SDrive (rev. 12.10.2008) (control program v01 20090403)
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The SDrive is a device that connects to Atari XL/XE's serial (SIO) port and simulates an Atari floppy disk drive with full read/write access to programs and data stored on a SecureDigital flash card (SD).

Main features:
- Supported flash cards: SecureDigital up to 2GB size, FAT16 filesystem
- Maximum number of drives: 4 (D1: to D4:) + 1 special boot drive
- Supported SIO transfer rates: 3.5 to 128kb/s (standard 19 and 69kb/s)
- Supported disk images: ATR, XFD, size up to 16MB, 128 or 256B sectors
- Supported executable files: COM, XEX, BIN.... (any filename extension)
- Device controlled by software running on Atari from the SD card, which can be therefore easily updated/replaced
- Drives swappable on the fly by buttons
- Write protect/enable switch
- SDrive ID number selection switch - simultaneous use of up to 4 SDrive devices
- Low cost design – no LCD, a few LEDs, cheap DIL28 Atmega8 MCU, single sided PCB
- Firmware and software source codes freely available

Special features:
- Buffered reads for speedup
- Delayed writes for speedup and greatly reduced flash write cycles
- Built-in bootloader requiring less than 256 bytes including sector buffer, relocatable in the $0500-$05F7 to $BE00-$BEF7 range, with SKCTL initialization before every block. Supports executable files of up to 8MB size.
- Directory with filename simulated for active files in drives, data handled through standard 128B sectors. Executable files can be run from most DOSes or Q-MEG. Random data files with arbitrary suffix can be activated and opened by a program through DOS or copied to disk images. (Note: 80KB file size limit applies to standard DOSes, 8MB to Q-MEG and MyDOS)

How it works:
After inserting the SD card the device looks for the SDRIVE.ATR file in the root directory and loads it in the special boot drive which is then made available as D1:. Your Atari then boots the control program from the D1: drive. The software offers, among other functions, mounting ATR and XFD floppy images or COM, XEX, BIN.. executables in the D1: ... D4: drives. Then Atari boots from the first drive. SDrive's buttons can be used to swap the contents of the D1: drive with that of the others, which allows the user to comfortably operate even multidisk games (up to 4 disks) by assigning the floppy images to the drives and swapping them with the D1: (called „system drive" from now on) when needed.
System drive number is derived from SDrive ID number, so for SDrive #1 - #4 there is system drive D1: - D4:.

Note: While booting the SDRIVE.ATR you can choose between loading the SDRIVE.COM control program (default), SDRIVEN.COM („NoAutoload" version), SDRIVENH.COM („NoAutoload" + built-in help), DOS II+ or S/XEGS RAMcart feeder of control program (SDRIVENH.COM) by holding Atari Shift and pressing keys 1 to 5.

Hardware

Controls and indicators:

BOOT button ... look up and mount of SDRIVE.ATR in the special boot drive and its activation as the system drive
LEFT button ... drive swap – decreases the number of the drive swapped
RIGHT button ... drive swap – increases the number of the drive swapped
1,2 switches – set SDrive ID number (#1 to #4) and also system drive number (D1: to D4:)
3 … UNLOCK switch ... unlocks the SDcard locked by its own switch
4 … WRITE switch ... write enable
RESET button ... resets the SDrive (return to default state)
Gren LED ... lights when waiting for SD card insertion after power on, later indicates reads from the card
Red LED ... indicates writes to the card (stays temporarily on during the delayed write, that is executed in 3 seconds after last sector operation)
1-4 Yellow LEDs ... indicates the number of drive being swapped with the system drive. If all lighted, the special boot drive is activated as the system drive

Examples:

SDrive ID=1, system drive=D1:, special boot drive activated as D1:, other drives unchanged

SDrive ID=1, system drive=D1:, D1: drive activated as D1:, all drives unchanged

SDrive ID=1, system drive=D1:, drives D1: and D2: swapped, i.e. access to D1: redirected to D2: and vice versa, other drives unchanged

SDrive ID=1, system drive=D1:, drives D1: and D4: swapped, i.e. access to D1: redirected to D4: and vice versa, other drives unchanged

SDrive ID=2, system drive=D2:, special boot drive activated as D2:, other drives unchanged

SDrive ID=2, system drive=D2:, D2: drive activated as D2:, all drives unchanged

SDrive ID=2, system drive=D2:, drives D2: and D3: swapped, i.e. access to D2: redirected to D3: and vice versa, other drives unchanged

Interfacing the Atari:
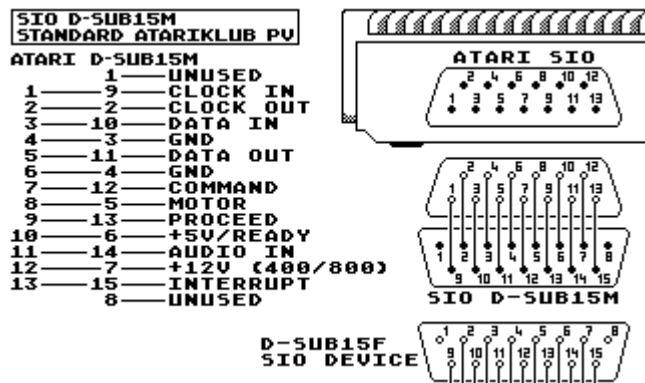The SDrive is equipped with the D-SUB15F connector which is connected to the Atari with the D-SUB15M<->SIO adapter.
The schematics of the adapter follow.


```
SIO D-SUB15M
STANDARD ATARIKLUB PV

ATARI D-SUB15M
              1----UNUSED
    1----9----CLOCK IN
    2----2----CLOCK OUT
    3----10----DATA IN
    4----3----GND
    5----11----DATA OUT
    6----4----GND
    7----12----COMMAND
    8----5----MOTOR
    9----13----PROCEED
   10----6----+5V/READY
   11----14----AUDIO IN
   12----7----+12V (400/800)
   13----15----INTERRUPT
         8----UNUSED
```

Software

Control program SDRIVE.COM (v01 20090403):

The program located in the SDRIVE.ATR disk image attempts to find an SDrive device (#1-#4) after startup, then it reads the settings from the configuration file SDRIVE.CFG from the disk image and reads the current state of the D1: to D4: drives from it, which it displays on the right of the screen. Beneath the drive list there is the name of the current directory, whose contents are displayed on the left. The basic selection is done by the up/down arrows, the left/right arrows move the listing one page up/down. Pressing the Return key on a file shifts the cursor to the right side where the drive selection can be made with the up/down keys. Pressing the Return key again activates the chosen file in the selected drive.

After the drives settings press the InverseVideo (or Atari reset) key for restart of Atari computer and load the selected program.

Control program SDRIVEN.COM „NoAutoload" (v01 20090403):

This version doesn't read the SDRIVE.CFG configuration file. When the automatic reboot function is activated, it's used for changing the settings, which would be impossible otherwise.

Complete description of the control program's functions:

Shift or **Fire** (holded while starting of SDRIVE.COM) ... Bypass the configuration file.
Help ... Shows the software version information and hotkey help (only the version with built-in help).
R (Refresh) ... Refresh all the drives' states and current SDrive settings and switch to the root directory.
Control+R (Read) ... Read the configuration.
Control+W (Write) ... Write the configuration which consists of active files in drives and optionally accelerated SIO transfer speed (U), bootloader location (B), automatic displaying of longnames (L) and/or automatic reboot (coldstart) (Inverse). Writing must be confirmed by pressing the „Y" key.
U, **Control+U, N** ... Accelerated SIO transfer speed switch. The hexadecimal value of the POKEY divisor and the approximate speed in bites per second are indicated in the bottom right corner.
I (Info) ... Shows the size in bytes, date and time of last modification of the selected item.
A ... Activates the directory and file preset in the current drive.
Control+F (Find) ... The item beginning with the string entered is looked for in the current directory. ('?' means one any character.)
Shift+A to **Shift+Z, Shift+?** ... Fast search of a file beginning with the letter pressed in the current directory.
F, **Space** ... Search of the next occurrence of the string entered. (Beep indicates unsuccessful search.)
H (Hardware) ... SDrive hardware (firmware) revision information.
L (Longname) ... Shows the long filename (first 80 characters max).
Control+L ... Turn on/off the automatic displaying of longnames.
V (View) ... Show the file's contents. (Doesn't work for disk images). View method selected by keys – A=ATASCII, C=ASCII, H=hexadecimal view, B=Atari binary file block structure
B, **Control+B** (BootLoader) ... Binary file bootloader relocation in the $0500-05F7 až $BE00-BEF7 range.
X (neXt SDrive) ... Tries to locate and switch to the next SDrive device. (ID of active SDrive indicated in the top right corner.)
Z, **Shift+1** to **Shift+4** ... Swaps the current drive or drives D1: to D4: and the system drive.
Inverse, **Shift+Inverse**, **Reset** ... Reboot.
Shift+Control+Inverse ... Atari coldstart (full reboot as when a computer is turned on).
Shift+< (Clear) ... Reset SDrive (full SDrive reset as when the SDrive reset key is pressed).
Q (Quit) ... Quits the program (must be confirmed with the „Y" key).

Left side:
Lists max. 20 entries of the current directory. Directory entries preceded by slash ("/").
UP arrow ... moves to the previous entry
DOWN arrow ... moves to the next entry
LEFT arrow ... moves to the preceding listing page (previous 20 entries)
RIGHT arrow ... moves to the following listing page (next 20 entries)
< ... moves to the first entry in the current directory
> ... moves to the last entry in the current directory
Esc ... moves to the parent directory
/ ... moves to the root directory
Tab ... jumps to the right side of the screen
Return ... activates the highlighted directory or file
1 to **4** ... immediately activates the highlighted file to the drive (D1: to D4:)
BackSpace ... deactivates the file in the current drive

Right side:
Lists the D1: to D4: drives and the corresponding activated files.
Esc, **Tab** ... jump to the left side of the screen
UP arrow ... moves to the preceeding drive
DOWN arrow ... moves to the following drive.
If the cursor has the shape of the left arrow:
  Return ... sets the directory and file activated in the current drive to the left side
  LEFT arrow ... moves to the left side
  RIGHT arrow ... changes the shape of the cursor to the right arrow if a file is selected on the left side
If the cursor has the shape of the right arrow:
  Return ... activates the file from the left side in the current drive
  LEFT arrow ... changes the shape of the cursor to the left arrow
The actual path to the directory shown on the left side is printed beneath the drives. A question mark before the name of the first subdirectory (in place of the usual slash) indicates nesting higher than 10.

Bottom right corner:
FastSIO – indicates the accelerated SIO transfer rate, the hexadecimal value of the POKEY divisor set and the approximate speed in bites per second
BootLoader – preset memory location of the bootloader

Alternative controls with joystick or console keys: (for example Atari XEGS)
A joystick or console keys can be used to select and mount files in drives besides the keyboard. The particular joystick directions and console keys have the same function as the keys indicated below.

Joystick:
UP ... UP arrow
DOWN ... DOWN arrow
LEFT ... LEFT arrow
RIGHT ... RIGHT arrow
Trigger+UP ... <
Trigger+DOWN ... >
Trigger+LEFT ... Esc
Trigger+RIGHT ... Return

Console keys:
Start ... Return
Start (held longer than 0.3 seconds) ... L (Longname)
Select ... UP arrow
Option ... DOWN arrow
Select+Start ... LEFT arrow
Option+Start ... RIGHT arrow
Select+Option ... Esc

Additional notes

- If the green LED stays on after card insertion the system is repeatedly unable to initialize it.
  If the green LED goes out and none of the yellow LEDs lights up after a card is inserted no FAT16 filesystem was found.
- SDrive disregards the „disk label" and „.." directory entries.
- Booting from a drive with an activated data file may cause a system lockup or other unpredictable results.
- The builtin bootloader uses the $43 to $46 memory adresses from the zero page, ignores redundant FF FF inside a segmented binary file and runs a program from the address of the first block in case the RUN address isn't supplied.
- Faster SIO transfer speeds may cause problems to some programs and games. Try to lower the speed or turn off the accelerated SIO transfer completely in that case.
- The OS (typically Q-MEG4) may stop reading after the FastSIO speed change because it remembers the previously used speed which is no longer valid. In that case switch the drive speed in the OS to N and again to F for the SDrive to detect the usable speed of the accelerated SIO transfer.
- When the red LED indicates a write or a delayed write in progress do not turn off the computer, remove the SD card or switch the WRITE or UNLOCK switch otherwise the operation may be interrupted or data corrupted!
- The SDrive does not retain any previously changed settings (FastSIO, Bootloader location) or drive assignments after SD card ejection, turning off the computer (power disconnection) or hitting SDrive reset button.
  (Note: a program running on Atari can restore all the settings after its booting from SDrive device.)

Tested and working flash cards:
A-DATA Speedy SD 1GB, A-DATA Turbo 150x SD 2GB, Apacer SD Memory Card 128MB, CakeMS SD HighSpeed 60x 1GB, , Elite Pro High Speed SD 2GB (China), EMTEC SD 2GB (China), Kingston SD 512MB, Kingston SD 1GB, Kingston SD 2GB (Taiwan), Kingston SD 2GB (Japan), Kingston microSD adapter + Kingston microSD 1GB (Taiwan), Kingston miniSD adapter + Kingston miniSD 2GB, Noname adapter + microSD 2GB (Taiwan), Noname 64MB SD Memory Card, SanDisk 512MB SD, SanDisk 1GB SD (China), SanDisk Ultra II (SD/USB) 1GB (China), Ultra-X SD 512MB, Verbatim SD 2GB (Japan)

Troublesome flash cards (either don't work at all or data transfers corruption occurs):
A-DATA Speedy DUO (SD/USB) 1GB

Further explanation:
If you happen to wonder why we don't support cards bigger than 2GB, other filesystems than FAT16, limit the number of drives to 4 and omitted this and that feature mind that the main limiting factor is the capacity of the MCU used – the Atmega8. Eight kilobytes of the program memory are almost filled up to the brim, 1KB RAM is likewise all used up (512B buffer for SD sectors, 256B buffer for Atari sectors and the remaining 256B must accomodate all the operations and drive settings and also the obligatory stack). On the other hand, these constraints have kept us motivated to designing all kings of improvements and optimizations and for the most part considering the usefulness or necessity of various features and functions and the picking the right candidates for omission. Try to see the SDrive as our vision of the optimal Atari SIO device with comfortable controls and minimal parts costs.