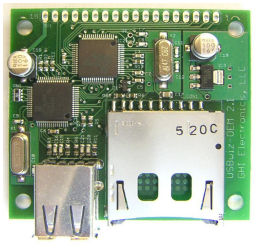
USBwiz User Manual

Rev.2.26 Date: August 4, 2008 User Manual

Document Information

Information	Description
Abstract	This document covers complete information about USBwiz, specifications, tutorials, and references.



USB WIZ

GHI Electronics

Table of Contents

1. Introduction

USBwiz is an optimized solution for easy interfacing almost any embedded system to USB hosting with a vast variety of USB drivers such as Printer Driver, HID Driver (mice, keyboards and joysticks), CDC Driver (modems, cellphone), USB-to-Serial device Drivers (FTDI, Silabs, Prolific) and Mass Storage Driver (Thumb Drives, memory readers, ..etc) accompanied with very reliable and fast FAT file system that allows the system to access storage medias and open or create files and folders.

USBwiz connects to a USB host controller (ISP1160) on one side and to your microprocessor on the other side (PIC, AVR…etc.). Using simple commands over I2C, SPI or UART (serial) you can talk to almost any USB device on the market.

1.1. Example applications

- Digital camera
- Data Logger
- Picture viewer
- USB thumb-drive MP3 player
- Automated machine
- Keyboard/mouse/joystick interface
- RS232 to “USB-printer” server
- Automated SMS Sending

1.2. Key features

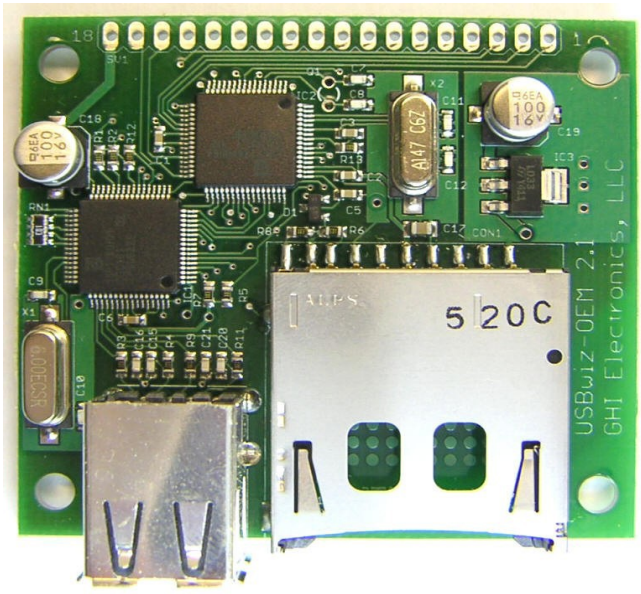
- FAT32, FAT16 and FAT12 support
- Simultaneous access to 3 FAT devices
- Multi Media Card (MMC) and Secure Digital (SD) memory cards
- USB host stack and raw access to USB devices
- HID support
- Printer support
- Mass storage support
- Utilizes ISP1160
- Easily used with any microcontroller including PIC, AVR, Zilog…etc.
- Runs with simple robust protocol over UART, I2C or SPI.
- UART runs as high as 921.6 K-baud, I2C up to 400kbps, and SPI clock is up to 7 MHz.
- Field upgradeable firmware from a file on the connected media!
- Built in RTC (Real Time Clock)
- Very few external components are needed
- Small LQFP 64 package

- 40 to 50 mA, power consumption
- Single supply 3.3V
- 5V tolerant I/O pins
- -40˚C to +85˚C temperature operating range
- Lead free

1.3. USBwiz Circuit Boards

USBwiz-OEM:

USBwiz-OEM board contains USBwiz chipset and the other needed circuitry.



key features:

- Fully assembled and tested
- Can be mounted to almost any case using 90 degrees brackets
- Standard .1" spaced holes for header for user interface
- Secure Digital (SD)/ Multi Media Card (MMC) Card connector
- Dual USB connector
- Requires "regulated" 5V

USBwiz-BOX (USBwiz in case solution):

This powerful board (formally known as USBwiz-DEV) is a complete USB host system.

Thanks to USBwiz chip, through RS232, UART, SPI or I2C interfaces you can access many USB devices, including USB memory drives. Also, you can read/write files from the any formatted SD or MMC card. The board comes with the D-SUB25 connector to access all USBwiz's functionality. Look at the schematics for more details.

key features:

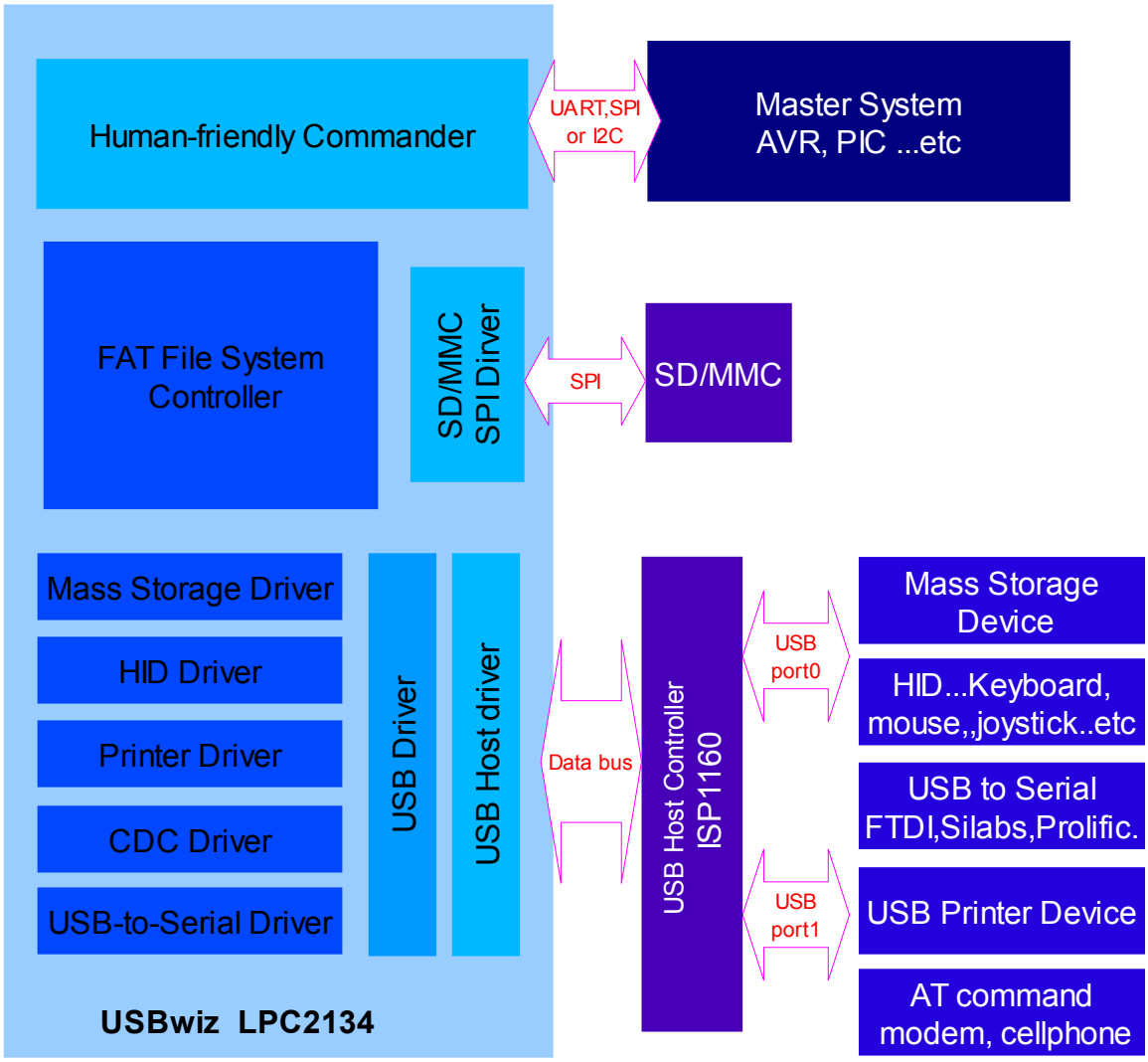
- Based on USBwiz chip
- Completely built and tested
- Plugs directly to any RS232 port, DTE (computer) or DCE (device)
- D-SUB25 with connections to all features, including UART, SPI and I2C.
- Designed to go directly in a plastic case

2. USBwiz Architecture

USBwiz is a single chip that performs all work needed for USB hosting and FAT file system. USBwiz connects to a USB host (ISP1160) on one side and to your product on the other side (PIC, AVR…etc.) Using simple commands over I2C, SPI or UART (serial), you can use almost any USB device on the market. If the device falls under a supported USB class, no USB knowledge is necessary, USBwiz does the work. This includes many of-the-shelf devices such as mouse, keyboard, joystick, USB memory, printer, modem (cell phones), and many more!

Also, USBwiz includes FAT file system. Microsoft FAT file system allows your product to create files on USB/SD storage media devices.

2.1. Block Diagram



2.2. LPC2134 Microcontroller

The LPC2134 microcontroller is based on a 32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed 256KB flash memory. A 128-bit wide memory interface and a unique accelerator architecture that enables 32-bit code execution at the maximum clock rate.

2.3. Commander

USBwiz uses LPC2134 UART, SPI or I2C to let the user communicate with boot loader, Commander. All commands are entered in ASCII characters. We chose to use ASCII to simplify troubleshooting and to allow humans to enter commands easily.

Main function of Commander is to provide user with simple tool to control USBwiz to get the full use of its functions.

2.4. FAT File System

USBwiz can connect to two kinds of storage media types. The media types are SD/MMC cards and USB Mass Storage devices (SCSI command subclass, bulk only protocol) which includes thumb flash, USB hard drives and card readers. USBwiz supports three simultaneous FAT devices. Keep in mind that all devices must be formatted FAT12, FAT16 or FAT32.

USBwiz can mount up to 3 File System Medias that are independent from each other, which means that all opened files and operations in one file system has no effect on the others. This gives USBwiz very great capability of flexible switching between the file system Medias and providing other valuable functions like reading from file in one Media and writing in another file in another media at the same time.

Some FAT File System features in USBwiz:

- Supports FAT12,FAT16, FAT32
- Can mount up to three independent File System independently
- accesses up to 4 opened files
- access unlimited subdirectory (folders) trees
- File access functions includes read, write, append, find, delete, make folder...etc.

2.5. USB Hosting

USB Host Controller

USBwiz connects to a USB host (ISP1160) through data bus. This Host Controller is manufactured by Phillips to fit embedded system applications with USB full speed and USB version 2.0 compatibility. It provides two USB host ports with internal root hub.

USB Driver and Host Controller Driver

USBwiz has a reliable USB driver that can fully control the traffic on ISP1160 Host Controller.

2.6. Supported USB Client Classes

The USB organization defines many classes for different USB devices. This means all USB devices of a certain type; keyboards for example, should run the same way. This is the reason why you do not need to install drivers when connecting a keyboard to your PC. Your operating system includes the “USB class drivers”. USBwiz comes with many USB class drivers. If a class is not supported by USBwiz, you can still use it by accessing the raw USB commands.

USB supported Devices:

- Human Interface Devices (HID) such as mouse, keyboard and joystick.
- Printers.
- Mass Storage (Thumb drives and external USB hard drives).
- Communication Device Class (Modems and cell phones) that contain Abstract Control Model Subclass Interface like Nokia Cell phones.
- USB to serial drivers such as FTDI, Silabs and Prolific.

3. Pin-Out and Description

The following table includes brief description about USBwiz chip pinouts:

Pin	Name	Description
1	UH_RD#	Read strobe. Used for USB host chip (must have a pull-up resistor on this pin or UH_CS#)
2	UH_WR#	Write strobe. Used for USB host chip
3	RTXC1	32KHz crystal for RTC
4	D11	Data line 11. Used for USB host chip
5	RTXC2	32KHz crystal for RTC
6	VSS	Connect to ground
7	V3A	Analog supply source 3.3V
8	D10	Data line 10. Used for USB host chip.
9	MISC	For future expansion
10	UH_RESET#	Reset pin. Used for USB host chip.
11	A0	A0. Used for USB host chip
12	D9	Data line 9. Used for USB host chip
13	ACTIVITY_LED	Goes high when executing a command and low when finished.
14	MISC1	Currently not used
15	SD_DET	SD card detect. Edge sensitive signal.
16	D8	Data line 8. Used for USB host chip.
17	SD_CS#	Chip select line for MMC or SD card
18	VSS	Connect to ground
19	UART_TX	In UART mode this is the transmit pin
	SPI_DATARDY I2C_DATARDY	In SPI and I2C modes, this flag indicates that USBwiz has data ready in SPI or I2C buffer and the master must read it. USBwiz will ignore any incoming command when this pin is high.
20	TRST#	Leave Unconnected
21	UART_RX	In UART mode this is the data receive pin
	SPI_BUSY I2C_BUSY	In SPI and I2C modes, this pin is a flag that indicates that USBwiz is busy and it will not accept any commands

Pin	Name	Description
22	I2C_SCL	The SCL line for I2C bus
23	VCC	3.3V power pin
24	RTCK/DBG#	Leave unconnected
25	VSS	Ground power pin
26	I2C_SDA	The SDA line for I2C
27	MMC/SD_SCK	Clock signal for MMC and SD memory cards
28	MODE0	Together with MODE1, selects the interface mode for USBwiz
29	MMC/SD_MISO	Data signal from MMC or SD memory cards. Pull-up resistor is required on this pin.
30	MMC/SD_MOSI	Data signal to MMC or SD memory cards
31	SD_WP	SD write-protect detect
32	MODE1	Together with MODE0, selects the interface mode for USBwiz
33	D0	Data line 0. Used for USB host chip.
34	D1	Data line 1. Used for USB host chip.
35	D2	Data line 2. Used for USB host chip.
36	D15	Data line 15. Used for USB host chip.
37	D3	Data line 3. Used for USB host chip.
38	D4	Data line 4. Used for USB host chip.
39	D5	Data line 5. Used for USB host chip.
40	D14	Data line 14. Used for USB host chip.
41	D6/BL#	Data line 6. This line MUST be high at USBwiz power up and reset. Make sure it has pull-up resistor.
42	VSS	Ground
43	V3	VCC power
44	D13	Data line 13. Used for USB host chip.
45	D7	Data line 7. Used for USB host chip.
46	UH_IRQ	IRQ. Used for USB host chip.
47	SPI_SCK	Clock for SPI bus
48	D12	Data line 12. Used for USB host chip
49	VBAT	Optional 3V battery to run the RTC
50	VSS	Ground
51	V3	3.3V power pin
52	TMS	Leave unconnected
53	SPI_MISO	In SPI mode, this pin is data output from USBwiz on SPI bus.

Pin	Name	Description
	UART_RTS	In UART mode, this pin is Ready To Send Signal.
54	SPI_MOSI	In SPI mode, this pin is data input to USBwiz on SPI bus.
	UART_CTS	In UART mode, this pin is Clear To Send Signal.
55	SPI_SSEL#	Select line for USBwiz in SPI mode
56	TCK	Leave unconnected
57	USBwiz_RESET#	Reset signal for USBwiz. USBwiz reset is required after power up.
58	UH_CS#	Chip Select. Used for USB host chip (must have a pull-up resistor on this pin or UH_RD#)
59	VSSA	Analog Ground
60	TDI	Leave unconnected
61	XTAL2	Connect to 14.7456Mhz crystal
62	XTAL1	Connect to 14.7456Mhz crystal
63	VREF	3.3V reference for analog inputs
64	TDO	Leave unconnected

4. Communication Interface selection

4.1. Selecting an Interface

USBwiz uses UART, SPI or I2C to communicate with any external microcontroller. At power up, USBwiz samples MODE0 and MODE1 to determine what interface to use. The MODE pins have a built in pull up resistors to default the pin to 1. Do not connect these pins to VCC, leave unconnected for 1 or connect to GND for 0.

MODE0	MODE1	Interface
0	0	Force boot loader. *
1	0	I2C
0	1	UART
1	1	SPI

* In this mode the boot loader will not execute the firmware and will run UART at 9600 baud.

4.2. UART Interface

In UART mode, UART_TX pin is used to send data/responses to your microcontroller and UART_RX pin to receive commands/data from your microcontroller. The default baud rate for UART is 9600 baud, 8-bit, no parity and 1 stop bit. USBwiz can be set to different baud rates.

CTS and RTS lines must be used in high band width applications. CTS pin is an input to USBwiz. When it is high USBwiz will not send data and will wait for CTS to go low. CTS should be low as long as possible to not slow down USBwiz. RTS pin is an output from USBwiz and it is set high when USBwiz FIFO is near full. Depending on data transfer speed, RTS pin may never go high because USBwiz is contentiously emptying the FIFO.

Note: The internal UART has hardware TX FIFO that is 16 byte long. After asserting CTS, USBwiz may still send the internal FIFO, up to 16 bytes.

Important: USBwiz will NOT send any data if CTS pin is high! If this pin is not used then it must be connected to ground.

4.3. SPI Interface Mode

In SPI mode six pins are used for communication to implement slave SPI, including two

pins for handshaking. SPI_SSEL, SPI_SCK, SPI_MISO, and SPI_MOSI are the standard SPI pins where SSEL is used for Slave Select, SCK is the Serial Clock (7Mhz running and 1.75Mhz for boot loader,) MISO is the data line going from USBwiz to your microcontroller, and MOSI is the data line going from your microcontroller to USBwiz. The other two pins are used for handshaking, they are DATARDY and BUSY. DATARDY pin goes high when there is data in the USBwiz SPI buffer. When BUSY is high a user must not send any new data to USBwiz.

The boot loader in SPI is half duplex. When DATARDY pin is high, USBwiz will not accept any commands and will assume the SPI transaction is for reading the data; therefore, the incoming data will be discarded. The other handshaking pin is BUSY. Before sending any command to USBwiz this pin must be checked and data can be sent only when BUSY pin is low.

On the other hand, the firmware runs SPI in full duplex mode. When SPI is full duplex, USBwiz will accept any incoming data while it is sending simultaneously. If USBwiz has no data to send back, it will send NDT (No Data Token.) The NDT is 0xff and is completely ignored by USBwiz and should be ignored by your system as well. When reading data from USBwiz but there is nothing to send, use NDT.

In some rare cases, there could be a need to send 0xFF (writing the hex value 0xFF, not ASCII 0xFF!!) This is resolved by using HDT (Half Data Token.) HDT is the value 0xFE. Whenever USBwiz or your system sees HDT, it must wait for one more byte to decide what that value actually is. HDT followed by another HDT results in 0xFE; otherwise, it is 0xFF. Keep in mind 0xFF is always ignored even if it came after HDT.

Here is a simple ‘C’ code example:

Note that this example ignores the incoming data from SPI and it shouldn’t be used.

```
SendData(char c)
{
        if( c == 0xFF )
        {
                SendSPI(0xFE);
                SendSPI(0);
        }else if (c == 0xFE )
        {
                SendSPI(0xFE);
                SendSPI(0xFE);
        }else
        SendSPI(c);
}
```

Important: USBwiz requires the following in order for SPI to work:

- SCK is output from your system

- SCK is idle high
- SCK is lower that 7Mhz. (1.75 in boot loader)
- Data is shifted out MSB first
- Data is shifted on the rising edge

For further details and timing diagrams, consult LPC2134 datasheet and manual from NXP Semiconductor.

4.4. I2C Interface Mode

Four pins are needed for I2C communication. The USER_I2C_SCL and USER_I2C_SDA are the two I2C bus lines. I2C_DATARDY and I2C_BUSY lines work exactly the same way as SPI_DATARDY and SPI_BUSY work. USBwiz runs in slave I2C mode always. The slave address of USBwiz is 0xA4. This address is fixed and can't be changed.

5. Getting Started with USBwiz

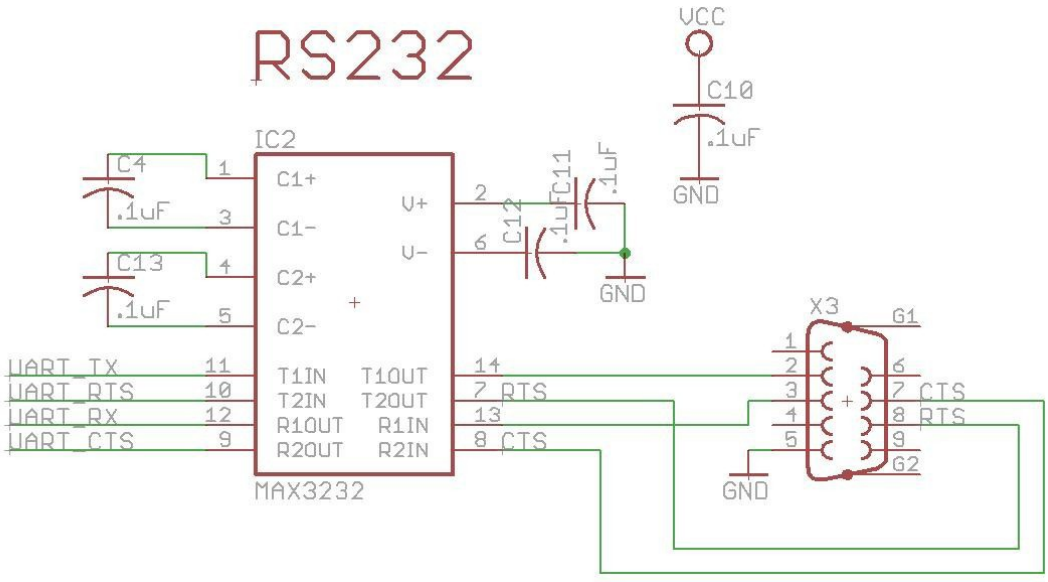
The following chapter give simple steps to get USBwiz working for first time user and that is through UART interface.

All you need:

- USBwiz OEM board
- RS232 adapter connected to UART Tx/Rx and connected to PC COMx
- PC COMx access through a terminal program
- USBwiz latest firmware

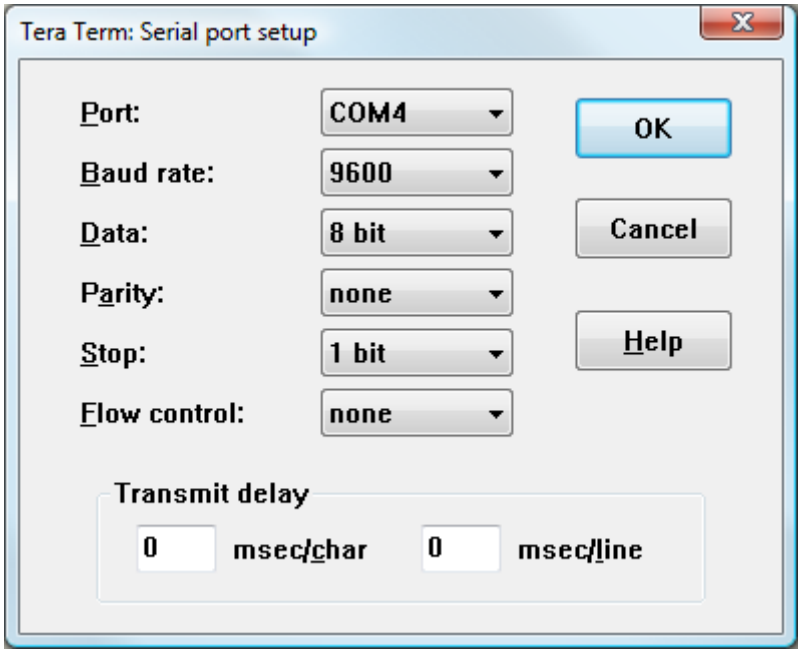
Step-by-Step:

1. confirm that all hardware connections are made:
   - MODE pins are set to UART mode
   - Power is connected
   - RS232 adapter signals connections and let's assume it is connected to PC COM4. If CTS and RTS signals are not available, user can ground CTS. Note that USBwiz and the OEM boards are TTL levels and UART signals are 0V to 5V, but the PC is RS232 -12V to 12V, therefore, you need a RS232 circuit. There are some RS232 converters available such as MAX3232. See schematic below:

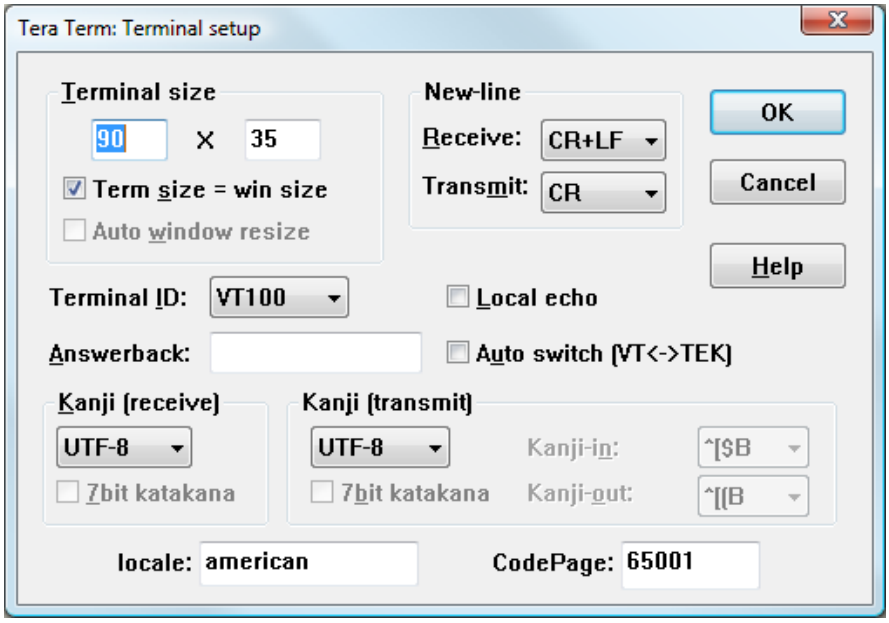


Other options are using USB to UART modules or cables. You will have a virtual COM port on your PC that communicates with USBwiz. Examples are UM232R and TTL-232R from FTDI.

2. Open COM port using a terminal program, for example TeraTerm, and ensure the baud rate is 9600, 8 data bits, 1 stop bit and no handshaking.



3. Select to receive a line end with the line feeds (LF+CR), because USBwiz only sends CR. For transmitting, only CR should be sent.



4. Reset the chip and you will get the GHI electronics banner similar to the following:

```
GHI Electronics, LLC
----------------------------
Boot Loader x.xx
USBwiz(TM) x.xx
!00
```

5. To update firmware, please refer to boot loader section in this document.

µPICFAT™ Development Board

For even easier and faster startup, GHI offers a development system for µALFAT and USBwiz. This is the component that provides power and communication to µALFAT/USBwiz. It also provides the serial interface to your computer, and contains the PIC micro controller PIC18F453 that will be used to interface to µALFAT/USBwiz. Complete with a programming port for direct interface to the ICD 2™ programmer. UPICFAT provides both 3.3V and 5.0V.

6. 1. USBwiz Functions

6.1. Commander

The commands and response in USBwiz are made in a way where they can be understood and read by a human and can be easily parsed by any simple 8-bit micro. Each command is 2 characters. Some commands take parameters and others don't. For example, VR command doesn't take any parameters and it returns the version number. On the other hand, MD requires parameter to run. MD creates (makes) a folder on the accessed media device. 'MD LOG' creates a folder with the name LOG.

Note: Commands has specific format, please refer to USBwiz Command Set.

6.2. FAT Storage Media

USBwiz can connect to two kinds of storage media types. The media types are SD/MMC cards and USB Mass Storage device (SCSI command subclass, bulk only protocol) which includes thumb flash, USB hard drives and card readers. USBwiz supports three simultaneous FAT devices. Keep in mind that all devices must be formatted FAT12, FAT16 or FAT32.

USBwiz can mount up to 3 File System Medias that are independent from each other, which means that all opened files and operations in one file system has no effect on the others. This gives USBwiz very great capability of flexible switching between the file system Medias and providing other valuable functions like reading from file in one Media and writing back in other file in another media at the same time.

To access FAT Storage Media, the media need to be mounted using FAT Mount command. Once the device is mounted, you can use any of the file access commands.

Example: Mount File System on SD/MMC:

```
FM S
MD FOLDER
```

Directories (Folders)

Folders are supported by USBwiz. Use Change Directory command (CD) to change Folders.

```
MD USBWIZ       Create “USBWIZ” folder
CD USBWIZ       Change the current folder access to “USBWIZ” folder
```

Files

USBwiz allows you to open up to 4 files at the same time using file handles. This is not how many files USBwiz can open on a drive. USBwiz can open thousand of files same as your PC. Handles are used for fast access to a file. If a user needs to log data to 2 files at the same time, “VOLTAGE.LOG” and “CURRENT.LOG” file handles become very useful. To do so, open VOLTAGE.LOG under handle 1 and CURRENT.LOG under handle 2. Now start sending your data to handle 1 and 2 instead of the file name. Handles can even point to files on different medias because USBwiz contains three independent FAT cores.

6.3. USB Mass Storage

USBwiz has an internal USB Mass Storage Driver that can control two Mass Storage Devices at the same time. In case there is a requirement to access a LUN, FM command can be used with the LUN extension. FM p>l where p is the port number and l is the LUN number. FM p command alone will use LUN0

```
FM 0
```

6.4. USB Human Interface Device

This USB class includes vast range of HID devices. Examples are: joysticks, mice and keyboards.

First, the HID must be registered like any other USB device. We will initialize the HID which is attached to USB port 1:

```
UH 1
```

Now USBwiz is ready get data from the HID which can be performed by Read HID:

```
HR 1
```

Then USBwiz will output the data size of the HID. Now, we can repeat HR 1 to read more data from the device. It is normal for HR to return code “HID_NO_DATA”.

When the user read data from HID devices, it can represent different things depending on the HID device. For example, it can represent a mouse move or a keyboard button press. Your reference should be USB Device Class Definition for Human Interface Devices and USB HID Usage Table from www.usb.org

Keyboard

Most keyboards return 8 bytes in the HID report which are decoded as follows:

First byte is the modifier byte: (When the bit is set, the associated button is pressed)

Modifier Key	Bit Order
Left CTRL	0
Left SHIFT	1
Left ALT	2
Left GUI	3
Right CTRL	4
Right SHIFT	5
Right ALT	6
Right GUI	7

Key array bytes follows with each byte represent a pressed key. Thus, several pressed keys can be reported at the same time. When many keys are pressed and the keyboard cannot handle them, it will return an error in the HID report. Here are the codes for the keys in this array:

Usage ID (Hex)	Usage Name	Remarks
00	Reserved (no event indicated)	Status indicator, Not a physical Button
01	Keyboard ErrorRollOver	Status indicator, Not a physical Button
02	Keyboard POSTFail	Status indicator, Not a physical Button
03	Keyboard ErrorUndefined	Status indicator, Not a physical Button
04	Keyboard a and A	remapped for other languages
05	Keyboard b and B	
06	Keyboard c and C	remapped for other languages
07	Keyboard d and D	
08	Keyboard e and E	
09	Keyboard f and F	
0A	Keyboard g and G	
0B	Keyboard h and H	
0C	Keyboard i and I	
0D	Keyboard j and J	
0E	Keyboard k and K	
0F	Keyboard l and L	
10	Keyboard m and M	remapped for other languages
11	Keyboard n and N	
12	Keyboard o and O	remapped for other languages
13	Keyboard p and P	remapped for other languages
14	Keyboard q and Q	remapped for other languages
15	Keyboard r and R	
16	Keyboard s and S	remapped for other languages
17	Keyboard t and T	

18	Keyboard u and U	
19	Keyboard v and V	
1A	Keyboard w and W	remapped for other languages
1B	Keyboard x and X	remapped for other languages
1C	Keyboard y and Y	remapped for other languages
1D	Keyboard z and Z	remapped for other languages
1E	Keyboard 1 and !	remapped for other languages
1F	Keyboard 2 and @	remapped for other languages
20	Keyboard 3 and #	remapped for other languages
21	Keyboard 4 and $	remapped for other languages
22	Keyboard 5 and %	remapped for other languages
23	Keyboard 6 and ^	remapped for other languages
24	Keyboard 7 and &	remapped for other languages
25	Keyboard 8 and *	remapped for other languages
26	Keyboard 9 and (	remapped for other languages
27	Keyboard 0 and)	remapped for other languages
28	Keyboard Return (ENTER)	Keyboard Enter and Keypad Enter generate different Usage codes
29	Keyboard ESCAPE	
2A	Keyboard DELETE (Backspace)	
2B	Keyboard Tab	
2C	Keyboard Spacebar	
2D	Keyboard - and (underscore)	remapped for other languages
2E	Keyboard = and +	remapped for other languages
2F	Keyboard [and {	remapped for other languages
30	Keyboard] and }	remapped for other languages
31	Keyboard \ and |	
32	Keyboard Non-US # and ~	
33	Keyboard ; and :	remapped for other languages
34	Keyboard ‘ and “	remapped for other languages
35	Keyboard Grave Accent and Tilde	remapped for other languages
36	Keyboard, and <	remapped for other languages
37	Keyboard . and >	remapped for other languages
38	Keyboard / and ?	remapped for other languages
39	Keyboard Caps Lock	
3A	Keyboard F1	
3B	Keyboard F2	
3C	Keyboard F3	
3D	Keyboard F4	
3E	Keyboard F5	
3F	Keyboard F6	
40	Keyboard F7	
41	Keyboard F8	
42	Keyboard F9	
43	Keyboard F10	
44	Keyboard F11	
45	Keyboard F12	
46	Keyboard PrintScreen	
47	Keyboard Scroll Lock	
48	Keyboard Pause	

49	Keyboard Insert	
4A	Keyboard Home	
4B	Keyboard PageUp	
4C	Keyboard Delete Forward	
4D	Keyboard End	
4E	Keyboard PageDown	
4F	Keyboard RightArrow	
50	Keyboard LeftArrow	
51	Keyboard DownArrow	
52	Keyboard UpArrow	
53	Keypad Num Lock and Clear	
54	Keypad /	
55	Keypad *	
56	Keypad -	
57	Keypad +	
58	Keypad ENTER	Keyboard Enter and Keypad Enter generate different Usage codes
59	Keypad 1 and End	
5A	Keypad 2 and Down Arrow	
5B	Keypad 3 and PageDn	
5C	Keypad 4 and Left Arrow	
5D	Keypad 5	
5E	Keypad 6 and Right Arrow	
5F	Keypad 7 and Home	
60	Keypad 8 and Up Arrow	
61	Keypad 9 and PageUp	
62	Keypad 0 and Insert	
63	Keypad . and Delete	
64	Keyboard Non-US \ and |	
65	Keyboard Application	
66	Keyboard Power	
67	Keypad =	
68	Keyboard F13	
69	Keyboard F14	
6A	Keyboard F15	
6B	Keyboard F16	
6C	Keyboard F17	
6D	Keyboard F18	
6E	Keyboard F19	
6F	Keyboard F20	
70	Keyboard F21	
71	Keyboard F22	
72	Keyboard F23	
73	Keyboard F24	
74	Keyboard Execute	
75	Keyboard Help	
76	Keyboard Menu	
77	Keyboard Select	
78	Keyboard Stop	
79	Keyboard Again	

7A	Keyboard Undo	
7B	Keyboard Cut	
7C	Keyboard Copy	
7D	Keyboard Paste	
7E	Keyboard Find	
7F	Keyboard Mute	
80	Keyboard Volume Up	
81	Keyboard Volume Down	
82	Keyboard Locking Caps Lock	
83	Keyboard Locking Num Lock	
84	Keyboard Locking Scroll Lock	
85	Keypad Comma	
86	Keypad Equal Sign	
8A	Keyboard International4	
8B	Keyboard International5	
8C	Keyboard International6	
8D	Keyboard International7	
8E	Keyboard International8	
8F	Keyboard International9	
90	Keyboard LANG1	
91	Keyboard LANG2	
92	Keyboard LANG3	
93	Keyboard LANG4	
94	Keyboard LANG5	
95	Keyboard LANG6	
96	Keyboard LANG7	
97	Keyboard LANG8	
98	Keyboard LANG9	
99	Keyboard Alternate Erase	
9A	Keyboard SysReq/Attention	
9B	Keyboard Cancel	
9C	Keyboard Clear	
9D	Keyboard Prior	
9E	Keyboard Return	
9F	Keyboard Separator	
A0	Keyboard Out	
A1	Keyboard Oper	
A2	Keyboard Clear/Again	
A3	Keyboard CrSel/Props	
A4	Keyboard ExSel	
A5-CF	Reserved	
B0	Keypad 00	
B1	Keypad 000	
B2	Thousands Separator	
B3	Decimal Separator	
B4	Currency Unit	
B5	Currency Sub-unit	
B6	Keypad (	
B7	Keypad)	

B8	Keypad {	
B9	Keypad }	
BA	Keypad Tab	
BB	Keypad Backspace	
BC	Keypad A	
BD	Keypad B	
BE	Keypad C	
BF	Keypad D	
C0	Keypad E	
C1	Keypad F	
C2	Keypad XOR	
C3	Keypad ^	
C4	Keypad %	
C5	Keypad <	
C6	Keypad >	
C7	Keypad &	
C8	Keypad &&	
C9	Keypad |	
CA	Keypad ||	
CB	Keypad :	
CC	Keypad #	
CD	Keypad Space	
CE	Keypad @	
CF	Keypad !	
D0	Keypad Memory Store	
D1	Keypad Memory Recall	
D2	Keypad Memory Clear	
D3	Keypad Memory Add	
D4	Keypad Memory Subtract	
D5	Keypad Memory Multiply	
D6	Keypad Memory Divide	
D7	Keypad +/-	
D8	Keypad Clear	
D9	Keypad Clear Entry	
DA	Keypad Binary	
DB	Keypad Octal	
DC	Keypad Decimal	
DD	Keypad Hexadecimal	
DE-DF	Reserved	
E0	Keyboard LeftControl	Used if modifier byte is not supported
E1	Keyboard LeftShift	Used if modifier byte is not supported
E2	Keyboard LeftAlt	Used if modifier byte is not supported
E3	Keyboard Left GUI	Used if modifier byte is not supported
E4	Keyboard RightControl	Used if modifier byte is not supported
E5	Keyboard RightShift	Used if modifier byte is not supported
E6	Keyboard RightAlt	Used if modifier byte is not supported
E7	Keyboard Right GUI	Used if modifier byte is not supported
E8-FFFF	Reserved	

Example: This example is taken from USB HID specifications. It assumes a 4-bytes HID report for a keyboard:

Key Event	Modifier Byte	Array	Array	Array	Comment
None	00000000B	00H	00H	00H	
RALT down	01000000	00	00	00	
None	01000000	00	00	00	Report current key state even when no new key events.
A down	01000000	04	00	00	
X down	01000000	04	1B	00	
B down	01000000	04	05	1B	Report order is arbitrary and does not reflect order of events.
Q down	01000000	01	01	01	Phantom state. Four Array keys pressed. Modifiers still reported.
A up	01000000	05	14	1B	
B and Q up	01000000	1B	00	00	Multiple events in one report. Event order is indeterminate.
None	01000000	1B	00	00	
RALT up	00000000	1B	00	00	
X up	00000000	00	00	00	

Mouse

Most mice return 4 bytes in the HID report which are decoded as follows:

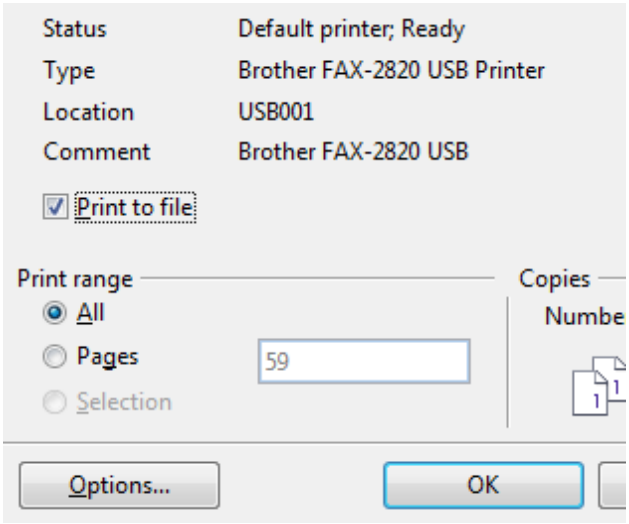
Byte0		Byte1	Byte2	Byte3
5 bits	3 bits			
Reserved	Buttons b0 left b1 right b2 middle	X position	Y position	Scroll Position
Constant	Variable	Variable	Variable	Variable
NULL	Absolute	Relative to the last position	Relative to the last position	Relative to the last position
0	Up=0 Down=1	-127 +127	-127 +127	-127 +127

6.5. USB Printers

USBwiz Printer driver support those that have interface with unidirectional protocol. The way USB printers work is very similar to Parallel port printers. But instead of the data going over the Parallel port, it is transferred over USB. This means that the application needs to know what data/scripts to be sent to the printer. USBwiz sends the data to the Printer as-is where the user's application needs to use appropriate printer scripting, just like in Parallel Port printers. Some of the printers scripts include PCL (from HP), ESC-P (from Epson.), and Postscript.

Note that low cost printers do not have any available scripting. Sometimes these are called “Windows only” printers. The reason behind the low cost is that the processor on these printers is very simple, it gets pre-processed data from windows. The printer driver software is actually what processes the image/text on the host PC and then sends final data to the printer. These printers can't be used with USBwiz unless specifications are provided by the manufacture, which are usually proprietary and very hard to obtain.

There is an easy way to test any USB printer, including those ones that do not have scripts support. First, we need the printer connected to a Windows PC with installed drivers. Create any simple document (small text file) on the PC and click print. This will bring up the “Print” window. On the drop-down menu, select the printer you need to test with USBwiz and then make sure you click the check-box “Print to file” as shown below.



Click “OK” and windows will prompt for a file name and location. Save the file anywhere you like. This file contains a processed data for the printer you selected earlier. Now, all we have to do is transfer the file to the printer using USBwiz.
Disconnect the printer from the PC and connect it to USBwiz. The file we generated earlier can go on an SD card or USB drive.

First command to be used is USB register printer UP:

```
UP 0
```

Now you can preform any printer commands, such as reset.

```
PR 0
```

The actual print command PP, will accept up to 255 bytes of data for every transfer. You can safely call the PP more than once.

```
PP 0>4
```

Get Printer Status Command PS is used to Get Printer Standard Status Byte which is identical to status byte that is usually returned from Parallel Port printers.

6.6. USB Serial Devices

USBwiz supports many serial USB devices. Communication Device Class (CDC) is one of them. This can be a USB modem or a cell phone. AT commands can be used to dial numbers, send SMS messages and transfer data on some of the CDC USB modems. Check your cellphone manual for a list of supported AT commands. Other serial devices are Prolific, Silabs and FTDI serial (UART) to USB converters. Most USB GPS modems out there use Prolific chipset. This allows you to connect a USB GPS to USBwiz. Same for Silabs and FTDI chipsets. Many devices use one of these chips and therefore they can communicate with USBwiz as easy as any other USB devices.

```
US 0>F>2850          Register an FTDI device at port 0
SW 0>4               Send 1234 to FTDI
```

6.7. Raw USB Access

Accessing a USB device is divided into three stages:

1. Enumeration stage: Includes USB addressing.
2. Learning Stage: Querying about the USB device and performing the required setup. (Setup transfers, opening Pipes, ...).
3. Read/Write Pipes stage.

Example: Accessing a USB mouse:

Stage 1:

Assign a device handle 0 for the connected device on port 0,

```
UI 0>0
```

Stage 2:

Load device descriptor into the internal Buffer,

```
LD 0>D
```

This is an optional command, since it is only used to display the internal buffer contents,

```
DB A
```
Output: *Device descriptor size + Device descriptor data in the internal buffer*

Load the first configuration descriptor into the internal buffer,

```
LD 0>C0
```

This is an optional command, since it is only used to display the internal buffer contents,

```
DB A
```
Output: *configuration descriptor size + configuration descriptor data in the internal buffer.*

Set the desired configuration which is, in this case, the first configuration,

```
SC 0>1
```
Note that using 0 means go back to addressing mode stage.

Find the specific Interface descriptor in the previously loaded Configuration descriptor in the internal buffer,

```
FI 03 01 02 00
```

class =HID, subclass=bootable, protocol=mouse, index=the 1st found interface descriptor that match this criteria.
Output: *The found interface descriptor size + the data*

It is also possible to use the following:

```
FI 03 FF FF 00
```

class=HID subclass=don't care, protocol=don't care, index=the 1st found interface descriptor that match this criteria.
Output: *The found interface descriptor size + the data.*

We will get the same result, if the device is a USB mouse with no other HID interfaces.

Set the found Interface,

```
SI
```

Find an Endpoint that belongs to the previously found Interface

```
FE 03 02

transfer= interrupt, direction= input
Output: found Endpoint descriptor size + the data
```

Open Pipe to the selected endpoint and assign handle 6 to it,

```
OP 6
```

It is also possible to search for any kind of descriptors in the loaded internal buffer using the FD command,

Example: Find the 1st HID descriptor in a previously loaded configuration descriptor,

```
FD 21 00

Output:
!00
$09
09 21 10 01 00 01 22 34 00
!00
```

Stage 3:

Read 4 bytes from Pipe 6

```
RP 6>04
```

Close Pipe

```
CP 6
```

Also, using the Setup command, it is possible to send setup requests on the default control pipe using the SS command,

Example: Get Device descriptor

```
SS device_handle>80 06 0100 0000 0012

Output:
0x12 0x01 0x10 0x01 0x00 0x00 0x00 0x08 0x2A 0x06 0x00 0x00 0x00
0x00 0x00
0x00 0x00 0x01
```

7. USBwiz Command Set

All commands below are entered in ASCII. We choose to use ASCII to simplify troubleshooting and to allow humans to enter commands easily. A special case is when accessing the data inside or outside a file. When writing/reading to/from a file or USB Pipe, USBwiz will use any kind of data. Basically, what you send is what goes on the file. It doesn't have to be ASCII.

When USBwiz is done processing a command, it will return an error code in the form "! xx<CR>" where xx is the error number. Also, some commands require returning some extra information. Returned data will come after the symbol $, unless noted otherwise.

You can send multiple commands to USBwiz until its FIFO is full (indicated by BUSY or RTS.) USBwiz will take the commands in one at the time, process them and send responses for each one. Always terminate commands with carriage return character.

Command	Description	Command	Description
BL	Update Firmware	**IT**	Initialize Real Time Clock
ST	Set Real Time Clock	**GT**	Get Current Real Time Clock
VR	Get Version Number	**BR**	Set UART Baud Rate
RT	Reset Firmware	**EE**	Enable/Disable Echo
RS	Read Sector	**WS**	Write Sector
FM	Mount File System	**DS**	Device Switch
II	Get USB Device Info	**UM**	Register USB Mass Storage
SD	Initialize SD card	**MS**	Get Media Statistics
QF	Quick Format Media	**IL**	Initialize List Files and Folders
NF	Get Next Directory Entry	**MD**	Make Directory
CD	Change Directory	**RD**	Remove Directory
OF	Open a file for read, write or append	**CF**	Close File Handle
FF	Flush File Data	**RF**	Read from File
WF	Write to File	**SH**	Shadow Write to multiple Files
RW	Read from File, Write to other file	**SF**	Split file
PF	Seek File	**FP**	Get Current File Pointer Position

Command	Description	Command	Description
ZF	Resize File	**DF**	Delete File
IF	Find File or Folder	**ND**	Rename File or Folder
UH	Register USB Human Interface Device	**HR**	Read HID Report
UP	Register USB Printer	**PR**	Reset USB Printer
PS	Get USB Printer Status	**PP**	Send Data to USB Printer to print
US	Register Serial Communication Device	**SR**	Read Serial Device
SW	Write to Serial Device	**EV**	Enable Events
SK	Store Key	**CK**	Check Key
TF	Print File	**UI**	Enumerate USB Device
UR	Release USB Device Handle	**LD**	Load USB Descriptor
DB	Display Internal buffer	**SC**	Set Configuration
FI	Find Interface	**SI**	Set Interface
FE	Find Endpoint	**FD**	Find Descriptor
SS	Send Setup Request	**OP**	Open USB Pipe
CP	Close Pipe Handle	**RP**	Read Pipe
WP	Write Pipe		

Notes on commander:

- Any command must not exceed 38 bytes and must be terminated with a carriage return.
- The user must read back the responses for each command properly and check whether the command was successful.
- The command format must be followed with the same number of arguments. Also, extra spaces count as errors.
- All numbers are Hexadecimal represented in ASCII. For example, to send the decimal number 16 to USBwiz which is 10 in Hexadecimal, you send 0x31 which is ASCII for 1 and 0x30 which is ASCII for 0. Also, for Hexadecimal numbers A to F, they must be entered in upper case letters.
- In all command's output description below, will assume the commands succeeded. n case of failure, the command would return an error code instead of success and alt. In other words, in any command, a !00 denotes success and the command can resume operation. But in case of failure, the error code is !xx, where xx is the error number and then the current command halt and the commander resume processing

further commands.

- Some commands have multiple error codes !xx, usually, the first error code denotes the command is accepted and then it is processed. Another error code is sent when the command has finished processing successfully. This is useful, because some commands can take some time to finish, so the first error can note that the command is accepted and then the user can do other application processing and then return to read the final error code.
- Below, data sent to USBwiz are BLACK and data received are RED. <CR> is a carriage return which is the Enter key on a keyboard, ASCII value 0x0D or in C language '\r'. <SP> is a space which is ASCII value 0x20.
- File/Folder names has a certain format and certain accepted characters according to the FAT File System. USBwiz supports Earlier FAT File Systems used short file names (noted as 8.3) which have the following features:
  - ASCII format
  - Only capital letters
  - Maximum of 8 characters for the file name
  - Maximum of 3 characters for the file extension
  - No spaces are allowed
  - Only one dot is allowed preceding the file extension
  - Numbers are allowed
  - The following characters are allowed: $ % ' - _ @ ~ ` ! ( ) { } ^ # &

BL - Update Firmware Using Boot Loader

Updates USBwiz firmware. The firmware can be updated from the Boot Loader or from the firmware using this command.

Upon initiating the command, USBwiz switches to Boot Loader mode and updates the firmware automatically. For details on updating the firmware, please consult the description for the Boot Loader and updating the firmware.

Format	BL<SP>d<CR> Switches to Bootloader mode and updates automatically	d The device type and can be S for SD or 0/1 for the USB port number
Example	BL<SP>0<CR>	Load new firmware from USB memory on port 0

IT - Initialize Real Time Clock

USBwiz has a built in real time clock that is used to save the date on the created files. Users need to specify if USBwiz will be running the RTC using the same oscillator as USBwiz or separate 32Khz oscillator and a battery. The advantage of running the RTC on a 32Khz oscillator and battery is that it will not loose the time when losing the main power source of USBwiz.

Format	IT<SP>t<CR> !00<CR>	t The mode to run RTC on. Can be B for backup battery or S for share mode with the oscillator used for USBwiz.
Example	IT<SP>S<CR> !00<CR>	Run RTC clock from same oscillator and power as USBwiz.

ST - Set Real Time Clock

After the time is set, the RTC inside USBwiz will keep track of the time. The accuracy of the RTC is 2 seconds.

Format	ST<SP>t<CR> !00<CR>	t The time and date as 32 bits that is formed as in the structure below.
Example	ST<SP>34210000<CR> !00<CR>	Set clock to 1/1/2006 00:00:00

* Time and Date structure is a 32-bits standard structure used in FAT system. For example, 0x34212002 is 01/01/2006 – 04:00:04

Bits(s)	Field	Description	0x34212000 Bits in Binary
31..25	Year1980	Years since 1980	001 1010
24..21	Month	1..12	0001
20..16	Day	1..31	0 0001
15..11	Hour	0..23	0 0100
10..5	Minute	0..59	00 0000
4..0	Second2	Seconds divided by 2 (0..30)	0 0010

GT - Get Current Real Time Clock

Obtains the current time. Returned value can be a 32-bit hex number or an ASCII string.

Format	GT<SP>f<CR> !00<CR> (DWORD or ASCII string time data)<CR> !00<CR>	f Returned data can be 32-bit hex (value X) or formatted ASCII string (value F)

Example 1	GT<SP>F<CR> !00<CR> 01/20/2006<SP>-<SP>06:21:04<CR> !00<CR>	Get time in formatted ASCII format.
Example 2	GT<SP>X<CR> !00<CR> $34210000<CR> !00<CR>	Get time in DWORD HEX.

VR - Get Version Number

It prints the version number of USBwiz firmware. Note that this version is not same or related to the version number of the boot loader nor the OEM boards we offer.

Format	VR<CR> USBwiz<SP>M.mm<CR> !00<CR>	M Major number mm minor number
Example	VR<CR> USBwiz<SP>2.28<CR> !00<CR>	

BR - Set UART Baud Rate

UART defaults to 9600 at power up. This is extremely slow but some systems don't support faster bauds. The baud rate can be set to many different standard baud rates. BR command sets the internal divider registers of the UART hardware. This way any possible baud rate can be set. To calculate the divider value use (OSC*4/BaudRate/16) The OSC we use on USBwiz is 14745600. The baud rate value is lost on reset and UART goes back to 9600.

Format	BR<SP>vvvv<CR> !00<CR>	vvvv: WORD HEX Baud Rate Divider
Example	BR<SP>0020<CR> !00<CR>	Baud Rate is 115200

Some common values:

Baud Rate	Divider in decimal	Divider in HEX
9600	384	0180
19200	192	00C0
38400	96	0060
57600	64	0040
115200	32	0020
921600	4	0004

RT - Reset Firmware

Format	RT<SP>OK<CR>	

EE - Enable/Disable Echo

To echo the sent data to USBwiz.

Format	EE<SP>h<CR> !00<CR>	h can be 0 to disable echo and 1 to enable echo
Example	EE<SP>1<CR> !00<CR>	Enables echo

RS - Read Sector

Format	RS<SP>mssssssss<CR> !00<CR> 512 Bytes is returned in HEX mode and (512*2 in ASCII mode) !00<CR>	Read Sector from the current File System Media m Returned data mode. H for HEX and A for ASCII. ssssssss HEX DWORD sector address
Example	RS<SP>H0<CR>	Read Sector 0

WS - Write Sector

Format:	WS<SP>ssssssss<CR> !00<CR> 512 Bytes must be sent to USBwiz !00<CR>	Write to Sector from the current File System Media ssssssss HEX DWORD sector address
Example	WS<SP>0<CR>	Write to Sector 0

FM - Mount File System

USBwiz can mount up to 3 File System Medias that are independent from each other, which means that all opened files and operations in one file system have no effect on the others. This gives USBwiz very great capability of flexible switching between the file system Medias and providing other valuable functions like reading from file in one Media and write it back in other file in another media at the same time.

FM takes the responsibility of mounting the dedicated File System and doing any necessary USB commands for USB memory.

Currently USBwiz accesses the first primary partition of a storage media by default. However, it can be forced into mounting the second primary partition which might be useful on some systems (iPods for example).

Format	FM<SP>d<CR> !00<CR>	Mount File System for device d d can be S for SD, 0 for USB 0 or 1 for USB 1
	FM<SP>d>l<CR>	Mount File System for device d and LUN l

	FM <SP>d>>2<CR> !00<CR>	Mount File system on the second primary partition of device d.
Example	FM<SP>0<CR> !00<CR>	Mount device on USB port 0 and use default LUN 0
	FM<SP>1>4<CR>	Mount device on USB port 1 and use LUN 4
	FM<SP>0>>2<CR> !00<CR>	Mount device on USB port 0 and use default LUN 0. Skip partition 1 and mount primary partition 2.

DS - Device Switch

Device Switch command switches the file access to different File System. The FM command automatically calls DS on the last successfully mounted media.

Format	DS<SP>d <CR> !00<CR>	d Can be S, 0 or 1
Example	DS<SP>S<CR> !00<CR>	Switch access to SD card

II - Get USB Device Info

Displays the available USB interfaces (functionalities). USB class, sub class and protocol are displayed for each found interface.

Note: This command resets the device.

Format	II<SP>p<CR> !00<CR> $vvvv>pppp>nn<CR> $cc>ss>rr<CR> !00<CR>	Read device info on port p Device vendor ID vvvv and product ID pppp. nn: The found interfaces count. Then one or more entries depending on the interfaces count where cc class, ss subclass rr protocol of the interface.
Example	II<SP>0<CR> !00<CR> $1234>5678>1<CR> $04>02>01<CR> !00<CR>	Read device info on port 0 This device has one interface.

UM - Register USB Mass Storage

USB Memory register command. Use it in case you need to read or write sectors from a USB memory that doesn't have FAT file system. This command is not needed if FM command is used.

Format1	UM<SP>p <CR> !00<CR>	p The port and can be 0 or 1

Example1	UM<SP>0<CR> !00<CR>	Register USB memory and use LUN 0
Format2	UM<SP>p>l<CR> !00<CR>	p The port and can be 0 or 1 l The LUN number
Example2	UM<SP>0>1<CR> !00<CR>	Register USB memory on port 0 and use LUN1

SD - Initialize SD card

Initialize SD card and have it ready for sector read and write. This is only needed if accessing media with no FAT file system and the user needs to use read/write sector commands. This is not needed if FM command is used.

Format	SD<CR> !00<CR>	
Example	SD<CR> !00<CR>	

MS - Get Media Statistics

Format	MS<CR> !00<CR> $ssssssss<SP>$ffffffff<CR> !00<CR>	ssssssss HEX DWORD Media Size In Sectors ffffffff HEX DWORD Free Size In Sectors

QF - Quick Format Media

This command cleans File Allocation Table only. No change occurs to Boot Sector or MBR.

Format	QF<SP>CONFIRM FORMAT<CR>

IL - Initialize List Files and Folders

It sets List Files and Folders Function pointer to the first Directory entry in the current root.

Format	IL<CR> !00<CR>

NF - Get Next Directory Entry

This command will print out the Directory Entry “File or Folder” and increments the Files and Folders list pointer.

Format	NF<CR> !00<CR> NNNNNNNN.EEE<SP>AA<SP>	NNNNNNNN File Name EEE File Extension AA HEX Byte File Attributes*

	ssssssss<CR> !00<CR>	ssssssss HEX DWORD File Size
Example	NF<CR> !00<CR> TEST0001.TXT<SP>00<SP> 0000FE23<CR> !00<CR> NF<CR> !00<CR> TEST0002.TXT<SP>00<SP> 00001234<CR> !00<CR>	Passing NF command two times and get the results.

* File Attributes are one byte Standard Attribute Structure in FAT system.

7	6	5	4	3	2	1	0
Reserved		Archive	Folder	Volume ID	System	Hidden	Read Only

MD - Make Directory

Creates a folder in the current directory (folder).

Format	MD<SP>foldername<CR> !00<CR>	
Example	MD<SP>MYFOLDER<CR> !00<CR>	Create a folder with name MYFOLDER

CD - Change Directory

Changes the current folder access. Folder must exist.

Format	CD<SP>foldername<CR> !00<CR>	
Example	CD<SP>MYFOLDER<CR> !00<CR>	

RD - Remove Directory

This command removes directory. The directory must be empty from any files or subdirectories.

Format	RD<SP>foldername<CR> !00<CR>	
Example	RD<SP>MYFOLDER<CR> !00<CR>	Remove the folder with name MYFOLDER

OF - Open a file for read, write or append

To open a file for read, write or append in the current Folder, use OF command. The command require a file handle and the access mode.

Open Modes are:

- 'R' Open for read, requires the file to already exist in the current media and the current accessed folder.
- 'W' Open for write, will create a new file and give write privilege to it. If the file already exists, it will be erased first then will open a new one for write.
- 'A' Open for append, will create a new file and give write privilege to it. If the file already exists, it will append data to the end.

Note: USBwiz has 4 available file handles. This is the number of files that can be open at any time and is not related to the number files USBwiz can access. USBwiz is able access unlimited number of files.

Format	OF<SP>nM>filename<CR> !00<CR>	Open file foldername with file handle n and access mode M M can be R,W or A n can be 0, 1, 2 or 3
Example	OF<SP>1R>VOLTAGE.LOG<CR> !00<CR>	Open file VOLTAGE.LOG with file handle 1 with read access mode.
	OF<SP>0W>CURRENT.LOG<CR> !00<CR>	Open file CURRENT.LOG with file handle 0 with write access mode.

FF - Flush File Data

Flushes the opened file. All buffered data will be written to the storage media. The file will still be opened and associated with a handle, after performing this operation. This command is useful to make sure all data are written to the media when needed.

If **any** data is written to a file, the file must be flushed (or closed – CF command) when done. Otherwise, the file and/or the file system might get corrupted.

Format	FF<SP>n<CR> !00<CR>	Flush File handle n

CF - Close File Handle

This command issues a flush file (FF – Command) automatically and then closes the file handle. Afterwards, the handle will available for future use.

Format	CF<SP>n<CR> !00<CR>	Close File handle n

RF - Read from File

After opening a file, any amount of data can be read using this command. To read more data, send another RF command and so on. If all requested data is not available (reached file end), USBwiz will pad the output with a filler byte given by the user.

When reading, the data is sent directly to the user with no formatting (no interpretation or conversion).

Format	RF<SP>nM>ssssssss<CR> !00<CR> ssssssss Bytes is returned $aaaaaaaa<CR> !00<CR>	n File Handle M Filler Character ssssssss HEX DWORD desirable data size to be read aaaaaaaa HEX DWORD actual read data from file size
Example	We have a file with 8 bytes (ABCDEFGH) in it, and it is opened for read with handle number 2.	
	RF<SP>2Z>5<CR> !00<CR> ABCDE $00000005<CR> !00<CR> RF<SP>2Z>5<CR> !00<CR> FGHZZ $00000003<CR> !00<CR>	Read 5 bytes twice from a file handle 2 with filler Z

WF - Write to File

After opening a file, any amount of data can be written using this command. To write more data, send another WF command and so on. Note that if first error code is not !00 (an error occurred), the command would halt and further commands are processed, so sending the file data upon an error code would result in the data being not being written and processing these data as commands.

When writing, the sent data is written directly to the file with no formatting (no interpretation or conversion). Also, when requesting to write a certain amount of bytes, all of them must be sent; if an error occurs while writing, USBwiz still expects all bytes before producing the final error code.

If **any** data is written to a file, the file must be flushed (FF command) or closed (CF command) when done. Otherwise, the file and/or the file system might get corrupted.

Format	WF<SP>n>ssssssss<CR> !00<CR>	n File Handle ssssssss HEX DWORD data size to be

	User sends data $aaaaaaaa<CR> !00<CR>	written aaaaaaaa HEX DWORD actual written size
Example	WF<SP>1>10<CR> !00<CR> 1234567890abcdef $00000010<CR> !00<CR>	Write 16 bytes to the file opened with handle 1

SH - Shadow Write to multiple Files

This command is similar to WF command except that it writes the same data into two or three files simultaneously.

Format 1	SH<SP>n<SP>m>ssssssss<CR> !00<CR> User sends data $aaaaaaa1 !00<CR> $aaaaaaa2 !00<CR>	N First File Handle m Second File Handle ssssssss HEX DWORD data size to be written aaaaaaaa HEX DWORD actual written data size to the first and second handles
Format 2	SH<SP>n<SP>m<SP>o>ssssssss<CR> !00<CR> User sends data $aaaaaaa1 !00<CR> $aaaaaaa2 !00<CR> $aaaaaaa3 !00<CR>	Same as the previous Format except for having a third shadow o Which is a third file handle
Example	SH<SP>1<SP>0<SP>3>10<CR> !00<CR> 1234567890abcdef $00000010 !00<CR> $00000010 !00<CR> $00000010 !00<CR>	Write 16 bytes to the files opened with handles 1, 0, 3 USBwiz accepted the command 16 bytes of data to go into the file USBwiz was able to write 16 bytes to the three files successfully with no errors occurrence.

RW - Read from File, Write to other file

This command is very powerful and fast! If we have two files, one is opened for Read and the other for write, this command allows copying data from a file to another even if they were opened in different storage media devices.

Format	RW<SP>r<SP>w>ssssssss<CR> !00<CR> $aaaaaaaa<CR> !00<CR>	r Read-Mode File Handle w Write-Mode File Handle ssssssss HEX DWORD data size to be read and written aaaaaaaa HEX DWORD actual

		written size
Example	Suppose that a file is opened for read and represented with handle 0 and another file is opened for write and represented with handle 1.	
	RW<SP>0<SP>1>100<CR> !00<CR> $aaaaaaaa<CR> !00<CR>	Read 256 bytes from file 0 and write them into file 1

SF - Split file

SF splits a file into 2 new files. The files can be opened on different drives or the same drive. It requires one file to be open for read and 2 other files to be open for write.

Files handles will be automatically closed after successful execution of the command.

Format	SF<SP>n>m+o@ssssssss<CR> !00<CR> $aaaaaaa1<CR> !00<CR> $aaaaaaa2<CR> !00<CR>	n Source Read-Mode File Handle m First part destination Write-Mode File Handle o Second part destination Write-Mode File Handle ssssssss HEX DWORD desirable split position in the source file aaaaaaa1 HEX DWORD actual written data size to the first part file aaaaaaa2 HEX DWORD actual written data size to the second part file
Example	Suppose that the source file is represented by file handle 1 with size 32 Bytes. And we want to split it at the position 16 and save the parts into files represented in file handles 0 and 2 which are opened in write-mode.	
	SF<SP>1>0+2@10<CR> !00<CR> $00000010<CR> !00<CR> $00000010<CR> !00<CR>	Split file 1 at position 16 into two files 0 and 2

PF - Seek File

This command changes the file pointer position. File must be opened in read mode.

Format	PF<SP>n>ssssssss<CR> !00<CR>	n File Handle ssssssss HEX DWORD new position
Example	PF<SP>1>10<CR> !00<CR>	Set file pointer at the 16th byte in file

FP - Get Current File Pointer Position

This command gets the current sector address and the position in that sector of file pointer. File must be opened in read mode.

Format	FP<SP>n<CR> !00<CR> $ssssssss<SP>$pppp<CR> !00<CR>	n File Handle ssssssss HEX DWORD Sector address pppp HEX WROD position in Sector

ZF - Resize File

This command sets file size to a certain position less than its size and omits the data after that position.

File must be opened in read mode.

File handle will be automatically closed after successfully executing this command.

Format	ZF<SP>n>ssssssss<CR> !00<CR>	n File Handle ssssssss HEX DWORD split size
Example	ZF<SP>1>10<CR> !00<CR>	Resize the file to 16 bytes

DF - Delete File

Format	DF<SP>filename<CR> !00<CR>	
Example	DF<SP>TEST.TXT<CR> !00<CR>	

IF - Find File or Folder

This command searches for a specific file or folder name in the current folder and prints out the file information which includes size, attributes and date & time of modification.

Format	IF<SP>filename<CR> !00<CR> $ssssssss<SP>$AA<SP>$ddddtttt<CR> !00<CR>	ssssssss HEX DWORD File Size AA HEX Byte File attributes* ddddtttt HEX DWORD time and date structure**
Example	IF<SP>TEST.TXT<CR> !00<CR> $00000F34<SP>$00<SP>$34210000<CR> !00<CR>	File has been found and its size is 3892 bytes with no special attributes. Last modification time is 00:00:00 date is 1/1/2006

* File Attributes are one byte Standard Attribute Structure in FAT system.

7	6	5	4	3	2	1	0
Reserved		Archive	Folder	Volume ID	System	Hidden	Read Only

** Time and Date structure is a 32-bits standard structure used in FAT system. For example, 0x34212002 is 01/01/2006 – 04:00:04

Bits(s)	Field	Description	0x34212000 Bits in Binary
31..25	Year1980	Years since 1980	001 1010
24..21	Month	1..12	0001
20..16	Day	1..31	0 0001
15..11	Hour	0..23	0 0100
10..5	Minute	0..59	00 0000
4..0	Second2	Seconds divided by 2 (0..30)	0 0010

ND - Rename File or Folder

Format	ND<SP>filename<SP>newname<CR> !00<CR>	
Example	ND<SP>TEST.TXT<SP>CURRENT.LOG<CR> !00<CR>	Rename the file with the name TEST.TXT with name CURRENT.LOG

UH - Register USB Human Interface Device

USBwiz has an internal HID Driver that can control 2 HID devices like Mice, Keyboards and Joysticks. This command must be used to access these devices.

Format	UH<SP>p<CR> !00<CR>	p is USB port number, can be 0 or 1
Example	UH<SP>0<CR> !00<CR>	Register USB device that is connected to port 0

HR - Read HID Report

This command read HID Report data. It also returns HID Report Size.

Format	HR<SP>p<CR> !00<CR> $nn<CR> Report's data !00<CR>	p the port number nn HID Report Size Report data are in ASCII Hexadecimal

UP - Register USB Printer

USBwiz has an internal p0rinter driver that can support up to 2 printers. This command must be used before accessing printers.

Format	UP<SP>p<CR> !00<CR>	p USB port number which can be 0 or 1
Example	UP<SP>1<CR> !00<CR>	Register USB device at port 1

PR - Reset USB Printer

Format	PR<SP>p<CR> !00<CR>	p is USB port number which can be 0 or 1
Example	PR<SP>1<CR> !00<CR>	

PS - Get USB Printer Status

Some USB printers may not be able to determine status.

Format	PS<SP>p<CR> !00<CR> $nn<CR> !00<CR>	p is USB port number nn is Printer Status*
Example	PS<SP>1<CR> !00<CR> $20<CR> !00<CR>	Register USB device at port 1 Printer status indicates: Paper Empty

* Status Structure

Bits(s)	Field	Description	
7,6	Reserved	Reserved	
5	Paper Empty	1= Paper Empty	0 = Paper Not Empty
4	Select	1 = Selected	0 = Not Selected
3	Not Error	1 = No Error	1 = Error
2,1,0	Reserved	Reserved	

PP - Send Data to USB Printer to print

Format	PP<SP>p>ss<CR> !00<CR> Data to Print !00<CR>	p is the USB port number ss data size, max of 255 bytes
Example	PP<SP>1>C<CR> !00<CR> Hello<SP>World! !00<CR>	Send C bytes to USB port 1

US - Register Serial Communication Device

USBwiz has an internal Serial Driver. This command must be used before accessing these devices.

Format	US<SP>p>t>bbbbbbbb<CR> !00<CR>	p is the port number t is type of the serial device. It can be C for CDC S for Silabs P for Prolific R for Prolific version 2 F for FTDI bbbbbbbb is the baudrate in hexadecimal
Example	US<SP>1>C>2580<CR> !00<CR>	Register USB CDC device on port 1 with baudrate 9600

SR - Read Serial Device

Reads data from device.

Format	SR<SP>p<CR> !00<CR> $ss<CR> ss bytes !00<CR>	Read serial device on port p Data size is HEX byte ss
Example	SR<SP>0<CR> !00<CR> $06<CR> Hello! !00<CR>	Read serial device on port 0 The device has 6 bytes Hello!

SW - Write to Serial Device

Format	SW<SP>p>ss<CR> !00<CR> Data to device !00<CR>	p is the port number ss is data size to be sent
Example	SW<SP>0>3<CR> !00<CR> AT<CR> !00<CR>	Write 3 bytes to serial device on port 0 Send AT followed by carriage return (0x0D)

EV - Enable Events

USBwiz can detect SD card and USB devices insert and removal. All events are returned with % symbol proceeding the event number. Appendix lists all events.

Format	EV<SP>V<CR> !00<CR>	v Events to enable: 0 Disable events 1 Enable SD card events 2 Enable USB device events 3 Enable USB and SD events
Example	EV<SP>3<CR> !00<CR> %02<CR>	Enable all events SD card was removed

SK - Store Key

Storing a manufacturer key on USBwiz, to validate originality:

1. User will send a secret key to USBwiz through this command.
2. The secret key is saved permanently in USBwiz and it can't be read, verified or deleted after it is been saved.
3. The manufacture will place the correct firmware on USBwiz and the "Secret key" before it ships to the customer.
4. The key is 16 bytes and stored as in "SK 00112233445566778899AABBCCDDEEFFCS"

   SK is Store Key command and then it is followed by 16 bytes (every byte is 2 ASCII Hexadecimal Characters) and then it ends with the checksum which is the sum of all bytes.
5. If the checksum is valid and no key existed before then USBwiz will save it.

This key can only be erased after uploading USBwiz firmware.

Format	SK<SP>16Bytes + CS<CR> !00<CR>	16Bytes key to be stored. CS Check Sum of the bytes: This is just the bytes added together.
Example	SK<SP>010203040506070 8090A0B0C0D0E0F1088< CR> !00<CR>	0102030405060708090A0B0C0D0E0F 10 16Bytes 88 The Check Sum

CK - Check Key

Checking the stored key:

1. The user application will generate a random 8 bytes and then encrypt them using XTEA algorithm against the "secret key" that was used above
2. The user application will keep the original values and will send the new encrypted values to USBwiz to the Check Key command"CK xxxxxxxxxxxxxxxx"
3. USBwiz will decrypt the incoming data using the "secret key" and send it back to the application.
4. The returned value will match what the user started with only if the "secret key"

was correct.

Format	CK<SP>8EncryptedBytes<CR> !00<CR> 8CorrectBytes, if the stored key was correct<CR> !00<CR>	8Bytes The 8 encrypted bytes.
Example	CK<SP>be5147f1cce6e72b<CR> !00<CR> 0102030405060708<CR> !00<CR>	be5147f1cce6e72b 8Bytes were decrypted against the previous key 0102030405060708 The actual bytes before decryption

XTEA Algorithm Code:

```
        This is the Encryption algorithm:
        v: an array of 8 bytes to encrypt
        k: the "Secret key"

void Encrypt8ByteBlock(int32* v, int32* k) {
        int32 v0=v[0], v1=v[1], i;
        int32 sum=0, delta=0x9E3779B9;

        for(i=0; i<32; i++) {
                v0 += (v1 << 4 ^ v1 >> 5) + v1 ^ sum + k[sum & 3];
                sum += delta;
                v1 += (v0 << 4 ^ v0 >> 5) + v0 ^ sum + k[sum>>11 & 3];
        }

        v[0]=v0; v[1]=v1;
}
```

TF - Print File

This command transfers a file from a connected storage media to a printer. This commands simply reads the file contents and send them to the registered printer.

Format	TF<SP>P>H>FileName<CR> !00<CR> !00<CR>	P: Register printer port number H: A free file handle to use FileName: Name of the file to transfer. !00 (First !00): This error code indicates that the command is accepted and the file transfer is in progress. !00 (Second !00): This error code indicates that transferring the file is

		done with no errors.
Example	TF<SP>0>0>PIC.PRN<CR> !00<CR> !00<CR>	

Notes:

1. The printer should be initialized before using this command (Refer to UP command).
2. The storage media should be initialized before using this command (Refer to FM command).

Q. Can I print a picture “PIC.JPG” directly using this command?

A. No, This command will read the file and send it (as is) to the printer. The printer would receive the picture bytes but it will not understand what the bytes mean. They might indicate a picture, text ...etc. You will need to send the data in a format that the printer will understand.

Q. How can I use the command then?

A. This command is useful for rapidly transferring a file from a media directly to the printer.

One way to turn your picture files(ex: JPG) or text files (ex: TXT) into a file that the printer understands is to use “print to file” in Windows. Windows will translate the file into another file that the printer understands using the appropriate drivers. Then you can put this file on a Thumb drive and print it using this command.

UI - Enumerate USB Device (Raw Command)

This command is used to enumerate the newly connected USB devices and assign a Device Handle to it. Before using any other raw commands the device should be enumerated. USBwiz has 3 device handles.

Format	UI<SP>p>h<CR> !00<CR>	p USB port number 0, 1 h USB device handle 0, 1, 2
Example	UI<SP>0>0<CR> !00<CR>	Enumerate the device connected on port 0 and assign handle number 0 to it.

UR - Release USB Device Handle (Raw Command)

Releases the device handle, so it can be used by other connected/re-connected devices.

Format	UR<SP>h<CR> !00<CR>	h USB device handle 0, 1, 2
Example	UR<SP>0<CR> !00<CR>	Release handle 0

LD - Load USB Descriptor (Raw Command)

Loads a device/configuration descriptor into USBwiz internal buffer. The descriptor must be loaded before calling any commands that uses it.

Note: The maximum internal buffer size is 512 bytes.

Format	LD<SP>h>xx<CR> !00<CR>	h USB device handle 0, 1, 2 xx Descriptor type: D Device Descriptor. Cx Configuration Descriptor where x is the Descriptor index.
Example	LD<SP>0>D<CR> !00<CR> LD<SP>0>C0<CR> !00<CR>	Load the Device Descriptor. Load Configuration Descriptor 0

DB - Display Internal buffer (Raw Command)

Display internal buffer contents.

Format	DB<SP>T<CR> !00<CR> $ssss<CR> Data !00<CR>	T Valid values: A Display data in ASCII format. H Display data in binary format ssss Data size in Hexadecimal.
Example	DB<SP>A<CR> !00<CR> $09<CR> 09<SP>01<SP>00<SP>03<SP>02<SP> 33<SP>04<SP>00<SP>00<CR> !00<CR> DB<SP>H<CR> !00<CR> $09<CR> data bytes !00<CR>	Display data in ASCII Display data in binary

SC - Set Configuration (Raw Command)

Set USB configuration.

Format	SC<SP>h>n<CR> !00<CR>	h USB device handle 0, 1, 2 n Configuration number. First configuration is 1 not 0. 0 is not configured.
Example	SC<SP>0>1<CR> !00<CR>	

FI - Find Interface (Raw Command)

Searches for an interface in the loaded configuration descriptor(LD command) in the internal buffer with a specific criteria. Since several interface descriptors might match a given criteria, the search parameter “Index” specifies how many matching descriptors shall be skipped. The found interface descriptor is displayed in ASCII format and the bytes are separated by space characters.

Format	FI<SP>cc<SP>ss<SP>pp<SP>ii<CR> !00<CR> $09<CR> 9 bytes in ASCII<CR> !00<CR>	cc Class. ss Subclass. pp Protocol. ii Zero-based index 09 is fixed
Example	FI<SP>03<SP>01<SP>02<SP>00<CR> !00<CR> $09<CR> 09<SP>04<SP>00<SP>00<SP>01<SP> 03<SP>01<SP>02<SP>00<CR> !00<CR>	Find the first interface(index = 0) with Class(3), Subclass(1) and protocol(2).

SI - Set Interface (Raw Command)

Only to be used after a Find Interface command (Resembles Set Interface setup request).

Format	SI<CR> !00<CR>

FE - Find Endpoint (Raw Command)

Searches for an endpoint in the found interface(FI command) with a specific criteria. The found endpoint descriptor is displayed in ASCII format and the bytes are separated by space characters.

Format	FE<SP>tt<SP>dd<CR> !00<CR> $07<CR> 7 bytes in ASCII<CR> !00<CR>	tt Transfer type: 00 Control transfer. 01 Isochronous transfer. 02 Bulk transfer. 03 Interrupt transfer. dd Data direction 00 Setup 01 Output 02 Input 07 is fixed
Example	FE<SP>03<SP>02<CR> !00<CR> $07<CR> 07<SP>05<SP>81<SP>03<SP> 04<SP>00<SP>0A<CR>	Find an endpoint in the previous interface with interrupt transfer and input direction.

	!00<CR>	

FD - Find Descriptor (Raw Command)

Searches for a descriptor in the loaded configuration descriptor(LD command) in the internal buffer with a specific criteria. Since several descriptors might match a given criteria, the search parameter “Index” specifies how many matching descriptors shall be skipped.

The found interface descriptor is displayed in ASCII format and the bytes are separated by space characters.

Format	FD<SP>tt<SP>ii<CR> !00<CR> $ss<CR> ss bytes in ASCII<CR> !00<CR>	tt Descriptor Type ii Zero-based index. ss Data size in hexadecimal.
Example	FD<SP>21<SP>00<CR> !00<CR> $09<CR> 09<SP>21<SP>10<SP>01<SP>00<SP> 01<SP>22<SP>34<SP>00<CR> !00<CR>	Find the first descriptor(index = 0) with (type = 0x21)

SS - Send Setup Request (Raw Command)

This command sends a USB setup transfer. Note that if an error occurred during any of the communication stages (Setup, Data, Status), USBwiz will return “!” with error code immediately without finishing all data transfer.

Format	SS<SP>h>tt<SP>rr<SP>vvvv<SP>iiii<SP>llll<CR> !00<CR>	h USB device handle 0, 1, 2 tt: bm RequestType rr: bRequest vvvv: wValue iiii: wIndex llll: wLength No Data stage.
	SS<SP>h>tt<SP>rr<SP>vvvv<SP>iiii<SP>llll<CR> !00<CR> USBwiz sends the received data from USB device !00<CR>	In Data-stage
	SS<SP>h>tt<SP>rr<SP>vvvv<SP>iiii<SP>llll<CR> !00<CR> USBwiz reads data from the user !00<CR>	Out Data-stage
Example	SS<SP>0>08<SP>06<SP>0100<SP>0000<SP	

	>0012<CR> !00<CR> USBwiz reads data from the user !00<CR>	

OP - Open USB Pipe (Raw Command)

This command opens a pipe to the found endpoint (FE command).

Note: USBwiz has 16 pipe handles.

Format	OP<SP>p<CR> !00<CR>	p USB Pipe
Example	OP<SP>0<CR> !00<CR>	

CP - Close Pipe Handle (Raw Command)

Format	CP<SP>p<CR> !00<CR>	p Used USB Pipe
Example	CP<SP>0<CR> !00<CR>	

RP - Read Pipe (Raw Command)

Format	RP<SP>p>ss<CR> !00<CR> $aa<CR> aa Bytes are returned !00<CR>	p Pipe handle ss size of data to read aa Actual read size
Example	RP<SP>0>F0<CR> !00<CR> $40<CR> 64 bytes are returned !00<CR>	Read 0xF0 bytes from pipe 0. 0x40 bytes were read

WP - Write Pipe (Raw Command)

Format	WP<SP>p>ss<CR> !00<CR> User sends ss bytes !00<CR>	p Pipe handle ss size of data to write
Example	WP<SP>1>10<CR> !00<CR> 1234567890abcdef	Write 0x10 bytes to pipe 1

	!00<CR>	

8. USBwiz Boot Loader

8.1. General Description

The boot loader is used to update the firmware of USBwiz. The firmware is the code that sits inside the USBwiz chip and does all the work. When there is a new firmware release, you can simply download the file from our website and, using simple commands, you can load it on USBwiz. At power up, USBwiz boot loader takes control and checks the mode pins (MODE0 and MODE1). If the mode pins are set in firmware interface mode, boot loader makes a jump to the firmware to start executing immediately. Once the firmware is executing, a user can access the loader through BL command. BL command is described in the firmware commands sections.

8.2. Boot Loader Commands

All commands return '!' followed by the error number, !00 means no error. The boot loader responds with 'Wxx(CR)' on every sector write, where xx is the sector number.

Command	Use	Notes
R	Load and run USBwiz firmware	If Boot loader returns BL then reprogramming USBwiz is required
LQUx	Load firmware file from connected media	The x is the drive letter. LQUA will load the firmware from MMC/SD card, LQUB will load the firmware from USB port 0 and LQUC will load it from USB port 1.
W	Write one sector to internal FLASH	Follow 'W' by the sector number then 512 bytes of sector data. Transaction must be terminated by a checksum byte. Checksum byte is calculated by adding all 512 data bytes. GHI Internal Use
V	Returns the loader version	

Note: The boot loader is entirely separate program that loads USBwiz firmware. The

version number of the boot loader may not match the version number of USBwiz.

Important Note: USBwiz chips come with no firmware on them.

8.3. Firmware Update

The easiest way to update USBwiz is by placing the new firmware on a SD card or a USB mass storage device. Then, connect the media to USBwiz and send the boot loader (BL) command to load the new firmware. Note that these commands are sent to a functional firmware and they are firmware commands. If the firmware didn't execute, there could be a need to set the mode pins in “force boot loader mode”. In this mode, the boot loader runs in UART mode at 9600 and will accept the boot loader commands.

The firmware update file must be placed in the root directory. We recommend formatting the media first.

Error Codes

Value (HEX)	Description
00	Operation has passed successfully.
01	Failed to read sector from SD/MMC media. For example, The media was removed
02	Failed to write sector to SD/MMC media. For example, The media was removed
03	Failed to erase sector on SD/MMC media. For example, The media was removed
04	Failed to initialize SD/MMC media. Check for media connectivity.
05	The report received is the last one. This is not an indication of any error.
09	Boot loader failed to write the firmware*
10	The secret key can be stored only once on the device.
11	Failed to read valid data from media. Try to format the media on PC*
12	Failed to read valid data from media. Try to format the media on PC*
13	Failed to read valid data from media. Try to format the media on PC*
14	Failed to read valid data from media. Try to format the media on PC*
15	The connected media is FAT12.
16	Failed to read valid data from media. Try to format the media on PC*
21	Failed to read valid data from media. Try to format the media on PC*
22	Failed to read valid data from media. Try to format the media on PC*
23	Failed to read valid data from media. Try to format the media on PC*
24	Failed to read valid data from media. Try to format the media on PC*
25	Media is full.
31	File names are limited to upper case characters only.
32	Only up to 8 characters is allowed for file names.
33	Only up to 3 characters is allowed for file extension.
34	File name is empty.
35	Media is full.
40	The file/folder you trying to create already exists.
41	The file/folder being accessed does not exist.
42	Failed to read valid data from media. Try to format the media on PC*
43	Failed to read valid data from media. Try to format the media on PC*
44	Failed to read valid data from media. Try to format the media on PC*
45	FAT16 root folder can only contain up to 512 entries. (FAT16 limitation)
46	Failed to read valid data from media. Try to format the media on PC*
47	Writing is not allowed on files that are opened for read access.
48	Seek only works on files opened for read.
49	Seek position must between zero and the file size.
4A	Trying to remove a folder that is not empty.
4B	The entry to remove is a file not a folder.
4C	The operation requested only runs on files opened for read.

Value (HEX)	Description
4D	This is not an error. Indicated the end of the file/folder list.
4E	Failed to read valid data from media. Try to format the media on PC*
4F	File handle is already used. Should close it first.
50	Reached the end of the file.
51	New size can't be zero.
52	The new file name already exists.
60	Failed to initialize ISP1160 host controller.
61	Failed to complete a USB transaction*
62	Failed to complete a USB transaction*
63	Failed to complete a USB transaction*
64	Failed to complete a USB transaction*
65	Failed to complete a USB transaction*
66	Failed to complete a USB transaction*
67	Failed to complete a USB transaction*
68	Failed to complete a USB transaction*
69	Failed to complete a USB transaction*
6A	Failed to complete a USB transaction*
6B	Failed to complete a USB transaction*
6C	Failed to complete a USB transaction*
6D	Failed to complete a USB transaction*
6E	Failed to communicate with ISP1160 HC.
6F	There is no media on the port being accessed.
70	Only port 0 and 1 are allowed.
71	No more pipes available for USB.
72	Handle is already being used.
73	The USB device returned invalid descriptor.
74	Non-control transfer error*
75	Data requested for transfer is larger than the allowed by the USB endpoint.
76	Timed-out waiting on a response from the USB device.
77	Control transfer is required.
78	USB device not responding.
79	USB handle is corrupted,
7A	Corrupted USB descriptor.
7B	Requested descriptor is not found.
7C	USB HUB not found.
81	USB Mass Storage command failed*
82	USB Mass Storage command failed*
83	USB Mass Storage command failed*
84	LUN number is incorrect.
85	USB Mass Storage command failed*
86	USB Mass Storage command failed*
90	USB Mass Storage device is not ready.

Value (HEX)	Description
91	USB Mass Storage device uses unsupported protocol.
92	USB Mass Storage device uses unsupported subclass.
93	USB Mass Storage command failed*
94	USB Mass Storage command failed*
95	USB Mass Storage device not found.
A1	Unknown command.
A2	Command string is too long*
A3	Invalid name.
A4	Invalid number.
A5	Failed to complete the write request.
A7	Failed to initialize the media.
A8	The requested command has incorrect parameters.
A9	Configuration is not loaded*
AA	Checksum is invalid.
AB	FAT file system is not mounted.
AF	Internal error*
B1	FTDI device is not registered.
B2	Vendor ID is invalid.
B3	Product ID is invalid.
B4	Printer is not registered.
B5	HID device has no data. This is not an error.
B6	HID device is not registered.
B7	CDC device is not registered.
B8	Prolific device is not registered.
D0	Address is out of range*
D1	Flash in not blank*
D2	Failed to verify*
D3	Internal error*
D4	Invalid checksum*
D7	Invalid firmware file.
D8	Unknown command.
DA	Trying to read from empty file.
DB	File not found.
DE	Null storage driver*
DE	Unknown command*
DF	Null interface*
F0	Unexpected value*
F1	Empty file*
F2	File not found*
FD	Internal error*

*There error codes are for GHI internal use. In case they are returned, please contact GHI with the steps taken to reproduce the error.

USBwiz Events

Value (HEX)	Description
01	SD inserted.
02	SD removed.
20	Failed to initialize ISP1160.
30	USB port 0 device inserted.
31	USB port 0 device removed.
32	USB port 1 device inserted.
33	USB port 1 device removed.

DISCLAIMER

IN NO EVENT SHALL GHI ELECTRONICS, LLC. OR ITS CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT IABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. SPECIFICATONS ARE SUBJECT TO CHANGE WITHOUT ANY NOTICE. PRICES ARE SUBJECT TO CHANGE WITHOUT ANY NOTICE. USBwiz AND ITS LINE OF OEM BOARDS ARE NOT DESIGNED FOR LIFE SUPPORT APPLICATIONS.