: Data rate.

**0** Unknown

**1** Single or Double Density (180k, 720k, etc.)

**2** High Density (1.2M, 1.4M, etc.)

**3** Extended Density (2.8M)

**Byte 13h: Recording mode.**

**0** Unknown

**1** FM

**2** MFM

Existing files should have zeroes in these bytes; hence the use of 0 for Unknown. LibDsk will guess the values in if the ones in the file are zero.