
USB and BASIC-Tiger®

Gunther Zielosko

1. Introduction

The Universal Serial Bus (USB) is a modern communication port designed for the PC world. Since Windows®98 was launched it has been an integral part of the PC and it is about to replace traditional interfaces such as serial, parallel and PS2 interfaces. This is because there is a USB version for almost every external component by now. Nevertheless every PC has been equipped with both the “new” USB port and the “old” ports until recently. This has changed – e.g. latest laptops have no serial interface any more. This should alarm the BASIC-Tiger® family. What if the new computer has no COM port for the BASIC-Tiger®? The application presented here provides solutions. We will notice that connecting BASIC-Tiger® to a USB port is not just a temporary solution due to a missing COM port but it will offer several new options. We will learn about the advantages of USB compared to traditional PC interfaces in the following section.

1.1. USB Port Basics

Universal Serial Bus is obviously a serial data transmission. However it is hardly comparable to the technology of the RS232 (COM) interface. USB has almost everything that RS232 is lacking:

- A very high data transmission rate of up to 10 MHz
- A very simple and most of all small plug connector with only 4 connections (fig. 1 type B) at the host’s end (usually the PC). There is a second USB plug connector standard (fig. 2, type A), which is mainly used for peripheral devices.



Fig. 1 USB plug type B for host (PC) with USB symbol

Fig. 2 USB plug type A for peripheral devices

- The option to automatically supply the connected device with current.

- Plug-and-Play capability, i.e. USB devices can generally be plugged in when PC or even the program is running without risking any crashes or having to boot again to be able to drive the accessories – it even works most of the time...
- Directly after plugging in information about the device connected is transmitted via USB to the PC which recognises it and informs the operating system that e.g. a scanner is connected. It is even possible that a connected device reports its current demand and the PC “provides” it.
- The number of USB ports can be increased easily. Small units, so-called HUBs make e.g. four USB ports out of one. So a laptop equipped with only one USB port can use a USB mouse, a USB printer, a USB digital camera and ... a USB BASIC-Tiger®.
- There is almost no device left that is not available as a USB version. Besides traditional accessories, such as mouse, printer, scanner, joystick, digital camera etc., there are those devices which have existed in the “inside” up to now, such as hard disks, TV and sound cards, drives for removable media (ZIP, LS120, all kinds of flash cards) and many more.
- You can make any traditional interface out of a USB interface nowadays. There are USB → RS232 converters, USB → LPT converters and USB → PS2 converters. Unfortunately it is not possible to reverse this conversion; a given COM interface can never be a USB port.

There are some problem areas in USB technology, but we will keep it short:

A USB device with features mentioned above can only be implemented, if the peripheral device brings certain intelligence. It has to be able to reveal itself when plugged to the PC; needs besides USB capability of the PC also specific device oriented software (drivers) and much more. Unfortunately on the hardware side a level converter, as used at the RS232 interface, does not suffice.

Nevertheless we realize that there is no way around USB. So which options do we have for our BASIC-Tiger® system to follow the trend? At least the advantage of USB mentioned last offers a simple solution.

2. USB to COM Converters

2.1. Finished Solutions – the interface converter USB → RS232

Converters which transform a USB interface to a RS232 interface are the simplest version to operate a BASIC-Tiger® system in the case of not existing or occupied PC COM ports. To operate means to create programs using Tiger-BASIC® and to download them to the BASIC-Tiger® Flash. To be precise, everything has to work as it does with a standard RS232 interface for the user. It has to be made sure that also the data transfer between BASIC-Tiger® and PC functions as usual via the interface converter, i.e. all parameter settings on the BASIC-Tiger's® and the PC's side have to be valid without constraints.

Such USB → serial adapters are by standard available as a cable (figure 3). One side has a USB plug; the other one usually has a 9-pin SUB-D plug. Software has to be installed on the PC, and if everything goes right, you will have an extra RS232 port or one at all. Several links to distributors of this category of adapters can be found on the Internet entering e.g. “USB to serial converter” into a search engine.

So much for this version, that could be used together with a Plug-and-Play-Lab. For some systems you will of course need BASIC-Tiger® with an integrated RS232 level converter or a similar external element (MAX232 or else).

2.2. Connecting USB → TTL directly

Why not connect BASIC-Tiger® (without integrated RS232 interface) directly to USB, i.e. without converting levels twice? Those level converters are expensive, need extra power and slow down data flow enormously. Sounds good – do these adapters exist? Yes, FTDI produces chips for all kinds of USB applications, among others the FT8U232AM. This 7x7 mm module has all the intelligence for a USB → serial conversion (RS232, RS422, RS485), it provides TTL levels, is able to implement data rates between 300 baud and 921 kbaud(!) for RS232 and it supports full hardware handshake or X-On/X-Off. Gigatechnology.com Pty Ltd provides a small 32-pin development system with the FT8U232AM, which we can use to easily test the module’s capabilities (fig. 4).



Fig. 3 Standard USB → RS232 converter
(cable version)

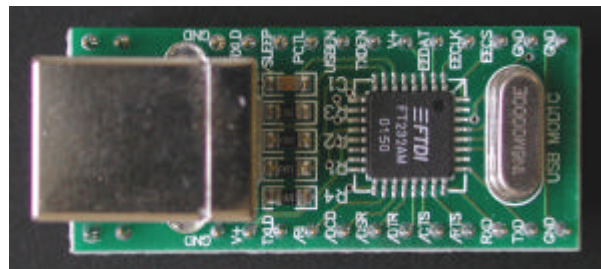


Fig. 4 Gigatechnology.com Pty Ltd USB
Plug and Play Serial Development
Module

Information about FT8U232AM
Information about the module

<http://www.ftdichip.com/Documents/ft232r08.pdf>
http://www.ftdichip.com/usb_mod1.htm

On the FTDI website you will find much more information about our project, as well as free-of-charge software (for providing a “new” COM port etc.), data sheets, distributors and application notes.

All our following USB activities refer to the USBMOD1 development system with the FT8U232AM.

2.3. USBMOD1 Development System with FT8U232AM

The module shown in figure 4 is actually a small circuit with 32 DIL raster 600 mil connections, which make it possible to plug or solder it to a standard socket. The module contains all components needed for operating; further external components are not required. The USB socket attracts attention, being the largest component (here: type A). For connecting it to the PC we need an adapter cable which has a USB plug type B on one side (most PC have type B sockets) and a type A plug on the other side. But why has the module so many pins? It is a development system – you have access to a large number of functions, some of which are necessary and others are less important in the individual case. The single pins and their functions are listed below.

RXD, TXD	the two most important communication pins for serial interfaces. They are used independently at BASIC-Tiger's® SER1 and together with further signals at SER0.
/RXD, /TXD, /CTS	Signals which could only be used at SER0.
/RI, /DCD, /DSR, /DTR	Further signals of a fully equipped serial interface. However, they are not used with the BASIC-Tiger® system.
TXLD, RXLD	LED drivers which are able to display USB activities
EECS, EECLK, EEDAT	are used for operating an (optional) EEPROM. We will tell you more about those possibilities later.
PCTL	If this pin is low, the system is supplied with power via the USB connection (very interesting for us!)
V+ (output!)	Here 5 V (90 mA) are outputted, when PCTL is low and the system is connected to the PC via USB. This feature makes us think of completely new applications without external operating voltage for BASIC-Tiger®.
SLEEP, USBEN, TXDEN	Pins for selecting the chip's operating mode.
GND	Ground pins

We realize that in the simplest case only 3 pins are required for communication (GND, RXD, and TXD). Since the FT8U232AM requires and provides pure TTL levels, only the BASIC-Tiger® without internal RS232 drivers is suitable (they are cheaper anyway!)

With those advices in mind the circuitry will look the following:

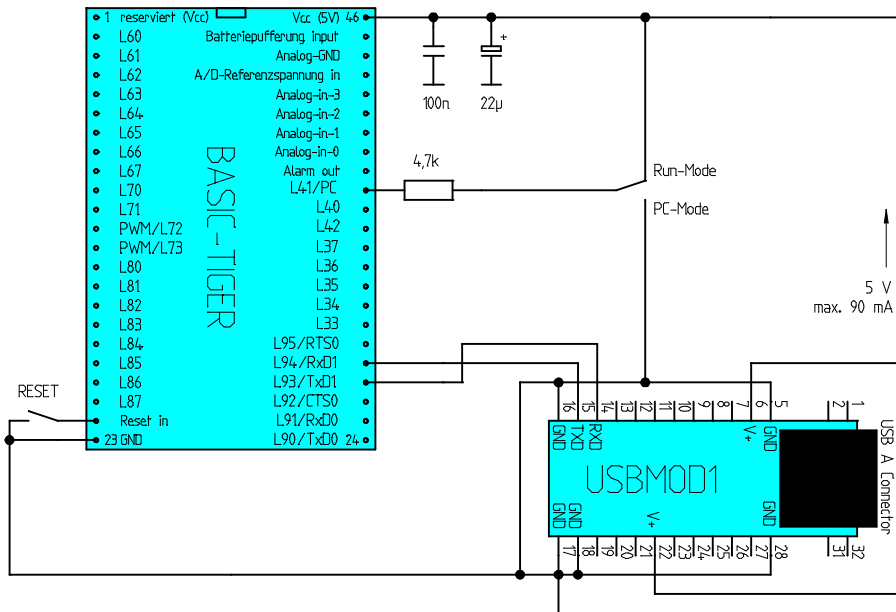


Fig. 5 Simplest connection of the BASIC-Tiger® to the USB module USBMOD1

The BASIC-Tiger® system can be used as usual, but keep in mind that the Plug-and-Play-Lab always expects and provides RS232 levels (-15 V / +15 V). Here you will have to remove the RS232 level converters MAX232 and connect RXD respectively TXD directly to the BASIC-Tiger®. If you do not plan to use the BASIC-Tiger® VCC self-supply via USB (maximum 90 mA!), remove the USBMOD1 VCC connections V+ from the remaining BASIC-Tiger® VCC!

3. Installing the driver software for USBMOD1

First of all we need the software for operating the module. You will find software and installation instructions for drivers suiting your operating system here:

FTDI drivers: <http://www.ftdichip.com/FTDriver.htm>
 Installing the driver software: <http://www.ftdichip.com/Documents/AN232-03.PDF>

The author uses a driver without PNP support suitable for Windows™98. Download the corresponding ZIP file and unpack it e.g. on a disk.

Now preparations are finished and we can set up an (extra) virtual COM port.

Due to the module's "power self-supply" it is operable right after unwrapping and connecting the USB cable (to remind you: type A to type B). Windows™98 will report that a new

hardware was found immediately after plugging it in. There are similar messages under other operating systems. Now we will proceed as described in the installation instruction mentioned above. You will find a new COM port in the hardware manager after installing.

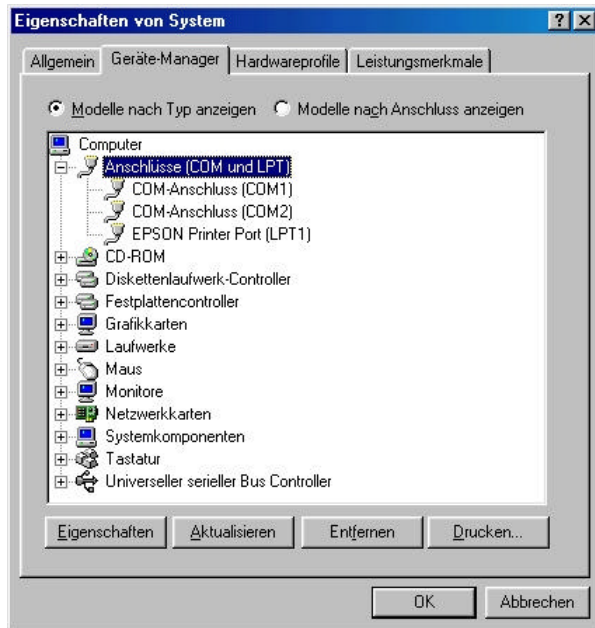


Fig. 6 Hardware manager before ...

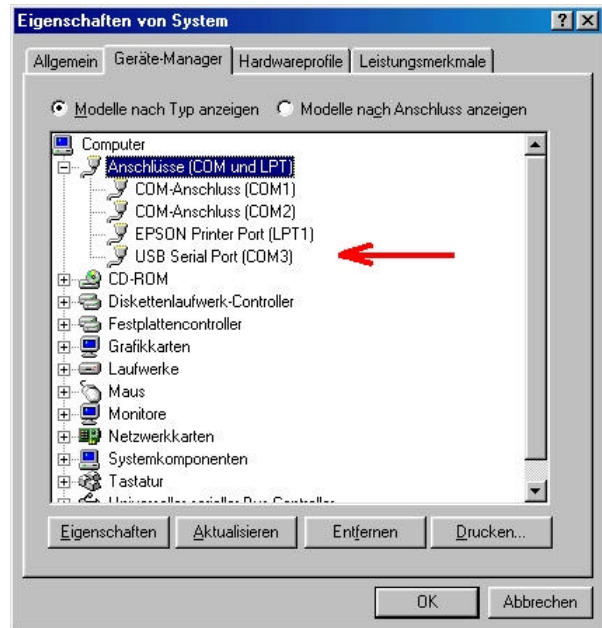


Fig. 7 ...and after connecting the USB cable and loading the driver: A new COM interface!

Excellent – the new COM port always appears when plugging and disappears likewise when unplugging. So nothing bars using it with BASIC-Tiger®.

4. Operation Using BASIC-Tiger®

To create a program BASIC-Tiger® is connected via SER1 to a PC. This remains the same when being converted to USB. Since we can only operate one interface by USBMOD1, the BASIC-Tigers® connection is applied to the USB module via SER1 and then via the USB cable to the PC USB port. Thus the circuitry shown in figure 5 can be used immediately. Of course data can be exchanged between PC and BASIC-Tiger® via this wiring later.

To avoid all problems with external VCC and possibly wrong levels at the Plug-and-Play-Lab in the first instance, it is the easiest way to test the new technology using an independent construction. It contains only the absolutely necessary BASIC-Tiger® components, the BASIC-Tiger® itself and the USB module. All these components are already shown in figure 5. There is no power supply in this case – we use one of the neat USB features, the bus supply for peripheral components. Figure 8 shows the author's simple breadboard construction.



Fig. 8 That simple is the USB-BASIC-Tiger®

The circuitry according to figure 5 can be connected to the PC now. As a precaution please check, if +5 V are applied to the BASIC-Tiger® VCC pin.

Now things become exciting – how will our small system cooperate with the Tiger-BASIC® software?

When installing the driver for the USB → serial converter, the device manager tells you the number of the new COM port. In figure 7 it is COM3, but it can be a different number in your system. Now run Tiger-BASIC® and set the new interface number via “Options” and “Communication”. When setting the switch to PC mode and actuating RESET, you can find out via “View” and “Tiger status”, whether the first attempt to communicate was successful. If it was not, you should check again, whether the PC mode was switched on, RESET was actuated, the new interface was chosen, a BASIC-Tiger® without internal RS232 converters is used and the wiring is correct. If so, you are almost there.

Now load the attached small testing program SIN_TEST.TIG to the BASIC-Tiger® and run it (run mode, RESET). With a terminal program (set new interface, 9600 baud, 8 bit, no parity etc.) you should now be able to watch a running sinus chart. Yippee! We’ve got a BASIC-Tiger® which is able to communicate directly via USB!

5. A New World

So far we have only dealt with adapting an existing serial interface to a modern USB port, a sort of makeshift. Yet USB is much more than just another communication interface, as we already found out. What are the tangible advantages for us BASIC-Tiger® users? The technique presented in this application note already offers:

- A solution for everybody who have no (free) COM port on their PC.
- An option for simple modules based on BASIC-Tiger® which start running immediately after plugging the USB cable and do not require an own power supply unit or battery.

- Plug and Play capability of independent modules due to USB. Connect the module via USB cable to the PC; the internal power-on-reset even saves the reset button. Communication starts automatically...
- A high transmission speed (from the USB → serial converter system 921 kbaud). It has to be checked in detail, in what way such data rates are achievable by the BASIC-Tiger® system taking the detour via SER1 and on the PC.
- No required changes in BASIC-Tiger® programs or in Tiger-BASIC®, everything can remain the same.
- A simple control of USB activities using simple LED without multipliers at pins RXLD (data reception) and TXLD (data transmission) against VCC is possible.

If you take a closer look at the hardware and software components available at FTDI, you will come up with visions...

- The tiny USB converter FT8U232AM and a few passive components could be integrated into a new BASIC-Tiger® generation. Instead of RS232 converters it would have USB converters inside. This would allow a higher data transmission rate starting from the processor (wouldn't it be a blessing, if the program transmission worked 10 times faster?)
- Another alternative would be a Plug-and-Play-Lab with an integrated USB port. With jumpers, switches or automatically you could choose the communication mode depending on the BASIC-Tiger® version and your needs. The extra outlay is a FT8U232AM and a few bits and pieces. This makes the Plug-and-Play-Lab fit for the new millennium...
- There is the option to operate an EEPROM 93C46 with the FT8U232AM (also on module USBMOD1). You can vary many interesting features of the module besides texts (with which each USB module reports). Like this e.g. current output at the USB port can be reset for the according application. Without EEPROM it is limited to 90 mA.
- FTDI offers drivers for virtually every purpose. It is easily feasible that a new Tiger-BASIC® directly accesses the USB module via DLL or other available drivers, i.e. without having to install an own driver software. Thus a USB port would be directly available for the user, besides the choice from traditional COM interfaces.
- Progressing from this idea, the newly available USB port could be "pre-programmed" with a much higher speed than 38 kbaud in the BASIC-Tiger® menu.
- Furthermore there is the option to implement two USB interfaces at one BASIC-Tiger® to facilitate a BASIC-Tiger® totally fitted to USB.

We wish you success!