

# I2C to PC

## USB & RS232 TO I2C/SPI ADAPTOR & CONTROLLER

### Features

- Uses [BL233](#) I2C-Serial IC
- Both RS232 & USB interfaces
- Three separate I2C busses
- 2x SPI bus
- 2x Dallas type 1-Wire bus
- Easy ASCII commands
- High-Speed
- On-board power supply
- Galvanic Isolation
- 82B715 High current Bus buffer
- Power-On, Watchdog and other autonomous actions without working PC
- Auto-switching USB/RS232
- Cross-Platform: Linux, Windows, PDA's etc
- USB Bus Powered
- 45x80mm

### Applications

- Evaluation Boards for I2C & SPI chips
- Rapid Prototyping & PnP design
- PC based instrumentation and control
- ATE for I2C/SPI based equipment
- Reader for 1Wire serial numbers
- Isolated I/O

- Cheap and Easy Data logging
- PC and Network Watchdogs
- PDA/Calculator Analog/Digital I/O
- Galvanically Isolated PC interface
- Education
- RS232 parallel I/O
- Evaluation of I2C and SPI chips

### Programmable

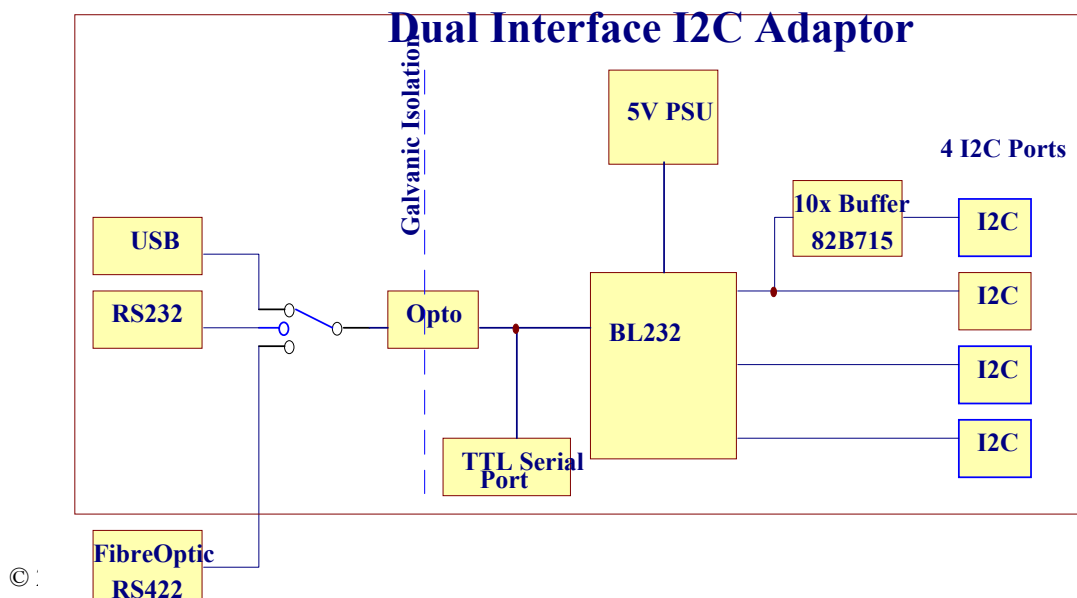
EEProm stores commands and settings

- Power On Reset actions
- Interrupt actions
- Watchdog timeout actions
- Macro's
- Autonomous actions

### Description

With both USB and DB9 serial interfaces this is a truly universal I2C interface, that opens your product up to the widest possible range of computing hardware, with the simplest and most portable software format.

Building an I2C based instrument needs nothing more than *your* I2C chip, everything else is included. There is an internal 5V power supply to run the interface and your target hardware. Simple systems will run from the USB



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bus power.  
er.

Unlike some competing products, it can sustain high baud rates, and has multiple I2C Busses  
Compared to cruder solutions, it doesn't rely on bit-bashing PC software, ill defined I/O characteristics, or processor and OS dependent timing.

Power-On-Reset actions can be set in EEPROM so that systems are properly initialised when the PC is not present.

Watchdog actions can be programmed to automatically respond to PC failure.

Galvanic isolation can be installed where the I2C busses need to be isolated from the computer.

An optional Fibre Optic interface is available where very high voltage or totally secure isolation is required.  
An RS422 interface is available for long distance or high noise immunity.  
Ferrite beads are fitted to all data lines for EMC protection.

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## 1 Commands

Read the [BL233](#) PDF Datasheet for a full description of commands and operation.

## 2 Software Interface

The I2C-2-PC appears as a serial port device when either the USB or RS232 are used. (Linux and Windows).

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No special API's or DLL's are required to access it. Almost any programming language can be used including Labview. Our customers are using it with

- VB
- C, C++
- Labview
- Matlab
- Delphi
- Java
- Python
- Perl
- PDA's
- Batch files

### 3 Installing and Testing Your New Adaptor

The I2C2PC is normally shipped set to **57,600 bd N81, RTS/CTS handshake**. If you have Galvanic Isolation fitted, read section 9.1

- Download, Install and Start [Realterm \(realterm.sourceforge.net\)](http://realterm.sourceforge.net)
- Change port settings to hardware handshake RTS/CTS. Set to HALFDUPLEX so you can see what you type. Alternatively you can make a shortcut with these parameters e.g. **“realterm.exe baud=57600 flow=2 half”**
- Ensure the Port Select jumper is in AUTO position (ie not fitted). The port will default to RS232 when the USB is not connected.
- Connect a DB9 serial extender (m-f) cable (not a cross over cable) to the RS232.
- Apply 9V Centre positive 2.1mm power supply.
- When you apply power you should see a default startup message like “HI I2C v103”.  
Note you probably won't see this when using USB power, as the message is normally sent before the bus has enumerated.
- Type “?”. The I2C2PC should reply with 2 hex bytes of the status byte eg “18”
- Install the Port Select Jumper in the AUTO position (towards the USB connector).  
Repeat the tests above (with RS232)
- If you are going to use the USB, install the FTDI driver software for Windows.  
<http://www.ftdichip.com/FTWinDriver.htm>

### 4 RS232-US B Selection

Selector <sup>1</sup>at edge of board under USB/DB9 connectors:

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<sup>1</sup> Boards before May 2003 are:  
Jumper toward DB9: Always USB

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- Jumper toward DB9: Always RS232
- Jumper toward USB connector: Always USB
- No Jumper: Autoselect USB when bus enumerates, RS232 otherwise.

Duplicate jumper holes are in the board above the 4052(J2), and can be fitted when you don't want to use the ones at the edge.

### 4.1 Aux Interface

You can add a 3<sup>rd</sup> interface, eg Fibre or RS422. This plugs into CN9, and is selected by fitting J1, and the "USB Always" jumper.

### 4.2 Bluetooth

A Bluetooth serial module could be connected to the Aux interface. This would be ideal for interfacing with PDA's.

## 5 I2C Bus Connector

The I2C Bus connector used is a *MICRO-MATCH* by AMP. Either 4 or 6 way can be used. Connectors are available from Farnell.

#	4 Way	6 Way	
1	SDA	SDA	
2	VDD	VDD	
3	VSS	VSS	
4	SCL	SCL	
5		INT / CS	Interrupt input (active low) <i>or</i> Chip select for SPI (jumper select)
6		VAUX	Aux supply. Not connected

The reason for the power lines being between the I2C wires is to stop the edges of SDA and SCL coupling together. This follows the Philips pattern set out in section 17.3 of The I2C Bus Specification.

œIf the length of the bus lines exceeds 10 cm

œThis arrangement will have similar capacitive loading on SDA and SCL. Where you don't use pins 5 & 6, it can be better to just use 4 wires.

---

Jumper toward USB connector: Autoselect USB when enumerated, RS232 otherwise.  
No Jumper: Always RS232

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	AMP www.amp.com	Farnell www.farnell.com	RS	
6 way male-on-wire	7-215083-6	149-068		
6 pin female-on-board	7-215079-6	148-519		
4 pin male-on-wire	7-215083-4	149-032		
4 pin female-on-board	7-215079-4	148-507		

Made up cable assemblies are available from Farnell.

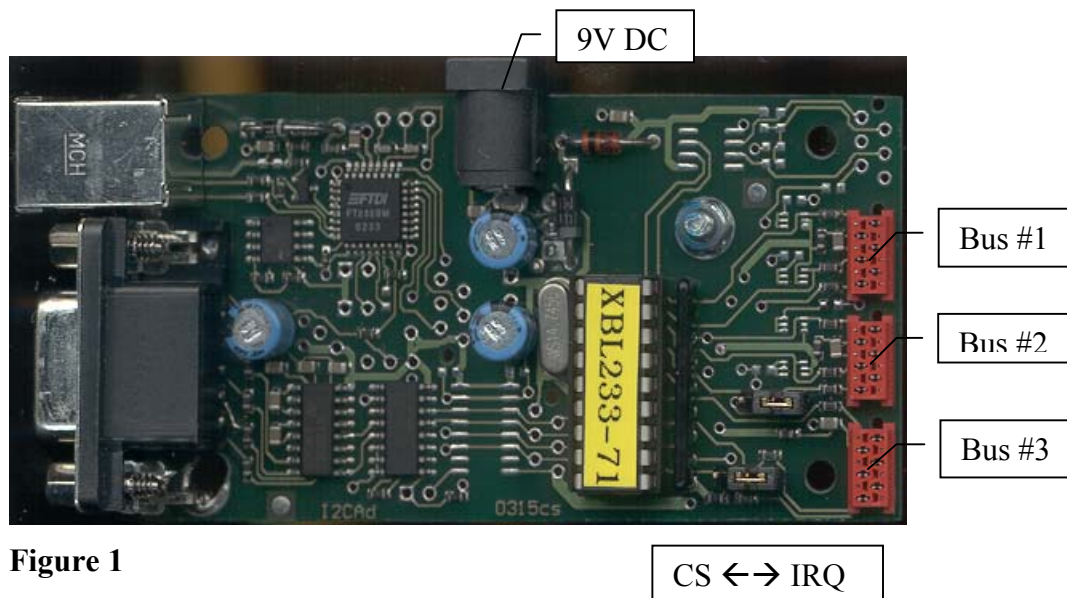


Figure 1

### 6 CS and Interrupt Pins

Jumpers are provided to select the function of pin 5 of the I2C connector between IRQ (input), and CS/1Wire (i/o). This is for BUS# 2, 3 only. Bus#1 is always connected to IRQ.

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The bus is fitted with 1k5 pullup resistors in SIL resistor packs. The BL233 can drive much higher currents if required, 15-20mA @5V VCC. There is a 47 ohm protection resistor in series with the outputs that will need to be reduced of course.

You will need a buffer at the other end of the bus.

If you want to reduce the current, replace the resistor pack. We recommend cutting it out with fine side cutters, removing the individual pins through the top of the board, and desoldering the holes.

### 8 Power Supply

External power is 9-12V DC, (2.1mm centre positive). An on board power supply regulator is fitted using a 7805.

- USB Bus Powered USB Data: ~50mA for I2C devices
- USB Bus Powered RS232 Data: ~50mA for I2C devices
- External Power, RS232
- External Power USB

#### 8.1 USB Bus Powered

The USB bus can deliver up to 500mA. Devices that draw > 100mA from the bus should have switched load.

#### 8.2 Power to I2C Devices

The I2C Bus VDD is connected to the interfaces VDD (5V).

To isolate an I2C Bus VDD from the I2C Adaptor's VDD, remove the associated 0603 ferrite bead by the connector. (FB9-12)

#### 8.3 Local AND USB Power

Boards manufactured after April 2003 should work happily with both external and USB power.

If you do not want the USB bus to try and power your equipment, remove D5 (by USB connector). Normally you would do this when building the I2C-2-PC into a standalone equipment that has its own 5V supply.

With boards manufactured before May 2003:

There are some traps to watch when using a local power source, and the USB adaptor. The USB chip will not see a power on reset when the USB Bus is connected, and local power is already applied, and may not enumerate correctly. See FTDI documentation for more reset details.

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### 9 Options

These options are *not* fitted as standard, as few users require them.

- IL716 Galvanic Isolation
- 82B715
- USB Leds
- Power LED
- USB EEPROM
- 3<sup>rd</sup> I2C bus connector
- Aux serial interface connector and jumper

#### 9.1 Galvanic Isolation

The [NVE IL716-3](#) magnetic isolator is used for galvanic isolation. For more information see the NVE datasheet.

##### 9.1.1 Power

When isolation is fitted, you have to power the PC side separately from the I2C side. Normally USB power is used for the PC side, and an external 9V supply for the I2C side.

If you want to use the RS232 interface, you can still use the USB connector to provide power. Just fit the "RS232" jumper to force the interface to use RS232. (with no jumper the interface autoselects USB when the USB is connected to a computer, but not when a USB power-only cable is used)

##### 9.1.2 External 5V to PC Side

If you are not using USB power, fit 2 pin connector CN4 and protection zener D1 (BZX85C5V6 or BZX85C6V2).

The PC side requires 5V, 30mA.

##### 9.1.3 Fitting a DC-DC Convertor

If you want to power one side of the isolation barrier from the other, you can fit a 5V-5V DC-DC convertor module. The easiest point to access VCC and GND is pins 1 and 6 of CN2 and CN9.

You can power either side from the other. Suitable convertors are available from Farnell, RS, Digikey etc.

##### 9.1.4 Bypassing the isolation

If you don't need the isolation you can simply join VCC and GND ie CN2-1 to CN9-1 and CN2-6 to CN9-6.

*Beware of forgetting that the isolation is gone!*



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### 9.1.5 Fitting Isolator Yourself

If you need isolation, either mill, or chisel the bridging tracks from the IL716 footprint and fit the IC.

If you use RS232, and an isolator you will need to power the RS232 section. Fit CN4, and protection diode D1 (BZX85C5V6 or C6V2)

### 9.1.6 USB Power only Cable

You can use a USB Power-only cable to power the PC side, when using RS232. This is just a USB cable with only the 2 power wires fitted.

### 9.2 82B715 Bus Extender

(See Bus Drive above. If you only need more current, you probably don't need the 82715 at the I2C-2-PC end)

The [Philips](#) 82B715 increases the drive of Bus 1 by 10x where long bus lengths must be driven. At the other end of the extended bus you have another 82B715 on a [Bus Extender Board](#)

### 9.3 USB Leds and Power Led

USB-RX (led1) and USB-TX (led2) leds can be fitted if you want. Use 5V built-in resistor type leds (or use 3mm leds + 330 ohm resistors). These LEDs flash briefly when data is sent or received through the USB bus. They are useful for debugging purposes. Led3 is a power LED.

### 9.4 USB EEPROM

USB info can be set in the 93C46B EEPROM. FTDI utilities allow you to set this. This will let you enumerate the device as something other than a generic usb/serial adaptor, as well as setting special information such as current consumption.

## 10 Example Applications

See the <http://www.i2cchip.com> for more examples.

### 10.1 8 Bit I/O Port

Use a Philips PCF8574 or Onsemi JLC1562. See <http://www.i2cchip.com/pcf8574.html> for i/o boards and keyboards. You can drive small relays like NAIS TQ-2 directly.

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Figure 2

### 10.2 Simple Data logger with no PC Software

Use a Philips PCF8591 4 channel 8 bit A-D chip.

Store this macro in the EEPROM at location 0. It will run automatically at power on, sending 4 channels of A-D data in hex, followed by LF

**S90 04 R04 T0A L0200 >00**

[Start][address 0x90 (8591)][Control register=0x04][Read 4 channels of A-D] [Type LF (linefeed)][delay 512 ms][goto start]

Capture the data to file with Realterm.

Plot it with Excel, Matlab etc.

### 10.3 Simple RS232 I/O Port

The I2C-2-PC can be used directly as an 8 bit I/O port with a 1 bit IRQ input. No I2C or SPI chips are needed at all. This is ideal for connecting relays, lights and switches to a PC.

**O OF**

[write 0x0F direct to pins]

**Q**

[read pins]

**?**

[read IRQ input]

### 10.4 RS232 to LCD Module adaptor

A single PCF8574 can drive a standard LCD module. This circuit is available built up.

### 10.5 Huge RS232 Parallel Port

To get a large number of cheap and easy output pins with good drive capability, use the SPI output, and 74HC4094 shift registers. Eg a 32 bit output with 4x 4094's.

SDA4 is used as STB for the 4094's

**G3 Y01020408 OFFFD OFFFC**

[select bus3][send 4 bytes to 4094's][pulse STB pin to latch data] nb **O** not zero

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### 10.6 Reading a DS2401 1 Wire serial number

To read a DS2401 serial number

**GC S ? W33 R04**

[Select 1 wire bus#1 (bus #C)][Start(reset)][Get status to check presence][ReadRom Command][Read 4 bytes of rom data]

Since Start can be followed immediately by write data, a shorter version is:

**GC S 33 R04**

[Select 1 wire bus#1 ][Start][ReadRom command][read 4 bytes]

## 11 USB

USB requires the Virtual Comport drivers for Windows. For other operating systems see <http://www.ftdichip.com/FTDriver.htm>

USB introduces latency that may affect your software design. See <http://www.ftdichip.com/knowledgebase/AppNotes/005/knowledgebase.htm>

This latency affects *all* USB devices. To avoid it you should structure your software to decouple the commands you send from the data coming back. ie you send as many commands as possible to the BL233, then you process the data as it returns. If you send a command, then wait for each response, performance can be very poor.

*Just because USB runs at 12Mbps does not mean it really works fast.* RS232 may perform better in practice. This is why we provide *both* interfaces.

The USB configuration in EEPROM can be changed so that it enumerates as a special device rather than a virtual comm port. FTDI utilities can be provided to do this FTDI provides D2XX DLL Drivers are to directly access the USB interface.

<http://www.ftdichip.com/FTD2XXDriver.htm>

We recommend using the Virtual Comm Port approach, as you retain the flexibility to use RS232 with no software changes.

## 12 FAQ

The BL233 datasheet is the place to find answers to your software questions!

*Can I use 3V IC's?*

Yes. Bus# 3 has TTL Levels. Use 2 shottky diodes to clamp SDA &SCL to the 3V VCC.

An alternative is a level shifter. Contact [sales@i2cchip.com](mailto:sales@i2cchip.com) for availability.

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*Can you supply a 3V version?*

Yes we can for OEM orders.

*My adaptor doesn't work. I have Galvanic Isolation.*

You have to power the PC side *and* the I2C side separately. See 9.1.1

*USB is really slow?*

Latency is an issue. See USB section 11

*The data is gobbledygook.*

First use Realterm to test the adaptor. Make sure the baud rate is correct (57600 is default) and that you are using RTS/CTS handshaking.

*Realterm doesn't do XXXX*

You can try the latest development version of Realterm at

<http://www.i2cchip.com/realterm>

*Does it work with Labview?*

Yes. Labview has good serial support

*How do I interface to a PDA?*

- Most PDA's have TTL level serial connections available. The BL233 will directly interface to this through the AUX header on the pcb.
- RS232 adaptor cables are available for some PDA's. You will probably need a null modem plug/cable to connect them together
- You can use an IRDA receiver connected to the AUX header. The IR port is a comm port to the PDA software
- Use a bluetooth module connected to the AUX header. These give up to 100m range.
- RS232 Compact Flash card. If your PDA has a CF slot you can get an RS232 card for it.

*My PDA has a USB cable. How do I use it?*

Except for the latest devices, most PDA's are a USB slaves, and cannot control other USB slaves. (ie you can't)

If your PDA can plug direct into a USB printer then it might be possible.

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### 13 Factory Test Procedure

This is the factory test procedure:

#### 13.1 Visual Inspection

#### 13.2 DC Supply current and Power supply

Set PSU to 0V.

Connect to DC socket.

Increase supply voltage *slowly* to 8V, whilst measuring the 5V line across D2, and watching for excessive current (>50mA)

Check supply voltage on CD4052 is between 4.75 and 5.25V

#### 13.3 RS232

Install RS232 jumper

Connect RS232 cable and set terminal program to nominal baud rate (normally 57600)

Connect power to adaptor

Terminal should display "HI I2CAD V1.04" or similar. Note that once the EEPROM has been changed this may no longer be true.

Type "?". Board will reply with 2 chars eg 18

Remove jumper (auto-select).

Type "?" again and check still works

#### 13.4 USB

(Note that FTDI USB/serial adaptor drivers may need to be installed first time)

Remove RS232.

Plug in USB.

Type "?" and check response.

In case of problems check the USB RX and USB TX LED positions with an oscilloscope. These pulse low when chars are received or sent. Note that you won't see the "HI I2CAD V1.04" power on message through the USB port as the USB connection is not enumerated yet, when the BL232 starts.

#### 13.5 I2C Bus 1

Connect the test PCF8574 board to I2C Bus1.

Type "S42F0P"

Half the leds will come on

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### 13.6 I2C Bus 2

Connect the test PCF8574 board to I2C Bus1.

Type "G2" to change to I2C Bus 2

Type "S42F0P"

Half the leds will come on

### 13.7 INT Pin

Put jumpers J4,5 in INT position

Send ?. Reply is "18"

Hold down a button on 8574 board.

Send ?. Reply is "08"

Check for 3 busses

## 14 Ordering Information

### 14.1 OEM Versions

It is available as a bare board in OEM packs. Bare boards can be supplied with a slightly different DB-9 if required for mounting the board on stand-offs.

Special builds are also available for volume orders.

- RS232 only
- USB only
- Bluetooth

### 14.2 RS232/USB to TTL Interface

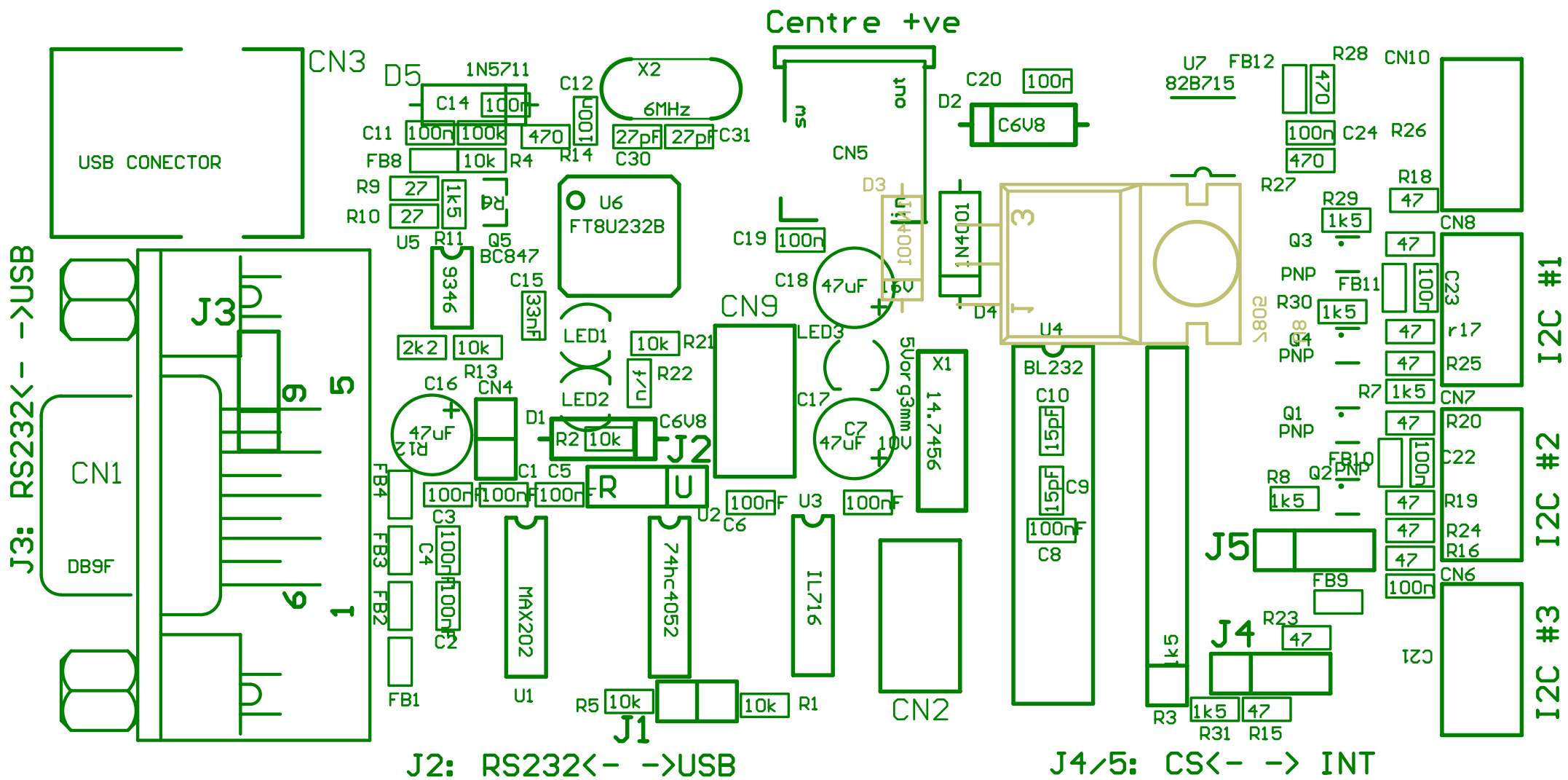
We supply this board for use as a built up serial interface to customers TTL level devices. Contact us for pricing.

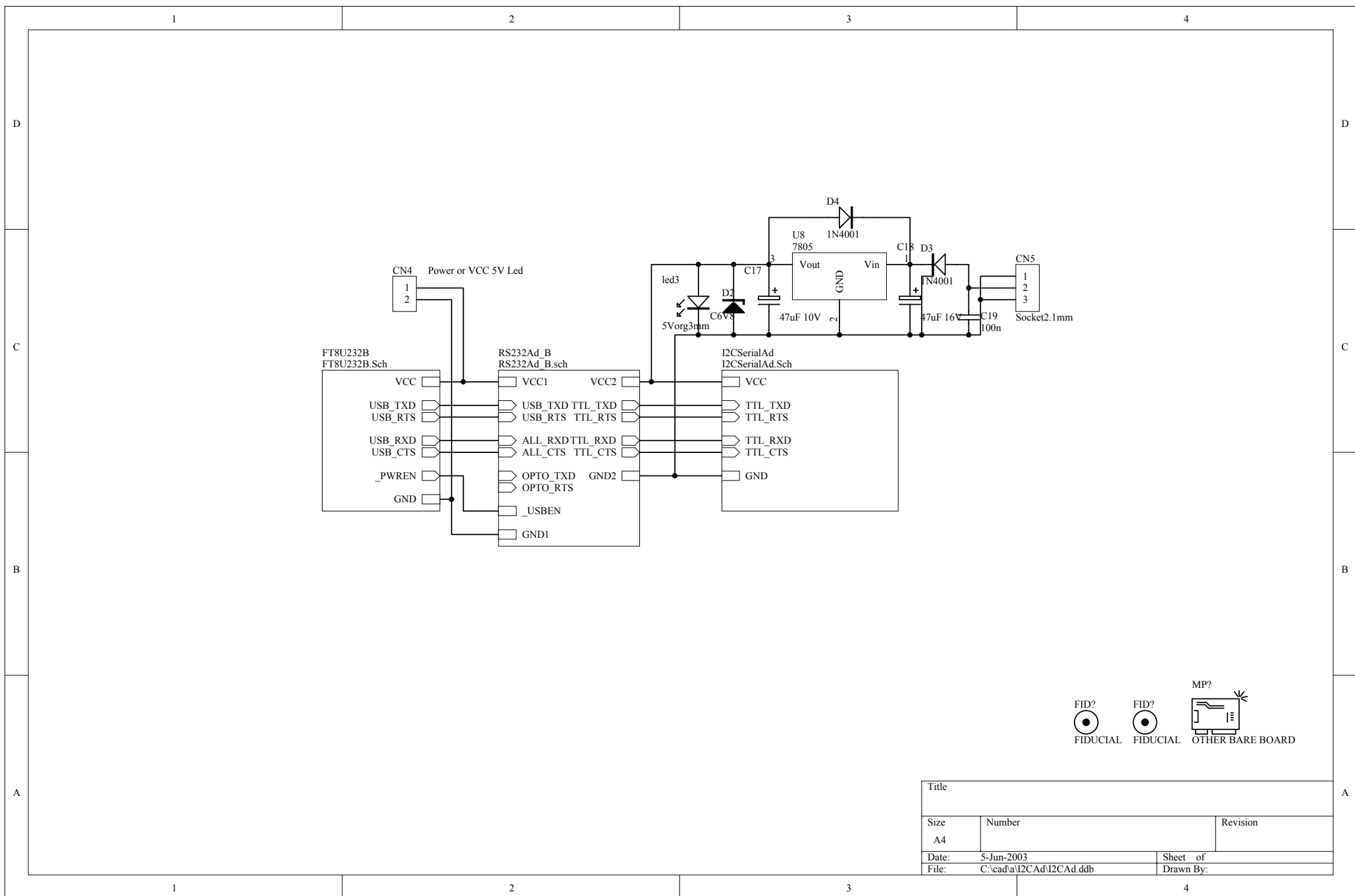
CN2 connects to your device and can power it.

Pin#	Direction	Function
1		V+
2	From PC	TTL RTS
3	From PC	TTL TXD
4	To PC	TTL RXD
5	To PC	TTL CTS
6		0V

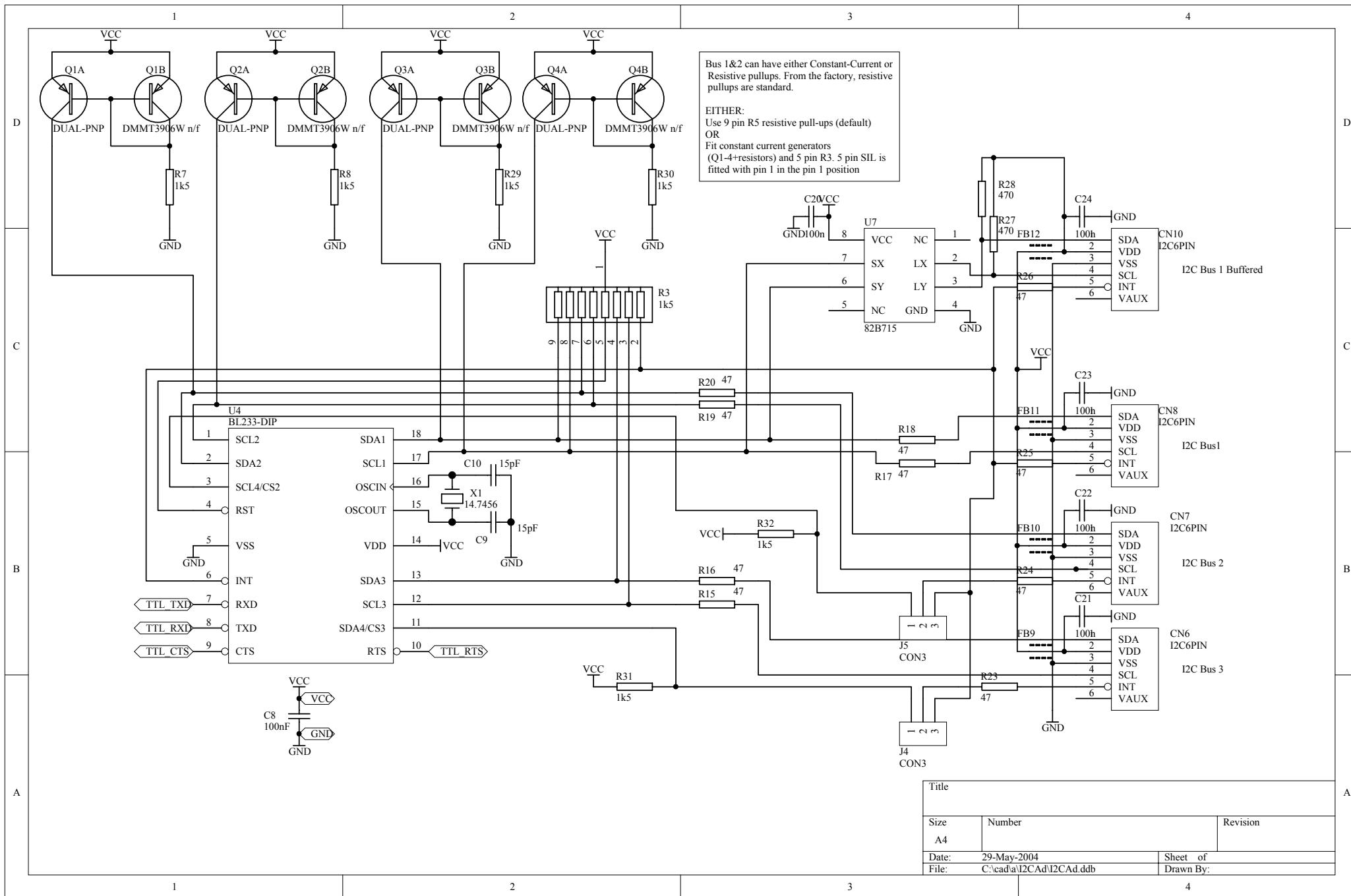
## 15 Co-operation

We offer all customers a link page on our web site, where others can find out about *your* products. We encourage you to use this.

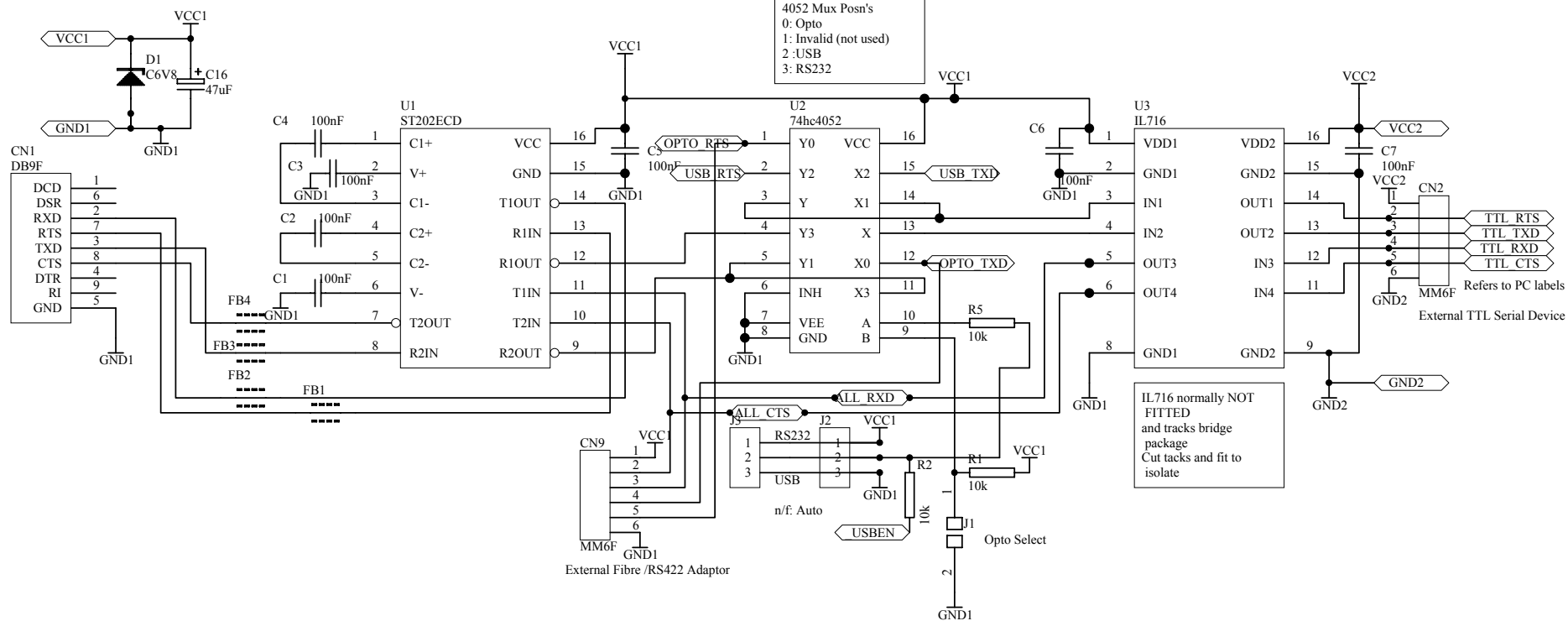








Title		
Size	Number	Revision
A4		
Date:	29-May-2004	Sheet of
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Title		
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Date: 5-Jun-2003	Sheet of	
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