USBMOD3 - USB Plug and Play Serial Development Module (Second Generation)

The USBMOD3 shown in Diagram 1 is a second generation, low-cost integrated module for transferring serial data over USB. Based on the FTDI FT232BM USB UART IC, the USBMOD3 is capable of transfer rates of up to 1000k baud (RS232) and 3000k baud (RS422 / RS485).

The USBMOD3 offers a complete plug and play solution making it ideal for rapid prototyping and development.
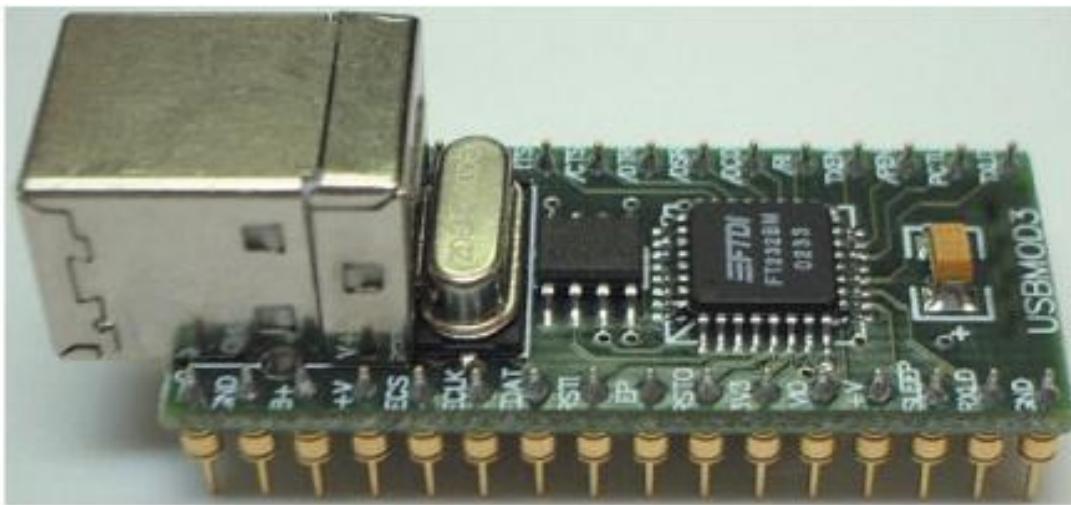
Diagram 1

MODULE FEATURES

- Single module High-Speed USB UART solution

- Based on the FTDI FT232BM High-Speed USB UART IC

- Integrated Type-B USB Connector

- On-board 6MHz Crystal

- External EEPROM on board for USB enumeration data

- No external passive components required

- Module powered from USB bus in addition to supplying up to 450mA user application

- 32-pin Dual In-Line Package Ideal for prototyping

- Fits into a standard 32-pin 600mil IC Socket

FT232BM IC FEATURES

- Single Chip Multi-Function Data Transfer Solution

- RS232 link from 300 baud to 1000K baud

- RS422/RS485 Link to 3000K baud

- 384 byte receive buffer / 128 byte transmit buffer for high data throughput

- Full hardware assisted or X-On/X-Off handshaking

- Support for Event Characters and Line Break condition

- Auto Transmit Buffer control for RS485

- Compact 32 pin (7mm x 7mm) MQFP package

- Integrated 6Mhz – 48Mhz Clock Multiplier aids emissions compliance

- Integrated 3.3v Regulator – No External Regulator Required

- UHCI / OHCI / EHCI Compliant

- USB 1.1 and USB 2.0 Compatible

- USB VID, PID, Serial Number and Product Description Strings in external EEPROM.

VIRTUAL COM PORT (VCP) DRIVERS for
- Windows 98, 98 SE and ME
- Windows 2000 / XP
- Windows CE **
- MAC OS-8 and OS9
- MAC OS-X **
- Linux 2.40 and greater

[** = In planning or under development]

FTD2XX
(USB Direct Drivers + DLL S/W Interface)
- Windows 98, 98 SE and ME
- Windows 2000 / XP

ENHANCEMENTS

This section summarises the enhancements of the 2nd generation device compared to its FT8U232AM predecessor. For further details, consult the device pin-out description and functional descriptions.

• **Integrated Power-On-Reset (POR) Circuit**
The device now incorporates an internal POR function. The existing RESET# pin (RSTI on the module) is maintained in order to allow external logic to reset the device where required, however for many applications, this pin can now be either left N/C or hard wired to VCC (+V on the module). In addition, a new reset output pin (RSTO# or RSTO on the module) is provided in order to allow the new POR circuit to provide a stable reset to external

MCU and other devices. RSTO# was the TEST pin on the previous generation of devices.

• **Integrated RCCLK Circuit**
In the previous devices, an external RC circuit was required to ensure that the oscillator and clock multiplier PLL frequency was stable prior to enabling the clock internal to the device. This circuit is now embedded on-chip – the pin assigned to this function is now designated as the

TEST pin and should be tied to GND for normal operation.

• **Integrated Level Converter on UART interface and control signals**

The previous devices would drive the UART and control signals at 5v CMOS logic levels. The new device has a separate VCC-IO (VIO on the module) pin allowing the device to directly interface to 3.3v and other logic families without the need for external level converter I.C.'s

• **Improved Power Management control for USB Bus Powered, high current devices**

The previous devices had a USBEN pin, which became active when the device was enumerated by USB. To provide power control, this signal had to be externally gated with SLEEP# and RESET#. This gating is now done on-chip -USBEN has now been replaced with the new PWREN# signal (/PEN on the module) which can be used to directly drive a transistor or P-Channel MOSFET in applications where power switching of external circuitry is required. A new EEPROM based option makes the device pull gently down its UART interface lines when the power is shut off (PWREN# is High). In this mode, any residual voltage on external circuitry is bled to GND when power is removed thus ensuring that external circuitry controlled by PWREN# resets reliably when power is restored.

• **Lower Suspend Current**

Integration of RCCLK within the device and internal design improvements reduce the suspend current of the FT232BM to under 200uA (excluding the 1.5k pull-up on USBDP) in USB suspend mode. This allows greater margin for peripherals to meet the USB Suspend current limit of 500uA.

• **Support for USB Isocronous Transfers**

Whilst USB Bulk transfer is usually the best choice for data transfer, the scheduling time of the data is not guaranteed. For applications where scheduling latency takes priority over data integrity such as transferring audio and low bandwidth video data, the new device now offers an option of USB Isocronous transfer via an option bit in the EEPROM.

• **Programmable Receive Buffer Timeout**

In the previous device, the receive buffer timeout used to flush remaining data from the receive buffer was fixed at 16ms timeout. This timeout is now programmable over USB in 1ms increments from 1ms to 255ms thus allowing the device to be better optimised for protocols requiring faster response times from short data packets.

• **TXDEN Timing fix**

TXDEN timing has now been fixed to remove the external delay that was previously required for RS485 applications at high baud rates. TXDEN now works correctly during a transmit send-break condition.

• **Relaxed VCC Decoupling**

The 2nd generation devices now incorporate a level of on-chip VCC decoupling. Though this does not eliminate the need for external decoupling capacitors, it significantly improves the ease of PCB design requirements to meet FCC, CE and other EMI related specifications.

• **Improved PreScaler Granularity**

The previous version of the Prescaler supported division by (n+0), (n+0.125), (n+0.25) and (n+0.5) where n is an integer between 2 and 16,384 (2^{14}). To this we have added (n+0.375), (n+0.625), (n+0.75) and (n+0.875) which can be used to improve the accuracy of some baud rates and generate new baud rates which were previously impossible (especially with higher baud rates).

• **Bit Bang Mode**

The 2nd generation device has a new option referred to as "Bit Bang " mode. In Bit Bang mode, the eight UART interface

control lines can be switched between UART interface mode and an 8-bit Parallel IO port. Data packets can be sent to the device and they will be sequentially sent to the interface at a rate controlled by the prescaler setting. As well as allowing the device to be used stand-alone as a general purpose IO controller for example controlling lights, relays and switches, some other interesting possibilities exist. For instance, it may be possible to connect the device to an SRAM configurable FPGA as supplied by vendors such as Altera and Xilinx. The FPGA device would normally be un-configured (i.e. have no defined function) at power-up. Application software on the PC could use Bit Bang Mode to download configuration data to the FPGA, which would define its hardware function, then after the FPGA device is configured the FT232BM can switch back into UART interface mode to allow the programmed FPGA device to communicate with the PC over USB. This approach allows a customer to create a "generic" USB peripheral who's hardware function can be defined under control of the application software. The FPGA based hardware can be easily upgraded or totally changed simply by changing the FPGA configuration data file. Application notes, software and development modules for this application area will be available from FTDI and other 3rd parties.

For further information regarding the FTDI FT232BM USB UART IC please refer to the FT232BM Datasheet. This datasheet can be found on the Elexol website at
http://www.elexol.com

As mentioned above in module features, the USBMOD3 is in a 32-pin Dual In-Line Package. This allows the module to fit into a standard 32-pin 600mil IC Socket, which makes the module ideal for prototyping and development work. Shown in Diagram 2 below is the pin out for the USBMOD3.

USBMOD3 PINOUT
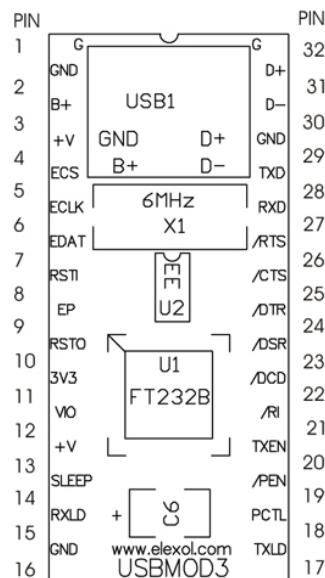
DIAGRAM 2

On the following page is the pin out table showing what the various pins are on the module.

USBMOD3 PINOUT TABLE

PIN #	SIGNAL	TYPE	DESCRIPTION
1	G	PWR	Device – Ground Supply Pin
2	GND	PWR	Device – Ground Supply Pin
3	B+	PWR	USB Bus Power
4	+V	PWR	Device - +4.4 volt to +5.25 volt Power Supply Pin NOTE: No external voltage is required when Bus Powered
5	ECS	I/O	EEPROM – Chip Select
6	ECLK	I/O	EEPROM – Clock
7	EDAT	I/O	EEPROM – Data I/O
8	RSTI	IN	Can be used by external device to reset chip. If not required tie to VCC
9	EP*	IN	Enumeration Power connect to RSTO for bus powered operation or 3V3 to instruct PC to connect to device
10	RSTO	OUT	Output of the internal Reset Generator. Stays high impedance for ~2ms after VCC >3.5v and the internal clock starts up, then clamps it 's output to the 3.3v output of the internal regulator. Taking RSTI low will also force RSTO to go high impedance. RSTO is NOT affected by a USB Bus Reset.
11	3V3	OUT	3.3 volt Output from the integrated L.D.O. regulator. This pin is decoupled to GND using a 33nF ceramic capacitor in close proximity to the device pin. Its prime purpose is to provide the internal 3.3v supply to the USB transceiver cell and the RSTO pin. A small amount of current (<=5mA) can be drawn from this pin to power external 3.3v logic if required.
12	VIO**	PWR	+3.0 volt to +5.25 volt VCC to the UART interface pins 10..12,14..16 and 18..25. When interfacing with 3.3v external logic connect VIO to the 3.3v supply of the external logic, otherwise connect to +V to drive out at 5v CMOS level.
13	+V	PWR	Device - +4.4 volt to +5.25 volt Power Supply Pin NOTE: No external voltage is required when Bus Powered
14	SLEEP	OUT	Goes Low during USB Suspend Mode
15	RXLD	O.C.	LED Drive – Pulses Low when Receiving Data via USB
16	GND	PWR	Device – Ground Supply Pin
17	TXLD	O.C.	LED Drive – Pulses Low when Transmitting Data via USB
18	PCTL	IN	Bus Powered – Tie Low / Self Powered – Tie High
19	/PEN	OUT	Goes Low after the device is configured via USB, then high during USB suspend. Can be used to control power to external logic using a P-Channel Logic Level MOSFET Switch. Enable the Interface Pull-Down Option in EEPROM when using the /PEN pin this way.

USBMOD3 PINOUT TABLE Continued

PIN #	SIGNAL	TYPE	DESCRIPTION
20	TXEN	OUT	UART – Enable Transmit Data for RS485
21	/RI	IN	UART – Ring Indicator Control Input
22	/DCD	IN	UART – Data Carrier Detect Control Input
23	/DSR	IN	UART – Data Send Ready Control Input
24	/DTR	OUT	UART – Data Terminal Ready Control Output
25	/CTS	IN	UART – Clear To Send Control Input
26	/RTS	OUT	UART – Request To Send Control Output
27	RXD	IN	UART – Receive Data Input
28	TXD	OUT	UART – Transmit Data Output
29	GND	PWR	Device – Ground Supply Pin
30	D-	I/O	USB Data Signal Minus
31	D+	I/O	USB Data Signal Plus
32	G	PWR	Device – Ground Supply Pin

* Note 1 – When connecting the USBMOD3 to the USB tie EP (pin 9) to RSTO (pin 10) so that the unit can enumerate.

** Note 2 – Tie VIO (pin 12) to either V+ (pin 13) to drive the FIFO pins to 5V CMOS Levels or 3V3 (pin 11) to drive the FIFO pins to 3.3V CMOS Levels

BUS POWERED OPERATION

The USBMOD3 are configured for bus powered of the assembly line. There are a few pins that need to be connected before the device will enumerate. They are

1. Connect EP to RSTO
2. Connect VIO to V+
3. Set PCTL low to indicate bus-powered operation.

SELF POWERED OPERATION

To self power the USBMOD3 the process is as follows:
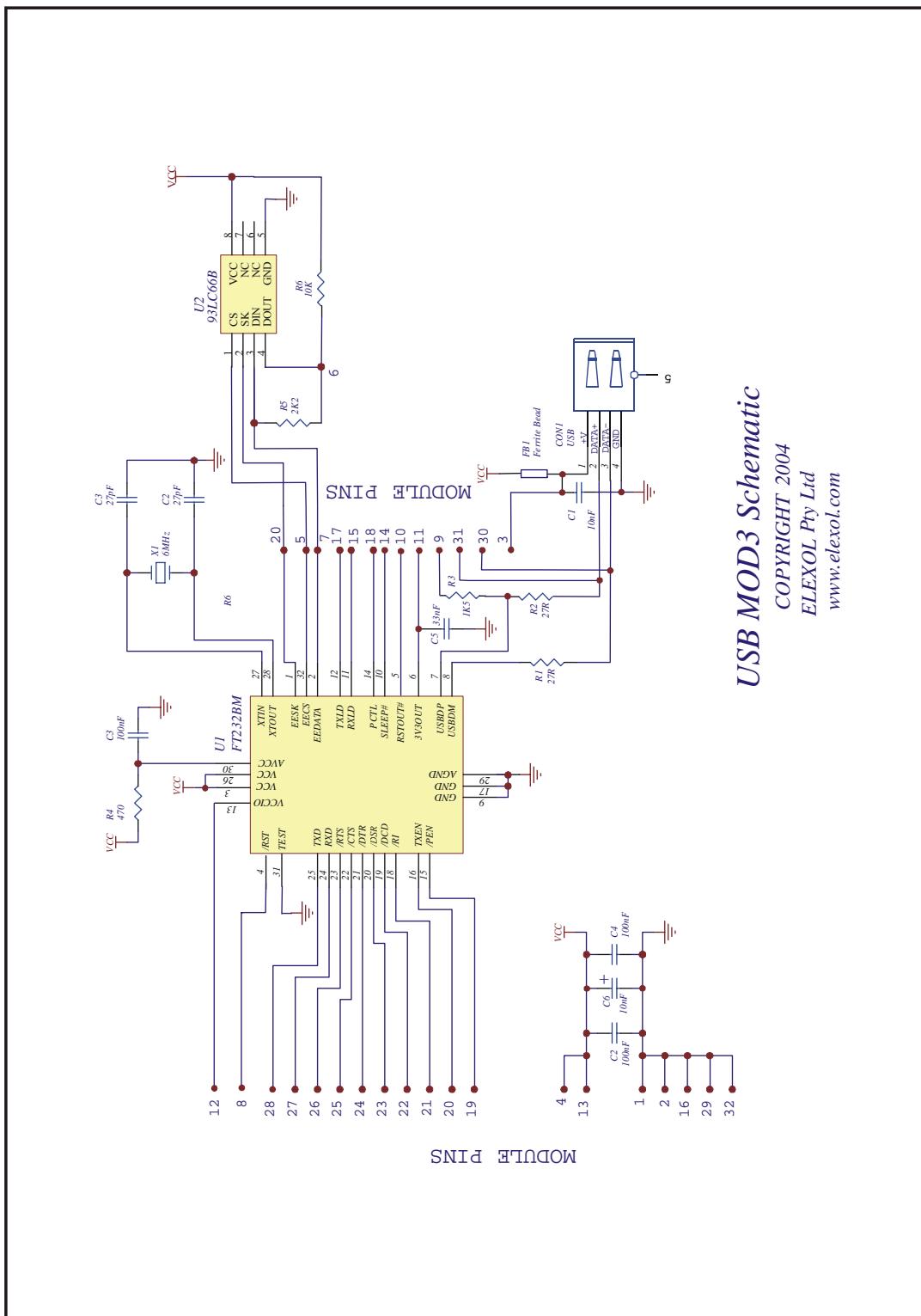
1. Remove the ferrite bead from the USBMOD3, disconnecting B+ and V+.
2. Connect EP to RSTO
3. Connect VIO to V+
4. Set PCTL high to indicate self-powered operation.
5. Connect V+ to an external 5V supply.
6. Connect /RESET to B+, via a resistor divider as per FT232BM datasheet

Reprogram the USB device Power descriptor to 0 to operate the unit in self-powered mode. The power descriptor is located in the EEPROM. The power descriptor can be changed by reprogramming the EEPROM using one of FTDI EEPROM programmers

The PCTL pin is connected to VCC for self powered configurations and GND for bus powered configurations this tells the USB Power descriptor in the FTDI chip which is stored in the EEPROM whether to draw any power from the USB.

The following page shows the schematic for the USBMOD3.

USBMOD3 SCHEMATIC

USB MOD3 Schematic
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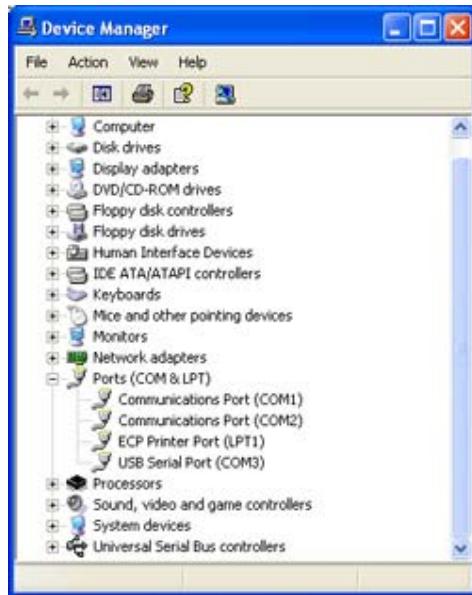
Driver Installation

Your first choice when using the USBMOD3 is whether you want to use the Virtual COM Port driver or the Direct DLL driver.

For programming simplicity, the best driver is the Virtual COM Port and when installed, the USBMOD3 will appear in the System Properties / Device Manager as an USB Serial Port (COMn) as follows.

The COM Port number will vary depending on the number of existing COM Ports on your computer and the number of USBMOD3's connected to your system.

To install the Virtual COM Port drivers, download the driver from our website and unzip the files to a local directory. Then connect the USBMOD3 and windows will automatically ask for the driver, select to specify a location and browse to the directory where you have unzipped the files. (Use the Non Plug & Play driver for the USBMOD3 to avoid a delay identifying)
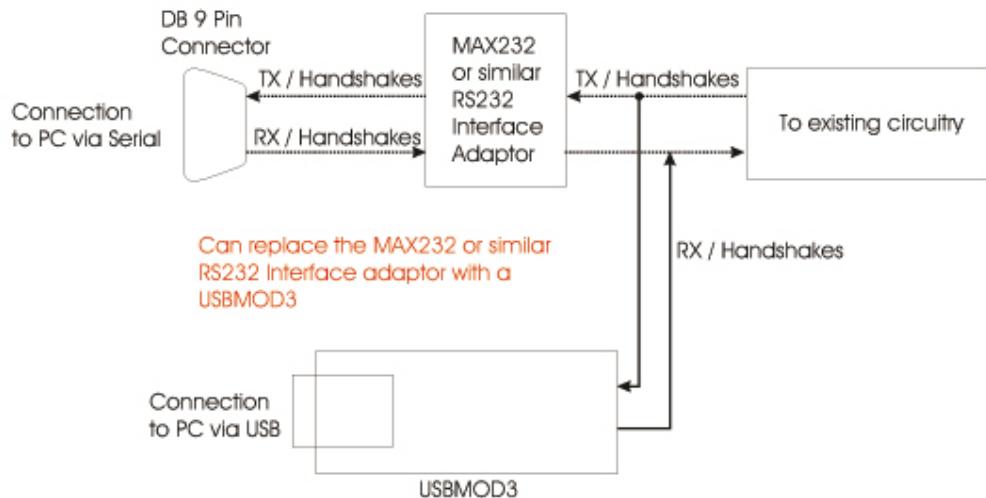
Once the Virtual COM Port is installed it can be programmed exactly as a regular serial COM port using the MSComm control from Visual Basic or API calls from C or other languages. Set the COM port to the same number as appears in the Device Manager, the baud rate, stop bits, parity etc are not used as the device always runs at full speed.

The Direct DLL driver is installed in a similar manner but using the alternative download from the website.

Programming the Direct DLL driver is by call to the DLL Library functions.
Please download the Direct DLL programmers guide from the Elexol website.

Application Notes
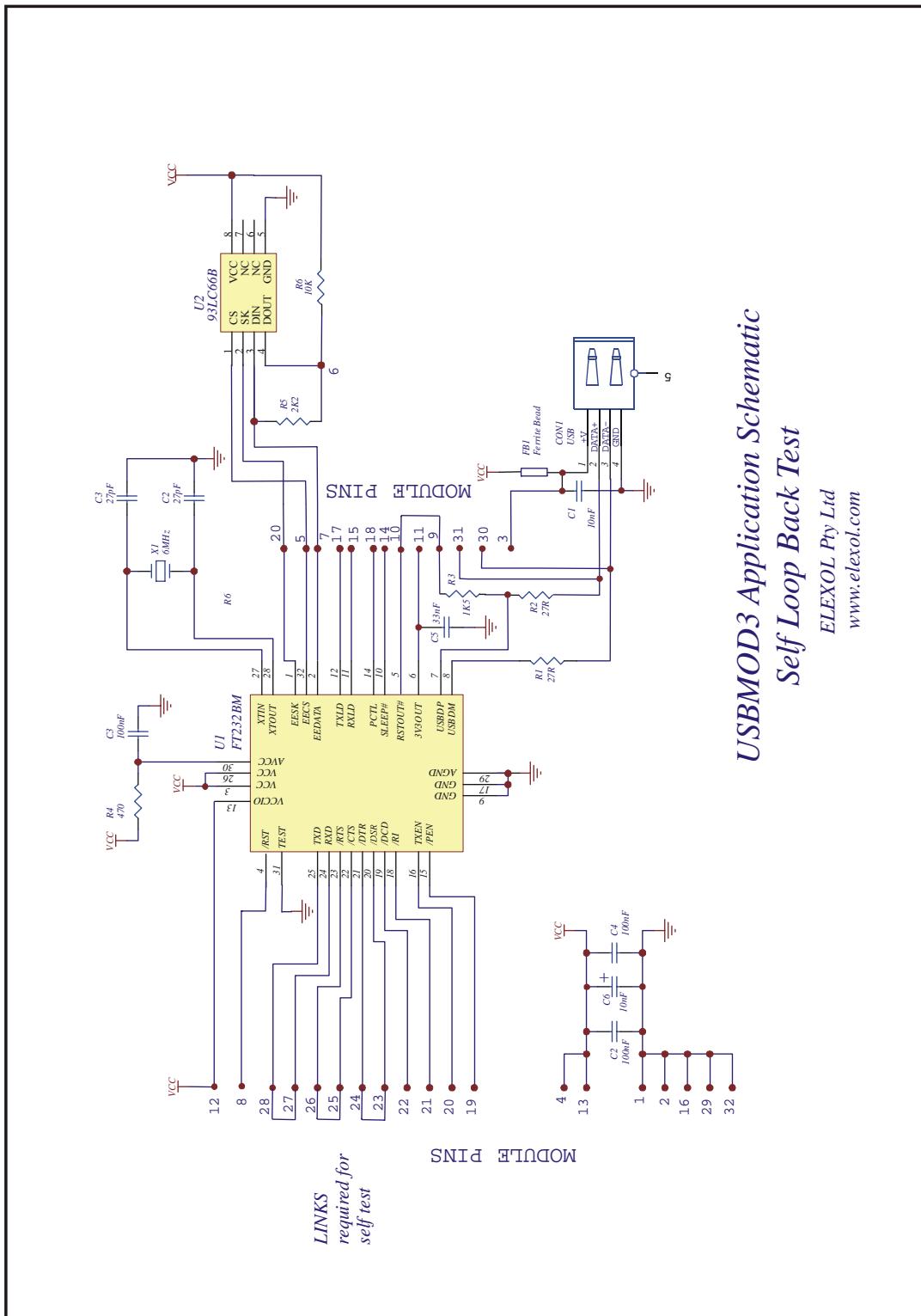
The USBMOD3 is a quick and simple way of changing from existing RS232 to USB. The existing RS232 interface adaptor can be replaced with a USBMOD3 in a matter of minutes by connecting TX, RX and handshake lines.

On the following pages there are schematic drawings showing various sample applications for the USBMOD3.

The first application is a self-loop back test using the USBMOD3.

SAMPLE APPLICATION No. 1
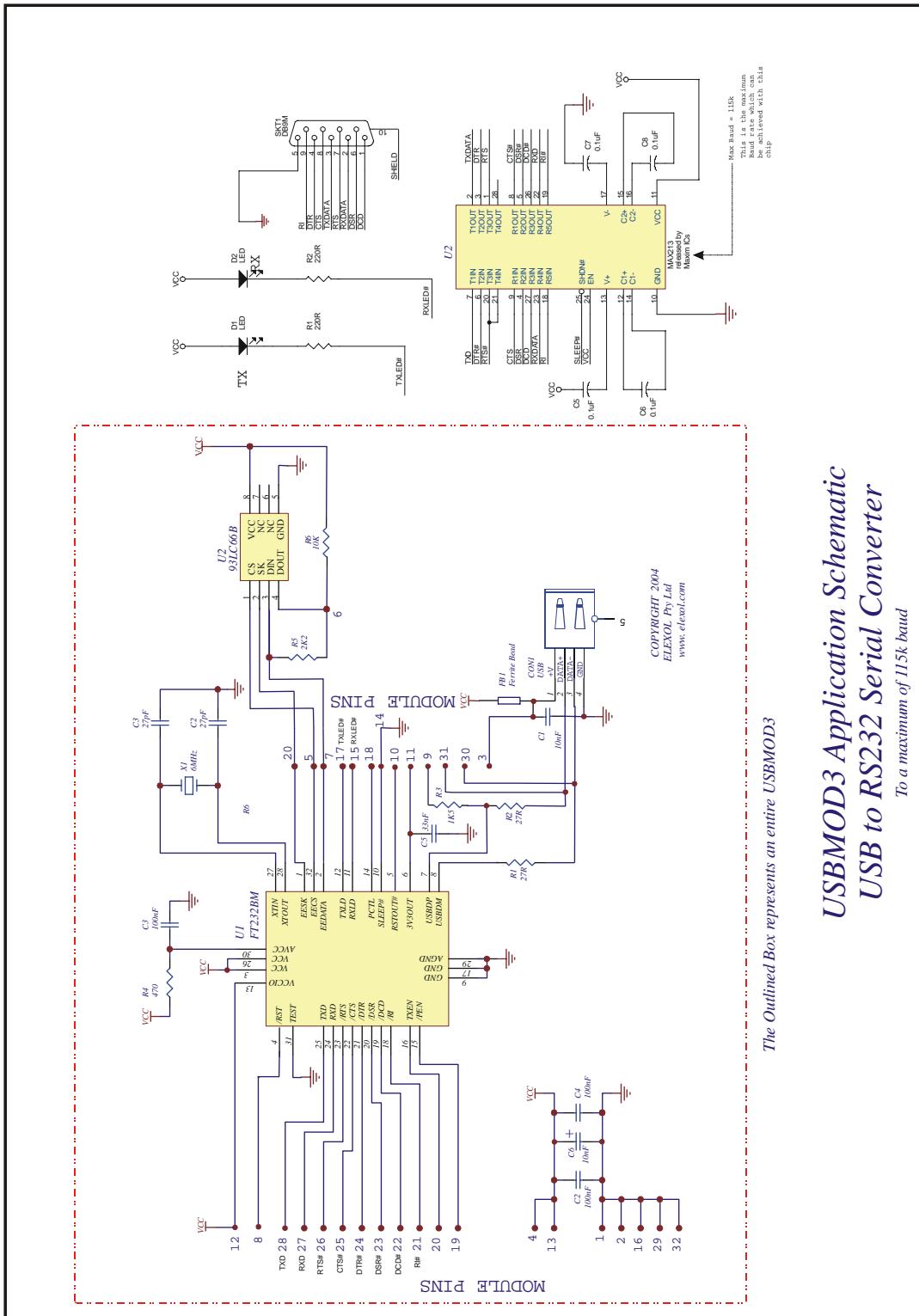
USBMOD3 Application Schematic
Self Loop Back Test

ELEXOL Pty Ltd
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The second application is a USB to RS232 converter, which is capable of achieving a maximum of 115k baud. The RS232 interface chip that we are using is a MAX213 chip.

SAMPLE APPLICATION No. 2

USBMOD3 Application Schematic
USB to RS232 Serial Converter
To a maximum of 115k baud

The Outlined Box represents an entire USBMOD3

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Absolute Maximum Ratings

Storage Temperature …………………………………….. -65°C to + 150°C
Ambient Temperature (Power Applied)………………….... 0°C to + 70°C
VCC Supply Voltage …………………………………….. -0.5v to +6.00v
DC Input Voltage - Inputs …………………………………. -0.5v to VCC + 0.5v
DC Input Voltage - High Impedance Bidirectionals …………… -0.5v to VCC + 0.5v
DC Output Current – Outputs ………………………………… 24mA
DC Output Current – Low Impedance Bidirectionals …………... 24mA
Power Dissipation ……………………………………………. 500mW

DC Characteristics (Ambient Temperature = 0°C .. 70°C)

Operating Voltage and Current

Parameter	Description	Min	Typ	Max	Units	Conditions
Vcc1	+V Operating Supply Voltage	4.4	5.0	5.25	V	
Vcc2	VIO Operating Supply Voltage	3.0	-	5.25	V	
Icc1	Operating Supply Current	-	25	-	mA	Normal Operation
Icc2	Operating Supply Current	-	180	200	uA	USB Suspend

UART I/O Pin Characteristics (VIO = 5V)

Parameter	Description	Min	Typ	Max	Units	Conditions
Voh	Output Voltage High	4.4	-	4.9	V	I source = 2 mA
Vol	Output Voltage Low	0.1	-	0.7	V	I sink = 4 mA
Vin	Input Switching Threshold	1.1	1.5	1.8	V	* Note 1
VHys	Input Switching Hysteresis		200		mV	

UART I/O Pin Characteristics (VIO = 3.3V)

Parameter	Description	Min	Typ	Max	Units	Conditions
Voh	Output Voltage High	2.7	-	3.2	V	I source = 2 mA
Vol	Output Voltage Low	0.1	-	0.7	V	I sink = 4 mA
Vin	Input Switching Threshold	1.0	1.4	1.8	V	* Note 1
VHys	Input Switching Hysteresis		200		mV	

* Note 1 – Inputs have an internal 200kΩ pull-up resistor to VIO

RSTI, ECS, EDAT I/O Pin Characteristics

Parameter	Description	Min	Typ	Max	Units	Conditions
Voh	Output Voltage High	4.4	-	4.9	V	I source = 2 mA
Vol	Output Voltage Low	0.1	-	0.7	V	I sink = 4 mA
Vin	Input Switching Threshold	1.1	1.5	1.8	V	* Note 2
VHys	Input Switching Hysteresis		200		mV	

* Note 2 – ECS and EDAT pins have an internal 200kΩ pull-up resistor to +V

RSTO Pin Characteristics

Parameter	Description	Min	Typ	Max	Units	Conditions
Voh	Output Voltage High	3.0	-	3.6	V	I source = 2 mA
Iol	Leakage Current Tri-State	-	-	5	uA	

USB I/O Pin Characteristics

Parameter	Description	Min	Typ	Max	Units	Conditions
UVoh	I/O Pins Static Output (High)	4.4	-	4.9	V	Rl = 1.5kΩ to 3V3Out (D+) Rl = 15kΩ to GND (D+)
UVol	I/O Pin Static Output (Low)	0.1	-	0.7	V	Rl = 1.5kΩ to 3V3Out (D+) Rl = 15kΩ to GND (D+)
UVse	Single Ended RX Threshold	0.8		2.0	V	
UCom	Differential Common Mode	0.8		2.5	V	
UVDif	Differential Input Sensitivity	0.2			V	
UDrvZ	Driver Output Impedance	29		44	Ω (ohm)	* Note 3

* Note 3 – Driver Output Impedance includes the external 27Ω series resistors on D+ and D- pins.

Technical Support and Further Information

For any questions relating to the USBMOD3 please contact us by Email, Fax or Phone.

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Product Use Limitations, Warranty and Quality Statement.

The USBMOD3 should not be used in any situation where it's failure or failure of the PC or software controlling it could cause human injury or severe damage to equipment.
This device is not designed for or intended to be used in any life critical application.

The USBMOD3 is warranted to be free from manufacture defects for a period of 12 months from the date purchase.
Subjecting the device to conditions beyond the Absolute Maximum Ratings listed above will invalidate this warranty.
The USBMOD3 is a static sensitive device, anti static procedures should be used in the handling of this device.

All USBMOD3 units are extensively tested at time of manufacture to be free of defects.

Elexol is committed to providing products of the highest quality. Should you experience any product quality issues with this product please contact our quality assurance manager at the above address.

Disclaimer.

This product and its documentation are provided as-is and no warranty is made or implied as to their suitability for any particular purpose.
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