oberon service
beyond printing

Oberon SSD/IO (Safety Secure Digital I/O)

API Developers Guide

Manual release	: 1.3D
Manual date	: October 2006

NOTE

- This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
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  (2) this device must accept any interference received, including interference that may cause undesired operation.
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Addendum B

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GENERAL DESCRIPTION

The SSD (Safety Secure Digital) and SSDIO (Safety Secure Digital I/O) are storage media compliant with the SD standard Rev 1.01. The SD is a low-cost mass storage device implemented as a removable card, very small and easy to move from one device to another with high performance in terms of read and write capabilities. The SD are commonly used on audio and video consumer electronic devices due to the high speed transfer rate and at their compactness/thickness: 2.1 mm for the normal and 1.4 mm for the thin version.

On SSD and SSDIO Oberon implemented a serial interface in order to connect it to external devices, keeping the SD specifications; the products are designed around Hyperstone's S2-16X flash Memory Controller, while the serial communication is handled by a UART 8051 processor. The products comes with a library of API in order to write and integrate the custom application in a simple way.

❐ Standard features

- Voltage range: basic communication 2.0 - 3.6 Volt
  other commands and memory access 2.7 – 3.6 Volt

- Clock: 0-25 Mhz (40 Mhz using R-C oscillator)
- Data transfer rate to flash memory up to 40 MBytes/s
- NAND type Flash Memory
- Support 32, 64, 128, 256, 512 and 1,2 Gbit NAND flash
- Error Correcting Code capabilities with 6 bytes in a 512 byte sector
- Flash memory power down logic and flash memory write protect control
- Firmware storage in flash memory
- Firmware is loaded into internal memory by the boot ROM (8 Kbyte)
- On-chip ECC unit
- 2 Digital I/O pins
- Serial RS-232 I/O capabilities

❑ Safety features

The Oberon SD implements a security feature that can be useful to protect applications. It simply works as a Password/Answer concept.

❑ Serial and I/O Features

The Oberon SD has the capability to communicate with devices using RS232 or driving/reading sensors using 2 DIGITAL I/O pins.

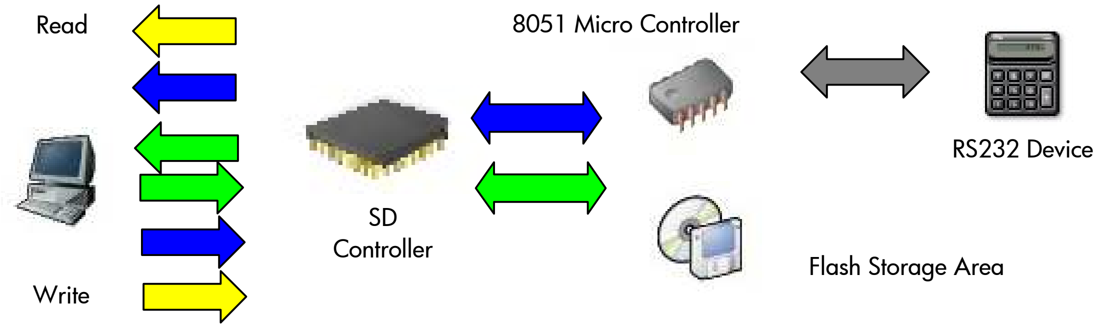
The RS232 communication is configurable from 2400bps up-to 57600bps, while the communications parameters are fixed to N81.

The 2 digital I/O pins are configurable as Input or Output and it is possible to drive them individually. The Safety feature can be implemented as well.

THEORY OF OPERATION

The flash storage sector 0 (first 512byte) is **virtually** used as R/W channel to drive the 8051 communication controller. The firmware running on the SD controller manages data received and transmitted during Read/Write commands issues by the host. A special filter is performing real write and read to storage device and virtual RS232 commands, to perform communications to/from serial devices.

Those commands, useful to communicate with serial devices, are simply performed reading and writing data on Sector 0 of the Oberon SD.



Legenda:

- □ Green : Real Read/Write on storage area
- □ Blue : Virtual Read/Write driving 8051 Micro Controller
- □ Yellow : Virtual Read/Write Security check

The following example shows how to perform those commands in Unix environment using C language:

```
/* Open the SD device */
int f = open("/dev/sd1", O_RDWR| O_DIRECT);

/* Positioning at sector  0  (not necessary at first opening)*/
lseek(f, 0, SEEK_SET);

/* Write to SSD device */
write(f, "Command or data to send to SD....", ...);

/* Repositioning at sector  0 */
lseek(f, 0, SEEK_SET);

/* Read data back from SD device*/
read(f, "data back from SD....", ...);

/* Closing device */
close(f);
```

Part numbers

The SSD and SSD-Io have the following P/N:

Safety Secure Digital 16 MB:	SSD90016
Safety Secure Digital 32 MB:	SSD90032
Safety Secure Digital 64 MB:	SSD90064
Safety Secure Digital I/O 16 MB:	SSD90116
Safety Secure Digital I/O 32MB:	SSD90132
Safety Secure Digital I/O 64 MB:	SSD90164

COMMANDS SUMMARY

Safety Commands

The SD controller recognizes the security commands by the 4 bytes (1111) four ones before the password sent from the host. In this case, when those bytes are received on sector 0, the controller will skip physical writing on the storage device. At the next reading of sector 0 it will answer with the answer key burned on its firmware, in case the password is correct. Otherwise the controller will return to the real flash sector 0 content.

RS232 and Digital I/O Commands

The SD controller recognizes RS232 and Digital I/O (IO0, IO1) commands by the 4 bytes (0000) four zeros in front of the real command. Driving the 8051 is always performed reading and writing the special commands on sector 0 of the storage device. Some of these commands are composed by strings and integer values and it is necessary to pay attention to descriptions.
The available commands are:

Single Command (Strings)	General Description
0000QQ	Query information about 8051 UART status
0000CC	Clear the 8051 UART buffer content
0000RR	Read the 8051 UART buffer content (data sent by the external rs232 device)
Composed Command (Strings + Hex values)	**General Description**
0000W%qS%s	Write data to 8051 UART buffer (data sent to the external rs232 device). %s is the data to send (string) while %q is the data length in hex.
0000W0x01B%b	Set RS232 speed as %b
0000W0x01C%i	Set Digital I/O direction as %i
0000W0x01O%s	Drive Digital I/O pins. %s is the status of pins to drive

RS232 COMMANDS SPECIFIC DESCRIPTION

Query 8051 UART - 0000QQ

This command allows to query information about 8051 UART buffer status and Digital I/O pins conditions. After the host writes this command, it has to read the sector 0 and the SD will answer with a sequence of 4 bytes repeated 64 times (default is 00-FF-02-0F).

The description of these values is:

- Byte 0
  Is the amount of buffer data available for reading. The returned value must be calculated as (Byte 0) + 1.Default at SD power-on is 0x00 (no data to read).

- Byte 1
  Is the amount of buffer data available for transmission. The returned value must be calculated as (Byte 1) + 1. Default at SD power-on is 0xFF (no data to transmit).

- Byte 2
  Is the control byte about the 8051 UART status. Default at SD power-on is 0x02

7	6	5	4	3	2	1	0
X	X	X	X	Tx data Overrun	Rx data Overrun	Tx data Empty	Rx data Avail

Bit 0	1 means new data are available to be read. 0 means no new data received by external device. Use the value of Byte 1 to calculate the quantity of data to read.
Bit 1	1 means the buffer is totally empty. 0 means that data are present on buffer waiting for transmission to the external device.
Bit 2	This bit is raised to 1 when new data are received by external device but the buffer if full.
Bit 3	This bit is raised to 1 when the buffer is full and new data are sent on it by the host.

❐ Byte 3

Is the control byte about the Digital I/O pins. Default at SD power-on is 0x0F

7	6	5	4	3	2	1	0
X	X	IO1 Direction	IO0 Direction	X	X	IO1 Status	IO0 Status

Bit 0	1 = UP (Default); 0 = DOWN
Bit 1	1 = UP (Default); 0 = DOWN
Bit 2	Always UP (1)
Bit 3	Always UP (1)
Bit 4	1 = OUTPUT; 0 = INPUT (Default)
Bit 5	1 = OUTPUT; 0 = INPUT (Default)

Clear 8051 UART - 0000CC

This command will clear the Receive/Transmit buffer. After issuing this command, the host has to perform a read call to check if the buffer was correctly cleared, expecting a buffer filled of character "C" repeated 256 times.

Read 8051 UART - 0000RR

This command reads the 8051's buffer content. After testing the status of the buffer using the query command (0000QQ) and check the number of data available (Byte 0), the host has to read the data from buffer using the read command (0000RR).

Write 8051 UART - 0000W%qS%s

This command writes the quantity %q of data %s to the 8051's buffer.
The write call must be performed in one time linking together command and data.

Example:

```
char *command = "0000W\10SABCDEFGHIK";
write(f, command, strlen(command));
```

where 0000WW is the write command, \10 is the hex value of data quantity and S is the command for 8051 to perform the send.

Configure 8051 UART Baud Rate - 0000W0x01B%b

This command will configure the baud rate %b of the 8051 UART.

Note: The value is kept until the SD is powered.

9600N81 is the factory default baud rate for UART at SD power on.

0000W0x01B0x01	2400N81
0000W0x01B0x02	4800N81
0000W0x01B0x03	9600N81 (default at power-on)
0000W0x01B0x04	19200N81
0000W0x01B0x05	38400N81
0000W0x01B0x06	57600N81

Example:

```
        char *command = “0000W\1B\x06”; /* Setting at 57600,n,8,1  */
        write(f, command, strlen(command));
```

DIGITAL I/O COMMANDS SPECIFIC DESCRIPTION

Configure Digital I/O directions - 0000W0x01C%i

This command is useful to set the direction of the Digital I/O pins named IO0, IO1.
The default configuration of these pins at power on is direction INPUT and status UP(1).

Note : When configuring the pins as OUTPUT, the status will automatically change to DOWN (0).

7	6	5	4	3	2	1	0
X	X	IO1 Direction	IO0 Direction	x	x	x	x

Bit 4	1 = OUTPUT; 0 = INPUT (Default)
Bit 5	1 = OUTPUT; 0 = INPUT (Default)

Example:
This command will set IO0 as INPUT and IO1 as OUTPUT

```
char *command = "0000W\1C\x20";
write(f, command, strlen(command));
```

Set Digital I/O - 0000W0x01O%s

After setting directions of Digital I/O pins with previous function (0000W0x01C%i), with this command it is possible to change the status (UP or DOWN) of pins configured as OUTPUT.

7	6	5	4	3	2	1	0
X	X	X	X	X	X	IO1 Status	IO0 Status

Bit 0	0 = DOWN; 1 = UP
Bit 1	0 = DOWN; 1 = UP

Example:
This command will set IO1 pin as UP and IO0 pin as DOWN.

```
char *commandDrive = "0000W\1C\x02";
write(f, commandDrive, strlen(commandDrive));
```

ELECTRICAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value	Unit
Supply voltage	Vcc	-02 to 3.6	V
Input Voltage ON pin	Vin	-0.5 to Vcc+0.5	V
Operating Temperature	Topr	-40 to +85	°C
Storage Temperature	Tstg	-40 to +125	°C

RECOMMENDED DC OPERATING CONDITIONS

Parameter	Symbol	Range	Unit
Supply Voltage	Vcc	2.7/3.6	V
Input High Voltage	Vih	Vcc + 0.3	V
Input Low Voltage	Vih	-0.3 to +0.8	V
Ambient operating temperature	Ta	-40 to 85	°C

DC PARAMETERS

Parameter	Symbol	Conditions	Range	Unit
Output High Voltage	Voh	Data at 1mA	2.4	V
Output Low Voltage	Vol	Data at 4mA	0.4	V
Input Current sleep mode	Icc0	Vcc 3.3V	0.3	mA
Input Current operating at 20 MHz	Icc1	Vcc 3.3V	30	mA
Input Current operating at 40 MHz	Icc2	Vcc 3.3V	50	mA
Input/output Capacitance	Ci/o	Vcc 3.3V	10	pF

AC PARAMETERS

Parameter	Symbol	Conditions	Range	Unit
Clock, Data transfer mode	Fpp	Cl ≤ 100pF	20	MHz
Clock Identification mode	Fod	Cl ≤ 250pF	400	kHz
Clock low time	Twl	Cl ≤ 100pF	10 - 50	ns
Clock high time	Twh	Cl ≤ 100pF	10 – 50	ns
Clock rise time	Ttlh	Cl ≤ 100pF	10 – 50	ns
Clock fall time	Twl	Cl ≤ 100pF	10 - 50	ns

AC PARAMETERS (continue)

Parameter	Symbol	Conditions	Range	Unit
CMD, DAT input setup time	Tisu	Cl ≤ 25pF	5	ns
CMD, DAT input hold time	Tih	Cl ≤ 25pF	5	ns
CMD, DAT output delay (data transfer)	Toldy	Cl ≤ 25pF	0 - 14	ns
CMD, DAT output delay (identification)	Toldy	Cl ≤ 25pF	0 – 50	ns

ELECTRICAL STATIC DISCHARGE (ESD) requirements

The ESD parameters are the following:

Contact Pads

+/- 4kV, Human body model according to the IEC61000-4-2 specifications

Non contact Pads area

+/- 8 kV (coupling plane discharge)

+/- 15 kV (air discharge)

DENSITY AND CMOS NAND E2PROM

The SSD90xx supports the following NAND flash devices TSOP 48 pins mounting.

128 MBIT

PRODUCER	P/N	Density	Organisation*	Vcc
TOSHIBA	TC58DVM72A1FT00	16M x 8 bits	528 x 32 x 1024	2.7V-3.6V
SAMSUNG	K9F2808U0C-PCB0	16M x 8 bits	528 x 32 x 1024	2.7V-3.6V
ST	NAND128W3A-2BN6	16M x 8 bits	528 x 32 x 1024	2.7V-3.6V
HYNIX	HY27UF08122M-TPC	16M x 8 bits	528 x 32 x 1024	2.7V-3.6V

256 MBIT

PRODUCER	P/N	Density	Organisation*	Vcc
TOSHIBA	TC58DVM82A1FT00	32M x 8 bits	528 x 32 x 2048	2.7V-3.6V
SAMSUNG	K9F5608U0C-PCB0	32M x 8 bits	528 x 32 x 2048	2.7V-3.6V
ST	NAND256W3A-2BN6	32M x 8 bits	528 x 32 x 2048	2.7V-3.6V
HYNIX	HY27UF08562M-TPC	32M x 8 bits	528 x 32 x 2048	2.7V-3.6V

512 MBIT

PRODUCER	P/N	Density	Organisation*	Vcc
TOSHIBA	TC58DVM92A1FT00	64M x 8 bits	528 x 32 x 4096	2.7V-3.6V
SAMSUNG	K9F1208U0A-PCB0	64M x 8 bits	528 x 32 x 4096	2.7V-3.6V
SAMSUNG	K9F1208U0M-PCB0	64M x 8 bits	528 x 32 x 4096	2.7V-3.6V
ST	NAND512W3A-2BN6	64M x 8 bits	528 x 32 x 4096	2.7V-3.6V
HYNIX	HY27UF08122M-TPC	64M x 8 bits	528 x 32 x 4096	2.7V-3.6V

1 GBIT

PRODUCER	P/N	Density	Organisation*	Vcc
SAMSUNG	K9F1G08U0A-PCB0	128M x 8 bits	2112 x 64 x 1024	2.7V-3.6V
HYNIX	HY27UF081G2M-TPC	128M x 8 bits	2112 x 64 x 1024	2.7V-3.6V

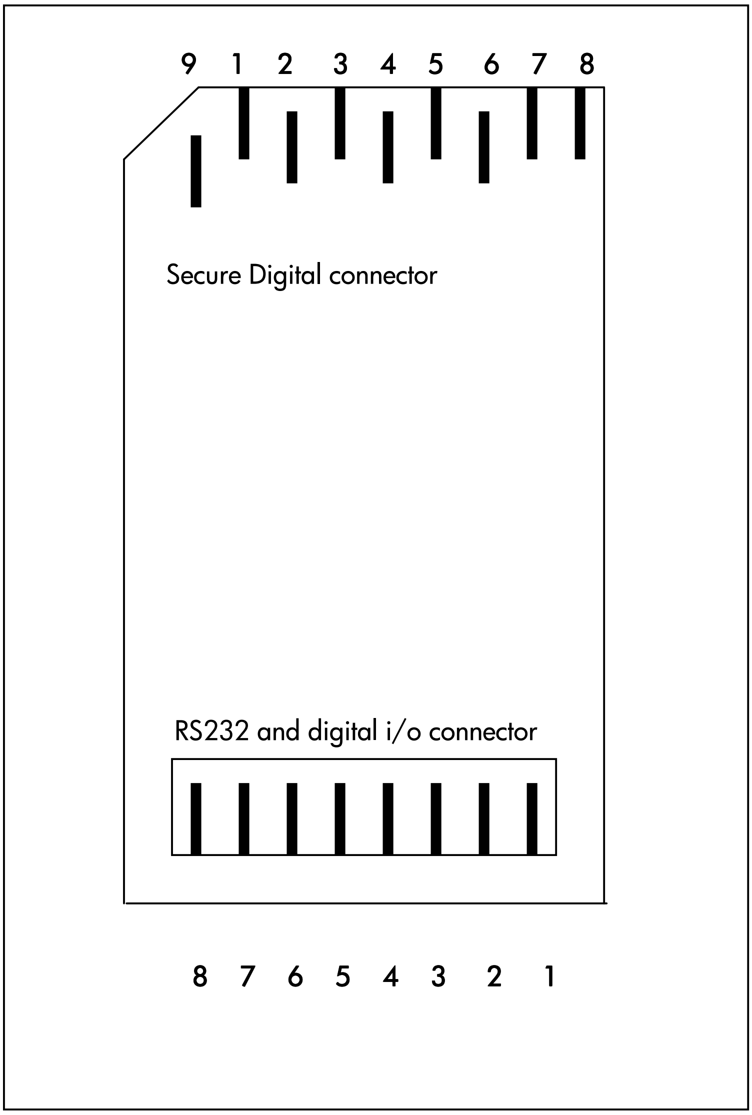
2 GBIT

PRODUCER	P/N	Density	Organisation*	Vcc
SAMSUNG	K9F2G08U0A-PCB0	256M x 8 bits	2112 x 64 x 2048	2.7V-3.6V
HYNIX	HY27UF081G2M-TPC	256M x 8 bits	2112 x 64 x 2048	2.7V-3.6V

- Bytes x pages x blocks

PIN SPECIFICATION

The SSD90xx SDS card has two connectors; the frontal connector is for SD slot insertion and the rear Molex connector is used to link external serial devices. The specifications are the following:



SSD90xx SDS pin specification

Secure Digital connector

Description	Pin #	Name	Type	Note
Card detect/Data Line Bit 3	1	CD/DAT 3	I/O/PP	I/O and Push Pull
Command/response	2	CMD	PP	Push Pull
Supply voltage ground	3	Vss1	S	Power Supply
Supply voltage	4	Vdd	S	Power Supply
Clock	5	CLK	I	Input
Supply voltage ground	6	Vss2	S	Power Supply
Data Line Bit 0	7	DAT 0	I/O/PP	I/O and Push Pull
Data Line Bit 1	8	DAT 1	I/O/PP	I/O and Push Pull
Data Line Bit 2	9	DAT 2	I/O/PP	I/O and Push Pull

Serial RS-232 and digital I/O connector

Description	Pin #	Name	Type	Note
Power supply	1	VCC	S	Power Supply
Digital I/O #1	2	DIO 1	PP	Push Pull
Digital I/O #2	3	DIO 2	PP	Push Pull
Not used	4	N/A	N/A	N/A
Not used	5	N/A	N/A	N/A
Transmit data	6	TXD 232	I/O	Input/Output
Receive data	7	RXD 232	I/O	Input/Output
Ground	8	GND	S	Power Supply

Serial RS-232 and digital I/O electrical specification

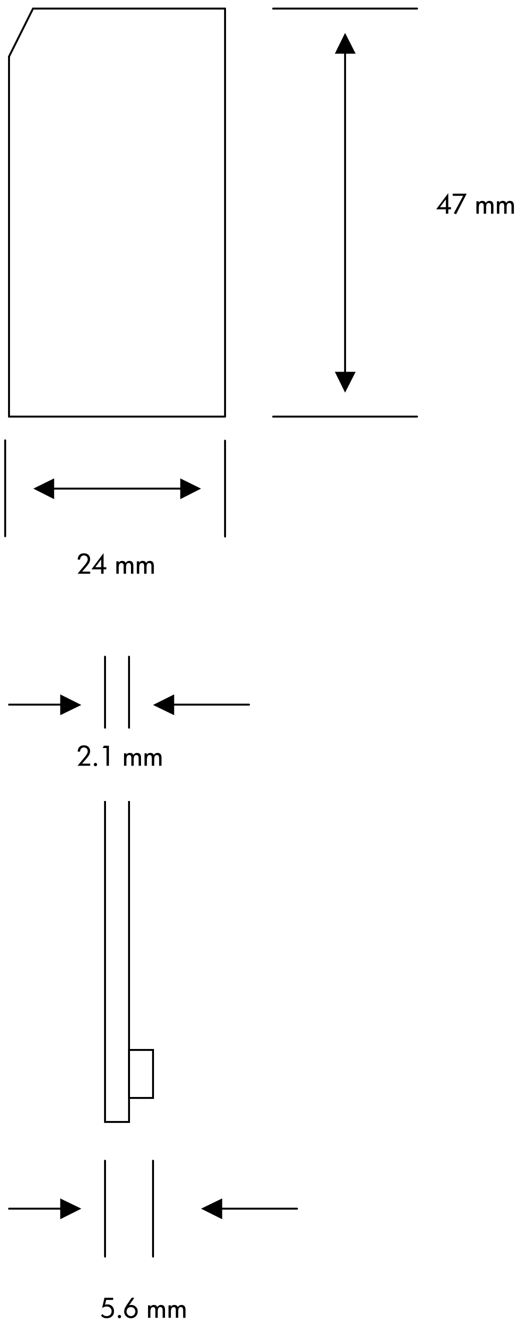
Description	Pin #	Range	Unit
Digital I/O #1	2	0 + 3.3	Volt
Digital I/O #2	3	0 + 3.3	Volt
Transmit data	6	-5 + 5	Volt
Receive data	7	-5 + 5	Volt

Serial RS-232 and digital I/O connector

The connector used is a 8 pin male connector, Molex 53398-0890 that allow the board to wire connection with female 8 pin Molex 51021-0800.

MECHANICAL SPECIFICATION

The SSD90xx follows SD mechanical specifications for the X-axis and for the thickness; the Y-axis is longer due to the RS-232 connector placed on the end-edge. The measurements are the following:



ADDENDUM A

Digital i/o commands with external Pull-up (Driving open drain)

Configure Digital I/O status- 0000W0x01C%i

This command is useful to set the output Digital I/O pins named IO0, IO1.
The default configuration of these pins at power on is status UP

7	6	5	4	3	2	1	0
X	X	IO1 status	IO0 status	X	X	X	X

Bit 4 1 = DOWN; 0 = UP (Default)
Bit 5 1 = DOWN; 0 = UP (Default)

Example:
This command will set IO1 pin as DOWN and IO0 pin as UP

7	6	5	4	3	2	1	0
X	X	IO1 status = 1	IO0 status = 0	X	X	X	X

```
char *command = “0000W\1C\x20”;
write(f, command, strlen(command));
```

ADDENDUM B

SSD and SSDIO card Identification command

The Developers should be careful in writing sector 0 of standard SD (not Oberon SSD and SSDIO) since writing this sector will turn the device unusable by the printers.
To avoid this mistake, an application should verify if SSDIO or SSD card from Oberon is inserted in the target slot.
The ATA controller recognizes the Identification commands by the 4 digits 1111 in front of the key ABCD and no real write will be performed on sector 0.
If the remaining 4 bytes (“ABCD”) match with the code burned on the controller, the read() call will return a 4 bytes (“OKOK”) answer, burned on the controller as well; otherwise the controller returns the first 4 bytes present on sector 0.

The sample code below shows how to restore the value of sector 0. By sending the sequence of char "1111ABCD" to the SD, the SSDIO or SSD must reply with the string "OKOK"; if it returns some other value, the following code restores the original value of sector 0, and the SD will work properly.

```
class RicohSD {

        private static final String password = "ABCD";
        private static final String device = "/dev/rsdc1c";

        public static void main(String[] args)  throws IOException{

                System.out.println("Hello SD Ricoh!");

                /* Check the original SSD  */
                SSDcheck _SSDcheck = new SSDcheck();
                //save the sector 0 of a SD for avoid the broker of not Ricoh SD
                _SSDcheck.saveSector();
                if(!_SSDcheck.checkOriginal(device,password)){
                        //restore the content of sector 0, the SD isn't a SDD Ricoh
                        _SSDcheck.restoreSector();
                }else{
                        // to do somethig, the SD is an original SSD Ricoh
                        ;
                }
        }
}
```

source 1

```
class SSDcheck{

        private final String answer = "OKOK";
        private String device = null;
        private byte[] saveBuffer; // buffer where to store the original 512 byte of the sector 0

        String strSecurity = null;
        boolean isSecurity = false;

        public SSDcheck(){
        }

        /* Check Security */
        public boolean checkOriginal(String device, String strPassword){
                boolean isSecurity = false;
                this.device = device;
                try{

                        strSecurity = sendPassword(strPassword);
                        if(strSecurity.equals(this.answer))
                                isSecurity = true;
                        else
                                isSecurity = false;
                }catch (Exception e){
                        isSecurity = false;
                }
                return isSecurity;
        }

        //send the password "ABCD" to the SD, if the SD is RICOH SD the method return the string "OKOK"
        public String sendPassword(String data) throws IOException {

                try{
                        String str = "";
                        byte[] dateString = data.getBytes();
                        FileOutputStream fos = new FileOutputStream (device);
                        byte[] date = new byte[512];
                        date[0] = '1';
                        date[1] = '1';
                        date[2] = '1';
                        date[3] = '1';
                        for (int i = 0; i < dateString.length ; i++ ){
                                date[i+4] = dateString[i];
                        }
                        fos.write(date);
                        fos.close();

                        FileInputStream fis = new FileInputStream (device);
                        byte[] readDate = new byte[512];
                        fis.read(readDate);
            for(int i= 0; i<4; i++){
                str = str + (char)readDate[i];
            }
            fis.close();

            return str;
                }catch (IOException e){
                        e.printStackTrace();
                        throw new IOException("SerialSSD :: checkSecurity - > "+e);
                }
        }
        public void saveSector() throws IOException {
                        FileInputStream fis = new FileInputStream (device);
                        saveBuffer = new byte[512];
                        fis.read(saveBuffer);
            fis.close();
        }
        public void restoreSector() throws IOException {
                FileOutputStream fos = new FileOutputStream (device);
                fos.write(saveBuffer);
                fos.close();
        }
}
```