



## KRYOFLUX 5.25 MODIFIED FLOPPY DISK DRIVE FOR PRESERVATION AND FORENSICS

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This drive has been carefully aligned and modified to be able to read side 1 even if this has been written with the disk flipped over in a single headed drive.

There are two versions of this modification/drive:

Version #1 ("Panasonic") works by modifying the drive so that it can step into the negative domain and access a virtual track -8 on the upper head – which is the location of track 0 of a "flipped disk" written with a single headed drive. Note: During a dump you'll see a message that says "00.0 : Control Command Rejected by the Device" - When you see this, it has passed the track 0 sensor. Since the Teac and Newtronics do not bypass the track 0 sensor, neither are the prone to getting stuck in the negative domain, nor are they passing the track 00 sensor. This drive can be used like a standard drive with a standard controller as well.

Version #2 ("Teac", "Newtronics") works by re-aligning track 0 to -8, which means that it is permanently shifted, so data read off standard disks will need to be adjusted in software. The version #2 drive does therefore no longer work with a standard controller (as it is permanently track-shifted).

### IMPORTANT

*Version #1 must be the only device on the Shugart bus (=connected to KryoFlux) OR any other drive connected (only one modded drive per bus) must not have contact to pin 33 (usually ground, used here for TRK00 bypass). Also, regardless of what the manual might say, KryoFlux must be powered (=connected to USB) before the drive itself is powered. Otherwise track 00 might become "invisible" for the drive. In both scenarios the drive will bang its head against the mechanical barrier trying to find track 00.*

Note: This drive is by definition to be used with the KryoFlux floppy disk controller only. Chances are that, depending on brand and model, the drive will work with other controllers. However, such operation cannot be guaranteed.

## SETUP

This drive can be connected to the KryoFlux with the supplied (if bought with a KryoFlux) or a standard floppy disk data cable. Please note that the data connector on the PCB has a marking for data line #1 which must be aligned with the red (or otherwise coloured) stripe of the data cable. As outlined above, Version #1 must be the only drive on the bus or any other drive must not be connected to data line 33.

**WARNING:** Floppy disk drives tend to initialize themselves at startup, e.g. by doing a seek to track 00, which will activate the track 00 sensor (“/TRK00”). Stopping a dump process while the drive is below track 0 (reading between -8 and -1) will leave the drive in an undefined position. The KryoFlux controller will, at the end of any dump process, re-position the drive to track 0. If the drive is left undefined, the next access (with a seek for track 00) will move the head further back (“outwards”) until it reaches a mechanical barrier. This will result in “banging”, a loud rattling sound, which might misalign or further damage the drive. If you hear such sound, remove power immediately. The drive can then carefully be repositioned by turning the motor spindle which moves the head. **DO NOT PUSH** the head carriage by hand!

*Damage caused by scenarios outlined above is exempt from warranty.*

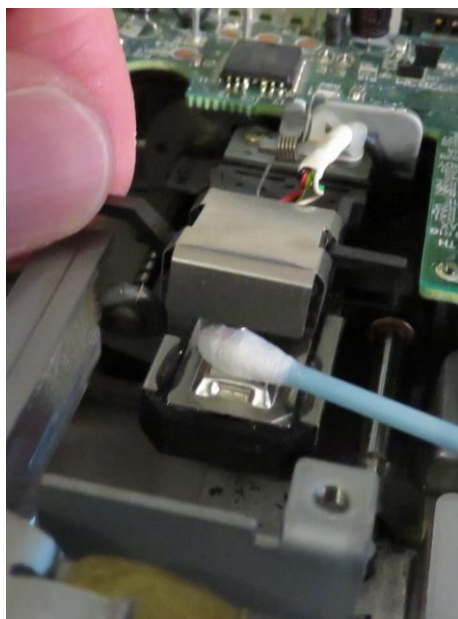
## CLEANING

Disks are old and most are very dirty. You may need to clean the heads on your drive from time to time to ensure you are producing accurate dumps.

Old media might be mouldy or the coating might come off the surface of the floppy disk platter. Regardless of these edge cases, even normal use will produce some dirt which, over time, will clog the heads. Even though heads are made of ceramic and are very sturdy, the construction they are being held by in place (usually sheet metal) allows for some wobble to enable the best contact to the magnetic platter. These small joints of metal are **VERY FRAGILE**. When cleaning the drive use only cotton swabs and 100% pure isopropyl alcohol (“IPA”). Do not use abrasive cleaners or solvents. Please also avoid cleaning disks. They only reach parts of the head which are in direct contact with the surface, but not the edges, where most of the clogging will occur. When cleaning, **DO NOT PUSH**. Excessive force will damage the device.

### Cleaning of the drive head

Simply use cleaning floppy for the drive with IPA. For best results unscrew the drive's metal lid and gently clean the drive head (upper and lower heads with cotton swabs + IPA). Be careful when lifting the upper head up. When cleaning the heads excessive force may damage the heads or their alignment. It is possible to permanently damage the head carriage with a cotton swab.



**Fig. 1:** Cleaning the lower head while carefully lifting the upper one

Typically a disk drive reads a disk without any distracting noise but by carefully listening as it spins you can hear the difference when the disk or the drive head requires cleaning. When the drive head starts to squeal, to drag or even scrape the diskette stop dumping immediately and clean the drive head and the disk.

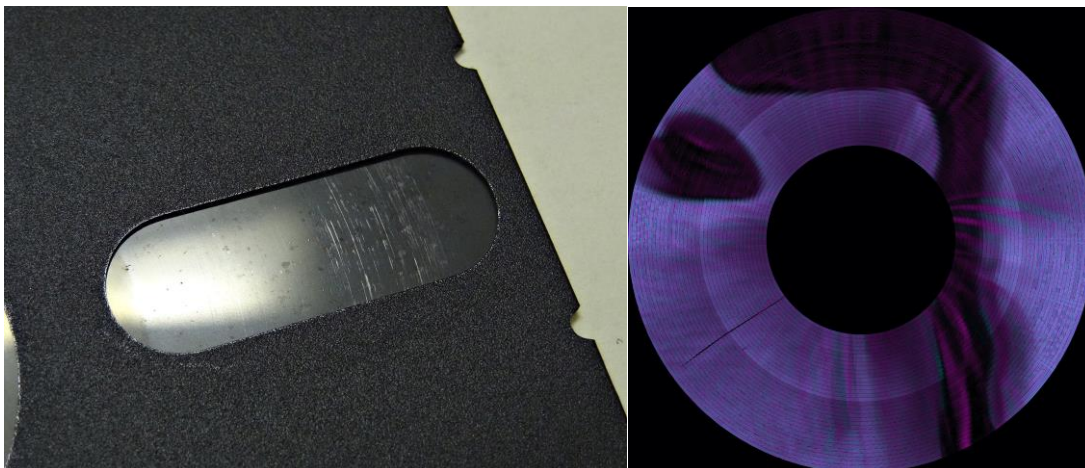
Bear in mind that dirty drive head that contains pieces of iron oxide may damage a disk's surface permanently by scratching it. Always after cleaning try dumping first the known good disk that loads without problems and disk surface is clean.

### **Cleaning the disk surface**

A common problem with old disks is the iron oxide coating that can strip away as its binders become brittle. Mould or dirt can as well be the reason for the fault but often reading is still possible after careful cleaning.

Spin the disk manually 360 degrees and check both sides. Dip the cotton swab in IPA mixed with distilled water and clean the disk surface carefully to remove mould or dirt. Practice is best way to learn how to properly clean the disk surface. We recommend to practice with spare/scratch disks. If you want to be really careful, take a new disk, cut the sleeve (three sides available) and remove the platter. Then cut original disk open, clean the platter on a clean surface and eventually put the cleaned disk in the new disk sleeve and try to read the disk.

Disks cleaning with 100% IPA is possible but often IPA mixed with distilled water gives better results. 40% IPA is recommended. In some rare cases 100% IPA might damage the disk surface, so be careful with very fragile disks. Don't practice on master disks! IPA availability depends on country, but often pharmacies or electronics stores are a good place to start. Anything non-pure should be avoided!



**Fig. 2+3:** Physically damaged disk surface (left) and partially degaussed disk (right; analogue illustration)

Left disk is an example of severe damage of the disk surface. Right disk was only partially readable since disk was very likely damaged by a magnet that was swept over the disk.

## USAGE

Please read the main manual, here are some command lines to get you started.

Note: All of these command line parameters can also be added to the GUI as presets.

Open a command prompt and navigate to where DTC resides. Now use the following commands depending on which floppy modded drive you have. These commands are to dump disks made for a C64 and will work on a computer where drive D: is the data directory.

Commodore 64 command examples:

Panasonic dual sided dump:

```
dtc -dd1 -p -b-8 -fD:\DiskName\DiskName_ -i0 -g2 -y -i6 -l8 -t10
```

Panasonic single sided dump:

```
dtc -dd1 -p -b-8 -fD:\DiskName\DiskName_ -i0 -g0 -i6 -l8 -t10
```

Newtronics and Teac dual sided dump:

```
dtc -p -a8 -fD:\DiskName\DiskName_ -i0 -g2 -y -i6 -l8 -t10
```

Newtronics and Teac single sided dump (g0 = side 0, g1 = side 1)

```
dtc -p -a8 -fD:\DiskName\DiskName_ -i0 -g0 -i6 -l8 -t10
```

Commodore 64 (side 0) and Atari 8-bit (side 1)

```
dtc -dd1 -p -b-8 -fD:\DiskName\DiskName_ -i0 -g0 -i6 -y -g1 -i3a -l8 -t10
```

- Convert streams to G64 files

```
dtc -p -m1 -fD:\DiskName\DiskName_ -i0 -fD:\DiskName.g64 -y -g2 -k2 -i22a -l8
```

### Parameters explained:

-dd1 sets the drive density line to 1. It means double-density mode; but it actually depends on the model and jumper settings. This is a flip switch, hence correct operation might depend on opposite setting as well.

Finding the correct setting is easy with a Panasonic drive: dump an unformatted, degaussed disk with with dd0 and dd1 and compress dump data (e.g. ZIP or RAR). Whichever archive is smaller is the mode you are looking for. DD mode on the Panasonic enables longer flux transitions to pass without the AGC kicking in and adding a "random" flux transition. The result is smaller archives files (a lot less random data on unformatted tracks) and some disks using way too long flux transitions for modern drives are only readable this way. Some poorly readable track data is actually more readable in HD mode (as it really needs better amplification), so if DD fails it's worth a try. Some drives can also be jumpered to default to DD in that case this parameter is not necessary; in this case it must be set to switch to HD mode.

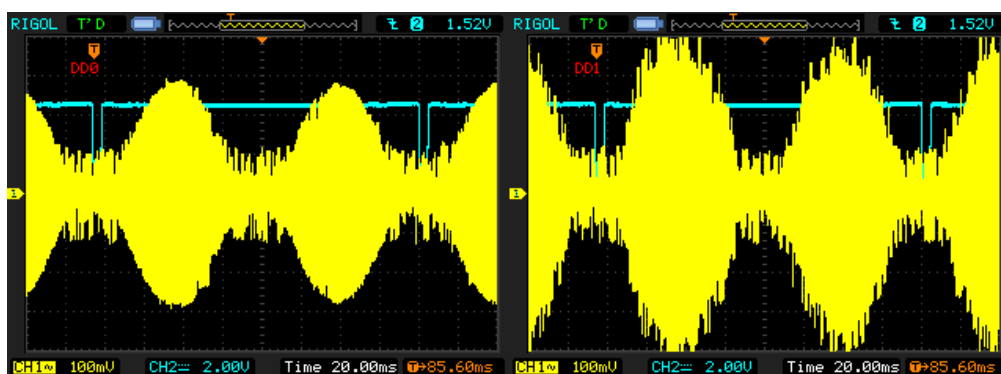


Fig. 4+5: Example of -dd0 (left) and -dd1 (right) on Newtronics; dd1 causes too high amplification.

-p Any file that contains a path after the -p parameter will have the directories created if necessary. Directories creation is recursive.

-b-8 / -a8 Physical track offset for the floppy modded drive you use. Panasonic uses -b-8 and Newtronics or Teac drives -a8 which stands for -a+8. Some disks are not duplicated properly, as the drive used for duplication couldn't work at -8 (they did the exact same thing what we do to mod the drives, kindly confirmed by Trace Digital). When that happens \*T warnings are displayed and the proper offset should be calculated from the expected track number vs the real track number found. Since the drives couldn't detect track 0 anyway (at least the common earlier models) they could get away with this. But it's a lot of hassle to rewrite the FreeForm script used to drive the Trace machine, so normally they used proper track offsets as long as it was possible. Be aware that if you stop dumping while the head is in the negative tracks (stopping DTC with CTRL-C) the head will usually get confused, and will only work as expected once you move it above track 0 with dumping or drive calibration command etc. You probably want to reset the board as well, just in case... alternatively, always wait until the head is above track 0.

-f Add the root filename that will be extended as necessary with track numbers and all folder will be created if they don't exist (and you have the OS permissions to do so)

-i0 Stream file and preservation mode enabled. Zero is not mandatory so giving only -i defaults to 0.

-g2 Decode the disk format of both sides. Parameter -g0 decode the disk format for side 0 and -g1 for side 1.

-y Flip side of the disk is reversed. This stands for a double sided drive to read a single sided disk. This has nothing much to do with the physical track offset, it just tells that the rotation of the disk is reversed the way it is read. Setting the physical track offset is what activates the track bypass/allow moving below track 0 to negative tracks. -y is not needed when using -g0.

-i6 Standard CBM format (CBM DOS). All parameters from the beginning to the command line to the first image format parameter (any -i<number>) specify the local parameters for the format described, except for parameters that modify hardware or software behaviour itself, rather than something to do with a format. The parameters reset to defaults after each -I found.

-i3a Standard Atari 8-bit disk (FM XFD)

-m1 Set device mode to image file. In this case producing for G64.

-k2 Set track distance to 40 tracks. Default value is 1 and it stands for 80 tracks.

-i22a CBM GCR image with mastering info.

## Multiple formats:

Since parameters are reset after each `-i` specifying multiple formats is possible in this way even for the same track correctly decoding to different files (if specified).

For example in the command:

```
dtc -dd1 -p -b-8 -fD:\DiskName\DiskName_ -i0 -g2 -y -i6 -l8 -t10
```

`-dd1` global (hardware change)

`-p` global (software change), but only active from after this (in our case active from the beginning of the command)

`-b-8` global (hardware)

`-fD:\DiskName\DiskName_ -i0` Format specific with the only parameter being the filename.

`-g2 -y -i6` Double sided, reversed side 1, standard CBM format. Note, that adding a filename is possible with `-f`. In that case the fully decoded data for the CBM format would be saved as well to the file specified here as a sector dump which that can be used either directly (e.g. as .D64, .ADF, .ST, .IMG etc) in various emulators or indirectly for e.g. comparing the data content of the dumps; see if for example two Vorpals protected games are identical or not.

All the formats you can specify in DTC are fully decoded to sector images, although most of the more exotic formats are only really useful for content comparison and guiding the track dumping process itself (e.g. retry bad tracks).

## Bad duplication:

A few disks are badly duplicated. For example Commodore 64 game 4x4 Off Road has a few track errors, which don't affect the game, but fail the complete verification. This is not very common though and only affects a handful of releases. The format decoding is important to decide whether the read was actually good; without a format specified for a given track there would be no way to know if the data read was bad and no retry would occur. Sometimes it is actually desirable to image a disk without specifying a format (except for using stream files); when the disk is nearly falling apart, or completely unknown/unsupported format, so retries won't occur unnecessarily.

In those cases you could use something like this:

```
dtc -dd1 -p -b-8 -fD:\DiskName\DiskName_-i0
```

Since no format gets actually decoded, each track will only ever be read once. SPS refer to this as "blind dump" - it may or may not be good.

## Protections

Certain disks require custom formats for dumping. Typical examples for Commodore 64 are Rapidlok or Vorpals protected disks. For instance Card Sharks uses Rapidlok and dumping with `-i6` shows `<unformatted>`. In such case its best to change the `-i6` in the command line to `-i16`. In case of Vorpals use `-i18`. This specifies the Vorpals custom format.

Pete Rittwage's Commodore 64 preservation page database can often give guidance for possible protection <http://c64preservation.com/database>

However many games have different revisions and releases and they might contain completely different protections.

## ABOUT FLIPPY DISKS

Important! We are using the correct term "cylinder" here, which means the physical location of data on the platter. The word "track" is very often used instead of "cylinder", but usually means the lower or the upper side of a cylinder. Cylinder 0 has two sides, 0 and 1. Speaking of tracks this would be track 0 and 1. Cylinder 1 has two sides, 0 and 1, with the tracks 2 and 3. Therefore a disk with 80 cylinders (0-79) would have a total of 160 tracks (0-159).

But back to the question. There isn't. At least not as long as a floppy disk is read in a floppy drive it was made for. Newer drives, which refers to all standard PC drives made after 1985, are dual headed. To avoid mechanical problems (too much pressure applied to the platter from two sides), there is an offset between these two heads. The relative distance is 8 cylinders. This distance is irrelevant when using such a drive with a disk written with or for such a drive. When accessing a cylinder, e.g. cylinder 10, side 0 for this cylinder will appear at head 0, side 1 for this cylinder will appear at head 1.

Now let's try this with a floppy disk. Let's try and read cylinder 10 again. Side 0 will read back correctly and will read data meant for cylinder 10. Side 1 will have a problem. The disk was written in a drive with one head only. Therefore track 10 is on the exact same position on both sides of the platter. Because of the offset (which is +8 for head 1 to be precise), head 1 will read data meant for track 18, not 10.

This problem could be taken care of in software. If you know the offset, data can be shifted to appear at the correct position. But let's try to read cylinder 0. Side 0 will read back correctly again, side 1 will return data meant for cylinder 8.

We would have to step back another 8 cylinders to access data for cylinder 0... but we can't! The drive will stop stepping when reaching cylinder 0.

There is a simple solution to this problem. Drives with one head only had their disks flipped to read or write the second side. Just flip the disk, and side 1 will appear at head 0 at the correct position.

BUT: You might notice the disk is not spinning. Chances are high it really does not. It might, but only if the disk has two index holes punched into the jacket. The reason is that modern drives use the index hole to detect drive speed and if the disk is spinning at all. Using a jacket with one index hole only will make this hole appear on the wrong side which the drive can not see.

To read a floppy disk with a modern drive, there are three major options:

1. Cut the jacket open and place the platter into a jacket that does have two index holes. You can punch in another hole into the original jacket as well. Now tell this a collector and make sure you can run fast enough...
2. Add a fake index to your floppy drive. Place a small magnet on the underside of the motor spindle and attach a small hall effect sensor (it will measure the magnet going by) to the drive's electronics. The drawback is that the index you generate is not connected with the original one. So while this does work, it's not useful for preservation.
3. Modify a drive to make it step to -8.

## SUPPORT

Sometimes its better to give disks for professionals instead of trying to dump them with own effort. If the disk is accidentally destroyed the disk the data is gone forever. If you are unsure how to handle fragile disks you can always contact Kryoflux support.