

APPLEBOX

The DISK][Drive - a classic storage system

Important Warning ! Never dismount or open drives unless they have been disconnected from the computer (i.e. unplugging the drive from the diskcontroller) and are without power !
Disobeying may lead to a damaged computer or damaged drive !

Only in very few tasks power will be needed and this will be mentioned within the text at the correct place pointing to the needed precautions!

This pages were created as a reaction of the fact that within the Applefritter-site a lot of threads are related to the topic of the Apple-Disk II-system. Due to the age of these diskdrives in a lot of cases they have malfunctions... sometimes just by dirt, sometimes caused by wrong storage and sometimes just as the result of earlier bad treatment like shocks or similar incidents.

So this pages will cover the entire topics of how this drives work, which parts might become damaged and how to maintain this drives by cleaning and adjustment. I will display pictures in detail with markings inserted and comments to explain steps of service to get that drives running again in perfect shape. The order is related to the "toplist" of malfunctions (i.e. i will treat the topics in the order sorted how often the mistakes happen the most common first and the rather rare mistakes thereafter).

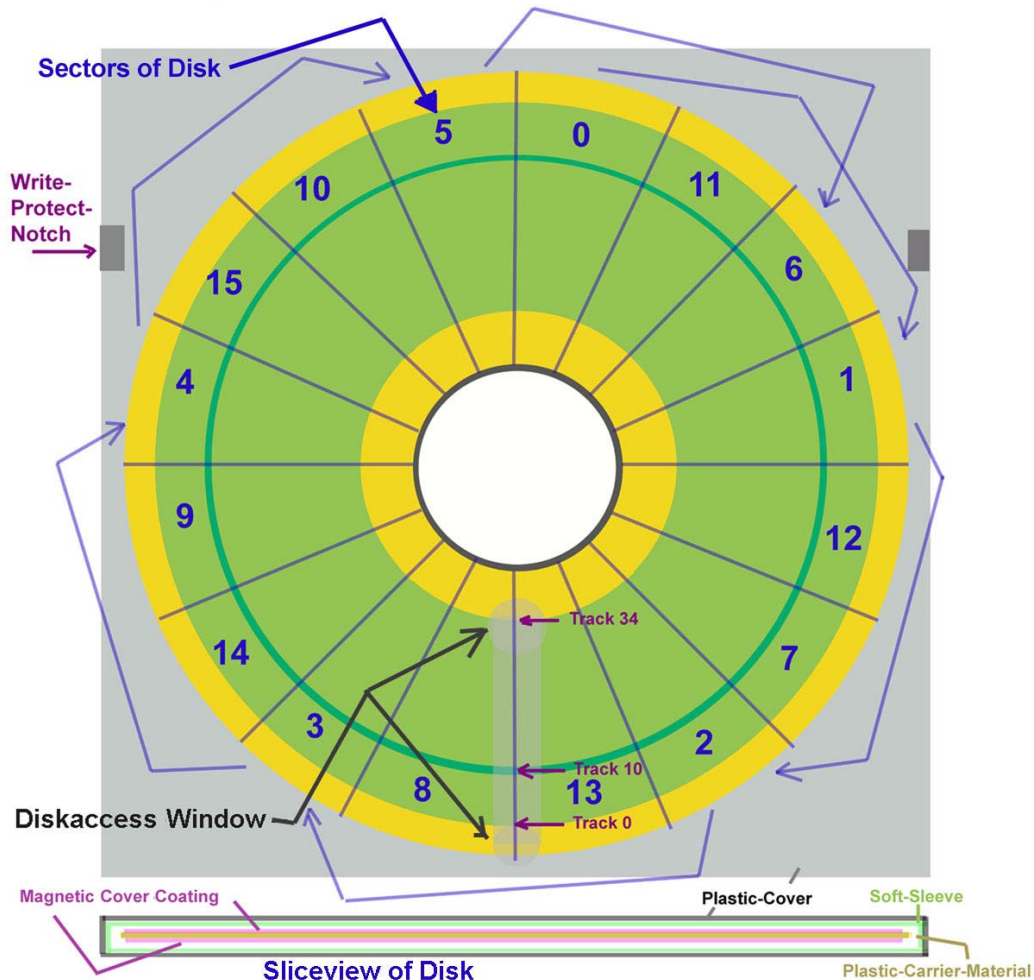
In the preliminary part i will first explain the way this drives work to provide the user with some **basic knowledge..... this should be read too because if you know how the drive works - you will know why you are doing something** and what the purpose of the task targets for... this will permit you to **perform this tasks better by understanding the task itself.**

I hope this pages will become some kind of reference to the topic and save in future a lot of redundant threads and help to keep this drives in good working condition.....

In the ancient days when this drives have been designed by Steve Wozniak, the specialized chips for diskette-drives were horrible expensive or not even designed ... so the Disk II -drive is equipped with very simple logic chips from so called "standard series" (i.e. no specialized chips where used).

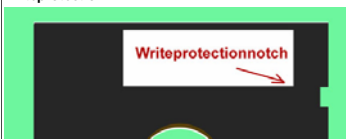
But before we examine the Drive and its components we first should take a closer view to the diskette (media) itself - this is important for understanding later explanations. So lets start with the following schematic-picture and the explanations of the picture in the text below:

Simplified Schematic of Diskettes



After the first overview lets examine first the so called "Sliceview of Disk" at the bottom: the basical center of a diskmedia is a circle of plastic-carrier-material that is covered with magnetic cover coating (one side at Disks marked with "1S" and if both sides are covered with the material its marked as "2S" - although this is in very many cases not true.... a lot of diskettes marked as "1S" are in fact coated at both sides, but for some reason (mistakes in the surface - or just because it was to much work to change the manufacturing-line) they were marked with "1S". So it was a common habit in old days to tryout, if the backside does work or not - and it therefor was also a common habit to punch a read/write-notch in the cover with a so called "Disknotchpuncher".

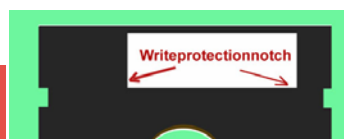
Disk with the common one notch for writeprotection



Disknotchpuncher



Disk after use of the Disknotchpuncher





That thin covered sheet of plastic covered with a magnetic surface (mostly on both sides) is also marked to be "SD" (for single Density = less quality of magnetic-coating) or as "DD" (for Double Density = better quality of magnetic coating) there is also material sold with marking "HD" used for Disks with so called "High-Density" material - but this material can't be used with any Apple Computer. It's "packed" in a soft sleeve to avoid any kind of damage to the surface. That "soft-sleeve" is within a cover made from thicker resistant flexible plastic which is the cover you handle with your hand.... - BUT: **Be CAREFULL !** In this cover is kind of "window" which permits direct view to the basic-disk-material itself - this is the window where the Read/Write-Head slides along the material and reads the data - similar to the tape - passing the readinghead in the recorder ! **Never touch the surface of the Diskette itself !!!** This can cause the diskette to become damaged severely and it gives risk that dirt gets moved to the Read/Write-Head of the Drive which is very extremely sensible ! Back to the marking: 1SDD is for example single-sided double-density.

Now lets take a look at the upper part of the picture: before starting any discussion about spinning and orientation lets agree to the following facts... this picture is a view from the top of the Disk towards the bottom of the drive ! So if you take a look to the diskturntable and the drivebelt from bottom to the direction of the top of the drive the motor and the disk is spinning clockwise but - if you turn the drive around and take a look at the disk from the top of the drive of course the turningdirection turn to opposite (!) so the disk turns in fact counterclockwise (!). So now you will understand that the orientation of the sectors of the disk are numbered correct ! Spinning the disk around counterclockwise if the sector 0 passes the Diskaccess Window the third sector to become visible will be the sector with the number 1 and then after another 2 sectors again the third sector will be the sector with the number 2 and so on.....

This skipping of sectors in the order on the physical disk is called "interleave". At the beginning it may sound crazy... but this is really the fastest way to read or write a disk ! To understand this we will examine very basically the things that happen after a sector has been read or written: After the Bytes have been read to the disk-controller and moved by the cable to the computer and there moved to the memory and the computer gave the instruction to fetch the next sector (and bear in mind that this tasks require some time !) in the meantime the disk of course has moved a bit ahead (2 sectors) so at the beginning of the third sector the reading-access starts just right again..... - just imagine the interleave would not have been executed ... in that case the read/write-head would be above the sector with the number 3 and it would need a delay of another 13 sectors till the sector with the number 2 would be available again at the Diskaccess Window !

In the very beginning of the Apple the diskettes were formatted with only 13 sectors - but after very few years it turned out to be better to use a format of 16 sectors. It is very important to recognize this fact ! The timing of the interleave is only determined by a time-delay-loop that is given by the software of the proms (P5 and P6) in the disk-controller ! So now at this moment just the facts: the numbers of the Proms of the 13-sector version of the controller show up with : ROM P5 is labeled 341-0009 and the ROM P6 is labeled with 341-0010. The Controller with the 16 sector version contains the proms P5A labeled as 341-0027-A, P5A 1981 while the P6A is labeled as 342-0028-A, P6A 1981.

This is an important thing to recognize - because it is impossible to read or write 16 sector format with 13 sector proms as well as it is impossible to read or write 13 sectors with a set of proms determined for 16 sector format ! The timing delay loops within the software just won't match with the speed and therefor won't match with the interleave-timing - no way !

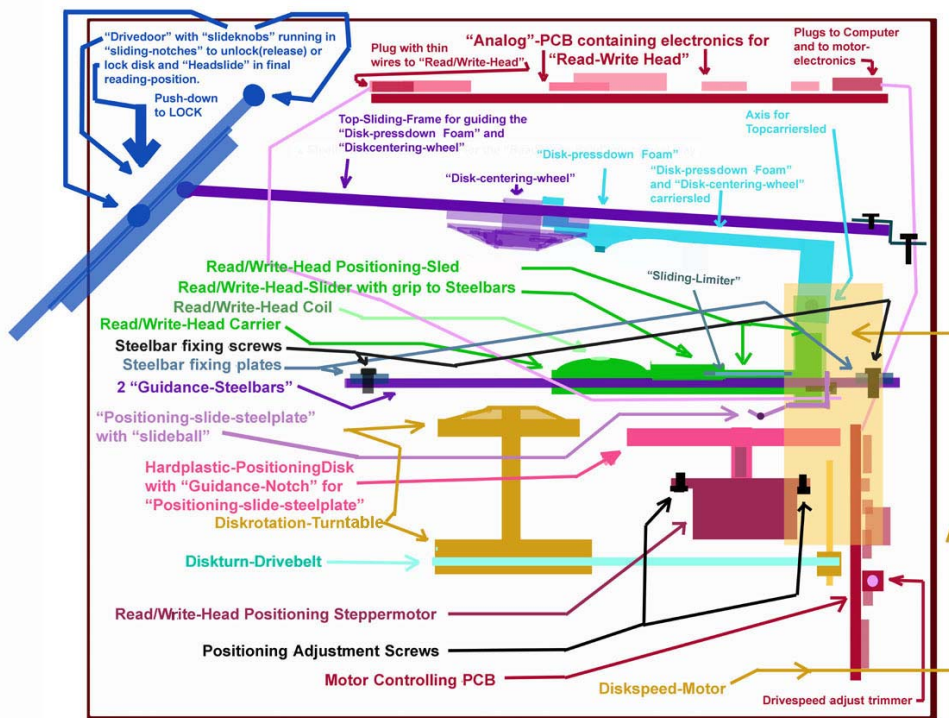
Although in the picture above both - the yellow and the light green area is covered with the magnetic-coating... but only the green area is really used within the Disk II. With the 40-track drives a larger part of the inner yellow area is additionally used too....

Important at the moment is just the fact that track zero is at the outer side and the tracks with the higher numbers are orientated towards the inner circle.

In another later part we will switch back to this picture for more detailed view and explanation but at the moment we can stay with the now explained knowledge.....

Now after the view to the diskette we can take a closer view to the details of the drive. The schematic in the picture below shows first of all a kind of explosionview splitted to function groups that have been taken apart to color groups. Colors similar to eachother belong together. In the text below of the drawing - the groups will be explained from the top of the drawing down to lower levels towards the bottom of the drawing after the explanations this groups will be also documented with pictures that contain additional comments in the pictures

Simplified schematic of "function groups" of the Drive

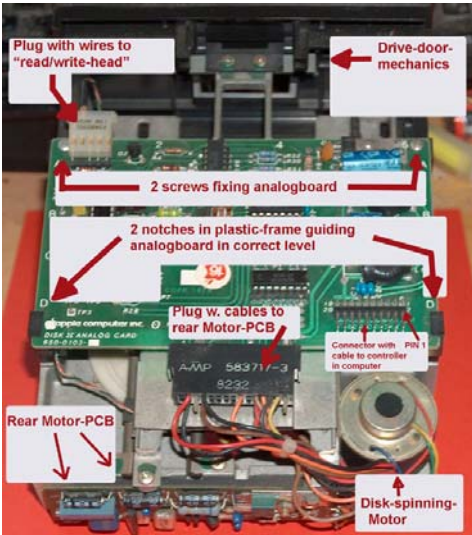


When you have removed the cover of the DISK II - drive by untightening the 4 screws at the bottom and sliding off the hood, you will first get the sight of the so called "Analogboard". At the front left side there is a plug with very thin wires - be very careful with that wires - it's the bunch of wires to the read/write-head of the drive and they may not be damaged ! At the center of the rearpart a very thick connector in the middle consists of a bunch of cables that lead to a PCB at the rearpart of the drive - which control the motor for spinning the disk and the electronics to drive the stepper motor which is responsible for the positioning of the "read/write-head sled". The "read/write-head-sled" is not visible at the moment because its beneath the shielding-top - it consists of 2 parts: the top part moves upward and downward by opening/closing the drive door and the Steelframe where the sliding-mechanic runs along. That steelframe carries in the front-middle the mechanic for centering the disk in the proper position when shutting the drive door, the upper part of the sled with plasticpart that I call the "Disk-pressdown-Foam" - if the door gets shut in front with a disk inserted it gives light pressure to the disk to make sure that it is fixed close to the "read/write-head at the bottom part of the lower part of the sled. At the one side of the sled there is a piece of steel mounted that I call the "Sliding-limiter" - this part makes sure that the "read/write-head" does not move out of its desired boundaries. We will later take a closer examination to this part of steel when treating the task of positioning-maintenance.....

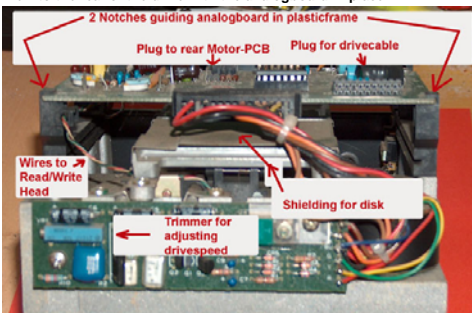
The analogboard is fixed at the rear side by running along within notches of the plastik frame and at the front its fixed at both sides with a screw.

So now at the moment first of all some pictures in the order what you will see while dismantling the drive:

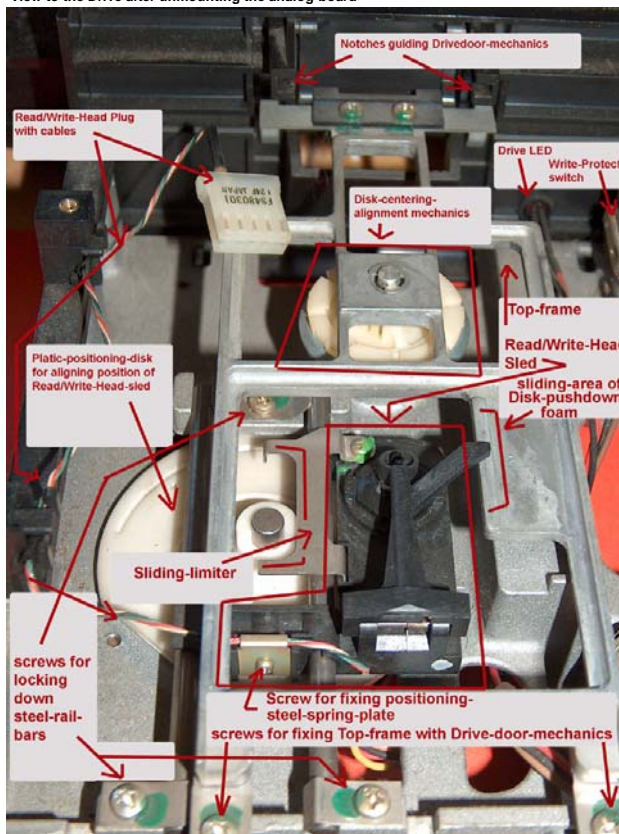
View to the top of the drive with analogboard in place



View to the rear of the drive with the analogboard in place

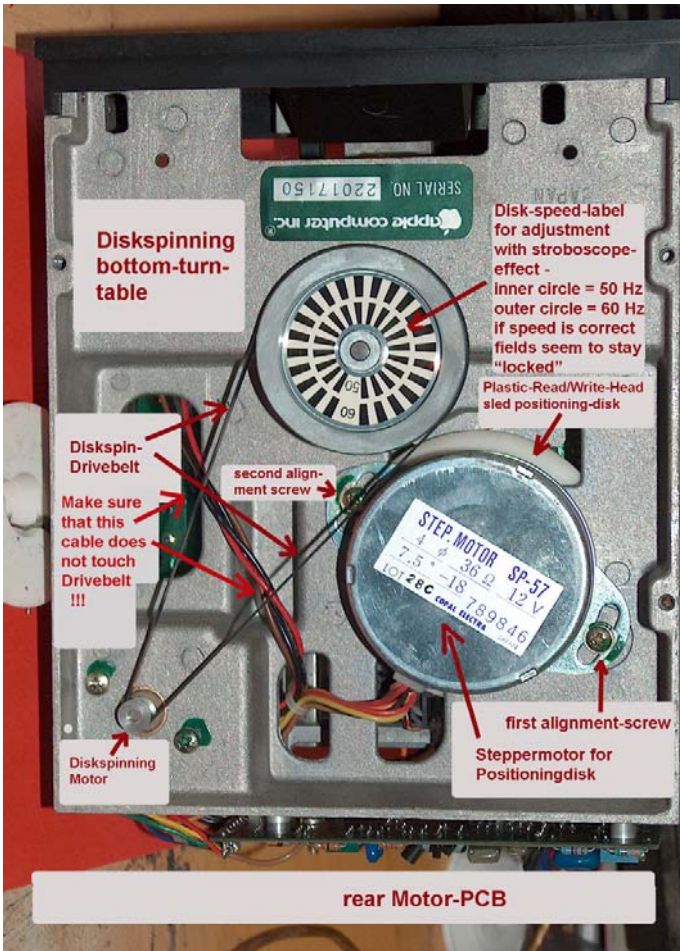


View to the Drive after unmounting the analog-board

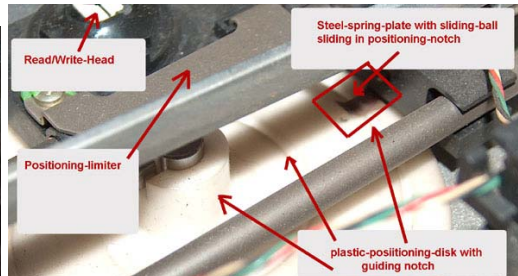


So now after this pictures lets take a short look from the bottom of the drive to get some more orientation on the components:

commented bottomview of the drive:



and to get the view of the positioning-mechanic complete here another detailed view of the steel-sliding mechanic at the plastic-positioning-disk with close view to the steel-sliding-plate with the sliding-ball :



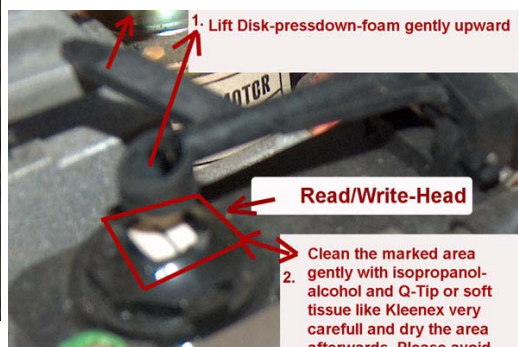
So now some additional remarks:


Up to this point the DISK II has been shown that far that we can treat first the typical maintenance tasks that could be performed also at drives that are working but are for example just noisy or have minor problems resulting from dirt or similar problems.

In the next part of the text and pictures i will therefor explain this servicetasks and i will treat the problems related with calibration of speed and track zero in the following additional pages to keep the pages handy for fast loading - at the end of this page there will be the links to the page about calibrate speed and a page about calibrating track zero.

Nevertheless i advice to also read the following text and view the pictures too, because after a repair it is recommended to carry out the task of supplying oil/grease to moving parts and cleaning the read/write head to ensure proper operation of the disk also in the future.

Cleaning the Read/Write-Head





any kind of hard pressure !

Getting the oil or grease to the right places and making sure that it keeps there and only there !

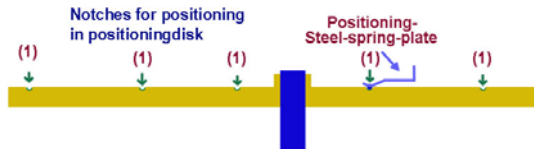
first again a short explanation:

If you use oil (specially if the oil is very liquid-fluent) like the oil used in sewing machines isn't a very good idea. First of all in the following time you can't predict which directions the oil will start running to after the drive was closed, where some drops might fall down (i.e. onto the inserted disk ?) and some kinds of oil have the bad habit, that they get thicker like resine or vaseline and then they don't provide good sliding attitude anymore.

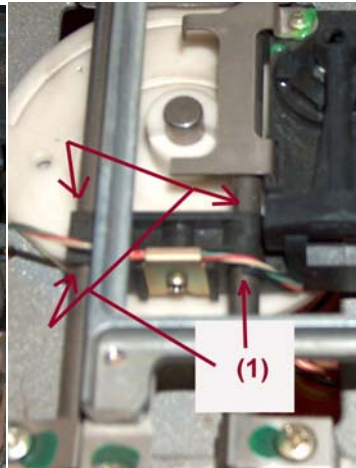
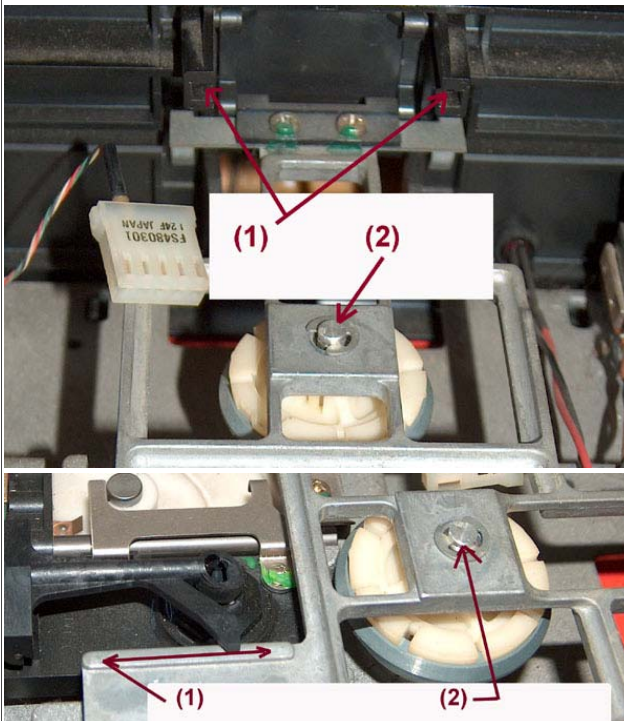
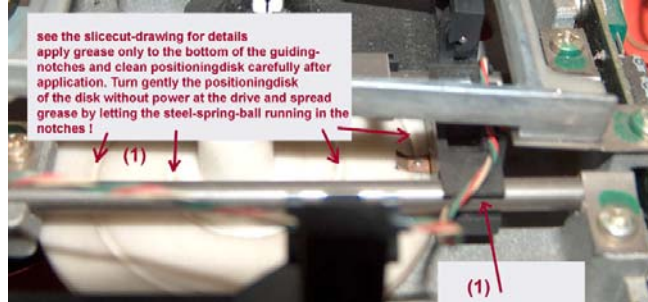
The best experiences i have made with little more expensive synthetic-grease as it is used for ballgears or positioning-chains in robotic systems. The consistency is quite similar to warm margarine, but it doesn't drop around, but just is adhesive to the spots where it has been applied to.

Such grease remains for years in the applied area and does not change its attitude to keep a very slippery and smooth sliding between the moving parts.

In the pictures below i will mark areas with (1) or (2). The marking with (1) will mean that grease should be applied (only very few) and the marking (2) will indicate where a very thin fluid oil should be applied.



Before applying the grease to the notches it is recommended to carefully clean the notches from any kind of dirt !



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[continue to next page about speedadjustment of the drive](#)

[continue to the page about calibrating the track zero](#)

[continue to the page about advanced adjustment of the offset of the electrical Read/Write-Head compensation cycle](#)