Yellowstone Universal Disk Drive Controller Card for Apple II
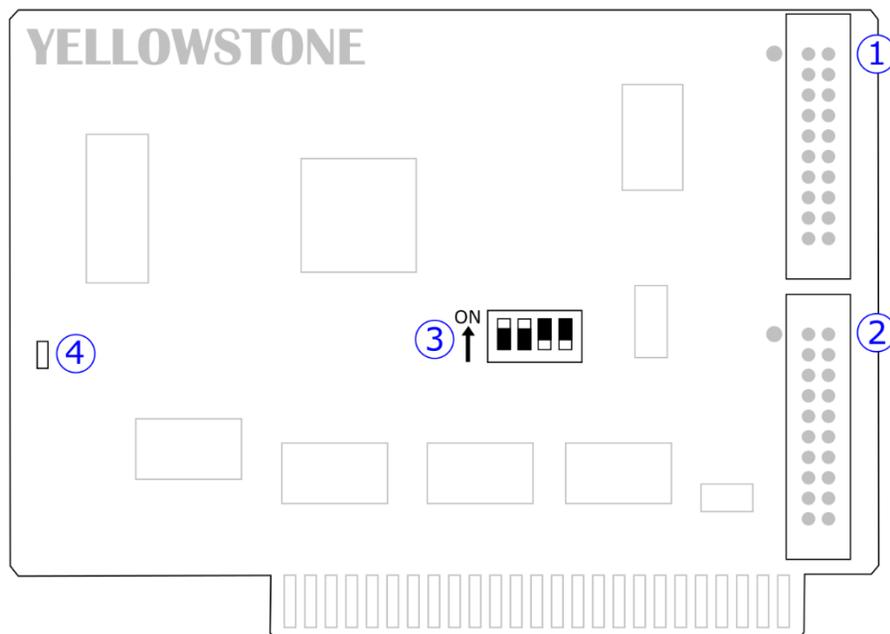
Designed by Big Mess o' Wires

Instructions revised May 2, 2022

OVERVIEW

Yellowstone is a universal disk controller for your Apple II computer, combining the power of a 3.5 inch disk controller, intelligent Smartport disk controller, and standard 5.25 inch disk controller into one slot.
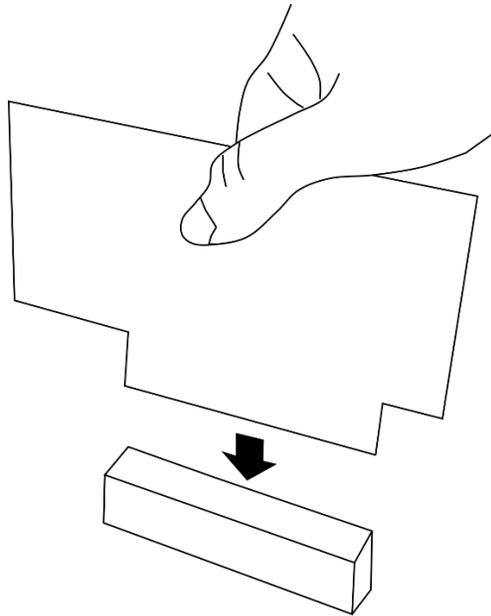
- Supports most Apple II and Macintosh disk drives, including 3.5 inch floppy, 5.25 inch floppy, Unidisk 3.5, and Smartport hard drives
- Compatible with Apple II+, Apple IIe, and Apple IIgs
- Works with DOS 3.3, ProDOS, and GS/OS
- Disk II compatibility mode for tricky copy-protected disks
- User-upgradeable firmware for future feature enhancements
- Works in any slot
- Maximum of 2 standard disk drives, or up to 5 drives when mixing smart and standard drives
- 20-pin ribbon cable connectors or optional 19-pin D-SUB

1 primary disk drive connector J1
2 secondary disk drive connector J2
3 configuration DIP switches (for normal use set switches 1 and 2 ON, 3 and 4 OFF)
4 drive status LED indicator

Apple II computers have seven numbered slots for peripheral cards. Yellowstone will work in any slot 1 through 7. Slots 5, 6, and 7 are most commonly used. If you're replacing your existing disk controller, it's recommended to install Yellowstone in slot 6. Some older games and other software are written with the assumption that the disk controller is in slot 6, and won't work correctly otherwise.

Most Apple II computers will automatically search for a disk controller and a boot disk when the power is turned on. The computer checks slot 7 first, then slot 6, continuing down to lower numbered slots until it finds a boot disk or reaches slot 1. This means that if more than one disk controller is present, the controller in the highest numbered slot will have priority when booting. If Yellowstone is installed in the highest numbered slot, then it will be checked first, and it will try to boot from the drives plugged into it. If there are no bootable disks in the drives, the computer will move to the next lower slot. Therefore, you can boot from another disk controller by simply removing all disks from the drives plugged into Yellowstone.

Some older Apple II computer models may not recognize Yellowstone as a disk controller, or may not automatically search for a disk controller. This means Yellowstone will not automatically boot at power-up, but you can still access it like a standard disk controller from DOS 3.3 or ProDOS. For example, to boot a disk from BASIC type: PR#n where n is Yellowstone's slot number.

2.1 — Apple IIgs Slot Configuration

If Yellowstone is installed in an Apple IIgs, then that slot must be set to "Your Card" in the IIgs control panel. To access the control panel press Control-OpenApple-Escape and use the arrow keys to select Control Panel from the menu. Then navigate to the menu entry for Slots, and change the entry for Yellowstone's slot number to "Your Card". Press the Return key to save this setting.

3.0 — Drive Compatibility

Yellowstone is compatible with these disk drives and drive emulators:

Can be connected directly	
Disk II A2M0003	Naked Apple 3.5" 800K, black label
Naked half-height Apple 5.25"	Naked Apple 3.5" 800K, red label [2]
Floppy Emu 5.25 mode	Naked Apple 3.5" 1.44MB, auto-inject [2]
Floppy Emu Model C dual 5.25 mode	Naked Apple 3.5" 1.44MB, manual-inject [2]
Floppy Emu 3.5 mode	wDrive
Floppy Emu Unidisk 3.5 mode [1]	
Floppy Emu Smartport hard disk mode [1]	
	And more…
Requires optional DB-19F connector	
Unidisk 5.25 A9M0104	Macintosh 800K External M0131
Disk IIc A2M4050	Apple SuperDrive (Apple FDHD Drive) G7287
Duo Disk 5.25 A9M0108	Unidisk 3.5 A2M2053 [1]
AppleDisk 5.25 A9M0107	Applied Engineering 3.5 [3]
Laser FD100 5.25	
Apple 3.5 Drive A9M0106	
	And more…

1 smart drive   **3** partial compatibility
2 requires Yellowstone's -12V turned off

A naked drive is a bare drive mechanism without any enclosure, such as an internal drive taken from a Macintosh, Apple IIc, or Apple IIc+.

Most 3.5 inch Macintosh drives can be used as Apple II drives with Yellowstone.

3.5 inch disks should be 800K type. 1.44 MB disks, 400K disks, and 400K drives are not supported.

3.1 — Drive Configurations

These combinations of disk drive types are possible when using Yellowstone.

J1	J2
5.25"	-
3.5"	-
Dual 5.25"	-
5.25" ↵ 5.25"	-
3.5" ↵ 3.5"	-
Smart (↵ Smart ↵ Smart ↵ Smart)	-
Smart (↵ Smart ↵ Smart ↵ Smart) ↵ 5.25" *	-
5.25"	5.25"
5.25"	3.5"
5.25"	Smart (↵ Smart ↵ Smart ↵ Smart)
3.5"	5.25"
3.5"	3.5"
3.5"	Smart (↵ Smart ↵ Smart ↵ Smart)
Smart (↵ Smart ↵ Smart ↵ Smart)	5.25"
Smart (↵ Smart ↵ Smart ↵ Smart)	3.5"

A ↵ B   B daisy-chained (plugged into) A
*   The 5.25 inch drive will behave as Drive 1
Dual 5.25   Apple DuoDisk, or Floppy Emu's dual 5.25 emulation mode (requires Emu Model C)
Smart   Apple Unidisk 3.5, or Floppy Emu's Smartport Hard Disk or Unidisk 3.5 emulation modes. Up to 4 smart drives may be connected together in a daisy chain.

3.2 — Types of Drive Connectors, DB-19 and Ribbon Cable

Yellowstone includes two independent rectangular ribbon cable drive connectors, J1 (upper) and J2 (lower). The first drive must be connected to J1. The connection of a second drive to J2 is optional. Except where noted below, all drives should be plugged in to the Yellowstone board, not to the "daisy-chain" connector of another drive.

Drives that use a rectangular ribbon cable can be plugged in directly to J1 and J2. Examples of such drives include the BMOW Floppy Emu, the Disk II, and naked 3.5 inch drives removed from a Macintosh computer.

When connecting a Disk II drive, be very careful to orient the cable correctly. Disk II cables don't have a polarity tab to guarantee correct orientation. The red stripe on the cable should be at the top, near the white dot on the Yellowstone board.

Drives that use a D-shaped 19-pin DB-19 connector can be plugged in to Yellowstone with the aid of a DB-19 female adapter cable, an optional item available from BMOW. Examples of such drives include the DuoDisk, AppleDisk 5.25, and Apple 3.5 Drive.

The optional DB-19 female adapter has a unique design that's specifically for use with Yellowstone. Do not use this adapter with any other equipment, or substitute other adapters.

3.3 — Smart Drives, Standard Drives, and Daisy Chains

Yellowstone supports two general types of disk drives:

- Standard 3.5 inch and 5.25 inch floppy drives, like the Disk II or Apple 3.5 Drive (A9M0106)
- Smart drives, like the Apple Unidisk 3.5 (A2M2053), or the BMOW Floppy Emu's Smartport Hard Disk emulation mode

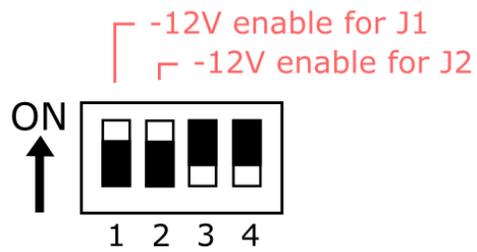See the drive table above for a list of standard and smart drives.

Smart drives may be present at Yellowstone connectors J1 or J2, but not both.

Pairs of standard drives may be daisy-chained together when the two drives are the same type: two standard 5.25 inch drives or two standard 3.5 inch drives. Daisy chains of mixed-type drives are not supported. Smart drives may be daisy-chained together, with up to four smart drives in a chain.

When daisy-chaining drives, the first drive of the chain should be connected directly to Yellowstone, and the second drive connected to the first. A daisy chain of four smart drives combined with a standard drive attached to a different connector will enable up to 5 total drives to be used with Yellowstone at the same time.

3.4 — Naked 3.5 Inch Drives and -12V

Some naked 3.5 inch drives require Yellowstone's -12V power supply to be turned OFF. These drives are indicated in the drive table above. To turn off -12V for the drive connected to J1, set DIP switch 1 to the OFF position. To turn off -12V for the drive connected to J2, set DIP switch 2 to the OFF position.

For 5.25 inch drives, and 3.5 inch drives in an external enclosure rather than naked, set the -12V DIP switch to the ON position.

The drive connected to J1 will be the computer's Drive 1, and will be the first drive that Yellowstone checks for a disk during power-up. If no boot disk is found in Drive 1, then Yellowstone will normally check Drive 2 for a boot disk. If Disk II Mode is enabled (see section 5), then only Drive 1 is checked for a boot disk.

Some Apple II software programs are written with the assumption that the boot disk is in Drive 1, and won't boot correctly from Drive 2. Examples include DOS 3.3 System Master, GS/OS, and some games. Software written with this assumption must be booted from Drive 1.

The computer's Drive 2 will normally be the drive connected to J2, but not always. When using a DuoDisk or Floppy Emu Dual 5.25 emulation mode, or a daisy chain of drives, then Drive 2 may be indirectly connected to J1 instead.

The LED indicator on the Yellowstone board gives feedback about the disk drive status:

- Steady On: normal idle
- Fast Blinking (4 blinks per second): drive activity
- Slow Blinking (1 blink per second): drive collision error

A drive collision error happens when two different drives attempt to talk at the same time. When this condition is detected, all drives are then disabled to avoid the risk of disk corruption. Drive collision errors may be caused by an unsupported drive configuration.

4.1 — Apple II+ and Unenhanced Apple IIe Boot Behavior

The power-up behavior of the Apple II+ and unenhanced Apple IIe is different than the Apple IIe Enhanced and Apple IIgs. These older Apple II models will not automatically recognize and attempt to boot from Yellowstone in its normal configuration. To boot a Yellowstone-attached disk from these models, type PR#n from a BASIC prompt, where n is Yellowstone's slot number, or enable Disk II Mode (see section 5).

4.2 — Slot and Drive Numbers

Each disk drive in an Apple II computer system will have a unique slot and drive number. Yellowstone Drive 1 will appear in DOS 3.3 and ProDOS as SnD1 where n is Yellowstone's slot number, and Drive 2 will appear as SnD2. If using a daisy chain of smart drives and more than two total drives are connected to Yellowstone, then ProDOS and GS/OS will automatically assign virtual slot numbers to the additional drives. The virtual slot assignments will depend on the primary slot number and what other disk controllers are present. After SnD1 and SnD2, the next three drives are typically assigned to S4D1, S4D2, and S1D1.

When necessary, Yellowstone can enable *Disk II Mode*, where it behaves exactly like a standard vanilla 5.25 inch disk controller card, and other types of drives will be ignored. This can be helpful for the small number of 5.25 inch disk programs that won't boot correctly when using Yellowstone's normal mode, due to incompatible copy-protection schemes or low-level assumptions about the disk-controller hardware.

Most programs that require Disk II mode are games, but some Pascal and CP/M software requires a vanilla 5.25 inch disk controller, as well as the utility programs Anti-M and Copy II+. If you are booting from a 5.25 inch disk, and the computer crashes immediately after starting to boot, try enabling Disk II Mode.

There are four different ways to enable Disk II Mode. Choose any method that's convenient:

1. Hold Control-D while turning on the computer
2. Restart the computer by pressing Control-OpenApple-Reset-D
3. Type `IN#n` from a BASIC prompt, where n is Yellowstone's slot number
4. Set DIP switch 4 to the ON position

5.1 — Enabling Disk II Mode Temporarily

The first three methods will enable Disk II Mode temporarily, and a reminder message will appear briefly at the top of the screen when booting. The message says:

```
YELLOWSTONE DISK II MODE
```

This message confirms that Disk II mode was enabled temporarily. If the message doesn't appear, then Disk II mode was not enabled successfully. After Disk II mode is enabled this way, Yellowstone will return to Normal Mode the next time the computer is turned off or rebooted from Yellowstone, unless one of these same methods is used again to re-enable Disk II Mode.

The Apple II+ and unenhanced Apple IIe don't support the Control-D or Control-OpenApple-Reset-D methods of temporarily enabling Disk II mode. Use the `IN#n` method instead.

Temporarily enabling Disk II mode requires the computer to be booted from a disk drive connected to Yellowstone. If the computer is booted from another disk controller, it may prevent Yellowstone from detecting the key presses needed to temporarily enable Disk II mode. If you must boot the computer from another disk controller, then use DIP switch 4 to enable Disk II mode permanently.

5.2 — Enabling Disk II Mode Permanently

Setting DIP switch 4 to the ON position will force enabling Disk II Mode permanently, until the switch is turned off. No reminder message will be shown. In this configuration, Yellowstone effectively turns into a clone of a Disk II controller card.

From time to time, BMOW may provide Yellowstone firmware updates to add new features or fix bugs. These firmware updates can be programmed to Yellowstone using the Apple II computer, without any special equipment.

Updates are distributed on a 5.25 inch disk image named YSUPDATE.DSK. You should boot the computer using this disk, using a drive emulator like the BMOW Floppy Emu, or by using a tool like ADTPro to make a physical 5.25 inch disk from the disk image. You may boot the disk using Yellowstone or another disk controller.

The updater program will prompt you for Yellowstone's slot number, and verify that a Yellowstone card was detected. It will report the version number of the currently-installed firmware, and ask if you wish to update. Follow the program's instructions to install the firmware update.

6.1 — Recovery Program Mode

In rare cases where Yellowstone is in a misconfigured state, such as when a previous firmware update was interrupted or failed, then the updater program may not be able to detect the Yellowstone card. If this happens, the Yellowstone firmware can still be updated using Recovery Program Mode.

To enable Recovery Program Mode, set DIP switch 3 to the ON position. When in Recovery Program Mode, Yellowstone will become passive and will not function as a disk controller, so you will need to boot YSUPDATE.DSK using another disk controller.

The updater program will report that no Yellowstone card was detected, and ask if you want to proceed anyway. Answer yes. The firmware installation will take slightly longer than normal, but when it's complete you should see a success message. After updating the firmware, return DIP switch 3 to the OFF position to re-enable normal disk controller behavior.

I see some strange text on the screen when attempting to boot a disk. The text looks like:

`FE21- A=00 X=F5 Y=FF P=37 S=EB`

A software crash (fatal error) has occurred, and the Apple II's built-in monitor program was started automatically. There are several reasons why a software crash to the Apple II monitor might occur, depending on the type of disk that you were attempting to boot. Please see the items below for some possible causes and solutions.

A 5.25 inch disk won't boot when Yellowstone is in a slot other than slot 6. It starts to boot, but then freezes or crashes to the Apple II monitor.

Many older games and other 5.25 inch disk software are written with the assumption that the disk controller is in slot 6, and won't work correctly otherwise. If you must use this software, move Yellowstone to slot 6.

A disk boots OK when it's in Drive 1, but not when it's in Drive 2. When in Drive 2 it starts to boot, but then freezes or crashes to the Apple II monitor.

Some Apple II software programs are written with the assumption that the boot disk is in Drive 1, and won't boot correctly from Drive 2. Examples include DOS 3.3 System Master, GS/OS, and some games. Software written with this assumption must be booted from Drive 1.

A 5.25 inch disk won't boot when it's in Drive 1. It starts to boot, but then freezes or crashes to the Apple II monitor.

A Pascal-based 5.25 inch disk won't boot, or reports an error about "SYSTEM.PASCAL".

A CP/M 5.25 inch disk won't boot, or reports an error like "Disk error on A" or "Rd Bios Err".

Some 5.25 inch disk software programs are written with the assumption that the disk controller is the original Disk II Interface Card. Try enabling Yellowstone's Disk II Mode (see section 5).

My Apple II+ or unenhanced Apple IIe won't boot any disks. The Yellowstone card is ignored.

The II+ and unenhanced IIe will not automatically recognize and attempt to boot from Yellowstone in its normal configuration. To boot a Yellowstone-attached disk from these computers, type `PR#n` from a BASIC prompt, where n is Yellowstone's slot number, or enable Disk II Mode (see section 5).

GS/OS reports an error while booting "unable to load START.GS.OS file"

GS/OS is written with the assumption that the boot disk is in Drive 1, and won't boot correctly from Drive 2. It must be booted from Drive 1.

Yellowstone's status LED shows continuous slow blinking (one blink per second), and none of the drives are working.

A drive collision error has occurred. This happens when two different drives attempt to respond to the computer at the same time, and can be caused by using an unsupported drive configuration. For example, there may be smart drives present at both Yellowstone connectors J1 and J2 (this is not supported), or another unsupported configuration. See section 3.1 for details on the supported drive configurations.

A 3.5 inch drive tries to eject the disk over and over again, as soon as the power is turned on.

Turn the -12V power supply for the drive OFF, using DIP switch 1 or 2 (see section 3.4).

I can't read any 5.25 inch disks using my Disk II, Disk IIc, DuoDisk, or Unidisk 5.25. The computer acts like there is no disk in the drive, or says there is a disk error.

Turn the -12V power supply for the drive ON, using DIP switch 1 or 2 (see section 3.4).

A drive connected to Yellowstone isn't recognized when I boot my computer from a DOS 3.3 disk using another disk controller.

If Yellowstone is used as a secondary drive controller, and the computer is booted from a DOS 3.3 disk using another disk controller (or the Apple IIgs built-in disk controller), and the other disk controller is in a higher numbered slot than Yellowstone, then Yellowstone's initialization routine will never have a chance to run. One work-around is to move Yellowstone to a higher-numbered slot. Another work-around is to manually boot from Yellowstone by typing `PR#n`, when n is Yellowstone's slot number, and then press Control-OpenApple-Reset to perform the normal boot search sequence without turning off the computer.

A 5.25 inch disk won't work when Yellowstone is installed in my Apple IIgs.

The software may have been designed for the slower CPU speeds of the Apple II+ and Apple IIe, and have problems with the higher speed CPU of the Apple IIgs. This is common with older games. Try using the IIgs control panel to temporarily change the System Speed from Fast to Normal.

If Yellowstone is installed in slots 1 through 3 of a IIgs, then DOS 3.3 and software derived from DOS 3.3 will not boot. Neither does a standard Disk II drive controller when installed in these slots. A work-around is to use the IIgs control panel to temporarily change the System Speed from Fast to Normal.

My daisy-chained disk drives are not working.

Smart drives may be daisy-chained together, with the first smart drive of the chain connected directly to Yellowstone. Standard drives can also be daisy-chained in some configurations, while other daisy chains of standard drives are not supported. See section 3.1 for details on the supported drive configurations.

I've forgotten what the DIP switches do.

There's a handy table on the back of the Yellowstone board. DIP switches 1 and 2 control the -12V power supply for the drives attached to connectors J1 and J2, respectively (see section 3.4). Switch 3 controls Recovery Program Mode (see section 6.1). Switch 4 controls Disk II Mode (see section 5).

I don't know what Yellowstone firmware version is installed.

The updater program will report the version number of the currently-installed firmware (see section 6). You can also check it using the Apple II monitor. From the BASIC prompt, type `CALL -151` to enter the monitor. At the monitor's `*` prompt, type `CnF5.CnF7`, where n is n is Yellowstone's slot number. This will display three bytes for the year, month, and day when the currently-installed Yellowstone firmware was created.