USB I/O 24 DIP Digital I/O Module

The USB I/O 24 DIP shown in Diagram 1 is a Dual Inline Package version of the USB I/O 24 module. The module's 50 pin Dual Inline Package (DIP) fits into a standard 50 pin 900mil wide IC Socket. This makes the USB I/O 24 DIP ideal for rapid prototyping and development work.

The module features 24 5V level signal lines individually programmable as input or output. As the module connects to the USB port, multiple modules can be connected to a single PC by the use of a USB hub or hubs. Each module features a serial number and the PC can identify each module uniquely allowing for multiple modules to be connected for a single application. The outputs of the module are able to source or sink up to 30mA per I/O, up to a maximum 50mA per port, to allow for direct connection to a variety of devices.

The USB I/O 24 DIP Module

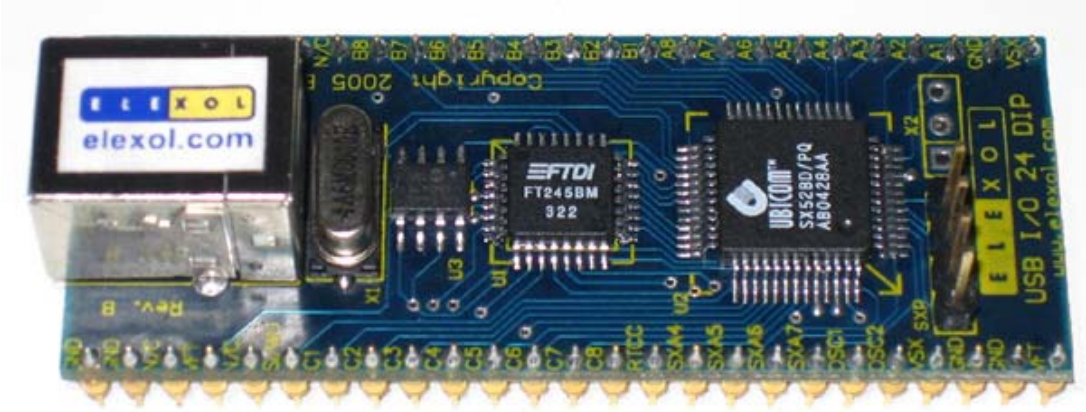


Diagram 1

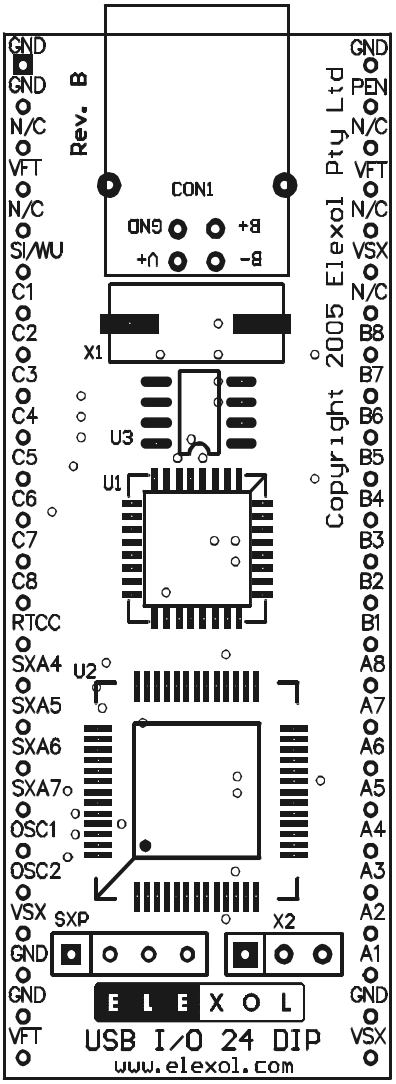
MODULE FEATURES

- Single module High-Speed Digital Input / Output solution.
- Integrated Type-B USB Connector.
- On-board unique serial number in EEPROM and custom programmable FLASH microcontroller.
- Both USB Enumeration information and Micro controller can be re-programmed
- Module powered by the USB from the PC (default option) and can also be configured for Self powered.
- 50-pin Dual In-Line Package Ideal for prototyping
- Fits into a standard 50-pin 900mil IC Socket

Module Standard Firmware & Software

- Virtual COM Port driver allows access as a regular serial port.
- Optional DLL based driver available.
- Easy to program from popular languages C++, Basic, Delphi, etc.
- Simple command set for easy control of ports and data transfer

Module Layout



Physical Dimensions

Length	65.4mm
Width	25.2mm
Height	19mm (not in IC Socket)

USB I/O 24 DIP Pin out Tables

Power Pins for the USB I/O 24 DIP

PIN #	SIGNAL	TYPE	DESCRIPTION
1	GND	PWR	Device – Ground Supply Pin
2			
23			
24			
27			
50			
3	N/C	N/C	No Connection
5			
44			
46			
48			
4	VFT	PWR	+4.35 to 5V VCC supply to FT245BM when in self-powered mode. Note: In USB powered mode this pin is linked to V+ from USB ** **NO** External power needs to be applied when in Bus powered mode** Module is bus powered out of box.
25			
47			
22	VSX	PWR	3.3 to 5V VCC supply to SX52 when in self powered mode. Note: In USB powered mode this pin is linked to V+ from USB via FET** **NO** External power needs to be applied when in Bus powered mode** Module is bus powered out of box.
26			
45			

Control Pins for the USB I/O 24 DIP

PIN #	SIGNAL	TYPE	DESCRIPTION
6	SI/WU	IN	The Send Immediate /WakeUp signal combines two functions on a single pin. If USB is in suspend mode (/PEN=1) and remote wakeup is enabled in the EEPROM, strobing this pin low will cause the device to request a resume on the USB Bus. Normally, this can be used to wake up the Host PC. During normal operation (PEN=0), if this pin is strobed low any data in the device RX buffer will be sent out over USB on the next Bulk-IN request from the drivers regardless of the pending packet size. This can be used to optimize USB transfer speed for some applications. Tie this pin high if not used.
15	RTCC	IN	Input to Real Time Clock Counter
49	PEN	OUT	Connected to P – Channel Logic Level MOSFET switch to control power to Ubicom SX52 circuitry. .

SX Programming Header Pins

PIN #	SIGNAL	TYPE	DESCRIPTION
20	OSC1	IN	Crystal Oscillator Input – external clock source input
21	OSC2	OUT	Crystal Oscillator Output -
22	VSX	PWR	3.3 to 5V VCC supply to SX52 when in self powered mode. Note: In USB powered mode this pin is linked to V+ from USB via FET** **NO** External power needs to be applied when in Bus powered mode** Module is bus powered out of box.
23	GND	PWR	Device – Ground Supply Pin

Note: There is also a programming header located on the board called SXP

I/O Connections (PORT A, B, C)

Listed below are the connections for the I/O connections on the USB I/O 24 DIP.

PORT A (Bi-Directional Data Bus pins)

PIN #	SIGNAL	TYPE	DESCRIPTION
35	A8	I/O	Programmable I/O pin with bit value of 128
34	A7	I/O	Programmable I/O pin with bit value of 64
33	A6	I/O	Programmable I/O pin with bit value of 32
32	A5	I/O	Programmable I/O pin with bit value of 16
31	A4	I/O	Programmable I/O pin with bit value of 8
30	A3	I/O	Programmable I/O pin with bit value of 4
29	A2	I/O	Programmable I/O pin with bit value of 2
28	A1	I/O	Programmable I/O pin with bit value of 1

PORT B (Bi-Directional Data Bus pins)

PIN #	SIGNAL	TYPE	DESCRIPTION
43	B8	I/O	Programmable I/O pin with bit value of 128
42	B7	I/O	Programmable I/O pin with bit value of 64
41	B6	I/O	Programmable I/O pin with bit value of 32
40	B5	I/O	Programmable I/O pin with bit value of 16
39	B4	I/O	Programmable I/O pin with bit value of 8
38	B3	I/O	Programmable I/O pin with bit value of 4
37	B2	I/O	Programmable I/O pin with bit value of 2
36	B1	I/O	Programmable I/O pin with bit value of 1

PORT C (Bi-Directional Data Bus pins)

PIN #	SIGNAL	TYPE	DESCRIPTION
14	C8	I/O	Programmable I/O pin with bit value of 128
13	C7	I/O	Programmable I/O pin with bit value of 64
12	C6	I/O	Programmable I/O pin with bit value of 32
11	C5	I/O	Programmable I/O pin with bit value of 16
10	C4	I/O	Programmable I/O pin with bit value of 8
9	C3	I/O	Programmable I/O pin with bit value of 4
8	C2	I/O	Programmable I/O pin with bit value of 2
7	C1	I/O	Programmable I/O pin with bit value of 1

SPARE I/O (Bi-Directional Data Bus pins)

PIN #	SIGNAL	TYPE	DESCRIPTION
16	SXA4	I/O	Bi-Directional I/O pin spare on SX52
17	SXA5	I/O	Bi-Directional I/O pin spare on SX52
18	SXA6	I/O	Bi-Directional I/O pin spare on SX52
19	SXA7	I/O	Bi-Directional I/O pin spare on SX52

Note: These spare I/O's are not implemented into the current version of the firmware.

Firmware

Communication Protocol

COMMAND	DATA	FUNCTION
'?'	Responds 'USB I/O 24'	Identify Device
'A'	1 Byte Port Data	Write to Port A
'B'	1 Byte Port Data	Write to Port B
'C'	1 Byte Port Data	Write to Port C
'a'	Responds with 1 Byte Port Data	Read from Port A
'b'	Responds with 1 Byte Port Data	Read from Port B
'c'	Responds with 1 Byte Port Data	Read from Port C
'!A'	1 Byte Port I/O Data	Write to Port A Direction Register
'!B'	1 Byte Port I/O Data	Write to Port B Direction Register
'!C'	1 Byte Port I/O Data	Write to Port C Direction Register
'H'	1 Byte specifying which I/O pin (0-23)	Set specific I/O Pin High
'L'	1 Byte specifying which I/O pin (0-23)	Set specific I/O Pin Low
'#'	Follow with Port write and binary data	Port Pull up feature for SX52
'@'	Follow with Port write and binary data	Set inputs to CMOS/ TTL level
'$'	Follow with Port write and binary data	Set Port Schmitt trigger enables
'2'		Sets unit to Mode 2 (Enables transmit on pin change)
'1'		Sets unit to Mode 1 (Exits Mode 2)

The commands in the above table are in ASCII format. All Data is sent in Binary format.

Mode 2 Functional Changes

All reads have a port designator (‘a’, ’b’ or ’c’) before the data.
All auto sends have a port designator (‘a’, ’b’ or ’c’) before the data.
All writes to the port that change the port will results in a port data auto send.

SPI Interface

Send / Receive SPI Byte on PORT A

COMMAND	DATA	REPLY	FUNCTION
‘S’	1 Byte of data sent on SPI Bus	1 Byte of data received on SPI Bus	Send / Receive SPI Byte on PORT A

Send / Receive SPI Byte on PORT B

COMMAND	DATA	REPLY	FUNCTION
‘T’	1 Byte of data sent on SPI Bus	1 Byte of data received on SPI Bus	Send / Receive SPI Byte on PORT B

Send / Receive SPI Byte on PORT C

COMMAND	DATA	REPLY	FUNCTION
‘U’	1 Byte of data sent on SPI Bus	1 Byte of data received on SPI Bus	Send / Receive SPI Byte on PORT C

Notes on SPI
Bit 1 is always Clock and must be set as an output from the SPI to function
Bit 2 is always Serial Data Out (MOSI) and must be set as an output from the SPI to function
Bit 3 is always Serial Data In (MISO) and must be set as an input from the SPI to function
All other port pins act as normal
Setting the port pin as high or low will set the clock as normally high or low before the SPI transaction begins.
Any of the other pins can be used as SS or CE when SPI is used.

Temperature Sensor Interface using DS18B20

Convert Start

COMMAND	DATA	REPLY	FUNCTION
'J'	1 Byte specifying which pin 0 to 23	1 Byte Status of Command	Start Conversion

Read Temperature

COMMAND	DATA	REPLY	FUNCTION
'K'	1 Byte specifying which pin 0 to 23	3 Bytes Byte 1 – Status (see below) Byte 2 – MSB of Temperature Byte 3 – LSB of Temperature	Read Temperature

Notes on the DS18B20

Status Bytes

G	Command execute normally
C	A CRC error occurred while reading the data
N	No sensor found
E	Bad pin number (only pins 0 to 23 are valid)
S	Bus Shorted (or pull up resistor missing)

The DS18B20 requires a resistor between 1K and 4.7K between the data line and the +5V rail. A DS18S20 may also be used if the higher resolution of the DS18B20 is not required.

Note: This function will not work with the 50 MHz upgrade

Reprogramming and Customising the firmware

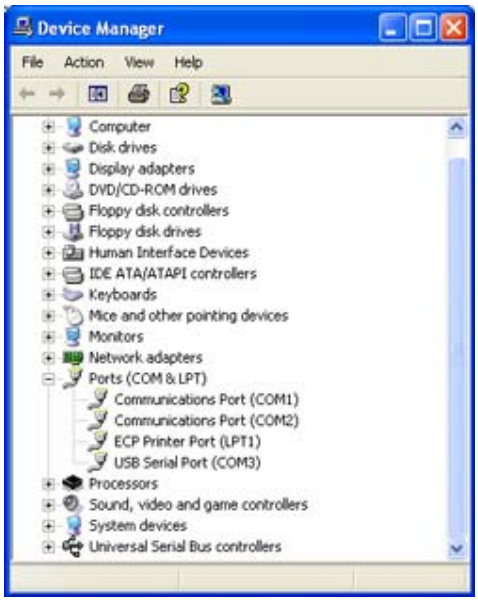
In order to reprogram the original or any customized firmware into the USB I/O 24 you will require a SX Key programmer. These programmers are available from Parallax. For further information on these programmers visit
http://www.parallax.com/sx/programming_kits.asp

The firmware for the USB I/O 24 DIP is available on request. Please contact
support@elexol.com

Driver Installation

Your first choice when using the USB I/O 24 DIP 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 USB I/O 24 DIP 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 USB I/O 24s or USBMODs connected to your system.

To install the Virtual Com Port drivers, download the driver from our website or the ftdichip.com website and unzip the files to a local directory. Then connect the USB I/O 24 DIP 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 of the Non Plug & Play driver for the USB I/O 24 DIP is recommended to avoid a delay on connecting the USB I/O 24 DIP)
Once the Virtual COM Port is installed it can be programmed exactly as a regular serial COM port using the MSComm control from within VB 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 FTDI website.

Programmers Reference Documentation

Programming the USB I/O 24 DIP from Visual Basic using the Virtual Comm Port.

To operate the USB I/O 24 DIP from within Visual Basic it's best to use the Microsoft MSComm control to access the com port. To input data from the USB I/O 24 DIP you must use the port in binary mode and receiving the data is a bit convoluted.

Opening the Port

As the USB I/O 24 DIP unit uses binary data transfer we must use the port in binary mode.
If the port number is incorrect or the USB I/O 24 DIP module is not connected then VB will generate an error.

```
MSComm1.CommPort = 3 ‘ Set this number as shown in the Device Manager
MSComm1.InputMode = comInputModeBinary ‘ Set Binary Input Mode
MSComm1.PortOpen = True ‘ Open the Port
```

Setting the pins as Inputs or Outputs

Setting the Ports as Input or Output you must determine the value for the pins you want set as inputs.
To set pins I/O1, I/O2 and I/O3 as inputs and the remaining pins as outputs you simply add the bit values of the input pins 1 + 2 + 4 = 7 and thus the value to be placed in the IOValx variable in the following example code is 7.

```
‘ Set I/O1, I/O2 & I/O3 of port A to inputs and the rest as outputs.

IOValA = 7 ‘ First 3 inputs all the rest as outputs
IOValB = 0 ‘ All outputs
IOValC = 0 ‘ All outputs
MSComm1.Output = "!A" + Chr$(IOValA) ' Write to Port A Direction Register
MSComm1.Output = "!B" + Chr$(IOValB) ' Write to Port B Direction Register
MSComm1.Output = "!C" + Chr$(IOValC) ' Write to Port C Direction Register
```

Writing to the Ports

To write to the Output Pins simple repeat the Above without the ! character.
The following example code sets the I/O8 pin on port B to high and the remaining pins as low.

```
IOValB = 128 ‘ I/O8 high, all the rest low
MSComm1.Output = "A" + Chr$(IOValB)
```

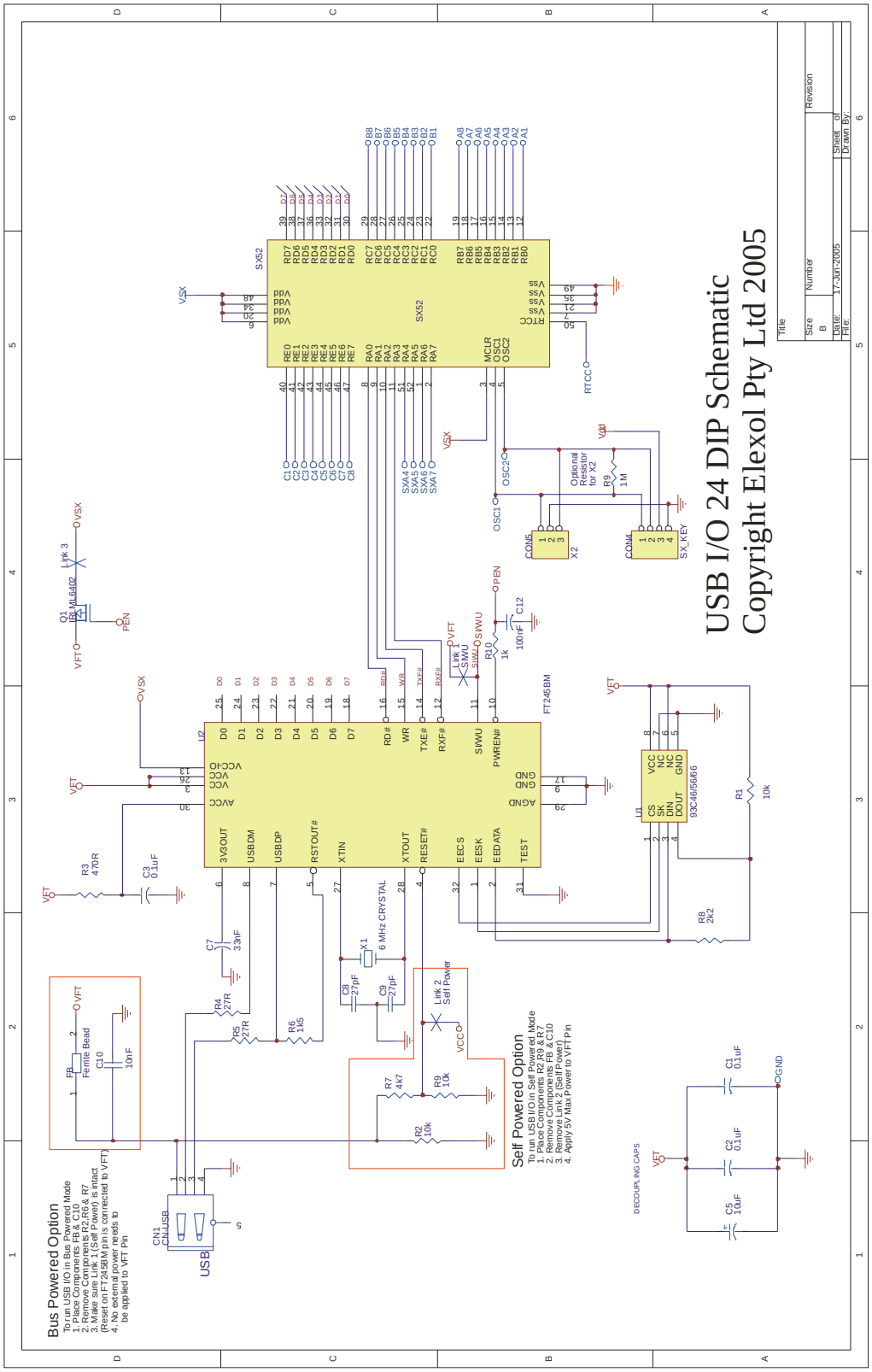
Reading from the Ports

To Read the Input Pins is a bit more complicated as we must request the data from the module, wait for it to arrive and then retrieve the data from the port. The following example reads the value from port A.

```
MSComm1.Output = "a" ‘ Request data from port A

T = Timer ‘ Use the Timer to allow the program to continue if there is an error
   While Timer < T + 0.4 And MSComm1.InBufferCount < 1
   Wend
If MSComm1.InBufferCount <> 1 Then
    Call MsgBox("Read Timeout", vbInformation, "USB I/O 24 DIP Error")
    Exit Sub
    End If
Dim TempBuffer As Variant
Dim ByteBuffer() As Byte
TempBuffer = MSComm1.Input
ByteBuffer = TempBuffer
PortAVal = ByteBuffer(0)
```

Schematic


USB I/O 24 DIP Schematic
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Bus Powered Option
To run USB I/O in Bus Powered Mode
1. Place Components FB & C10
2. Remove Components R2,R8 & R7
3. Make sure Link 2 (Self Power) is intact
(Reset on FT245BM pin is connected to VFT)
4. No external power needs to be applied to VFT Pin
Self Powered Option
To run USB I/O in Self Powered Mode
1. Place Components R2,R8 & R7
2. Remove Components FB & C10
3. Remove Link 2 (Self Power)
4. Apply 5V Max Power to VFT Pin
SX52
FT245BM
93C46/56/66
6 MHz CRYSTAL
USB
DECOUPLING CAPS

Hardware Configurations for the USB I/O 24 DIP as per schematic

The USB I/O 24 DIP has a number of different hardware configurations that can be implemented. Each of the configurations are listed below:

Bus Powered (FTDI Chip)

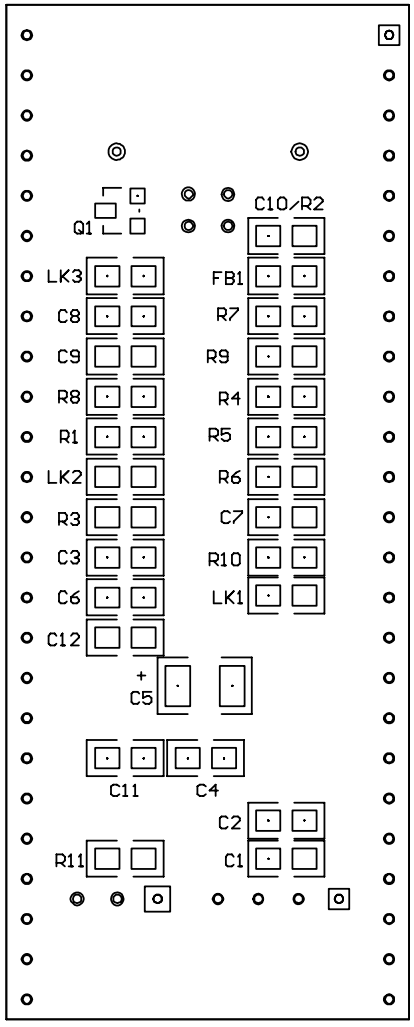
The bus powered mode draws power from the USB Bus. This option is the current configuration that is used when the USB I/O 24 DIP is sent out.

Self Powered (External power supplied to FTDI Chip)

The self-powered mode of operation draws power from its own external Power supply and doesn't draw any current from the USB Bus.

Note: The FTDI chip can only be bus powered or self powered

Component Designators for underside of board



Underside View

Self Powered Option

To run USB I/O in Self Powered mode

1. Remove Components FB & C10
2. Remove Link 2 (LK2)
3. Place components R2,R7 & R9
4. Apply 5V Max Power to VFT Pin

Where R2 = 10k, R7 = 4k7, R9 = 10k

Powering SX 52 Options

There are a number of different ways that the UBICOM SX52 micro controller can be powered. These various options are shown below.

Note: When the SX52 is powered from the USB this also means that the USB Bus will also power the FTDI FT245BM.

USB 5V

The SX52 draws it power from the USB Bus. This is the default setting out of the box.

External Power to SX52 (3.3V to 5V)

The SX52 draws it power from its own external power supply. Either 3.3V or 5V power can be used to power the SX52.

Absolute Maximum Ratings

Subjecting the device to conditions outside these rating will invalidate the product warranty and may cause irreparable damage the device.

Maximum Voltage on Any Pin (referenced to GND) .....5.1 V DC
Minimum Voltage on Any Pin (referenced to GND) ..... -0.1V DC
Supply current when USB enumerating 55mA
Supply current when running with no load on I/O pins..... 32mA
Total Current to or from Any Single I/O Pin..... 30mA
Total Current to or from Any PORT (8 Single I/O make a PORT)..... 50mA
Total Current in or out of all the module's I/O pins 200mA

Further Reading and Examples

More information and examples for the USB I/O 24 DIP can be found on our websites at www.elexol.com
Updated drivers and further information about the USB interface chip can be found at the FTDI website www.ftdichip.com
Information about the SX52 micro controller can be found on the UBICOM website at www.ubicom.com

Document Revision History

USB I/O 24 DIP Datasheet V1.0– Initial document created 6th July 2005
USB I/O 24 DIP Datasheet V1.1 – Updated 20th March 2006

- Updated schematic due to multiple designators being used
- Added component designator diagram for bottom layer components

Technical Support and Further Information

For any questions relating to the USB I/O 24 DIP please contact us by Email:
support@elexol.com

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Product Use Limitations, Warranty and Quality Statement.

The USB I/O 24 DIP 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 USB I/O 24 DIP 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 USB I/O 24 DIP is a static sensitive device, anti static procedures should be used in the handling of this device.

All USB I/O 24 DIP units are tested during manufacture and are despatched 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.

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