

Flexer: CDOS Floppy Drive Exerciser  
Version 3.05  
Users Manual

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## 1.0 Description

Flexer is a general-purpose floppy drive exerciser program that runs under Cromemco CDOS 2.XX. Flexer is designed to exercise any type of floppy drive that is attached to a Cromemco 4FDC, 16FDC, or 64FDC Floppy Disk Controller, and is especially suitable as a tool for the somewhat tricky task of aligning PerSci drives. (Note that PerSci drives are not supported on the 64FDC Floppy Disk Controller.)

### 1.1 System Requirements

- A Z-80 based computer running at exactly 4.0 MHz
- At least 16K of available 0 wait-state RAM starting at address 0000, in addition to CDOS's memory requirements
- A Cromemco 4FDC, 16FDC, or 64FDC floppy disk controller
- CDOS 2.XX operating system

### 1.2 Supported Drive Types

- Shugart-compatible 8" drives (with stepper motor actuators)
- PerSci-compatible 8" drives with voicecoil actuators (not supported on the 64FDC)
- 5-1/4" minidisk drives
- 1- and 2-sided diskettes (The 4FDC only supports 1-sided drives)
- Single and double density diskettes (The 4FDC only supports single density diskettes)

### 1.3 Key Features

- Position control of the read/write head (seeks) using either step commands or fast voicecoil control
- Sequential seeks between multiple tracks, useful for alignment operations
- Whole-track pattern-write command specifically for tuning the read channel and data separator
- Track ID command to identify the track number, sector size, and density
- Sector read and write commands that include controlling and observing the Deleted Data Marks
- Read-back verify after sector writes
- Read/Write Buffer editing, to create or edit any sector's data
- Spindle motor on/off (for drives with motor control input)
- Head load/unload control
- Track 0 sensor monitoring
- write protect sensor monitoring
- PerSci drive remote-eject control

## 2.0 Flexer Operation

Initiate Flexer by typing FLEXER at the CDOS prompt. Flexer will print its sign-on banner, and then the Flexer prompt, '%'. Once Flexer is running, you can type '?' at the prompt to see its list of commands. You can also type 'SE' to see Flexer's current settings, and the status of the selected unit, if one is selected.

Flexer has two types of commands. Most commands are executed when you type <Return> at the end of the line. However, the immediate commands execute as soon as you type their single-character command.

### 2.1 Buffers

**The Read/Write Buffer** is a 1024-byte buffer for read- and write-sector operations. All sector read and write operations start with buffer address 0000, using as much buffer data as necessary for the current sector size. You can display and edit the entire 1024-byte Read/Write Buffer, regardless of the current sector size.

**The Verify Buffer** is a 1024-byte buffer used exclusively for verify operations. You can display the Verify Buffer, but cannot edit it.

Note that the WP command will overwrite both of these buffers.

### 2.2 General Commands

% ?      Display the help screen.

% QU     Quit to CDOS.

### 2.3 Flexer State Commands

% SE     *Display Flexer settings and state.* This will display all of the user settings (see below), as well as the drive's state, including:

- Selected unit
- Drive type
- Max track number
- Single/double density
- Bit transfer rate
- Step rate
- Motor on/off
- Selected side
- Current track
- Head loaded/unloaded
- Drive ready/not ready (8" drives only)
- Diskette write-protected/unprotected state
- Track 0 sensor state
- Spindle rotation time
- Automatic/manual mode
- Verbose mode on/off
- Max read retries

% **A**={0/1} *Set Automatic mode for seek and step commands: '1' selects automatic mode; '0' selects manual mode.*

This setting can be changed by using the "A" immediate command while the SK or ST command is active.

% **D**={S/D} *Select single or double density.*

Note that ID, SR, and SW commands change this setting to match the observed density of the current track.

Note also that many drives (e.g. the PerSci 277 and the Shugart SA800/801) are not specified for double density operation.

% **M**={1-99} *Set the maximum track number.*

This overrides the default set by the "SE T=" command.

% **N**={0-99} *Set the maximum number of retries during track ID reads, sector data reads, and verify reads.*

% **R**={0-3} *Set the step rate for all stepping operations, as well as for seek operations when not using a voicecoil drive. Stepping rates are as follows:*

R=	8" drives	Minidisks
0	3 mS	6 mS
1	6 mS	12 mS
2	10 mS	20 mS
3	15 mS	30 mS

% **S**={0/1} *Select the diskette side.*

Note that this signal will be ignored by single-sided drives, such as the PerSci 277 and the Shugart SA800/801. However, if you set the side to '1' when working with a single-sided drive, then you will get a side mismatch error during read, write, and verify operations.

% **T**={5/8/V} *Select drive type.*

'5' selects 5.25" minidisk drives.

'8' selects 8" drives.

'V' selects 8" drives with voicecoil actuators (i.e. PerSci drives).

Note that the step rates are different for these modes. (See 'SE R=' command, above.)

Both 8" drive types set the maximum track number to 76. Minidisk drive type sets the maximum track number to 39. After setting the drive type, you can change the maximum track number with the "SE M=" command (for example, type "SE M=79" if you have an 80-track minidisk drive).

Note that the "SE T=V" option is not supported on the 64FDC controller.

- % **U={A-D}**     *Set the desired unit.*  
                   Note that PerSci 277 and 299 drives each contain 2 units.
- % **V={0/1}**     *Set verbose mode off/on.*  
                   When on, the track number and seek time are displayed  
                   after seek operations, including when in automatic mode.  
                   This setting can be changed by using the "V" immediate  
                   command while the SK or ST command is active.

#### 2.4 Actuator Commands

- % **EJ**           *Eject the diskette in the selected unit. Flexer will send a  
 1-second pulse to the EJECT signal on the drive interface.*  
                   (This command only applies to PerSci drives, and is not  
                   supported on the 64FDC.)
- % **MO {0/1}**   *Spindle motor control for the selected unit: '0' turns the  
 motor off; '1' turns it on.*  
                   Note that many 8" drives and some minidisk drives do not  
                   support remote motor control.
- % **MO**           *Spindle motor test mode.*  
                   Press space to toggle the spindle motor on and off.  
                   While the motor is on, Flexer will continuously measure and  
                   report the spindle's rotational time.  
                   To exit motor test mode, type ^C or <ESC>.

#### 2.5 Actuator Immediate Commands

- % **H**           *Head Load/Unload. Each time you type 'H', the head will  
 either load or unload.*

#### 2.6 Head Positioning Commands

- % **RE**           *Restore the selected unit to track 0.*  
                   If the unit is a voicecoil drive (as selected by the 'SE  
                   T=V' command), then Flexer will send a 1-second pulse to  
                   the RESTORE signal of the drive interface. Otherwise,  
                   Flexer will use the WD1793 disk controller's RESTORE  
                   command to send a sequence of STEP OUT commands to the  
                   drive interface.  
                   If the drive is a voicecoil drive and the drive does not  
                   respond with a SEEK COMPLETE signal within 8 seconds, then  
                   the restore will timeout with an error message.
- % **SK**           *Seek previous track(s). Flexer will seek the same track or  
 list of tracks from the previous SK or ST command. If there  
 is no previous track, then it will seek track 0.*
- % **SK <T>**     *Seek track <T>. Flexer will issue a voicecoil seek, if  
 voicecoil drive is selected. Otherwise it will step to the  
 specified track at the specified step rate.*

If Verbose Mode is enabled, then the seek time and ending track number will be displayed.

% **SK** <T1> <T2> ...<Tn> *Sequentially seek the listed tracks.* Flexer will issue a voicecoil seeks for a voicecoil drive. Otherwise it will step to the specified tracks at the specified step rate.

If Verbose Mode is enabled, then the seek time and ending track number will be displayed after each seek. You can toggle Verbose Mode on/off by typing "V" while the SK command is active.

If Automatic mode is enabled, then this command will seek rapidly through the list of tracks until ^C or <ESC> is typed.

If Manual mode is selected, then it will pause at each listed track until space is pressed (to proceed to the next track), or ^C or <ESC> is typed (to quit). You may also issue any of the immediate commands between track seeks.

You can toggle Automatic/Manual Mode by typing "A" while the SK command is active.

% **ST** *Step to previous track(s).* Flexer will step to the same track or list of tracks from the previous SK or ST command. If there is no previous track, then it will step to track 0.

% **ST** <T> *Step to track <T>.* Step to the specified track at the specified step rate.

If Verbose Mode is enabled, then the total step time and ending track number will be displayed.

% **ST** <T1> <T2> ...<Tn> *Sequentially step to the listed tracks at the specified step rate.*

If Verbose Mode is enabled, then the total step time and ending track number will be displayed after each seek. You can toggle Verbose Mode on/off by typing "V" while the ST command is active.

If Automatic Mode is enabled, then Flexer will step continuously through the list of tracks until ^C or <ESC> is typed.

If Manual Mode is selected, then it will pause at each listed track until space is pressed (to proceed to the next track), or ^C or <ESC> is typed (to quit). You may also issue any of the immediate commands between track steps.

You can toggle Automatic/Manual Mode by typing "A" while the ST command is active.

## 2.7 Head Positioning Immediate Commands

- % +        *Step in one track.* Each time you type '+', the head will step inward one track, unless it is already at the maximum track.
- % -        *Step out one track.* Each time you type '-', the head will step outward one track, unless it is already at track 0.
- % >        *Nudge head inward.* Each time you type '>', the head will step inward one track and then immediately outward one track, unless it is already at the maximum track. (This is useful for observing the effect of actuator lash.)
- % <        *Nudge head outward.* Each time you type '<', the head will step outward one track and then immediately inward one track, unless it is already at track 0. (This is useful for observing the effect of actuator lash.)
- % H        *Load/unload the head.* Each time you type 'H', the head will toggle between loaded and unloaded. Note that the 4/16FDC will load the head while it seeks or steps tracks.

## 2.8 Read/Write Commands

- % ID        *Read ID* from current track. Flexer will report the track number, the sector size (bytes per sector), sectors per track, and the density of the current track.  
  
Flexer's density setting will be changed to match the density found on the current track.  
  
An error will be reported if the track's ID cannot be read.
- % SR <S>    *Read sector <S>* from the current track into the Read/Write Buffer starting at buffer address 0000.  
  
An error message will be printed and no read will occur if Flexer's track number does not match the track number found on the diskette.  
  
If the side field in the sector does not match Flexer's side setting, then the sector will still be read, but an error message will also be printed.  
  
Flexer will report the number of bytes read from the sector and the density of the track, as well as the presence or absence of the Deleted Data Mark.  
  
Flexer's density setting will be changed to match the density found on the current track.  
  
If the specified sector could not be found or a read error occurred, then the read will be retried up to the number of times set by the 'SE N=' command. If the read was still unsuccessful, then a read-error message will be printed. If the read was ultimately successful after some number of retries, then the number of retries will be printed.

% **SW** <S> [**D**] *Write & verify to sector <S> on the current track with data from the Read/Write Buffer starting at buffer address 0000.*

An error message will be printed and no write will occur if Flexer's track number or side number do not match those found on the diskette.

An error message will be printed and no write will occur if the specified sector could not be found.

An error message will be printed a write error occurred.

If the D option included, then the sector's Deleted Data Mark flag will also be set.

Flexer will report the number of bytes written to the sector, as well as the density found on the track.

Flexer's density setting will be changed to match the density found on the current track.

After a successful write, the sector will be read back into the Verify Buffer, which is then compared to the data in the Read/Write Buffer. An error message will be printed if the two do not match. If a read error occurs, then this verify-read will be retried in the same way as with the SR command. Note that the verify-read will not be retried if the Verify Buffer data merely does not match the Read/Write Buffer data.

% **SV** <S> *Verify Sector <S> on the current track. Flexer will read sector <S> into the Verify Buffer, and then compare the data to the Read/Write Buffer data and report the result.*

An error message will be printed if the two do not match. If a read error occurs, then this verify read will be retried in the same way as with the SR command. Note that the verify-read will not be retried if the Verify Buffer data merely does not match the Read/Write Buffer data.

% **WP** <H1> <H2> ... <Hn> *Write entire track with pattern sequence of hex values. The entire current diskette track is written with the specified pattern without any formatting - no track header, no sector headers, etc.*

This command also fills the Read/Write Buffer and the Verify Buffer with the specified pattern of hex values.

This command is useful for inspecting and tuning the drive's read channel.

**Note:** Any track written with the WP command can no longer be used with the ID, SR and SW commands, because all sector-formatting has been overwritten on that track. Also, a diskette that has been written with this command will need to be reformatted before it can be used again by CDOS.



## 2.9 Buffer Manipulation Commands

- % **BD**     *Display the Read/Write Buffer (in both hex and ASCII) starting at address 0000.*
- The display will pause after every 256 bytes, allowing you either to continue by pressing Space or quit by typing ^C or <ESC>. (The Read/Write Buffer is used for SR and SW commands.)
- % **BE <A>**     *Editing the Read/Write Buffer starting at hex address <A>.*
- <A> must be no higher than 03FF (since the maximum sector size is 1024 bytes). Editing begins at 0000 if no address is given.
- To leave a value unchanged, press <Return>. To change the value, enter a new hex value, and then press Space. Each time you press Space, the contents of the next buffer address are displayed for editing.
- To quit editing, type ^C or <ESC>.
- % **BF <H>**     *Fill Read/Write Buffer with hex value <H>.*
- % **VD**     *Display the Verify Buffer (in both hex and ASCII) starting at address 0000.*
- The display will pause after every 256 bytes, allowing you either to continue by pressing Space or quit by typing ^C or <ESC>. (The Verify Buffer is only used for SW and SV commands.)