

Flexer

CP/M Floppy Disk Drive Exerciser for the
California Computer Systems 2422 Disk Controller

Version 2.00

Users Manual

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1.0 Description

Flexer is a general-purpose floppy drive exerciser program that runs under CP/M. Flexer is designed to exercise any type of floppy drive that is attached to a California Computer Systems Model 2422 Floppy Disk Controller, and is especially suitable as a tool for the somewhat tricky task of aligning PerSci drives.

1.1 System Requirements

A Z-80 or 8080 based computer running at either 2 MHz or 4 MHz
At least 16K of available 0 wait-state RAM starting at address 0000, in addition to CP/M's memory requirements
A California Computer Systems Model 2422 floppy disk controller
CP/M 1.4 or 2.x operating system

1.2 Supported Drive Types

Shugart-compatible 8" drives (with stepper motor actuators)
PerSci-compatible 8" drives with voicecoil actuators
5-1/4" minidisk drives
1- and 2-sided diskettes, any drive type
Single and double density diskettes, any drive type

1.3 Key Features

Automatic detection of minidisks versus 8" disks
Position control of the read/write head (seeks) using either step commands or fast-seek (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
Continuous write operation, specifically for debugging the write channel
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 CP/M 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 keys as the first character after the prompt, or during the operation of another command, such as the SK or ST commands.

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 CP/M.

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:

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

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

% **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 when the drive is selected.

% **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={S/V}** *Select drive type.*

'S' selects drives with stepper motor actuators (e.g. Shugart drives).

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

% **U={A-D}** *Set the desired unit.*

Note that PerSci 277 and 299 drives each contain 2 units.

Flexer will restore the specified drive to track 0, and then determine whether it is an 8" drive or a minidisk drive, setting several defaults accordingly.

% **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.

% **Z={2/4}** *Set CPU Speed.*

Set to 2 for a 2 MHz CPU and 4 for a 4 MHz CPU. Flexer needs to know the CPU speed for timing measurements, which employ software timing loops.

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.)

% **MO {0/1}** *Spindle motor control* for the selected unit: '0' turns the motor off; '1' turns it on.

Note that most 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. (Be sure to tell Flexer your CPU's speed with the Z= command before using this command.)

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.

% **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, the same as the ST command.

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

You can issue any of the immediate commands between track seeks. You can toggle between automatic mode and manual mode by typing 'A' as an immediate command.

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 enabled, then Flexer will pause at each listed track until space is pressed (to proceed to the next track), or ^C or <ESC> is typed (to quit).

% **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 issue any of the immediate commands between track seeks. You can toggle between automatic mode and manual mode by typing 'A' as an immediate command.

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

If Manual mode is enabled, then Flexer will pause at each listed track until space is pressed (to proceed to the next track), or ^C or <ESC> is typed (to quit).

2.7 Head Positioning Immediate Commands

% **I** *Step in one track.* Each time you type 'I', the head will step inward one track, unless it is already at the maximum track.

% **O** *Step out one track.* Each time you type 'O', 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.)

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 CP/M.

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.)