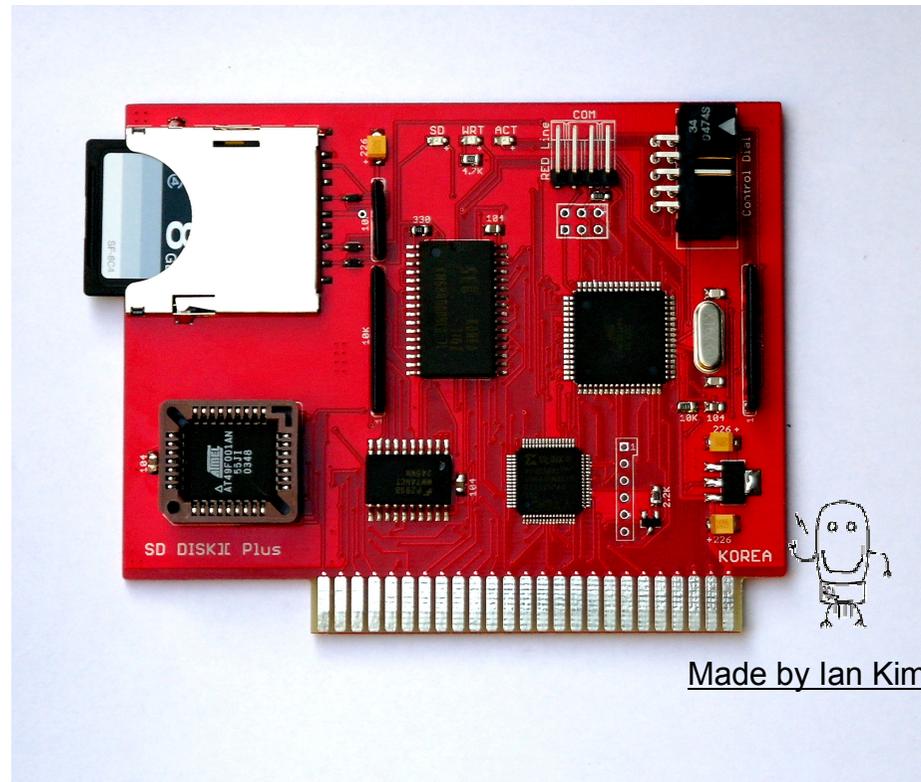


SD DISKIC Plus



Made by Ian Kim

Introduction

- SD DISK] Emulator is a slot type virtual DISK Emulator for APPLE][,][+, //e and IIgs
- It emulates two FDD or two Hard Drives with unlimited image file replacement included HDD image too.
- It doesn't require any physical Floppy drive/controller even diskette. Just need SD memory card with proper disk Image. Then it will work as you have two Floppy Disk Drives or two Hard Disk Drives.
- The SD DISK] Emulator has an external dial controller for image selection and console by USB serial connection.
- Enjoy with your APPLE][as your younger time.

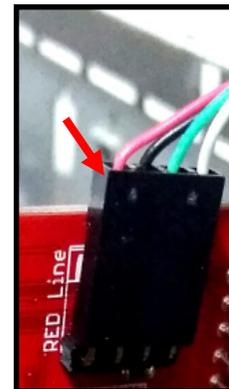
General Functions

- It emulates two FDD or It emulates two HDD.
- Supported image
 - **NIB, DSK** on FDD Mode and **HDV,2MG** on HDD mode.
- Easy to handle images by external dial controller.
- All disk images can be replaceable while ON APPLE2 by terminal and LCD dial.
- Up to 39 tracks supported (FDD mode).
- Total 512KB Read/Write-back cache integrated to keep SD card life longer. (Each drive reserved to 256KB)
- Easy firmware updates by user.

Connect cables



1. Please connect LCD&Dial controller cable
2. USB serial dongle it optional, if you need to change configuration, or want to use terminal for complex commands you need it. Be careful the **RED** wire should go left most.



**** SD DISK [I] Plus can work without cable.**

For easy image file handling, You need to connect the LCD Dial controller or USB Serial dongle.

How to Start with your APPLE][

1. Unplug of your APPLE2 and Monitor before to open APPLE][.
(Someone asked me he did OFF the APPLE][but, why it still need to unplug power cord, my answer is even if power OFF, but internally there is slight connected and it may have make high voltage leak current. please remove power cord)
2. Please connect cable on the SD DISK][plus (Make sure proper direction must not reversal)
3. Insert the SD DISK][plus card into the APPLE][slot (Recommended slot#6)
4. Power ON the APPLE2
 - 1) You can see busy LED ON.
 - 2) Maybe it will run by booting image file.

Good! If you see some program running.. You can continue.. But, if not, there is some mistake. Please clean card edge with cotton bud and/or try it on another slot#.

To use

- If you see your APPLE][is working with SD DISK][Plus, You need to learn how to change image file and navigate directory to get the image file to put into SD DISK][.
- When SD DISK][is get the file, it will work as the DISK inserted.
- Also HDD mode would be helpful for your joy.
- Please keep read this manual.

External Dial Controller

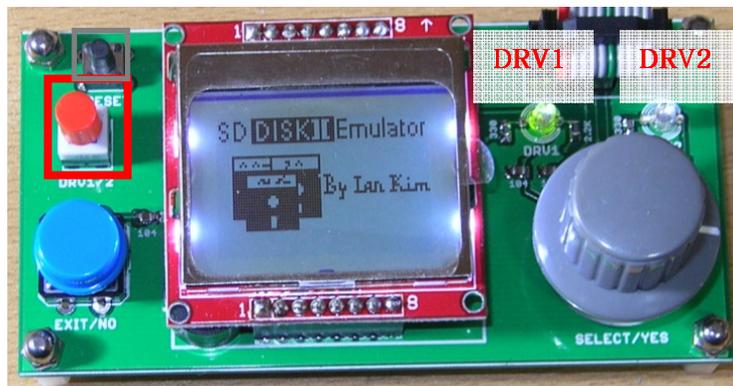
There are three buttons and one dial.

it assigned as **Exit**, **Reset** and **DRV1/2** selection.

You can control SD DISKII[Emulator with those buttons and dial combinations.

You can use it for below functions,.

1. Select(load) image files
2. Navigate directories
3. DRV1/DRV2 drive select
4. Create blank FDD image
5. Select Emulation mode (FDD and HDD)



- DRV Green LED indicates the location of DRV1/2 push switch.
- If Drive is Busy, RED light also will ON the location.

How to Change LCD Contrast

Push **EXIT/NO** (keep press) and turn Dial and then LCD screen will be changed contrast when it done, simply release the Exit/No.

It may interfere function so, please do it when SD DISKII is not busy.

Buttons and LEDs

Reset
Reset the SD DISK[plus

DRV1/2

it is to set the position of DRV1/HDD1
or DRV2 of FDD/HDD2
it makes on **GREEN LED** over the
dial so you can know what FDD
will controlled for load.

RED Color will **ON** when Drive access.

H1(FDD1) **H2(FDD2)**



EXIT

You can use it to exit current directory or
some negative answer as **NO**

Change Emulation mode

(Long push)

FDD<>HDD

DIAL

You can turn it but also can push.

Turning is select some case and Push
means mostly positive answer as
YES

Select image file and change directory

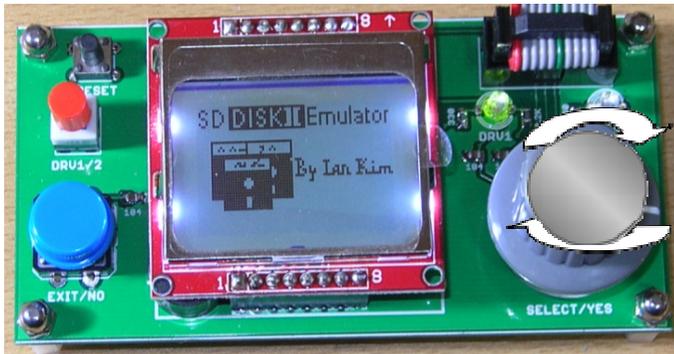


👉 If you can't see any file or directory, Try to push the **EXIT button, it will update internally the list of file.**

**If turn the dial, you can see present directory or image files on the LCD screen and terminal screen(if connected).
To select the file for loading just push button. SD Emulator will load a file or go into the directory.**

***Tip; if selected a file on root directory(1st level) and next directory(2nd level), It will be a next power on booting disk.**

Navigate directory

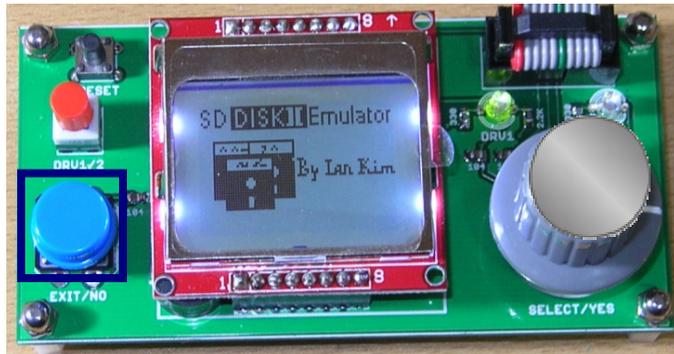


If turn the dial, you can see image file or another directory on the LCD screen, To select the directory, press Dial over the directory name.



To exit current directory
Press **Dial** on '1..' location or
press '**EXIT**' button. every exit, will go upper
directory to head the root directory.

Make blank image file for DOS3.3



Some case, user need to have new image file to save personal file or make another copy image from COPY utility.

In this case, you can create Blank image disk.

To make blank image

- 1) Push Dial (OK) then
- 2) Push EXIT button simultaneously. (Pushing order is important)
- 3) Select (Turn) new name of disk image.

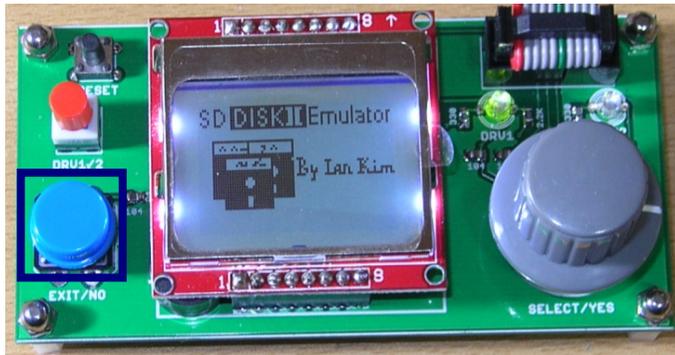
```
New DISK#  
NEWDSK22.NIB
```

(TO cancel it, Press 'EXIT')

- 4) Press Dial to accept.

It will make DOS3.3 formatted blank disk. so, you can user after load it without format. but, it doesn't contained DOS so, can't use for booting. To make it boot, you can easily copy DOS on COPY][PLUS utility.

Mode change HDD<-> FDD



- SD DISKII Plus support two type of emulation one is 32MB 2 HDD the other is 2 FDD mode. If you want switch to another mode, you need to simply press EXIT button for 2 seconds. and you need to reboot to use image file for new mode.

Please Press **EXIT** button for two seconds.
Then you will have this message

HDD mode(Y/N)?

Or

FDD mode(Y/N)?

Push dial is 'YES' exit button is 'No'

* Refer the **MODE** command

Serial connection recovery



- Some of cases, Serial baud rates may have problem. You may see only [] [] such as this.. in this case, You have to recover it as under.
- Power OFF you APPLE II and Press **EXIT** button while the **Power ON** APPLE II then It will start to recovery serial connection. you can see proper text if recovered.
- If it doesn't work properly, please contact me.

Firmware updates



SD Smart Drive can be updated with proper firmware file. When I added new function or need to patch, I will announce newer firmware version on <http://www.apple2.net> please check the web of the SD Smart drive category.

If you don't have inconveniences on current version, you can skip some of versions
However, updating firmware job should do carefully.
Read the warning before to perform it.

WARNING

Your APPLE2 must not lose **electric power** while firmware updating.
If this were happen, the firmware couldn't completed and may fail to to restart even firmware updating may fail.
In this case, You need to send it back to me for re-building codes.
(Free of charge to fix this issue but, shipping costs will be your responsibility).

If you are ready to update, please read it first and follow this instruction.

- 1) Power **OFF** the APPLE2.
- 2) Remove the SD Memory card (Present working SD Memory card should work fine)
- 3) Copy the new firmware file(**SDSmart.ROM**) to root directory in SD Memory card.
- 4) Return the SD memory card to SD Smart Drive.
- 5) Push **Dial button(SELECT/YES) +EXIT button** simultaneously, then power **ON** the APPLE2 now.
- 6) Then release a few seconds later. You may see on LCD as 'system check.....'
- 6) A while later, SD Smart Drive will restart
- 7) Reboot your APPLE2 and check if the version is properly updated.
- 8) Done. Now, Enjoy with new version of firmware.

LCD Contrast adjust



If screen got too light or too dark, It need to adjust the contrast.
To adjust the LCD contrast.

Prees **EXIT** and Turn your **Dial**
You can adjust contrast then release the EXIT button.

** Some of LCD has can't change contrast, just blinking.. It isn't wrong, the LCD has optimized fixed contrast.

USB Serial dongle



It is using for terminal software.

User can do with terminal commands such as file selection or control the board. There are lots of commands , load file, delete file, change directory and etc..

```
[>-----<]
[> SD DISK][ EMULATOR V2.46 <]
[>                by SDKim <]
[>-----<]
MODE: [FDD DOS3.3]
-----
02 13-08-29 <DIR> CPM
03 13-09-03 <DIR> APPLE2
04 13-08-29 <DIR> TEST
05 13-08-29 <DIR> TREE1
06 13-08-26 <DIR> HDD
07 13-09-03 <DIR> BUSINESS
08 13-08-28 <DIR> BACKUP
09 13-08-15 <DIR> APPS
10 13-08-15 <DIR> GAME1
11 13-08-12 <DIR> GAME2
12 13-08-14 232960 *DOS33.NIB
13 01-01-01 232960 NEWDISK2.NIB
-----
D1:
D2:
-----
1 ..
```

Terminal

Speed; 115200bps , Stop bit: 1 , Data bit; 8 , Parity;
None , No flow control

Terminal

```
=====
HELP for terminal commands V2.590
-----
DIR[=W](=CAT) [*.*];Dir files(Default NIB/DSK/HDV/2MG)
HOME(=CLS); Clear to screen
CD(=PREFIX) [DIR];Change directory
RD [DIR];Remove directory
MD [DIR];Make directory
DEL(=DELETE) [filename.ext];Delete file
LOAD [filename.ext],[D1/D2];Load file
UNLOAD(=EJECT) [A11/D1/D2];Unload Disk
MODE [FDD/HDD];Set mode for FDD/HDD
REN [oldfile.ext],[newfile.ext];Rename file
NEWDISK [filename.[DSK/NIB]];Make formatted image file
COPY [file#1.ext],[file#2.ext];Copy file
CONVDSK [filename1.dsk],[filename2.nib];Convert DSK to NIB
LOCK [filename.ext];Lock file
UNLOCK [filename.ext];Unlock file
STAT[=STATUS] ;Driver status
SAVE [D1/D2],[filename.ext];Buffer to file
RESET; Restart SD DISK][ Emulator
RAMTEST; Buffer ram test
BLUESSET,[DEVName],[Pin#]; Bluetooth setup
ECHO [ON/OFF]; Terminal echo ON/OFF
FIRMWAREUP; Firmware Update with SDBIOS.ROM file
SETROTARY [0/1] Set rotary configuraion (CW/CCW)
RX(=UP) [filename.ext]; Xmodem128+CHK Receive file
TX(=DN) [filename.ext]; Xmodem128+CHK Send file
SETBAUD [115200/57600/38400/19200/9600]; Set BAUD
MENU [ON/OFF]; Boot menu ON/OFF
POWER ON+EXIT; LCD & Bluetooth baud rate recovery
POWER ON+EXIT+SELECT; Firmware updates with SDBIOS.ROM
도움; Korean help message
Thanks for purchasing the SD DISK][ Emulator
Need more Help? please mail to quick09@gmail.com
=====
```

- If you need commands help, ‘?’ and enter key
- For user conveniences, There are lots of commands and similar with APPLE][commands such as CAT, PREFIX etc..
- Terminal command may added or removed by version.
- Please check with ? Command then you can see all of commands.

Terminal commands

DIR(=CAT); Show present directory and files and but usable mode files only such as *.NIB or DSK and directory names. It also accept limited '*' for file selection.

HOME(=CLS); Clear screen. your terminal should emulate VT100 to do it.

CD(=PREFIX); Change directory. **CD..** is upper directory.

RD; Remove directory, should not have any file in the directory.

MD; Make directory

DEL(=DELETE); Delete file. Need full file name include file extension.

LOAD; Load image file. Need full file name include file extension default drive is D1 if you want Drive 2, add D2

UNLOAD(=EJECT); unload image and clear the file buffer,

MODE; change emulation mode ex) MODE FDD

REN; Rename file name (Need full file name)

NEWDISK; Create new image, it will create a NIB or DSK formatted image.

COPY; Copy a image NIB file but slow. Load and save command is recommended to do same function.

CONVDSK; Convert DSK file to NIB format and but use 2nd DISK buffer so, 2 drive will lost

LOCK; Lock the image file it will make image file Read only. It stop to be updated from that time. Hard disk image must not lock.

UNLCOK; Unlock image file. make image file to be updated.

STAT(=STATUS); Show SD DISK][status.

SAVE; Save buffer memory to file. You can save many time buffers to disk image.

RESET; Reset SD DISK][Emulator. It acts same as pressing reset button on dial controller.

RAMTEST; Testing buffer RAM.

Terminal commands

- **RX(=UP);** You can send a file to SD DISK][Emulator(XMOEM128 checksum protocol)
- **TX(=DN);** You can receive a file to your PC (XMODEM128 Checksum protocol)
- **115200baud** rates may have difficulty to Send a file, I recommended to reduce speed to 57200bps, to change speed, Please refer SETBAUD command.
- **ECHO;** Command echo on/off for Terminal.
- **SETBAUD:** You can change serial port speed, to do it, you have to little care, Bluetooth connection should be disconnected condition and should be blinking LED condition.
- **MENU;** You can ON/OFF the Power-ON Boot menu. If ON, you can see File selection menu on the APPLE II.

*Some command may change or added as followed version of firmware.

File Transfer

- File transfer function was designed to send a file or receive file without open your APPLE][. But, It could make bother you if you Just need a few files for copying.
- Hence, I prepared very useful commands, You can get a file or copy file on the terminal.
- SD DISK][Emulator support XMODEM file transfer protocol, XMODEM is old time protocol, Who may know it these days? Anyway, With the commands, you can get a file or copy a file of the SD memory card without open the APPLE II case of course you need terminal connection with dongle.

If you need very often add or delete file,
please consider to use **WIFI SD memory card**, you
can manage file with WIFI connection.

RX; Receive a file

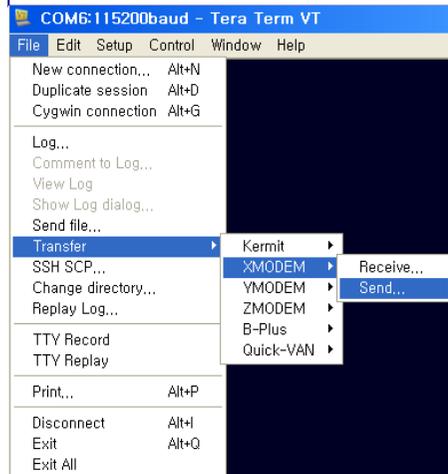
This function provided for file transfer due to someone don't want to open APPLE][frequently as me.. 😊

Please do it with **Teraterm** software.

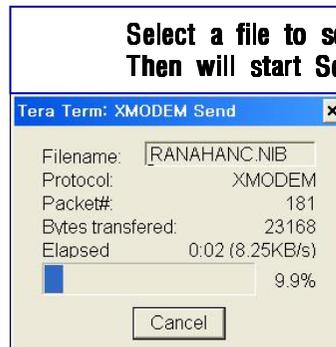
```
dir
-----
Volume ID SD_TEST
01 #
02 15-09-04 <DIR> DCIM
03 14-04-12 259584 *CPS.NIB
04 14-11-19 259584 *FDDTST.NIB
05 14-02-13 232960 TETRIS.NIB
-----
D1: *FDDTST.NIB
D2:
rx test.nib
```

Refer the command
SD Memory card will receive a file and save as 'test.nib' on the SD memory card.
(Becareful, It doesn't use your sending file name)

On the Teraterm, go to 'XMODEM Send..'



Select a file to send.
Then will start Send



After completed, You can see the new file.
(Anyway date isn't true)

```
dir
-----
Volume ID SD_TEST
01 #
02 15-09-04 <DIR> DCIM
03 14-04-12 259584 *CPS.NIB
04 14-11-19 259584 *FDDTST.NIB
05 14-02-13 232960 TETRIS.NIB
06 14-11-19 232960 TEST.NIB
-----
D1: *FDDTST.NIB
D2:
```

TX; Send a file to PC

```
dir
-----
Volume ID SD_TEST
01 #
02 15-09-04 <DIR> DCIM
03 14-04-12 259584 *CPS.NIB
04 14-11-19 259584 *FDDTST.NIB
05 14-02-13 232960 TETRIS.NIB
06 14-11-19 232960 TEST.NIB
-----
D1: *FDDTST.NIB
D2:
tx cps.nib
Starting Xmodem128-Chksum
Sending file:CPS.NIB
Ctrl-D:Abort
```

If you want send a file to your PC such as updated image file or create image from the real DISKETTE, you may need to send a file to PC.

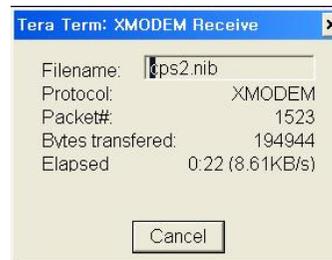
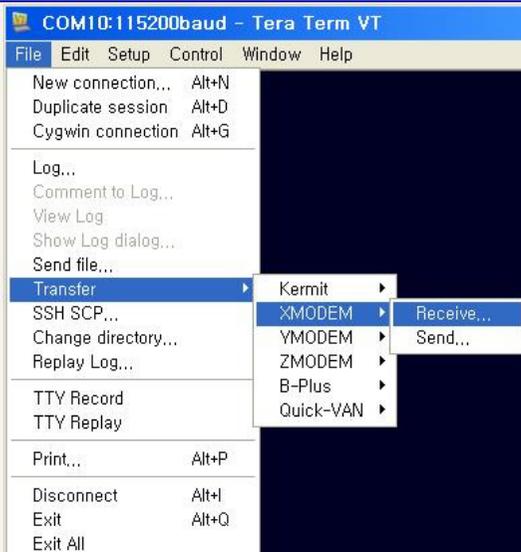
Use the TX command.

On the example, you will receive **cps.nib** file from APPLE][
'tx cps.nib' it means that you will send 'cps.nib' file to your PC

```
dir
-----
Volume ID SD_TEST
01 #
02 15-09-04 <DIR> DCIM
03 14-04-12 259584 *CPS.NIB
04 14-11-19 259584 *FDDTST.NIB
05 14-02-13 232960 TETRIS.NIB
06 14-11-19 232960 TEST.NIB
-----
D1: *FDDTST.NIB
D2:
tx cps.nib
Starting Xmodem128-Chksum
Sending file:CPS.NIB
Ctrl-D:Abort
```

Make your own **name of file**.
then it will start to send data.

On the TeraTerm, go to 'XMODEM Receive..'



When it finished, you
can see 'End of TX'

```
dir
-----
Volume ID SD_TEST
01 #
02 15-09-04 <DIR> DCIM
03 14-04-12 259584 *CPS.NIB
04 14-11-19 259584 *FDDTST.NIB
05 14-02-13 232960 TETRIS.NIB
06 14-11-19 232960 TEST.NIB
-----
D1: *FDDTST.NIB
D2:
tx cps.nib
Starting Xmodem128-Chksum
Sending file:CPS.NIB
Ctrl-D:Abort
End of TX
```

Power ON Boot menu

First, You need to **MENU ON** by terminal command.

When you Power ON your APPLE II, You can see simple menu as the picture.

You can select image file on the APPLE II screen.

It is very simple one.



You can select a file to load.

It can be a FDD image file or HDD image file.

It will load only D1 or H1 for booting.

It doesn't support scroll back yet.

Commands

Number(HEX) ; File directory select

0 ; Go to upper directory.

ESC ;Exit this menu

If you press **EXIT** button on **LCD&Dial controller**,

It will stop this menu.

This menu will start only when your **POWER ON**.

Working message and Indicators

+D2 TR#02 B Ready

+ ; Moving head, D# driver number, TR# track number.

*D2 TR#04

*; Virtual writing on D2(Buffer only not loaded disk image)

>>D2 TR#08

>>; Updating buffer to Disk Image file.

√D2: NonameD2.nib

√Done update.

D1 R#0001

Status message example on HDD mode

Drive number, Read Block#.

RED; SD memory card is BUSY

 must not remove memory Card while this **LED ON**
SD Memory card may damaged or lost data if removed

Blue; DISK Writing

ORANGE; Drive **BUSY**

How to update firmware

SD DISK][Emulator can be updated by **SDBIOS.ROM** file.
When I added new function or need to patch, I distribute newer firmware.
However updating firmware job need to care to be done properly.
Read this warning before you do it.

WARNING

Your APPLE2 must **not lose** electric power while the firmware updating.
SD Disk][may fail to restart, or you won't be able to update firmware anymore.
In this case, please return the board to me for re-programming. (Free of charge to fix this issue but shipping costs it not included)

If you are ready to upgrade, please read carefully.

- 1) Power **OFF** the APPLE2 and open the cover.
- 2) Remove the SD Memory card only, leaving the Disk][board in the computer.
(Present working SD Memory card should work fine)
- 3) Copy proper version of firmware file for your **SD DISK][Plus** card.
Copy **SDBIOS.ROM** to **ROOT** directory.
- 4) Re-insert this SD memory card to SD DISK][Emulator board
- 5) Push **Dial button (YES)** + **Exit button** simultaneously, then power **ON** your APPLE][.
- 6) You should see as '**system check.....**'(if set **115200baud**) on the terminal screen or LCD.
- 6) A while later, SD DISK][Emulator will start.
- 7) Please **Power OFF and Power ON** your APPLE2 again and check if the version is properly renewed.
- 8) Done.

Recover serial baud rates

SD DISK][Emulator provide several BAUD rates for DIYers.

Some of users are using by their own terminal device so, you can change the Baud rates.

But, if you lost the speed, you can easily return the default speed. 115200baud.

Also LCD dial have to follow the Baud rate be able to see properly.

Due to some reason, LCD dial may lose the baud rates and then show strange letters on the Screen.

If happened, Don't panic, just try this recover process.

To perform it.

Press [Reset on dial + Exit button](#) together then release both.

SD DISK][emulator will start to recover the serial connection,

You can hear some of beep sound while recovering.

After finished it. It will back to 115200 bps.

If you can't recover it, Please try again.

If you still have problem, please contact me by email. It may damaged.

Tips and information

- SD DISK][plus tested on APPLE][Plus, APPLE][e and APPLE][GS.
- SD DISK][plus support Read/Write and format on the FDD image, if format DISK image, it may not (not always) usable on APPLE2 software emulator. If you want to sure to run on APPLE2 software emulator too, you should copy NIB file from Software emulator. This issue is due to the differences between actual DISK format with virtual DISK format. SD DISK][plus will create true DISK Images.
- DSK extension image file is not write supported. In fact, SD DISK][Plus internally converts DSK to NIB data format and doesn't update back to DSK image file. So, if you want to have updated image file, you need to use NIB image file. To convert you can use the cider press Anyway, there is a command as CONVDISK. Anyway, if you save buffer to image file, it will save NIB format.
- Read Only(**LOCK**ed) image file can be write even works DISK **format**, but it doesn't update to actual image file. It it only working on buffer. So, you can use some special purpose such as saving at that time present game or for crack or testing purpose.
Be careful, it doesn't work on HDD image. Hard disk image should not locked always must writable.
- When you use **lock** command on loaded image file, from that time, SD DISK][Plus stop to update and ignore any changes. It only works only buffer side. When you set **unlock**, from that time SD DISK][Plus can write the image file so you can have updated image file. You can lock your disk file at any time.
- To transfer from Actual **DISKETTE** to **SD memory** card, Simply use the **COPY II PLUS** to copy actual DISK to SD DISK][Plus then You can have copyed image file. Vice versa you can copy image file to actual disk. No more need to use serial transferring with time consume.
- Please don't try use control dial while the emulator **BUSY LED ON**, You may have data error. DISK emulation is timing sensitive.
- SD DISK][Plus support **hot swap** SD memory card. So you can change SD Memory card. After replace to another SD memory card, just press reset button once or run reset command. This hot-swap should do when SD DISK][Emulator is not busy.
- SD DISK][Plus have **512KB R/W cache**, Due to cache function, it needs some of seconds to complete the **write** operation, So, don't off while on **BUSY LED**. In general, it required some seconds not more than 10 seconds to be completed image file. just wait until the **BUSY LED OFF** then 3 seconds later you can power OFF. If not, you may lose your written data especially critical on HDD image.

Tips and information

SD DISK][Plus support virtual FDD blank writing, even if you don't load any DISK image on drive even though it acts as you inserted one of bulk disk. If you write some location you can have new named file. disk name will be named as NODSK1?.NIB(if Drive1) or NODSK2?.NIB(if Drive2). if you know the APPLE2 DISK structure, you can use this track saved data file.

- SD DISK][Plus recommended to insert into the slot #6. other slot also work but, many of softwares looking for disk on the **Slot#6**.
- SD DISK][Plus using **8.3 short file name**. long file name will show ~ postfix.
- Please make **label name** on SD Memory card. SD DISK][is using to detect root directory and power on booting.
- New **Firmware** will be announced at <http://www.apple2.net> and check SD DISK][category.
- SD DISK][Plus supported some of copy protected images.
- Recommended and tested DISK COPY programs are
 - Copy II Plus 5.1; RW Format OK
 - Copy II Plus 6.0; RW Format OK
 - Copy II Plus 7.4; RW Format OK
- SD Memory lock switch is ignored so, SD memory card is always writable.
- While running HDD emulation, Your DRV1 and DRV2 image files should be in same directory if not may failed to access.
- ** SD DISK][Plus is very similar to SD DISK][Emulator and share most of routine of firmware. Please refer the SD DISK][Emulator manual for some useful information.

Tips and information

- Use NIB file for FDD emulation if you want to write/update image file.
 - DSK file only work virtual write, (Write function is working but not updated to **DSK** file). Someday I will make it possible.
- 800K image file
 - SD DISK][plus support *.2MG and 800K file.
 - If no header exist, the 800K file can renamed to HDV and it may work.
- 2MG image files
 - It works but little slower than HDV image. Most of cases, you can remove 64bytes header data and can renamed it to HDV then will work faster than 2MG format.
 - You can't load it on FDD mode, SD DISK][plus handling it under HDD mode.
- Laser128
 - SD DISK][Plus tested on the Laser128 but you have to consider the actual slot#.
- Can work without external controller or serial dongle
 - Serial dongle is for command access way to control the SD DISK][plus.
 - External LCD dial is easy image file selector for FDD and HDD emulation.
 - If you just want to use as a HDD without external controller, you can remove it but your booting disk would be the latest selected one.

Some of PRODOS Commands

- CATALOG or CAT(PRODOS); Show Directory and files.
- LOAD {file name}; Load BASIC program.
- BLOAD {file name}; Load Binary file
- PREFIX {Directory} ; Change directory
- RUN {file name}; Run BASIC program file
- BRUN {file name}; Run Binary file
- PR#6; Boot from slot #6 (DRIVE-A only), Mostly 5.25" FDD connected on this slot.

Error messages

SD DISK][Plus may show some error or warning. Please refer below.

SD Memory card related error

SD media detection error; ERR#233

Some memory card may not work with SD DISK][Emulator. not all memory cards tested.
Try to use another memory card or try to format the memory card on your PC.

Error while on RAMTEST

Buffer ram error ; ERR counted #

While you testing RAMTEST. If error counted as above, internal memory may get fault.
You have to try it again. This RAMTEST command must run when SD Emulator and APPLE2 are not busy. All indicators LED must be off status.

Other error of PRODOS HDD mode

Command SPIN error

PRODOS protocol error. You need to change another HDD image file.
If continue the error, please try cleaning of the golden edge connector. Use a cotton bud and apply some of alcohol and clean it. Then insert in the APPLE2 slot.

Any Other malfunction?

still doing strange behavior? It may have some error on the board anyway you can press to reset button to restart SD DISK][plus and test RAM first. If you have any difficulties, please send email quick09@gmail.com I will help you.

WARRANTY

Warranty periods are 180 days.

If failed within the period, I will repair or replace to another one.

Out of warranty case it may charged the actual repair costs.

(But don't worry, I will repair the board even if 10years when I alive)

If you need any help please contact me. Quick09@gmail.com

If anything of hardware change, disassemble, Reverse engineering, It would expire any warranty.

Any of document, comments, hardware components may change for better performance without notice.

Thank you very much!

