# UM10014

## ISP1520 Hi-Speed USB Hub Demo Board

**Rev. 06 — 29 October 2007** **User manual**

### Document information

| Info | Content |
|---|---|
| **Keywords** | isp1520, hub controller, usb, universal serial bus |
| **Abstract** | This document describes the ISP1520 hub demo board. It also contains the related schematics, the PCB layout, and the bill of material. |

### Revision history

| Rev | Date | Description |
|---|---|---|
| 06 | 20071029 | Sixth release. Corrected Fig 9: the SW1 TEST_HIGH block. |
| 05 | 20070124 | Fifth release.<br>Updated Section 6.<br>Updated ESD part type in Table 7. |
| 04 | 20040511 | Fourth release. Updated Section 6. |
| 03 | 20040414 | Third release. Updated the following:<br>Section 2.<br>Section 4.<br>Section 5.5.<br>Section 6. |
| 02 | 20030410 | Second release. Updated Section 5.5 and Section 6. |
| 01 | 20021126 | First release. |

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# 1. Introduction

The ISP1520 is a Hi-Speed Universal Serial Bus (USB) hub IC, with four downstream facing ports. The ISP1520 hub demo board is designed to demonstrate the features and functionality of the ISP1520. This version is targeted at low-cost designs. Nevertheless, it still contains a lot of features and options to be evaluated.

This document describes the ISP1520 hub demo board. It also contains related schematics, the PCB layout, and the bill of material.

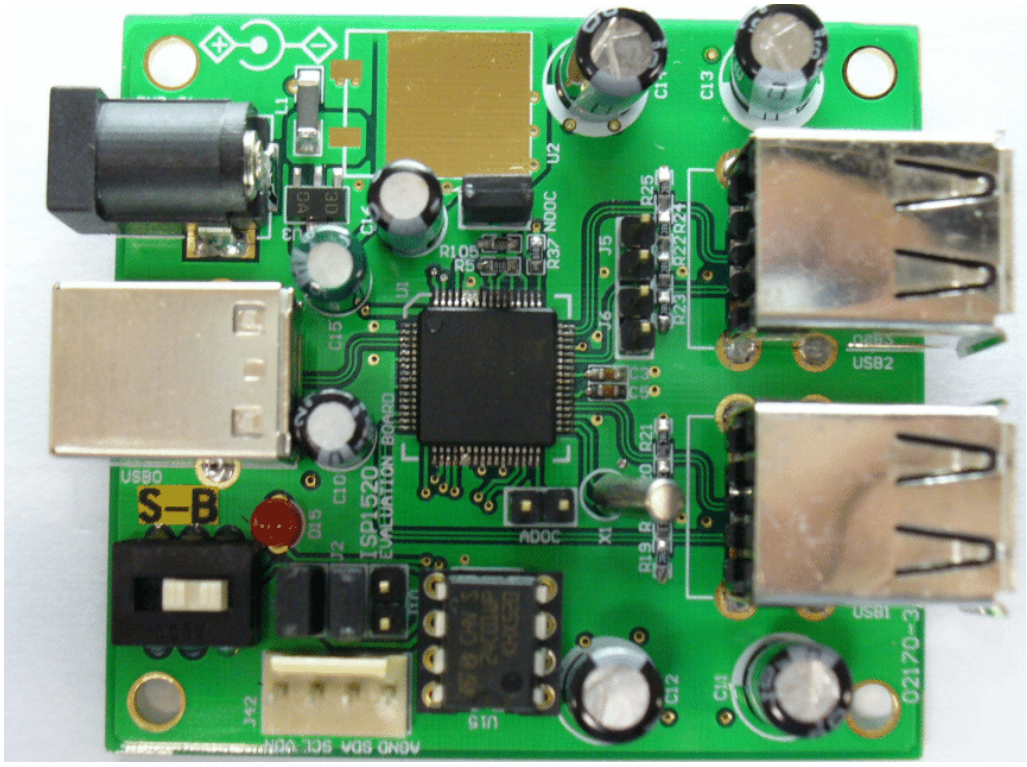


**Fig 1. ISP1520 hub demo board**

# 2. ISP1520 hub demo board features

- Complies with *Universal Serial Bus Specification Rev. 2.0*
- Supports self-powered operation
- Configurable number of downstream facing ports (from two to four)
- Customizable vendor ID, product ID and serial number, by using an external EEPROM or an external microcontroller
- Individual power switching and individual overcurrent protection
- USB traffic indication (GoodLink LED) on the upstream facing port

# 3. System requirements

This hub can be attached to a computer that has a USB or Hi-Speed USB host installed, and running any of these operating systems:

- Microsoft Windows 98
- Windows Me
- Windows 2000
- Windows XP
- Mac OS

If this hub is plugged into a USB host controller, it will only work as a full-speed hub.

# 4. Power supply adapter requirements

Regulated output: $5.1V_{CC}$ ± 5 %, 2.5 A

**Warning**: If you are using board version 02170-2, ensure that the power plug polarity is (+) at the core and (–) at the outer shield.

# 5. Hub demo board description

## 5.1 ISP1520 64-pin LQFP package

The ISP1520 has the following port configurations:

- One Hi-Speed USB and Original USB capable upstream facing port (USB0), and
- Four Hi-Speed USB and Original USB capable downstream facing ports (USB1, USB2, USB3, USB4)

Downstream facing ports USB3 and USB4 can be disabled. By design, ports USB1 and USB2 cannot be disabled.

Table 1 shows the jumper setting versus port activation.

**Table 1. Jumper setting vs. port activation**

| J6, J5 | Active ports |
|---|---|
| Off, off | 1, 2, 3, 4*[1] |
| On, on | 1, 2 |

[1] * - Indicates default setting.

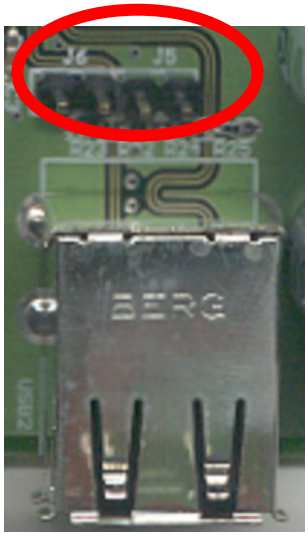


Fig 2. J5 and J6

## 5.2 GoodLink indicator

NXP GoodLink LED D15 (red) is located near the upstream facing port. This LED blinks on every successful USB transaction.

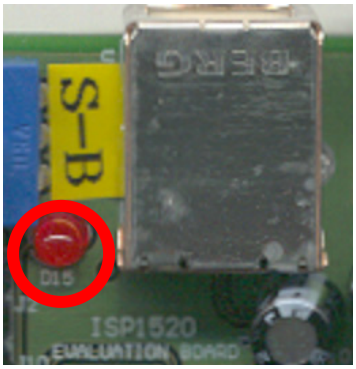


Fig 3. GoodLink D15

## 5.3 Port power switch transistors

The hub switches the bus power of each downstream facing port through a low ohmic Positive Metal Oxide Silicon (PMOS) transistor.

## 5.4 Overcurrent circuit detection

The integrated analog overcurrent detection circuit of the ISP1520 senses the voltage drop across the power switch. When the port draws too much current, the voltage drop across the power switch exceeds the trip voltage threshold. The overcurrent circuit detects this and automatically switches off the power switch. More information on choosing the switch and trimming the overcurrent detection voltage can be found in the *ISP1520 Hi-Speed Universal Serial Bus hub controller* data sheet.

The hub demo board also contains an option to disable the overcurrent detection. This can be done in two stages. First place the NOOC jumper in the appropriate position to set the hub's descriptor (see Table 2).

**Table 2. Overcurrent detection selection using NOOC**

| NOOC | Overcurrent detection | Logic state |
|---|---|---|
| On | yes | 0 (LOW) |
| Off | no | 1 (HIGH) |

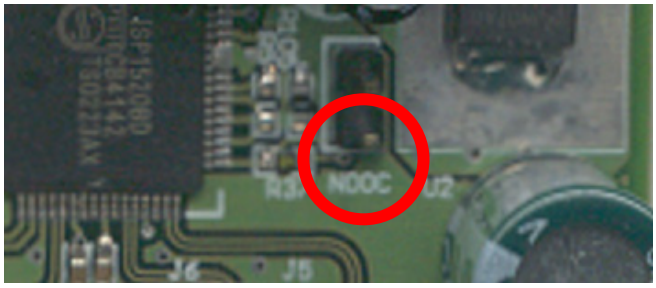


**Fig 4. NOOC**

Then, de-solder R28, R29, R30 and R31, and solder R32, R33, R34 and R36 on the PCB (see schematics).

As a lower cost alternative, there are provisions on the board to use polyswitches to handle overcurrent conditions. In this case, the port switching transistors are bypassed. If this solution is preferred, then the overcurrent detection circuit inside the chip must be switched to digital mode.

**Table 3. Mode selection using ADOC**

| ADOC | Mode | Logic state |
|---|---|---|
| On | digital | 0 (LOW) |
| Off | analog*[1] | 1 (HIGH) |

[1] *- Default settings.

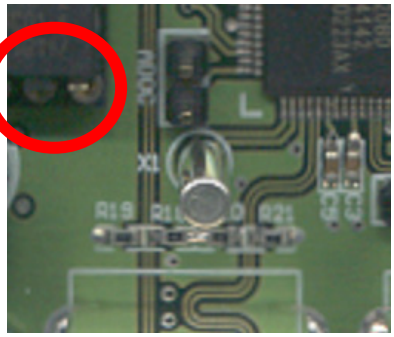

Fig 5. ADOC

## 5.5 Power supply

This hub demo board can be used as a self-powered USB hub. When used as a self-powered hub, use the provided power supply.

The SW1 switch sets powering mode in hub's descriptors; see Table 4.

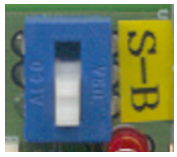


Fig 6. SW1

Table 4. Power mode selection using SW1

| SW1 | Power mode |
|---|---|
| S | self-powered*[1] |
| B | ignore |

[1] *- Default settings.

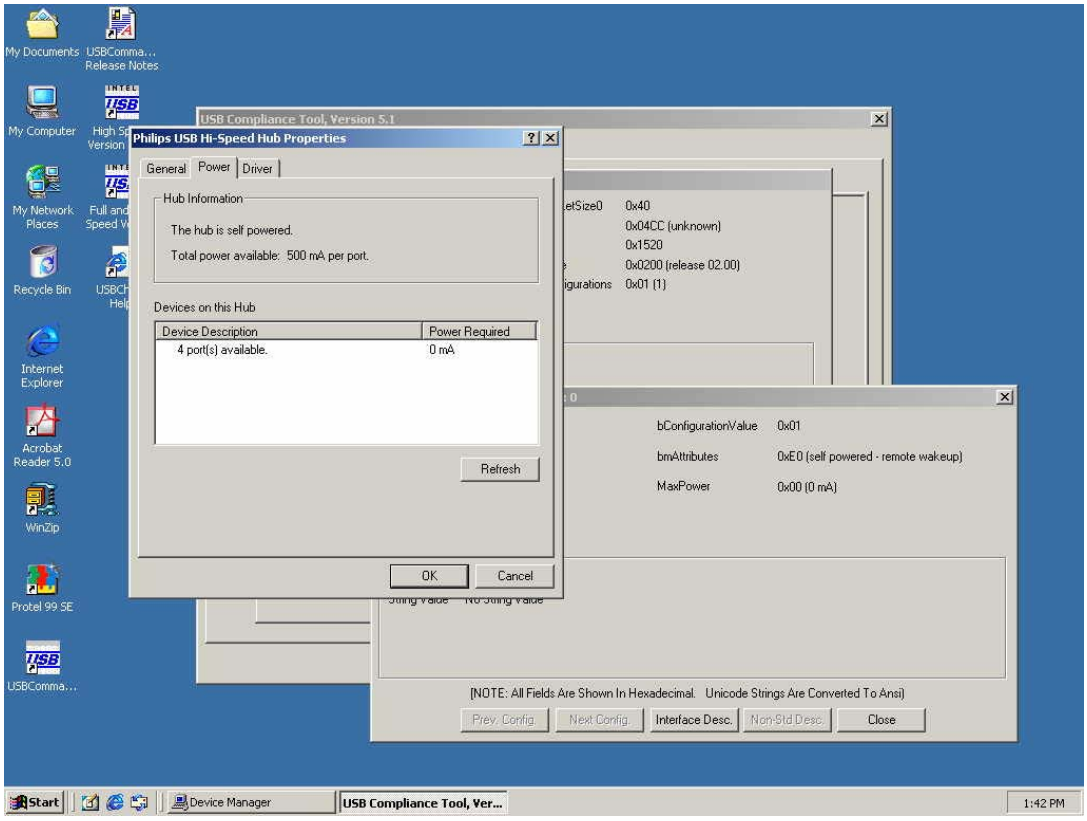


**Fig 7. Windows reporting of self-powered mode**

## 5.6 I²C-bus interface

The ISP1520 can use either its USB descriptors from the internal ROM, or from an external I²C-bus EEPROM or microcontroller. Mode selection is done using jumpers J1and J2 (see Table 5).

**Table 5. Mode selection using J1 and I2**

| J1 | J2 | Mode[1] | SCL | SDA |
|---|---|---|---|---|
| On | on | internal ROM | LOW | LOW |
| Off | off | I²C-bus EEPROM*[1] | HIGH | HIGH |

[1] *- Default settings.

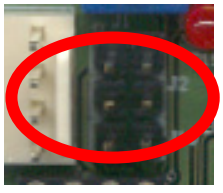

**Fig 8. J1 and J2**

An external $I^2C$-bus controller acting as a master can also be used to update hub descriptors through the J42 connector.

The J10 jumper is connected to the 'Write Protect' pin of the $I^2C$-bus EEPROM. The hub controller and the EEPROM have different $I^2C$-bus device addresses. To program this IC on-board, select the jumper according to Table 6. It is recommended that you program the $I^2C$-bus EEPROM before connecting the hub to USB through the USB host.

For convenience, the hub demo board is equipped with a socket for this component, allowing easy programming using a universal EPROM programmer as well.

**Table 6. EEPROM programming**

| J10 | WP_N |
|---|---|
| On | write enable |
| Off | write protect |

# 6. Schematics

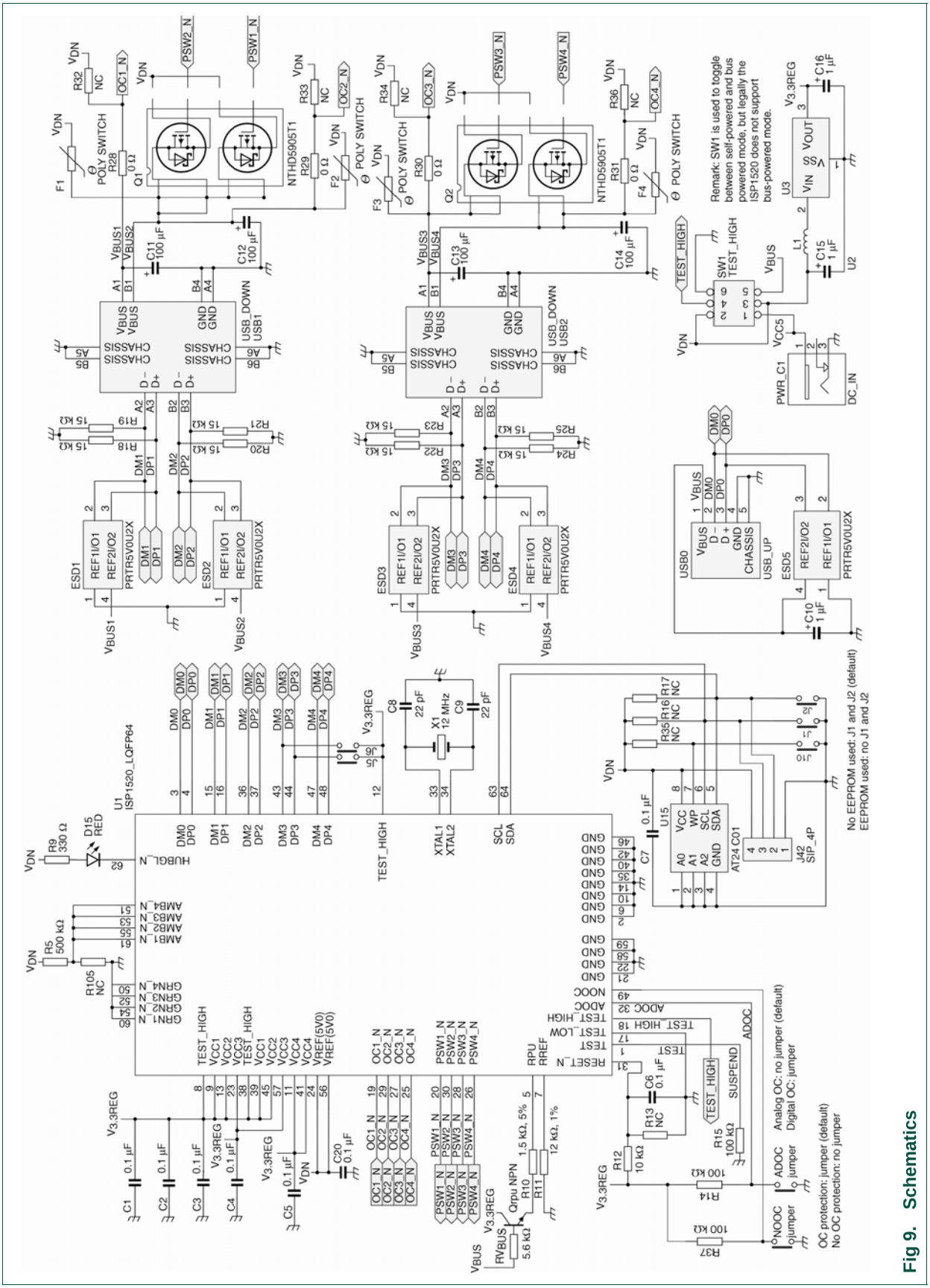


Fig 9. Schematics

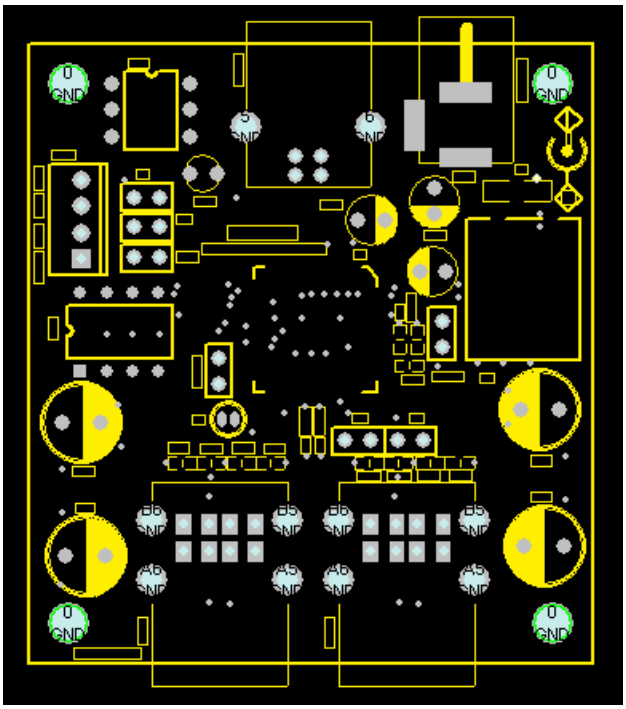


Fig 10. Component placement

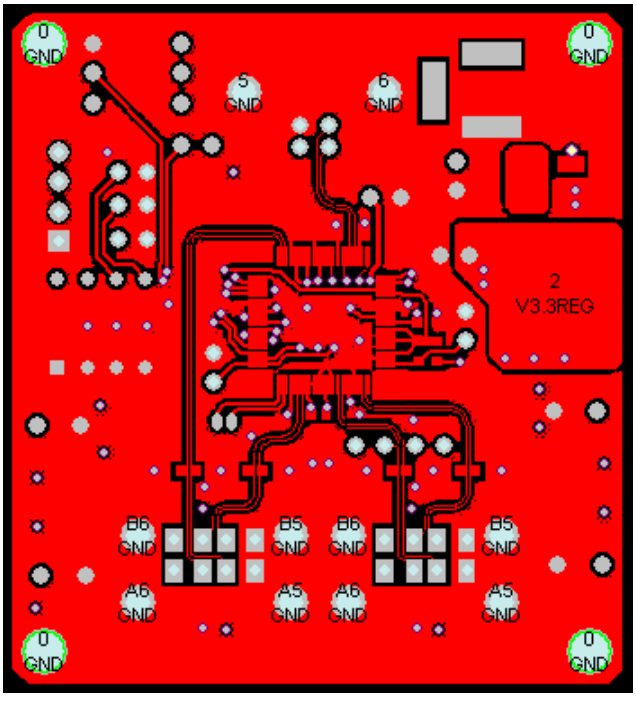


Fig 11. Layer 1: top routing

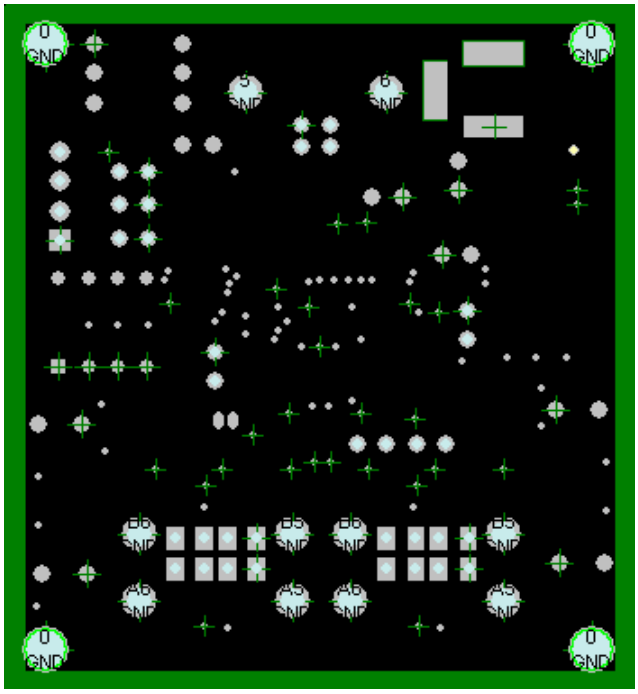


Fig 12. Layer 2: ground planes

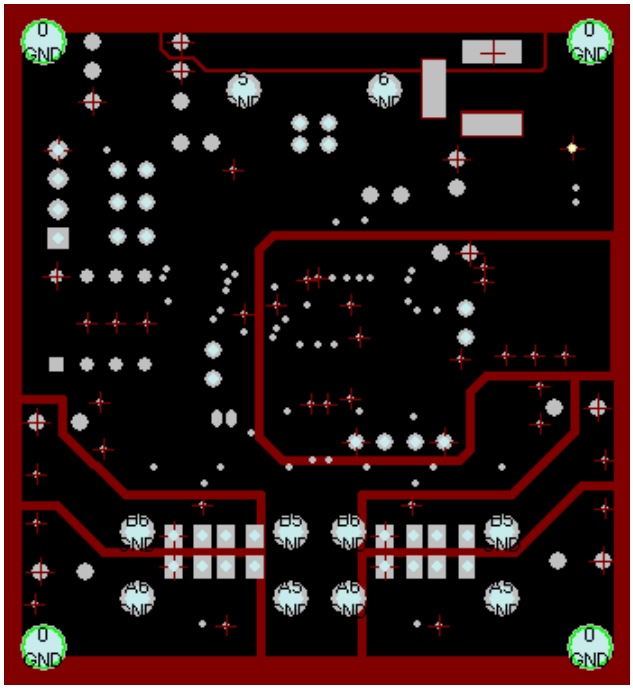


Fig 13. Layer 3: power planes

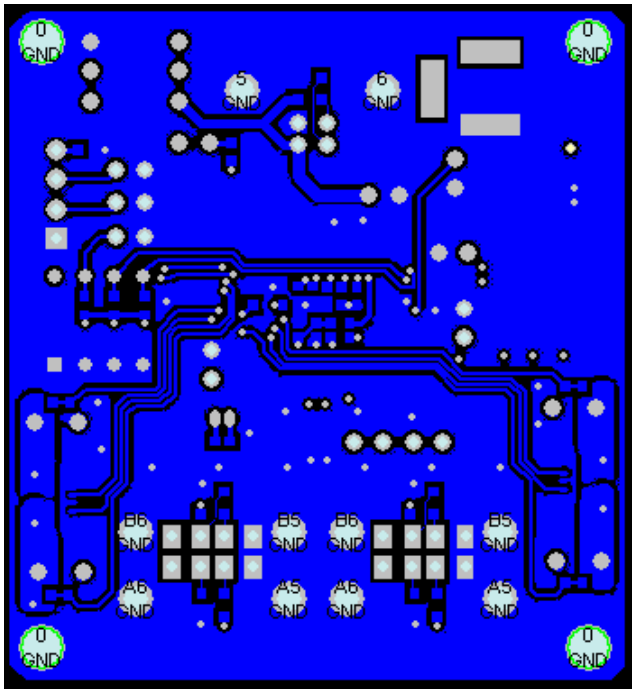


**Fig 14. Layer 4: bottom routing**

## 7. Installing the board

Assuming that you have already installed the USB host adapter, including drivers, on a computer running Windows, installing the hub is fairly simple.

1. Plug in power from the power supply to the hub. The power supply must meet the requirements specified in Section 4.
2. Plug a USB cable in the USB0 port, and connect the other end of the cable to the USB host. After a while GoodLink LED D15 starts to blink. This indicates that the enumeration process has successfully completed and the hub is now ready for use.

You can check the driver installation in the Device Manager window. To check whether the hub is correctly installed in high-speed, select the **View-Devices by connection** command in the Device Manager window.

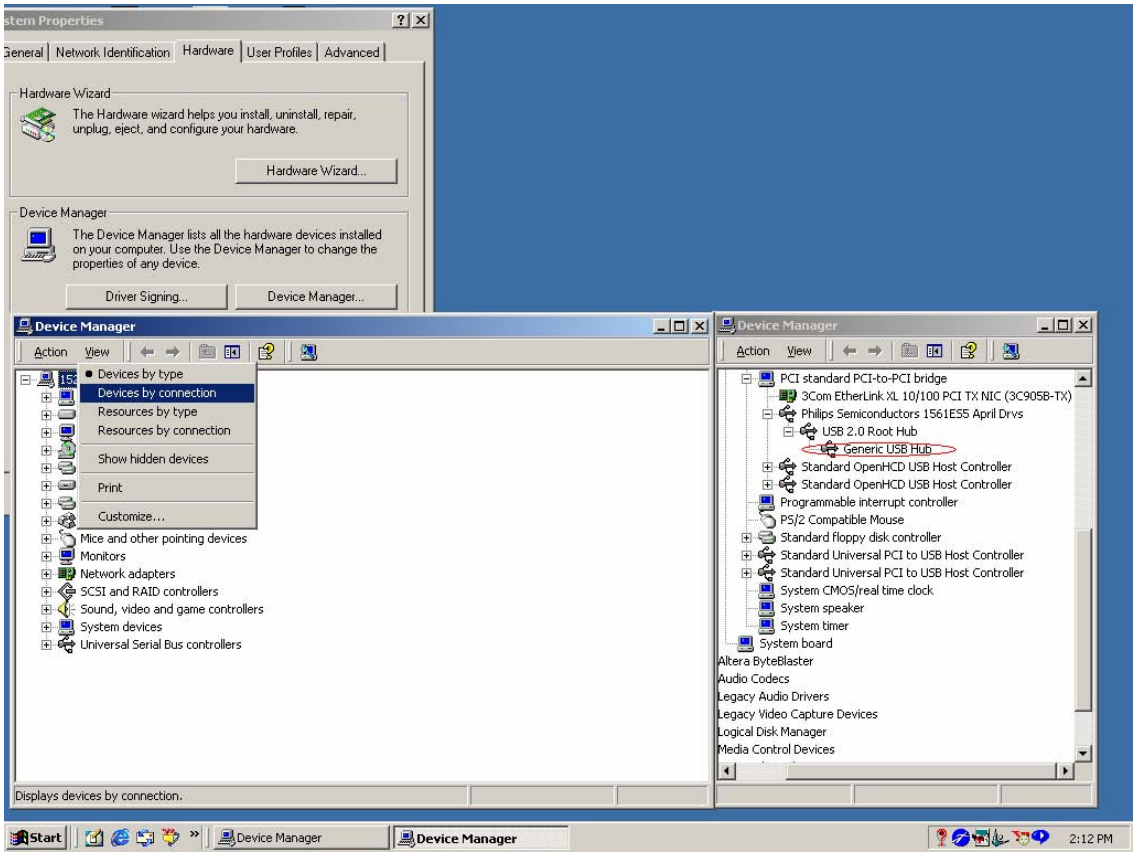


**Fig 15. Device manager**

3. Plug in devices at downstream facing ports.

## 8. Bill of materials for the hub demo board

**Table 7. Bill of materials for the hub demo board**

| Part type | Designator | Footprint | Description |
|---|---|---|---|
| 0.1 µF | C1 C2 C3 C4 C5 C6 C7 C20 | 0603C | capacitor |
| 0 Ω | R105 R32 R34 R31 R29 R30 R28 R33 R36 | 0603R | - |
| 1.5 kΩ, 5 % | R10 | 0603R | - |
| 1 µF | C10 | REC1-2 | electrolytic capacitor |
| 2.2 kΩ | R16 R17 | 0603R | - |
| 10 kΩ | R12 R13 | 0603R | - |
| 10 µF | C15 | REC1-2 | electrolytic capacitor |
| 12 kΩ, 1 % | R11 | 0603R | - |
| 12 MHz | X1 | XTAL7 | crystal |

| Part type | Designator | Footprint | Description |
|---|---|---|---|
| 15 kΩ | R20 R19 R18 R25 R22 R24 R23 R21 | 0603R | - |
| 22 pF | C9 C8 | 0603C | capacitor |
| 22 µF | C16 | REC1-2 | electrolytic capacitor |
| 100 kΩ | R14 R15 R37 R5 R35 | 0603R | - |
| 100 µF | C11 C14 C12 C13 | REC15-3 | electrolytic capacitor |
| 330 Ω | R9 | 0603R | - |
| AT24C01 | U15 | DIP8 | - |
| BLM41P600S | L1 | 1206CUST | - |
| DC_IN | PWR_C1 | DC-JACK2 | - |
| PRTR5V0U2X | ESD1 ESD2 ESD5 ESD4 ESD3 | SOT-143B | ESD protection * |
| ISP1520_LQFP64 | U1 | LQFP64 | - |
| J1 | J10 J1 | RAD0.1 | jumper |
| J5 | J5 | RAD0.1 | jumper |
| J6 | J6 | RAD0.1 | jumper |
| J16 | J2 | RAD0.1 | jumper |
| JUMPER | NOOC ADOC | RAD0.1 | jumper |
| XC6206P302 | U3 | SOT89 | - |
| NTHD5905T1 | Q1 Q2 | CHIPFET | logic level dual P-channel MOSFET |
| POLYSWITCH | F4 F2 F3 F1 | POLYSWITCH | - |
| RED | D15 | LED3 | - |
| SIP_4P | J42 | PS24254-4 | connector |
| SP/BP# | SW1 | DIP6 | - |
| USB_DOWN | USB2 USB1 | USB-TYPEA-737745 | - |
| USB_UP | USB0 | USB-TYPEB | - |

## 9. References

[1] Universal Serial Bus Specification Rev. 2.0

[2] ISP1520 Hi-Speed Universal Serial Bus hub controller data sheet

# 10. Legal information

## 10.1 Definitions

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