SECTOR SLIP™

Technical Manual

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REVISION HISTORY

ECO No.	Date	Description	Pages

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1.0   WHAT IS SECTOR SLIP?

The Sector Slip Program (optional) allows you to run your
disk drive as if it had error-free media. The Sector Slip
Formatter (SLIPS) analyzes the disk for sectors which
cannot transcribe data reliably, then reformats the disk
such that those bad sectors are ignored during subsequent
operations. In effect, the bad sectors are invisible to
the Operating System. The Controller firmware will slip
past these sectors during read/write operations without
further intervention from the host CPU.

Each slipped sector is replaced by a sector at the end
of the same track. Since disk space is sacrificed to
obtain error-free media, you should consider whether
this trade-off is of value in your particular situation.
Unless there is a reason for running with error-free
media, you will probably not choose to give up disk
space. Some situations where Sector Slip might be needed
are:

- The Operating System requires error-free media.
- The application is time-critical and depends
  on having large contiguous blocks of data.
- The disk has more bad blocks than the Bad Block
  Table can accommodate.

If the Sector Slip feature is needed, you should plan for
it when selecting the disk drive. The disk parameters must
be such that there will be unused sectors available for
slipping. Please refer to the manual section discussing
your particular ZETACO controller for additional information.

2.0   HOW MANY SECTORS SHOULD BE SLIPPED?

In order to slip a bad sector from the disk there must be a free sector at the end of the track. A free sector is one that is physically available but is not configured for use when running. For each sector slipped from a particular track there must be an unused sector at the end of that track. In general, this will be a number between 1 and 16. Certain ZETACO controllers can slip only 4 sectors on each track. Refer to the manual section describing your controller for more information on these limits.

It is not possible to recommend a number of sectors to slip for all situations; there are a number of interacting variables. To determine the best number of sectors to reserve for slipping in a specific situation, all of the following must be considered:

- physical characteristics of the disk drive.

- how many bad sectors your drive has. You will need to reserve at least as many sectors as there are on the worst track. For example, if there are 4 bad sectors on the disk drive, two of which are located on the same track, there must be at least two sectors for slipping on each track. You can reserve a larger number.

- features and limitations of the particular controller. ZETACO controllers allow you to logically restructure your disk to obtain maximum disk usage. Not all methods of restructuring are available on all controllers when Sector Slip is implemented. Refer to the manual section on the limitations of a particular controller for more information. In general, the controllers with Virtual Mapping provide the greatest flexibility.

- the need for fitting your disk drive into particular Operating System-supported emulations. When a certain emulation is essential, you will be able to slip only the difference between physical sectors and sectors required by the emulation.

- throughput rate. The speed of the disk drive, the
data transfer rate, and the CPU speed all interact to
produce a throughput rate for your application(s).
ZETACO controllers have features which improve per-
formance in cases where the CPU cannot keep up with
the drive on consecutive sector Reads/Writes. One of
these features, interleaving, is not supported on all
controllers when Sector Slip is implemented. An al-
ternative to interleaving is to set the drive for less
physical sectors than the maximum in the specs for the
drive. As the head will travel a greater distance from
one sector to the next, this increases the CPU's chances
to keep up with the drive. Refer to the usage guidelines
in the Controller manual for more information on this
topic.

3.0   BMX-3 AND DC-297

ZETACO's Virtual Mapping™ feature is available on these
controllers. When it is implemented, the entire disk
capacity is available for fitting into AOS and AOS/VS
emulations. Therefore, drives do not need to fit within
specific head, sector and cylinder counts. As Sector
Slip requires some sectors on each track for slipping,
the freedom provided by Virtual Mapping can be very
helpful. You must select Virtual Mapping mode or the
limitations will be the same as those for the BMX-1
and ZDF-1 controllers.

3.1   LIMITATIONS WHEN USING SECTOR SLIP WITH VIRTUAL MAPPING

Disk Arithmetic

The total number of sectors on the disk will be reduced
by (# secs reserved for slip) x (# hds) x (# cyls).
Assuming that the worst track has 3 bad sectors,
you would lose 3x(# hds)x(#cyls) sectors on the disk.

Maximum number of sectors per track that can be slipped is 16.

Maximum number of usable sectors per track is 64.
        (Effectively 128 when you have split sectors
         and doubled cylinders.)

The maximum number of physical sectors per track is 144.
        (128 + 16)

You Cannot Run with Physical Interleaving.

3.2   LIMITATIONS WHEN USING SECTOR SLIP WITHOUT VIRTUAL MAPPING

Refer to the limitations for BMX-1 and ZDF-1 in section
4.1.

3.3   HOW TO SET UP THE DISK

Set Up the Drive

The drive should be set for the number of available
physical sectors, as referenced in the Controller manual
installation section entitled "Sectors Per Track
Selection."

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Run the Configurator Program

The controller should be configured for Virtual Mapping
mode. When asked if you want to SLIP the disk, respond
"Yes". You will then be asked to specify how many sectors
per physical track you wish to set aside for slipping.
Valid responses are between 1 and 16.
You must still select Sector Slip from the Configurator
menu to implement this feature.
Select ECC from the Configurator menu and Disable ECC.

Run the Reliability Program

- Use starting address 504 to run the Quickie Formatter
- Use starting addresses 500 and 505 and run each test for
  five minutes.

If problems other than media flaws occur, run Diagnostics
to isolate the problem.

Run the Sector Slip Formatter Program

The Sector Slip Formatter will display a menu and you
should select the DO ALL option. Enter the number of
physical sectors. The configured parameters will
automatically be read from the Controller. The
disk will be formatted, analyzed, and bad sectors
slipped as they are found. When slipping is complete,
print out the Error History and save it.

NOTE: If you run Diagnostics after the Sector Slip
         Formatter has been run, be sure to turn Switch
         7, Diagnostic Program, ON so that the disk does
         NOT get reformatted.

Run the Configurator Program

Reconfigure the Controller to enable ECC.

Run the Reliability Program

This step is optional as the Initializer will do some
analysis. If you will not be doing analysis with the
Initializer, you should run at least 1 pass of both
500 and 505. If any bad sectors are found, they can be
slipped individually by running SLIPS again. Refer to
the manual section on operating SLIPS for details on how
to do this.

Run the Initializer Program (CSDKINIT for RDOS, DFMTR for AOS or AOS/VS)

If any bad sectors are found by the Disk Initializer, they can be slipped individually by running SLIPS again. Refer to the manual section on operating SLIPS for details on how to do this.

3.4   EXAMPLES

Fujitsu 2351 (EAGLE) under AOS

The physical characteristics of this drive are:

Heads=20, Cylinders=842, and Sectors=48

This drive can be configured under Virtual Mapping mode as two 6061's (190 megabytes each), leaving 3 sectors per track for slipping.

CDC 9715-340 under AOS

The physical characteristics of this drive are:

Heads=24, Cylinders=711, and Sectors=35

This drive can be configured under Virtual Mapping mode as a 277 megabyte Vulcan emulation (6122), leaving 3 sectors per track for slipping.

CDC 9715-515 under AOS

The physical characteristics of this drive are:

Heads=24, Cylinders=711, and Sectors=51

This drive can be configured under Virtual Mapping mode as two 190 megabyte drives (emulation 6061), leaving 7 sectors per track for slipping.

Fujitsu 2361

The physical characteristics of this drive are:

Heads=20, Cylinders=842, and Sectors=70

The speed of this drive is such that, depending on
the CPU and data transfer method, it may not be possible
to make consecutive sector reads/writes when the drive
is set for 70 sectors.

CASE 1 - The system cannot make consecutive sector reads/
writes using all 70 sectors. There are two ways
of structuring this disk.

a. Logically interleave the disk.
Select disk F9 on the Fujitsu menu, allocate
4 sectors for slipping and respond YES to
logical interleaving. There will be
enough blocks for two 277 megabyte disks.

b. Set the drive physically for 68 sectors.
When configuring, enter "ND" as the drive
type. This allows you to specify the
characteristics of the drive as follows:

Heads=20, Cylinders=842, and Sectors=68

Allocating 4 sectors for slipping leaves 64
available, and the drive can be broken into
2 (or more) logical units.

NOTE: The correct ZETACO Media format for
this drive is ZETA2.

CASE 2 - The system can make consecutive reads/writes using
all 70 sectors. You can then slip any number of
sectors between 2 and 16.

4.0   BMX-1 AND ZDF-1

4.1   LIMITATIONS WHEN USING SECTOR SLIP

Disk Arithmetic Under AOS and AOS/VS

The number of sectors on each track is reduced by the
number of sectors needed for slipping. I.E: assuming
that you need 3 sectors for slipping, the drive will
effectively have 3 less sectors per track.

Care must be taken taken when fitting the drive into AOS
or AOS/VS emulations. For example, if the number of
physical sectors is 35, slipping will reduce the sectors
per track below that necessary for the Kismet or Vulcan
emulations. This would reduce a 73 megabyte drive to 50
megabytes, or a 277 megabyte drive to 190 megabytes.

Maximum Number Of Sectors Per Track That Can Be Slipped Is 16.

You Cannot Configure The Disk As 2 Logical Units.

If your disk drive has 70 sectors, under AOS you would
normally split this disk into 2 logical units (either
35/35 sectors or 24/24 sectors). However, Sector Slip
cannot be implemented on a drive configured as 2 logical
units. Therefore, under AOS or AOS/VS, implementing Sector
Slip could result in considerable loss of disk space.

You cannot split the sectors and double the cylinders with
ZDF-1 controllers. You can do this and also slip with
the DC-297 non-virtual.

This feature of splitting sectors and doubling cylinders
is not available on BMX-1 or BMX-3 non-virtual, so the
limitation is irrelevant with these controllers.

Maximum Number Of Usable Sectors Under RDOS Is 64.

This is a consequence of the above limitation.
The maximum number of physical sectors is 80. (64+16)

You Cannot Run With Interleaving.

If the disk speed relative to CPU speed is such that
interleaving is necessary for acceptable performance,
then Sector Slip cannot be implemented.

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4.1   HOW TO SET UP THE DISK

Set Up the Drive

The drive should be set for the number of available
physical sectors, as referenced in the Controller manual
installation section entitled "Sectors per track
selection."

Run the Configurator Program

The controller should be configured for the number of
sectors you will actually be running (NOT the number
that is physically available). For example, if the
drive is set for 35 sectors, you could configure the
controller for 32 sectors. This leaves 3 sectors
for slipping.

Select Sector Slip from the Configurator menu to enable
this feature.

Select ECC from the Configurator menu and Disable ECC.

Run the Reliability Program

- Use starting address 504 to run the Quickie Formatter
- Use starting addresses 500 and 505 and run each test for
  five minutes.

If problems other than media flaws occur, run Diagnostics
to isolate the problem.

Run the Sector Slip Formatter Program

The Sector Slip Formatter will display a menu and you
should select the DO ALL option. Enter the number of
physical sectors. The configured parameters will
automatically be read from the Controller. The
disk will be formatted, analyzed, and bad sectors
slipped as they are found. When slipping is complete,
print out the Error History and save it.

NOTE: If you run Diagnostics after the Sector Slip
         Formatter has been run, be sure to turn Switch
         7, Diagnostic Program, ON so that the disk does
         NOT get reformatted.

Run the Configurator Program

Reconfigure the Controller to enable ECC.

Run the Reliability Program

This step is optional as the Initializer will do some
analysis. If you will not be doing analysis with the
Initializer, you should run at least 1 pass of both
500 and 505. If any bad sectors are found, they can be
slipped individually by running SLIPS again. Refer to
the manual section on operating SLIPS for details on how
to do this.

Run The Initializer Program (CSDKINIT for RDOS, DFMTR for
AOS or AOS/VS)

If any bad sectors are found by the Disk Initializer,
they can be slipped individually by running SLIPS
again. Refer to the manual section on operating SLIPS for
details on how to do this.

4.3 EXAMPLES

CDC 9762 under RDOS

The physical characteristics of this drive are:

Heads=5, Cylinders=823, and Sectors=35

This drive can be run using 32 sectors, leaving 3
sectors per track for slipping. If any track has more
than 3 bad sectors, you will not be able to slip the
disk with this configuration. You will lose 3/35 of
your possible disk space. Set up the drive for 35
physical sectors and configure the controller for 32
sectors.

Fujitsu 2351 (EAGLE) under AOS

The physical characteristics of this drive are:

Heads=20, Cylinders=842, and Sectors=48

This drive can be run as a 277 megabyte Vulcan emulation (6122), using 35 sectors per track. The best setting for the physical sectors depends on CPU speed and whether data transfer is DCH or BMC. BMX-1 interfaces either BMC or DCH; ZDF-1 interfaces only DCH. The number of physical sectors should be small enough that the CPU can keep up on consecutive sector reads/writes. Running on the BMC, the drive can probably be set for 48 sectors (586 bytes). Running DCH, the drive may need to be set for 43 or less physical sectors. The best setting depends on both CPU speed and drive speed.

5.0   DC-295, DC-295C, DC-296 AND DC-296C

5.1   LIMITATIONS WHEN USING SECTOR SLIP

Disk Arithmetic Under AOS

> The number of sectors on each track is reduced by the number of sectors needed for slipping. I.E: assuming that you need 3 sectors for slipping, the drive will effectively have 3 less sectors per track.

> Care must be taken taken when fitting the drive into AOS emulations. For example, if the number of physical sectors is 35, slipping will reduce the sectors per track below that necessary for the Kismet or Vulcan emulations. This would reduce a 73 megabyte drive to 50 megabytes, or a 277 megabyte drive to 190 megabytes.

Maximum Number Of Sectors Per Track That Can Be Slipped Is 4.

You Cannot Set Up One Disk As 2 Logical Units.

> If your disk drive has 70 sectors, under AOS you would normally split this disk into 2 logical units (either 35/35 sectors or 24/24 sectors). However, Sector Slip cannot be implemented on a drive configured as 2 logical units. Therefore under AOS, implementing Sector Slip could result in considerable loss of disk space.

You cannot split the sectors and double the cylinders.

Maximum Number Of Usable Sectors Under RDOS Is 64.

> This is a consequence of the above limitation.
> The maximum number of physical sectors is 68. (64+4)
> Refer to the Bank Table in your controller manual for the available sector settings.

You Cannot Run With Interleaving.

> If the disk speed relative to CPU speed is such that Interleaving is necessary for acceptable performance, then Sector Slip cannot be implemented.

5.1   HOW TO SET UP THE DISK

Set up the drive

   The drive should be set for the number of available
   physical sectors, as referenced in the Controller manual
   installation section in tables 3.1 and 3.2.

Set the Controller

   The switches should be set for the number of sectors
   you will actually be running (NOT the number that is
   physically available). For example, if the drive is
   set for 35 sectors, you could set up the switches for
   32 usable sectors. This leaves 3 sectors for slipping.
   You should enable Sector Slip and disable ECC.

Run the Reliability Program

   - Use starting address 504 to run the Quickie Formatter
   - Use starting addresses 500 and 505 and run each test for
     five minutes.

   If problems other than media flaws occur, run Diagnostics
   to isolate the problem.

Run the Sector Slip Formatter Program

   The Sector Slip Formatter will display a menu and you
   should select the DO ALL option. Enter the number of
   physical sectors. The switch settings will automatically
   be read from the Controller. The disk will be formatted,
   analyzed, and bad sectors slipped out as they are found.
   When SLIPS is complete, print out the Error History and
   save it.

   NOTE: If you run Diagnostics after the Sector Slip
            Formatter has been run, be sure to turn Switch
            7 ON so that the disk does NOT get reformatted.

Set the Controller

   Set the switch to enable ECC.

Run the Reliability Program

This step is optional as the Initializer will do some
analysis. If you will not be doing analysis with the
Initializer, you should run at least 1 pass of both
500 and 505. If any bad sectors are found, they can be
slipped individually by running SLIPS again. Refer to
the manual section on operating SLIPS for details on how
to do this.

Run the Initializer program (CSDKINIT for RDOS, DFMTR for AOS)

If any bad sectors are found by the Disk Initializer, these
can be slipped individually by running SLIPS again.
Refer to the manual section on operating SLIPS for details
on how to do this.

5.3   EXAMPLES

CDC 9762 under RDOS

The physical characteristics of this drive are:

Heads=5, Cylinders=823, and Sectors=35

This drive can be run using 32 sectors. There
will be 3 free sectors on each track for slipping.
If any track has more than 3 bad sectors, you will not
be able to slip the disk. You will lose 3/35 of
your possible disk space. Set up the drive for 35
physical sectors and set up the Controller for 32
sectors.

Fujitsu 2351 (EAGLE) under AOS

The physical characteristics of this drive are:

Heads=20, Cylinders=842, and Sectors=48

This drive can be run as a 277 megabyte Vulcan (6122)
using 35 sectors. The best setting for physical sectors
depends on the CPU speed. The number of physical sectors
should be small enough that the CPU can keep up on
consecutive sector reads/writes. You may need to set the
drive for 43 or less physical sectors.

6.0   OPERATING SECTOR SLIP FORMATTER (SLIPS)

The Sector Slip Formatter allows you to format and slip bad sectors from your drive. Any previous data or disk structure will be lost when you run SLIPS.

Remember that Sector Slip must be enabled on the Controller when running SLIPS. If SLIPS displays the fatal error "Too Many Bad Sectors" after a series of contiguous bad sectors, you are probably running without Sector Slip enabled.

This is the program menu:

      A - Do all
      B - Input parameters
      C - Format only
      D - Analyze/Slip only
      E - Enter bad blocks
      H - History of slipped sectors
      L - Logging to printer
      Q - Quit

Do all   - initiates the following functions in order: Input
             Parameters, Format, Analyze/Slip, History of slipped
             Sectors, and Enter bad blocks.

Input parameters - accepts entry of the disk device code and
             unit number, reads the disk characteristics (heads,
             sectors and cylinders) from the Controller and asks
             you to enter the number of sectors for which the
             drive is physically set.

Format only - formats each track on the disk without
             performing any analysis.

Analyze/Slip only - analyzes each track, slipping bad sectors
             as they are found. The disk must already be
             formatted to run this function.

Enter bad blocks - specific sectors can be slipped. You will
             need to enter the Cylinder and Head number for the
             track and the physical sector number(s) to slip
             on that track. This can be done for any number
             of tracks.

History of slipped sectors - displays all sectors which were
    slipped by the Analyze/Slip routine just completed.
    This information is lost when the program terminates.

Logging to the printer - sends all output to the printer at
    device code 17. The printer can be either DMA or
    programmed I/O. The output will still appear on
    the user console.

Quit - terminates the program.

You should log your output to a printer if at all possible.
This will provide you with hard copy for future reference.
We suggest you select the DO ALL option from the SLIPS menu
when running for the first time.

SLIPS will format the drive and then analyze each track,
slipping bad sectors. After all tracks have been analyzed
and slipped, print out the history of all sectors slipped.
If you do not have a printer in the system, write down the
PHYSICAL sector number of all slipped sectors. Save the
history of slipped sectors as this information is necessary
if you ever need to slip additional sectors.

If you need to add additional bad sectors, you can do so
by entering ALL bad sectors on a specified track. There is
no need to disable ECC when entering bad sectors. You must
know the PHYSICAL sector number of each bad sector, because
the command that slips sectors will destroy the flag(s) of
any sectors previously slipped on that track.

To convert a logical sector number to a physical sector
number, remember that any sectors slipped from a track do
NOT contribute to the logical count. The Reliability and
Initializer programs report sector errors by logical sector
number. Sector Slip Formatter History reports errors by
physical sector number.

EXAMPLE:

The SLIPS program identified physical sector 2 as bad and
slipped it. The track on the disk would look like:

```
        Logical    0   1 Slipped 2   3    4
        Physical   0   1    2     3   4    5
```

Let us assume that the Initializer found (logical) sector 2
bad on the same track. From the slipped history log you
determine that physicl sector 2 was slipped. Thus the sector
which is now logical sector 2 is physical sector 3. Select
the Enter Bad Sectors function from the SLIPS menu. You must
specify both sectors 2 and 3 to slip. The result on the disk
track will be:

```
Logical    0   1 Slipped Slipped  2    3
Physical   0   1    2        3     4    5
```

When entering a bad sector on a track with ONLY ONE bad
sector, the physical sector number and the logical sector
number are the same.