



UM10011

ISP1521 Hi-Speed USB hub demo board

Rev. 06 — 7 February 2007

User manual

Document information

Info	Content
Keywords	isp1521, hub controller, usb, universal serial bus
Abstract	This document describes the ISP1521 hub demo board. It also contains the related schematics, the PCB layout, and the bill of material.

Revision history

Rev	Date	Description
06	20070207	Sixth release. Updated the ESD part in Fig 10 and Table 6 .
05	20061213	Fifth release. Updated Fig 1 and Section 6.
04	20040617	Fourth release. Updated Section 6.
03	20040414	Third release. Updated the following: Section 2 Section 4 Section 5.5 Section 6
02	20030410	Second release. Updated Section 5.5 and Section 6.
01	20021126	First release.

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1. Introduction

The ISP1521 is a Hi-Speed Universal Serial Bus (USB) hub IC, with seven downstream facing ports. The ISP1521 hub demo board is designed to demonstrate the features and functionality of the ISP1521.

This document describes the ISP1521 hub demo board. It also contains related schematics, the PCB layout, and the bill of material.

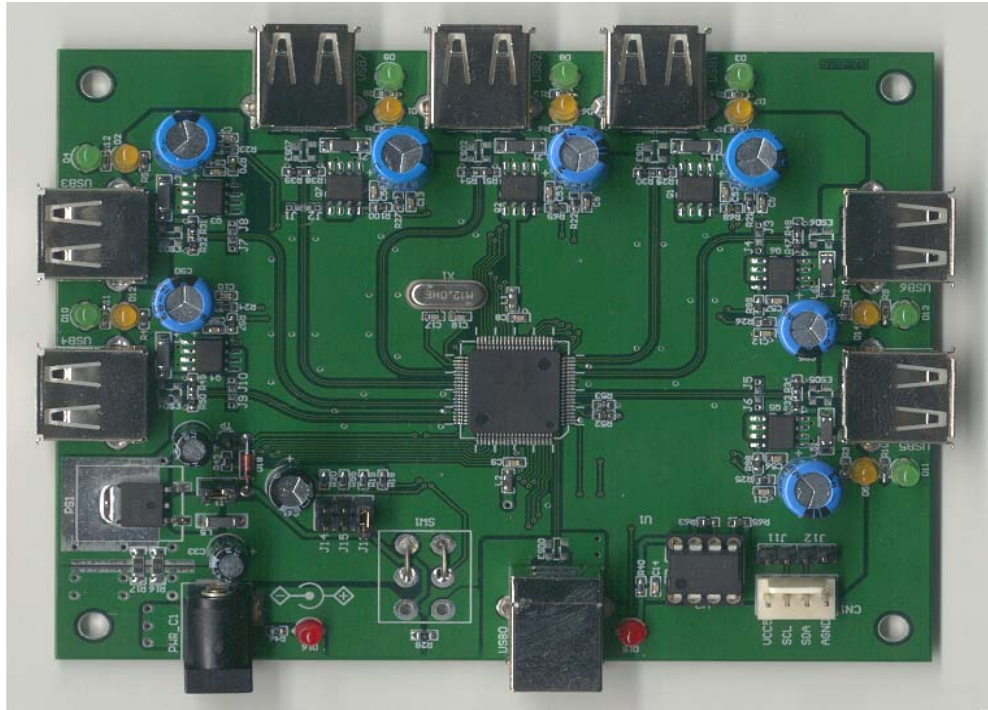


Fig 1. ISP1521 hub demo board

2. ISP1521 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 seven)
- 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
- Port status indicators

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 the hub is plugged into a USB Host Controller, it will work only as a full-speed hub.

4. Power supply adapter requirements

Regulated output: $5.1V_{CC} \pm 5\%$, 4 A

Warning: The power plug polarity is (–) at the core and (+) at the outer shield.

5. Hub demo board description

5.1 ISP1521 80-pin LQFP package

The ISP1521 has these port configurations:

- One Hi-Speed USB and USB capable upstream facing port (USB0), and
- Seven Hi-Speed USB and USB capable downstream facing ports (USB1, USB2, USB3, USB4, USB5, USB6, USB7).

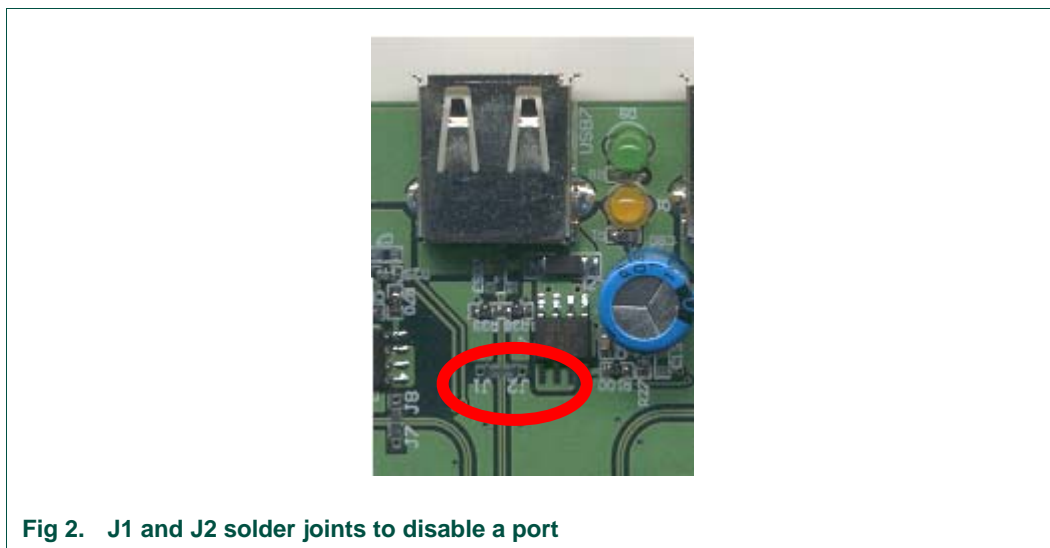
Port numbers are marked near USB connectors on the silkscreen. Downstream facing ports USB3, USB4, USB5, USB6 and USB7 can be disabled. Disabling a port will also disable all higher-number ports. For example, disabling port USB4 will disable ports USB5, USB6 and USB7 as well. Therefore, apart from port USB7, it is not possible to selectively disable a port. For example: only USB5. By design, ports USB1 and USB2 cannot be disabled.

Table 1. Jumper settings vs. port activation

J2, J1	J4, J3	J6, J5	J10, J9	J8, J7	Active ports
Off, off	off, off	off, off	off, off	off, off	USB1 to USB7 ^{*[1]}
On, on	off, off	off, off	off, off	off, off	USB1 to USB6
Off, off	on, on	off, off	off, off	off, off	USB1 to USB5
Off, off	off, off	on, on	off, off	off, off	USB1 to USB4
Off, off	off, off	off, off	on, on	off, off	USB1 to USB3
Off, off	off, off	off, off	off, off	on, on	USB1 to USB2

1. Symbol * indicates default settings.

These jumpers are set to 'on' by placing a solder joint on the provided footprints.



5.2 Port indicators

D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13 and D14 are port indicators. Conforming to *Universal Serial Bus Specification Rev. 2.0*, each downstream facing port has two port indicators, green and amber, placed to its right.

If the green LED is on, it means the device connected to the port is successfully enumerated and is functional.

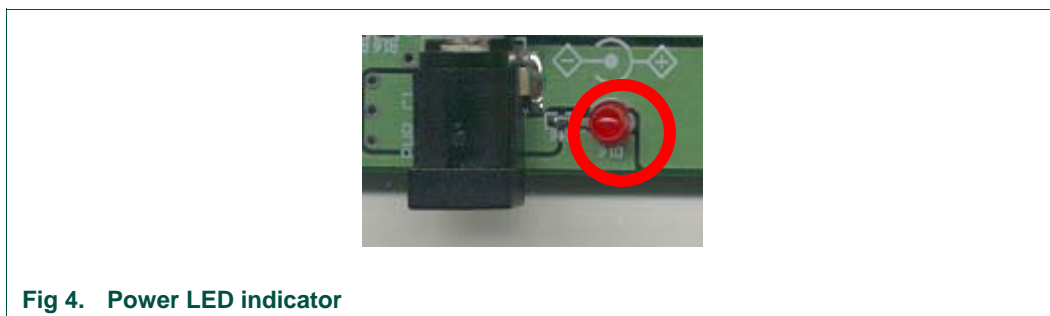
If the amber LED is on, it means there is an overcurrent condition.

Custom software applications or drivers may flash these LEDs to attract user attention.



5.3 Power LED indicator

When power is supplied to the board, LED D16 lights up (red).



5.4 GoodLink indicator

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

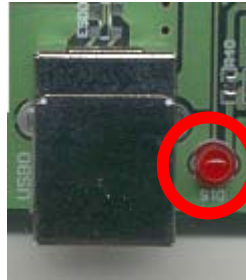


Fig 5. GoodLink LED

5.5 Port power switch transistors

The hub switches on or off the bus power to each downstream facing port through a low ohmic PMOS¹ transistor.

5.6 Overcurrent circuit detection

The integrated analog overcurrent detection circuit of the ISP1521 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 *ISP1521 Hi-Speed Universal Serial Bus hub controller* data sheet.

5.7 Power supply

To power up the hub, plug the power supply into the power supply socket (PWR_C1). Jumper J15 will set powering mode in hub's descriptors as self-powered hub; see [Fig 6](#).

Table 2. Setting the power mode using J15

J15	Power mode	Logic state
Off	Self* ^[1]	1 (HIGH)

1. Symbol * indicates default settings.

1. Positive Metal Oxide Silicon

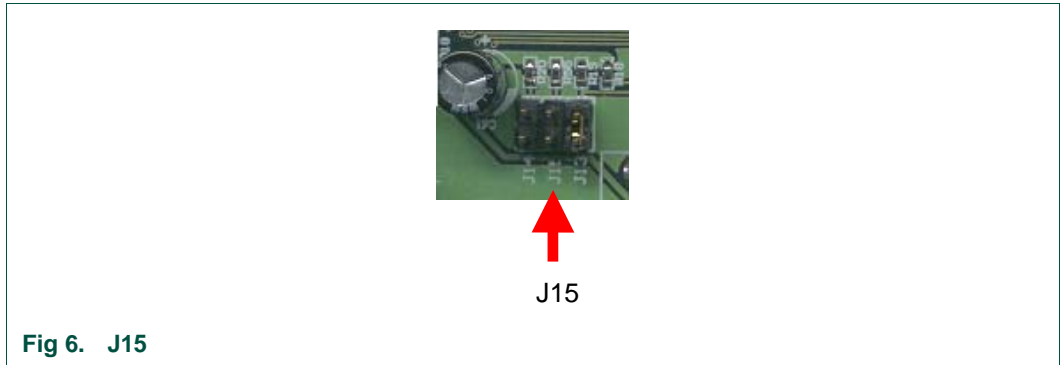


Fig 6. J15

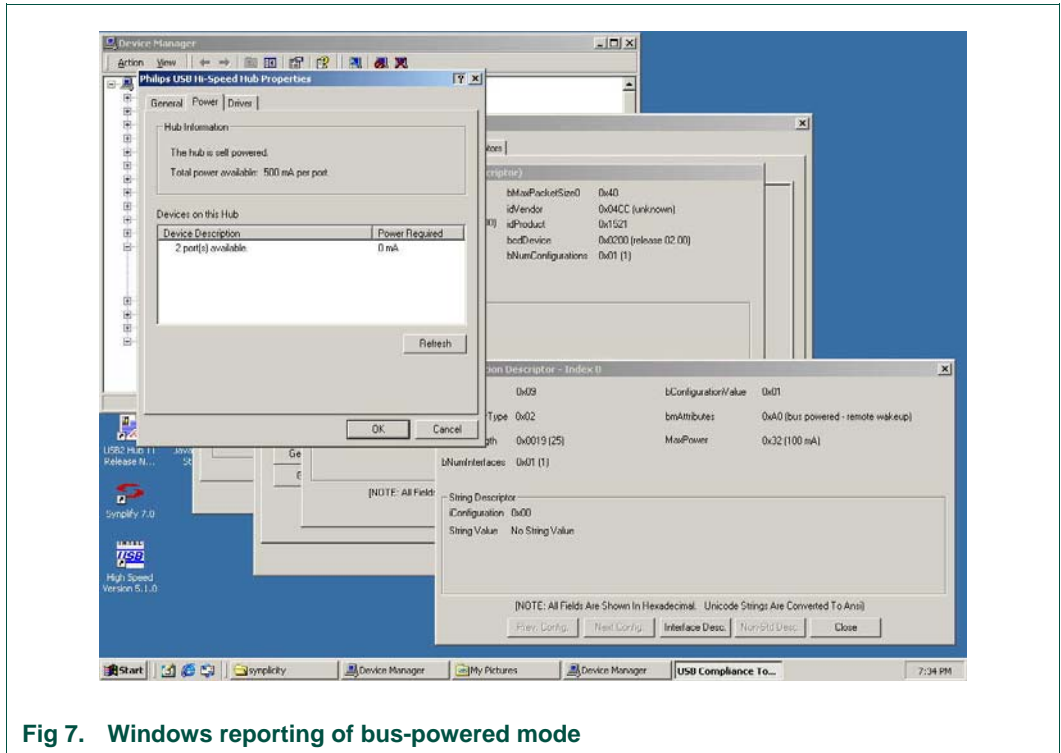


Fig 7. Windows reporting of bus-powered mode

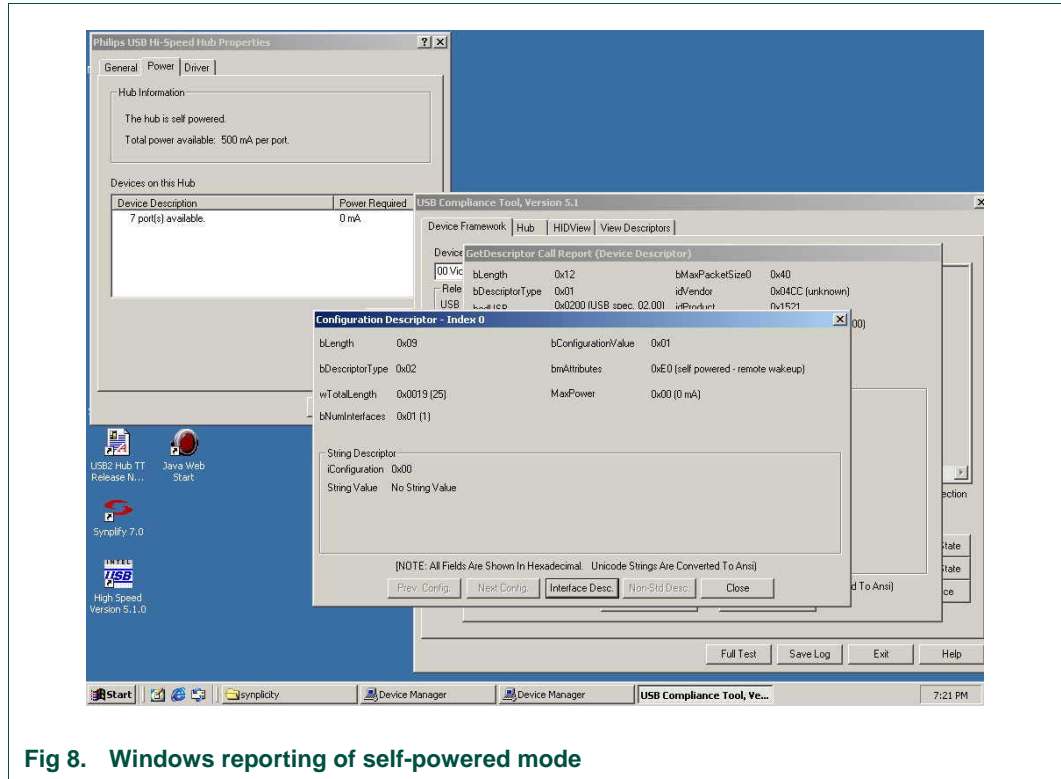


Fig 8. Windows reporting of self-powered mode

5.8 I²C-bus interface

The ISP1521 can use either its USB descriptors from the internal ROM, or from an external I²C-bus EEPROM or microcontroller. Mode selection is done through jumpers J11 and J12 (see [Table 3](#)).

Table 3. Mode selection using J11 and J12

J11	J12	Mode	SCL	SDA
On	on	internal ROM	LOW	LOW
Off	off	I ² C-bus EEPROM ^{*1}	HIGH	HIGH

1. Symbol * indicates default settings.

An external I²C-bus controller acting as a master can also be used to update hub descriptors through the CN1 connector.

Remark: The I²C-bus external EEPROM cannot be programmed on-board.

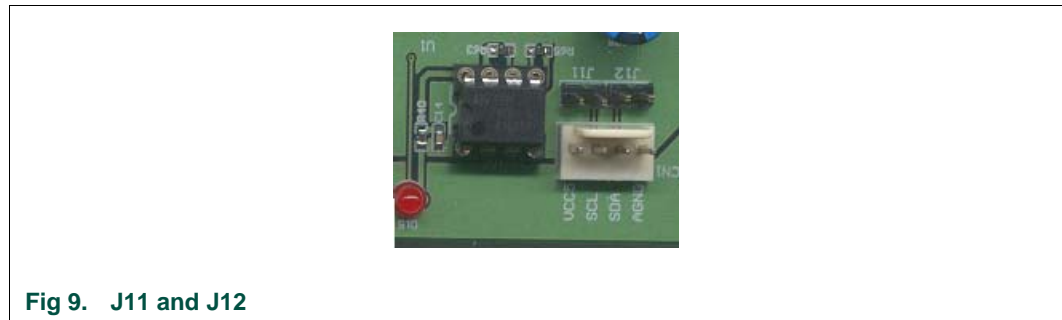


Fig 9. J11 and J12

5.9 Other jumpers

5.9.1 J13 (NOOC)

This jumper will set the overcurrent capabilities in the hub's descriptors (see [Table 4](#)).

Table 4. Overcurrent support selection using J11 and J12

J13	NOOC	Logic state
Off	no overcurrent support	1 (HIGH)
On	overcurrent support* ^[1]	0 (LOW)

1. Symbol * indicates default settings.

Remark: This jumper is to set the hub's descriptor only. To inhibit the overcurrent detection, overcurrent pins must be tied to V_{CC} (5 V).

5.9.2 J14 (SUSPEND)

This jumper is provided for debugging purposes. Logic 1 on the SUSPEND signal indicates that the hub is in suspend mode. In the default setting, jumper J14 is used (pulled down to GND).

Table 5. J14 mode setting

J14	Mode
Off	debugging purpose
On	normal mode (default)

6. Schematics

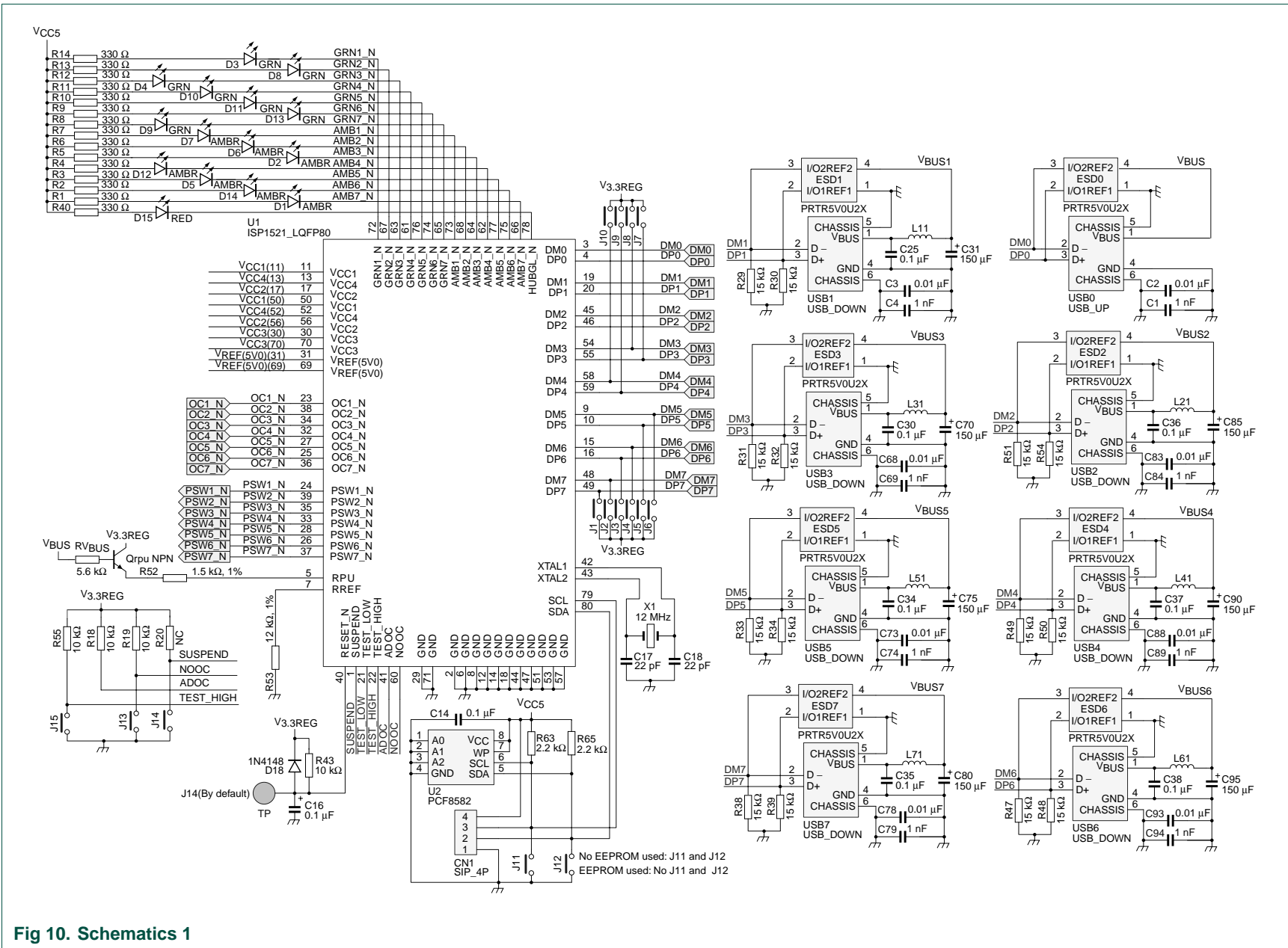


Fig 10. Schematics 1

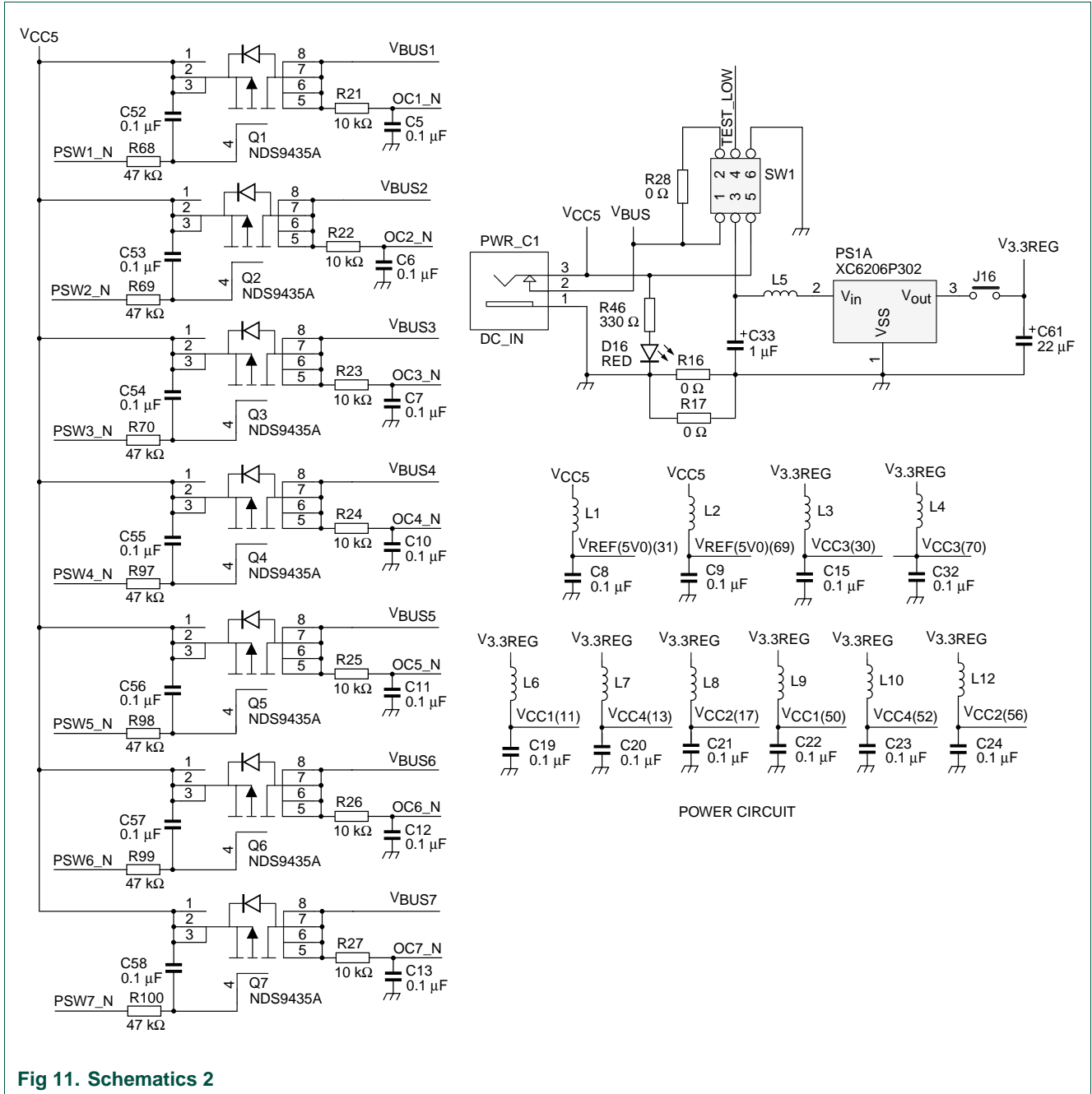


Fig 11. Schematics 2

7. Component placement

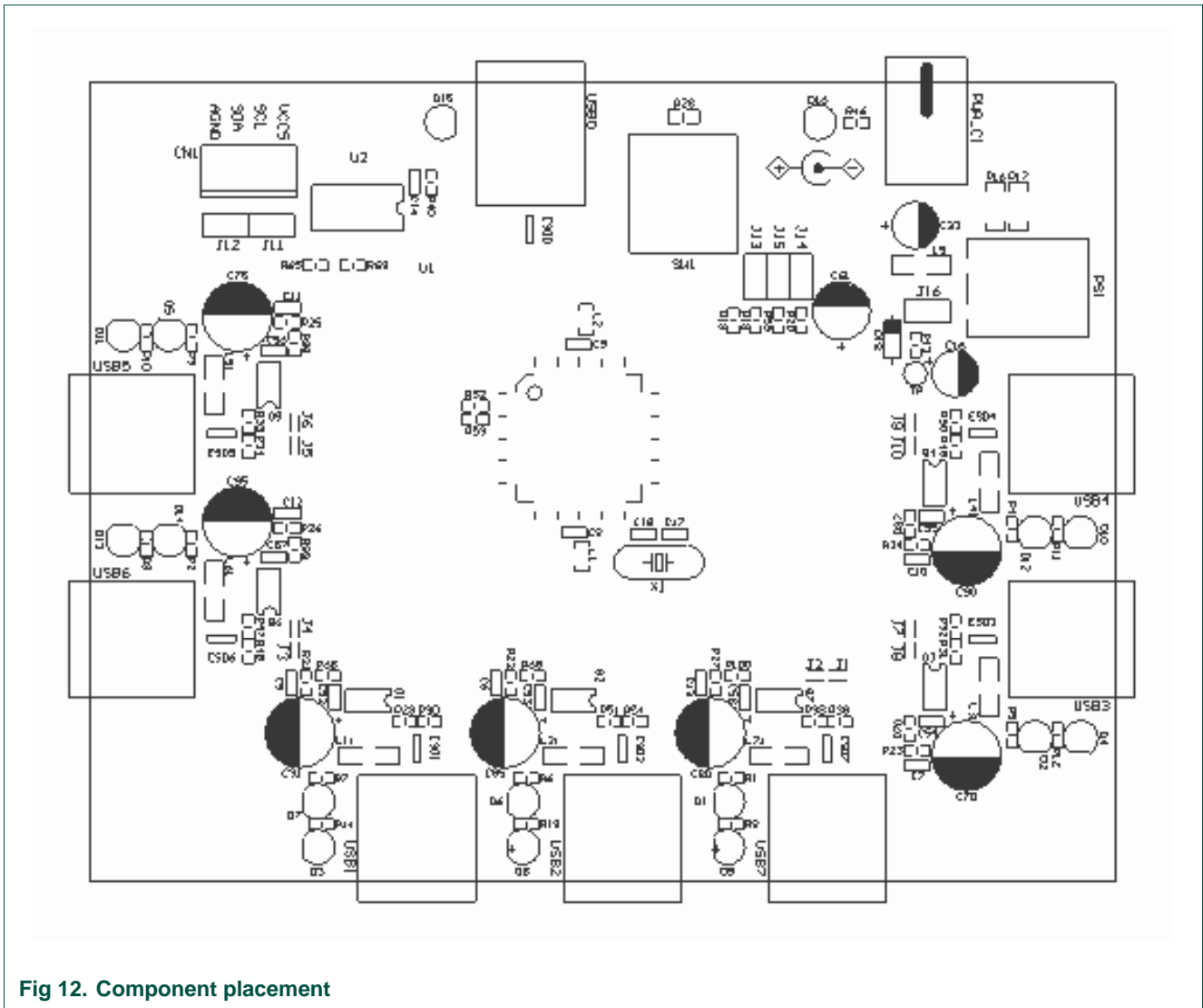


Fig 12. Component placement

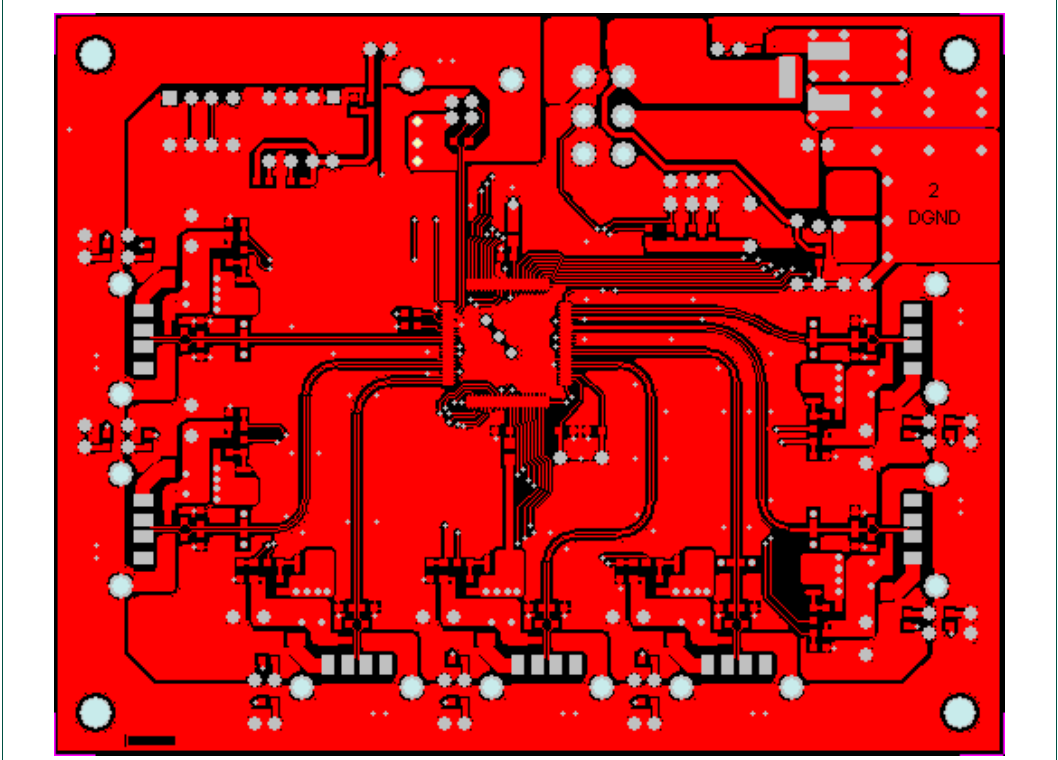


Fig 13. Layer 1: top routing

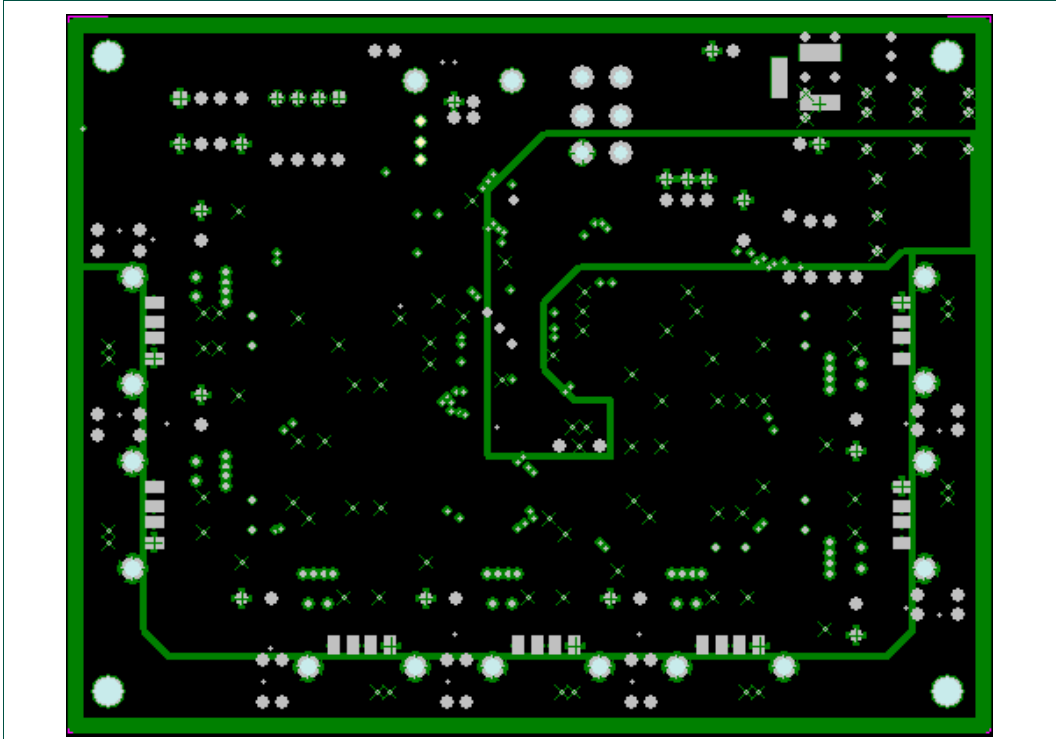
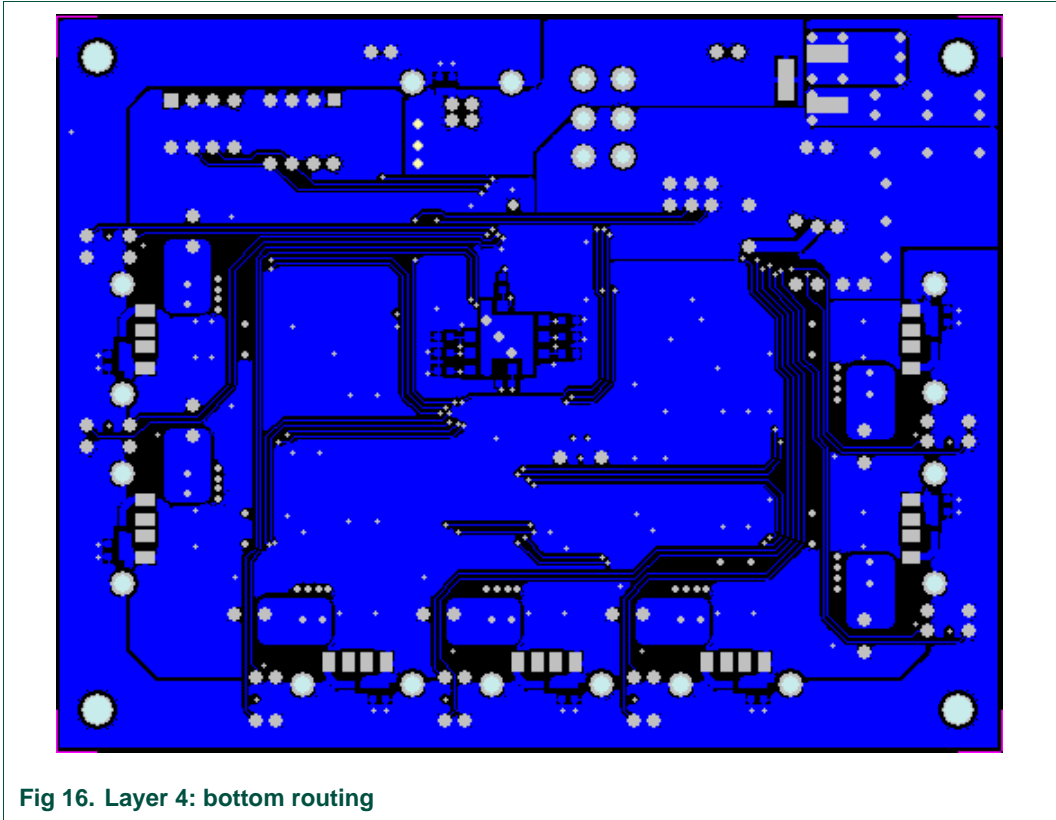


Fig 14. Layer 2: ground planes



8. 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 the GoodLink LED (D15) will start to blink. This means 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, choose the **View-Devices by connection** command in the Device Manager window.

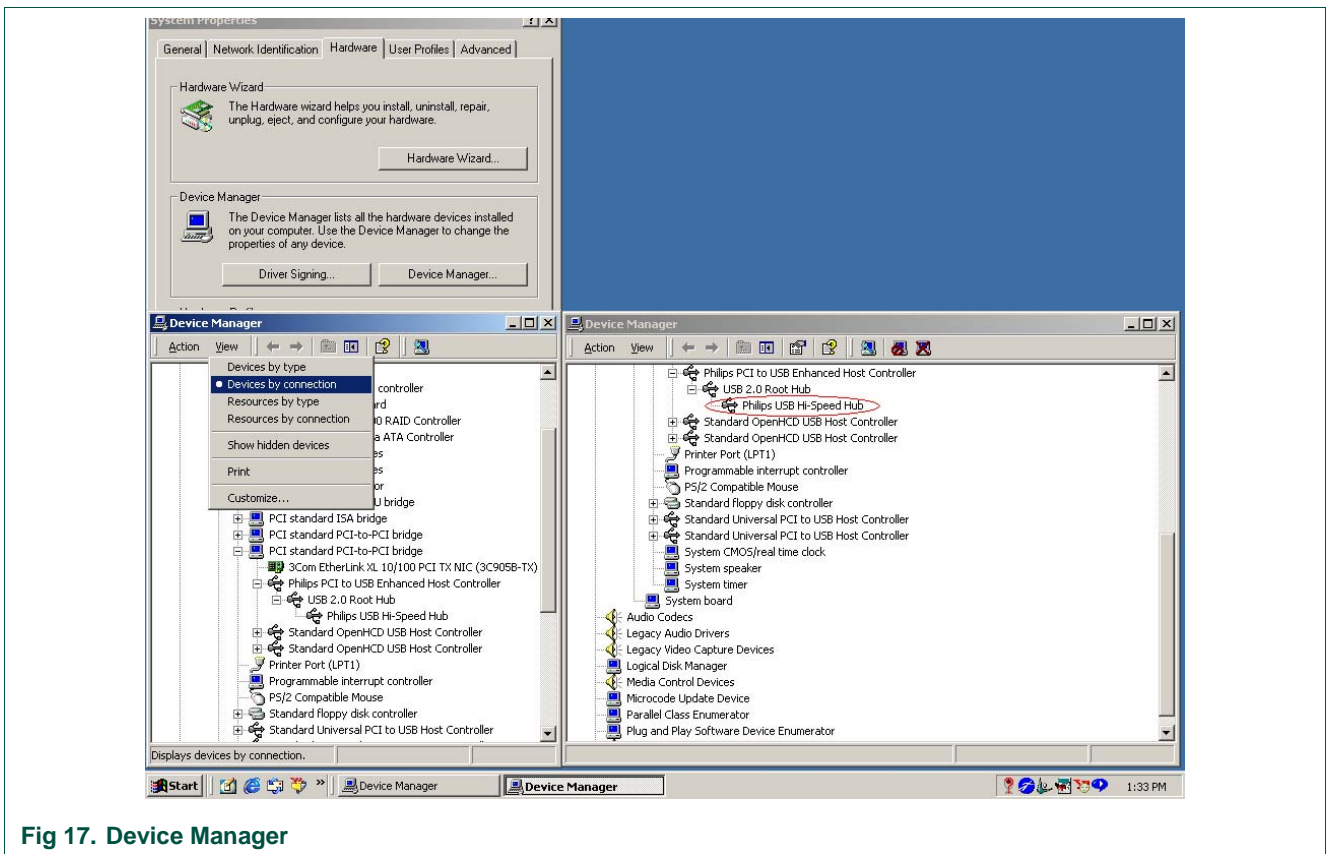


Fig 17. Device Manager

3. Plug in devices to downstream facing ports. After these devices are properly enumerated, green LEDs will turn on.

9. Bill of materials for the hub demo board

Table 6. Bill of materials for the ISP1521 hub demo board

Part type	Footprint	Quantity	Designator
0.01 μ F	0603C	8	C2, C3, C68, C73, C78, C83, C88, C93
0.1 μ F	0603C	32	C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C19, C20, C21, C22, C23, C24, C25, C30, C32, C34, C35, C36, C37, C38, C52, C53, C54, C55, C56, C57, C58
0 Ω	0603R	1	R55
0 Ω	0805GR	1	R28
0 Ω	1206G	2	R16, R17
100 μ F / 10 V	REC2-25	1	C61
10 k Ω	0603R	11	R18, R19, R20, R21, R22, R23, R24, R25, R26, R27, R43, R44
10 μ F / 10 V	REC1-2	1	C33
10 μ F	REC1-2	1	C16
12 k Ω , 1 %	0603R	1	R53
12 MHz, low profile	XTAL7	1	X1
150 μ F / 10 V	REC15-3	7	C31, C70, C75, C80, C85, C90, C95
15 k Ω	0603R	14	R29, R30, R31, R32, R33, R34, R38, R39, R47, R48, R49, R50, R51, R54
1.5 k Ω , 1 %	0603R	1	R52
1N4148	DIODE0.3	1	D18
1 nF	0603C	8	C1, C4, C69, C74, C79, C84, C89, C94
22 pF	0603C	2	C17, C18
2.2 k Ω	0603R	2	R63, R65
330 Ω	0603R	16	R1, R2, R3, R4, R5, R6, R7, R8, R9, R10, R11, R12, R13, R14, R40, R46
47 k Ω	0603R	7	R68, R69, R70, R97, R98, R99, R100
AMBER	LED3	7	D1, D2, D5, D6, D7, D12, D14
BLM21AG221 SN1	0805G	10	L1, L2, L3, L4, L6, L7, L8, L9, L10, L12
BLM41P600S	1206CUST	8	L5, L11, L21, L31, L41, L51, L61, L71
DC_IN	DC-JACK2	1	PWR_C1
GREEN	LED3	7	D3, D4, D8, D9, D10, D11, D13
ISP1521	LQFP80-0.5	1	U1

Part type	Footprint	Quantity	Designator
Jumper	0603	4	J1, J10, J2, J3, J4, J5, J6, J7, J8, J9
Jumper	RAD0.1	6	J11, J12, J13, J14, J15, J16
XC6206P302	SOT89	1	PS1A
USB_UP	USB-TYPEB	1	USB0
NDS9435A	SO-8	7	Q1, Q2, Q3, Q4, Q5, Q6, Q7
PCF8582	DIP8	1	U2
PRTR5V0U2X	SOT-143B	8	ESD0, ESD1, ESD2, ESD3, ESD4, ESD5, ESD6, ESD7
RED	LED3	2	D15, D16
SIP_4P	PS24254-4	1	CN1
SW1	TOGGSW2	1	SW1
Test point	TP	1	TP1
USB_DOWN	USB-TYPEA	7	USB1, USB2, USB3, USB4, USB5, USB6, USB7

10. References

- [1] Universal Serial Bus Specification Rev. 2.0
- [2] ISP1521 Hi-Speed Universal Serial Bus hub controller data sheet

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