VLSI AppNote:
VSx053 Simple DSP Board

Description

This document describes the VS1053 / VS8053 Simple DPS Board and the VSx053 Simple DSP Host Board. Schematics, layouts and pinouts of both cards are included. The document has info on how to connect the boards to the PC and to external circuits.
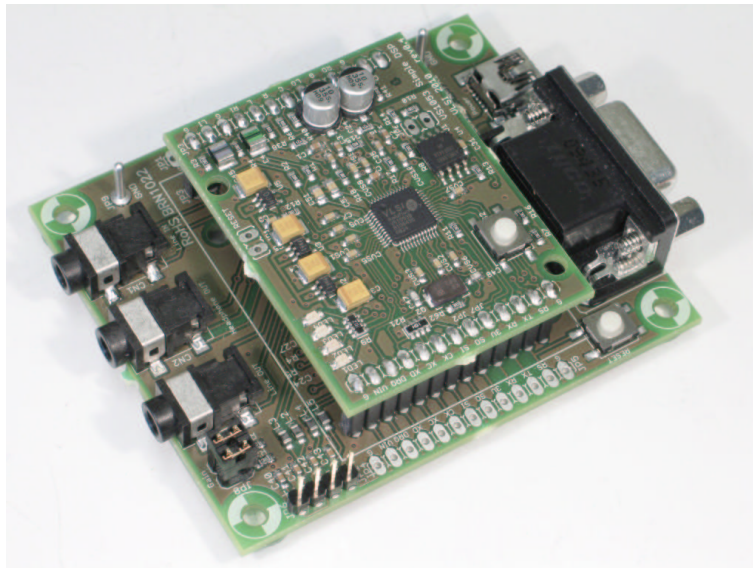

Figure 1: VSx053 Simple DSP Board mounted on the Host Board

All design files, schematic and layouts for both boards are freely available at *http://www.vlsi.fi/*. They can be used free of charge in any application using VLSI Solution's Audio Codec IC's.

Software examples are available in the latest VSIDE package that is also available at *http://www.vlsi.fi/*.

Revision History			
Rev	**Date**	**Author**	**Description**
1.1	2010-10-20	HH	Minor corrections.
1.0	2010-08-10	PLe	Initial revision.

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1   VSx053 Simple DSP Board

VSx053 Simple DSP Board is a small, low-cost and high performance audio DSP board for the VS1053 or VS8053 Audio Codec IC from VLSI Solution Oy. VSx053 features a high quality AD and DA converters, a headphone driver, and dedicated MAC-hardware for fast and efficient DSP-applications. For more info in VS1053 and VS8053 see *http://www.vlsi.fi/*.

The VSx053 Simple DSP Board is meant to be used in DSP software developement and as a "plug-in" module in electronic applications. The board has two rows of pin headers. One on each edge of the board. One edge has digital connections for connecting to serial port or to SPI port. This can be used to interface the board with a PC and VSIDE or a host micro controller. The other edge has analog connections featuring Line-in, Line-out and headphone out. Line-in and Line-out are AC-coupled and can be connected diretly to other audio circuits.

The board has necessary power supplies for the VSx053. It also has four LED's, and a button for UI. A boot EEPROM is included so that application software and also sound samples can be stored on the board.

The board can be used with the VSx053 Simple DSP Host board for easy connectivity to the outside world. Figure 2 shows how different functionality is shared between the DSP Board and the Host Board. For more info on the Host Board see chapter 2.

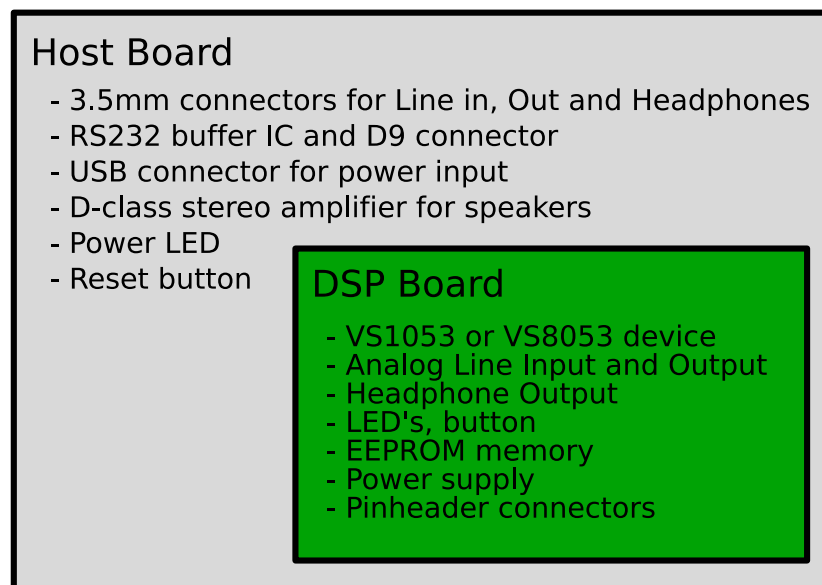Figure 3 shows the schematic of the Simple DSP Board.

Figure 2: Active DSP functions are done on the DSP Board. The Host Board provides easy connectivity to the outside world.
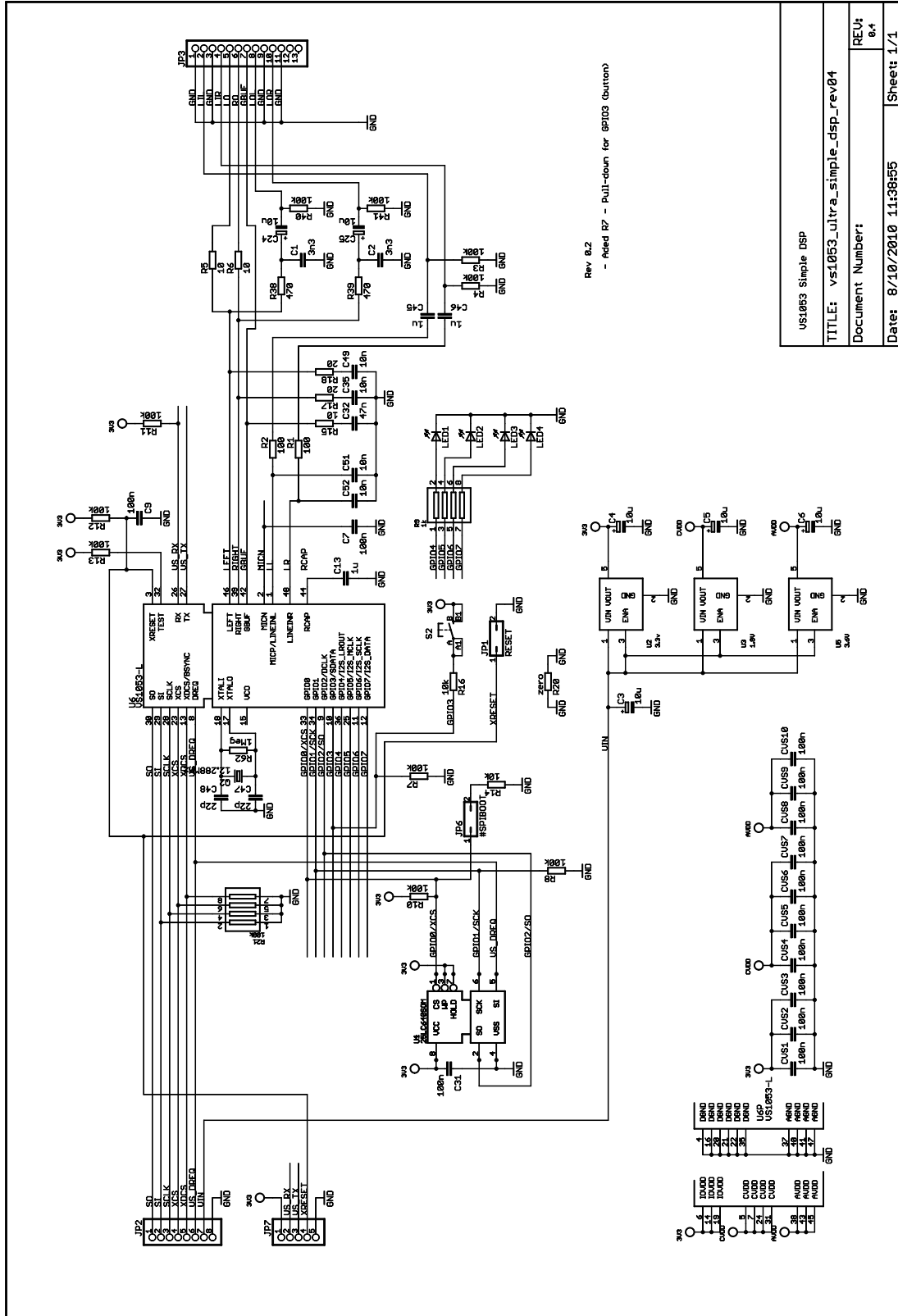
Figure 3: Schematic of the Simple DSP Board

1.1   DSP Board Features

- VS1053 or VS8053 DSP device with high-quality AD and DA converters.
- AC-coupled Line Input and Output.
- DC-coupled Headphone Output.
- On-board power supplies, only one operating voltage is needed.
- EEPROM for code and data storage.
- Four LEDs and one button for user interface.
- SPI interface for connecting to microcontroller.
- Logic level serial port for connecting to PC.
- All connections are on pinheaders for easy access.

1.2   Notes on the Schematic

- LED's are connected to GPIO[4 ..6]. Drive high to light an LED.
- The button is connected to pin GPIO3. Active high.
- JP6 prevents SPI boot. Use to boot to ROM monitor when there is code in the EEPROM
- JP1 is reset. Short to reset board.
- Line outputs have a first order RC low-pass filter that removes some of the DA converter quantization noise. Usefull when connecting to a limited bandwidth amplifier.
- Headphone outputs (including common buffer) are biased to 1.2V. Do not connect to ground!!
- Input power supply is connected to pin 7 of JP2.

1.3   Placement and Pinout

Figure 4 shows the component layout of the board. It also shows the pinheader signal names on left and right side of the board.

The following tables list the pin functions. For more info on digitall busses and analog performance see datasheets at *http://www.vlsi.fi/*.
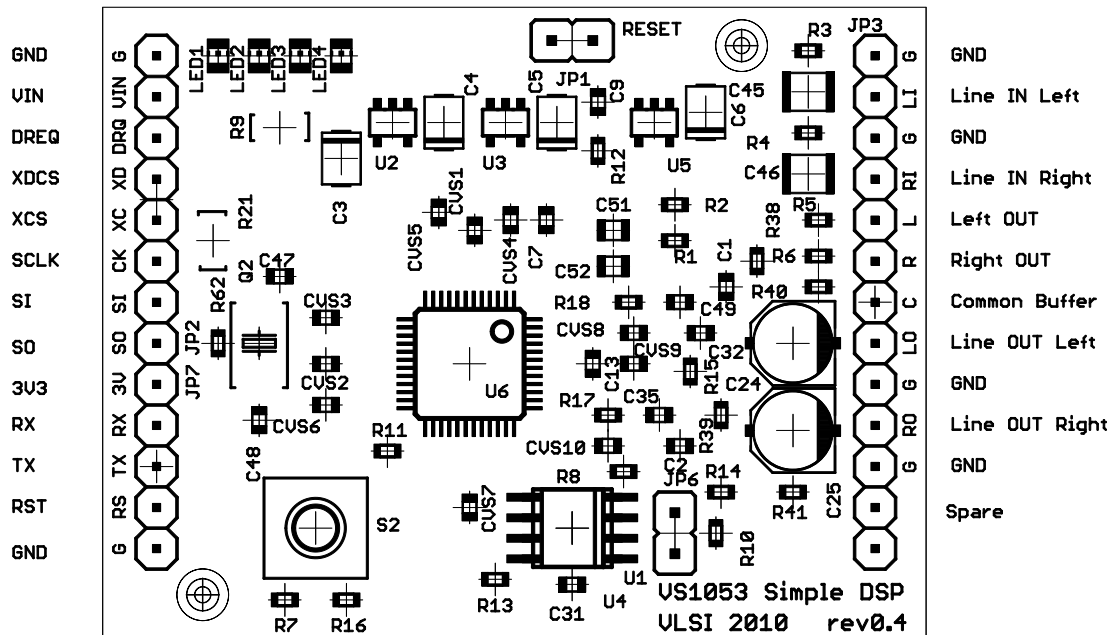
Figure 4: Layout and pin names of the Simple DSP Board

Digital Pin description (left side, top to bottom)		
Pin	**Function**	**Description**
G	GND	Ground. Connected to ground plane
VIN	VIN	Input Voltage. Power supply for the board. 3.4V - 6V allowed
XD	XDCS	SDI bus Chip Select
XC	XCS	SCI bus Chip Select
SC	SCLK	SPI bus clock input
SI	SI	SPI bus data input
SO	S0	SPI bus data output
3V	3V3	Output of DVDD regulator, for RS232 buffer
RX	RX	Serial port receive
TX	TX	Serial port transmit
RS	RST	Active Low reset for VSx053
G	GND	Ground. Connected to ground plane

Analog Pin description (right side, top to bottom)		
Pin	**Function**	**Description**
G	GND	Ground. Connected to ground plane
LI	Line In Left	Left channel line input (AC coupled)
G	GND	Ground. Connected to ground plane
RI	Line In Right	Right channel line input (AC coupled)
L	Left OUT	Headphone left channel output (note DC-bias)
R	Right OUT	Headphone right channel output (note DC-bias)
C	Common Buffer	Headphone common output (note DC-bias)
LO	Line OUT Left	Left channel line out (AC-coupled)
G	GND	Ground. Connected to ground plane
RO	Line OUT Right	Right channel line out (AC-coupled)
G	GND	Ground. Connected to ground plane
-	Spare	Not connected
-	Spare	Not connected

1.4   PCB Layout

Figure 5 shows the top layer of the board and figure 6 shows the bottom layer viewed from top. GERBER and design files are available at *http://www.vlsi.fi/*.

Note: The "zero width" traces on the board are removed from the production masks. They are used to separate Digital and Analog grounds. The grounds are connected only at the power supply. If the zero-ohm resistor is installed under the board then grounds are also connected under the VSx053. Try different configurations to find optimum performance for your application.
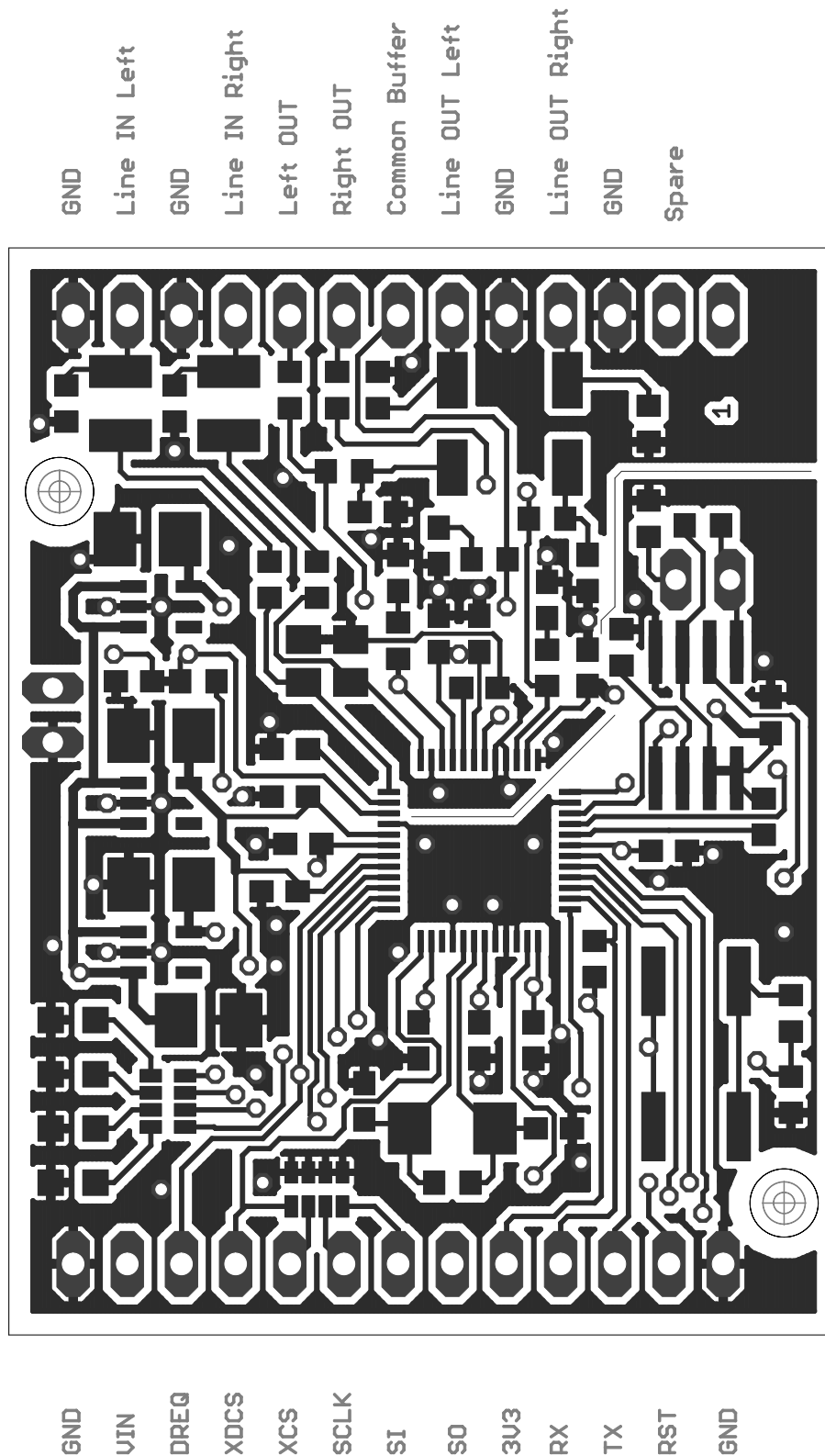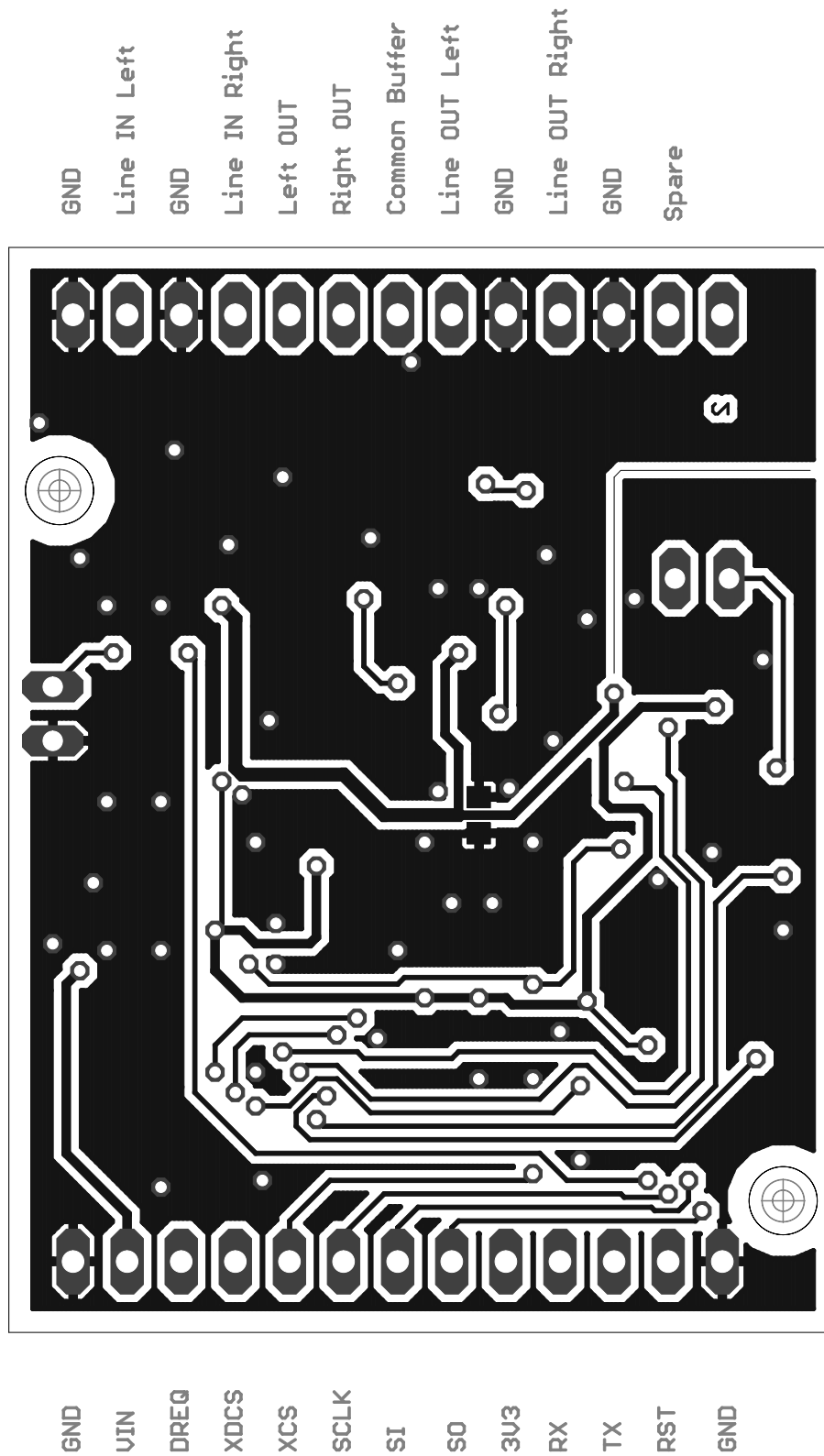
Figure 5: Top layer PCB layout

Figure 6: Bottom layer PCB layout

2   VSx053 Simple DSP Host Board

VSx053 Simple DSP Host Board is a board meant to be used with the Simple DSP Board to make connecting to outside world easier when developing software. It has 3.5mm jack connectors for analog IO, an on-board D-class amplifier that can drive small speaker directly, RS232 buffer and 9-pin D-connector for interfacing with PC and VSIDE, a USB connector for supplying power to the board (notice that USB is ONLY used as power supply), and a reset button.

VSx053 Simple DSP Board is connected with the host by pinheader connectors. If you have purchased the Board and the Host Board separately you may need to solder pinheaders to the Board.

Note the orientation of the Board. Holes on the Board and the Host Board must align!

Figure 7 shows the schematic of the Simple DSP Board.

2.1   Host Board Features

- 3.5 mm connector for Line In, Line Out and Headphone Out.
- RS232 buffer and D9 connector for connecting with PC serial port.
- D-class stereo amplifier for driving speakers.
- USB connector for supplying power to DSP Board and peripherals.
- Connector to DSP Board through pinhead connectors.
- Additional pinheaders for extra connections.
- Reset button.
- Power LED.

2.2   Notes on the Schematic

- Power is supplied through the USB connector. USB is not used for anything else.
- LED1 show that board has power
- X3 is the serial port connection to PC. Use direct RS232 cable (only RX, TX and Ground are used)
- JP8 sets the gain of the on-board D-class amp.
- If amplifier outputs are shorted it goes in to a protection mode and can be recovered by powerin the board off and on.
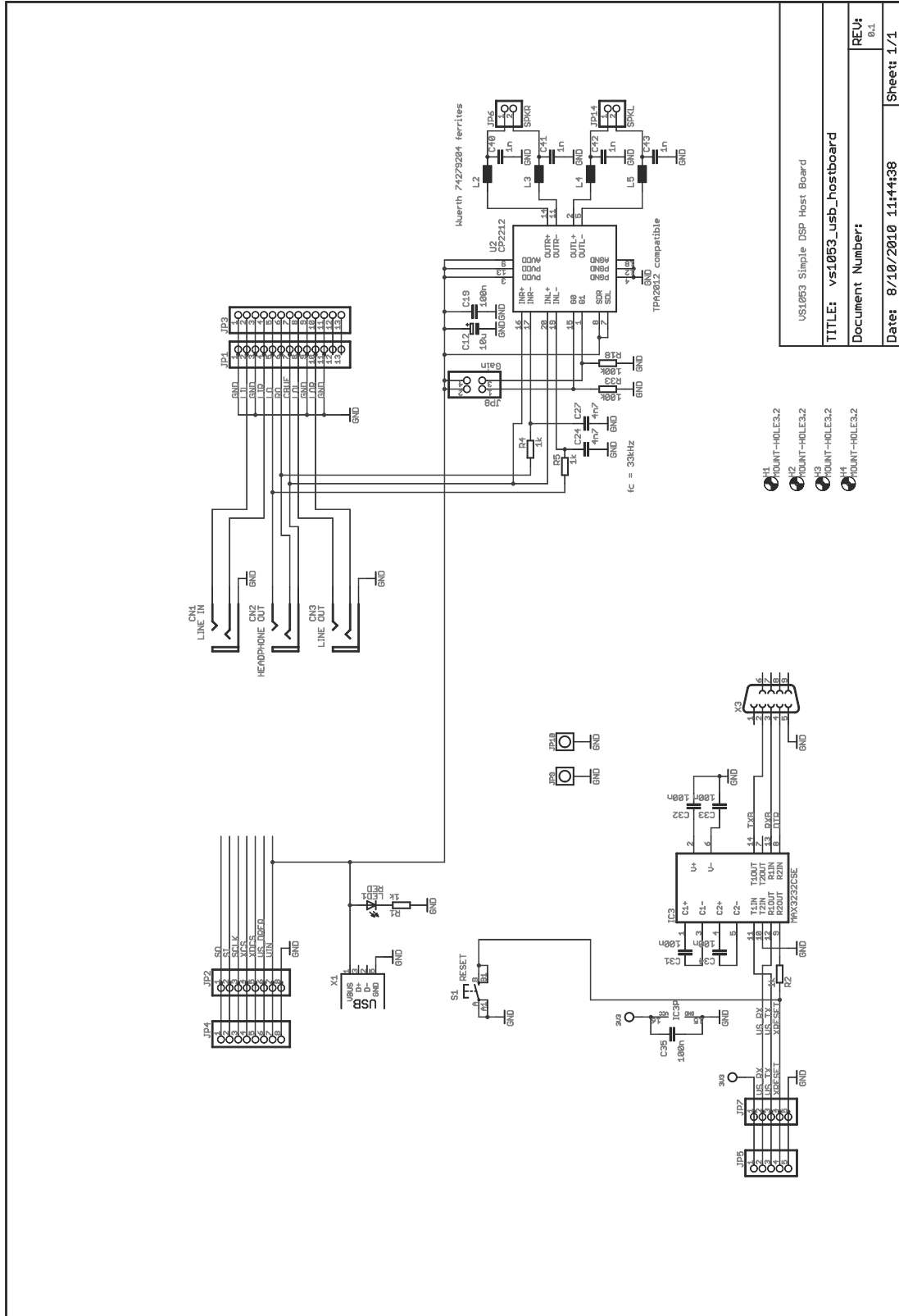- S1 resets the VSx053 Simple DSP Board mounted on the Host Board.

Figure 7: Schematic of the VSx053 Simple DSP Host Board

2.3 Placement and Pinout

Figure 8 shows the component layout of the Host Board. It also shows the pin-header signals names on left and right side of the board and connector names and positions.

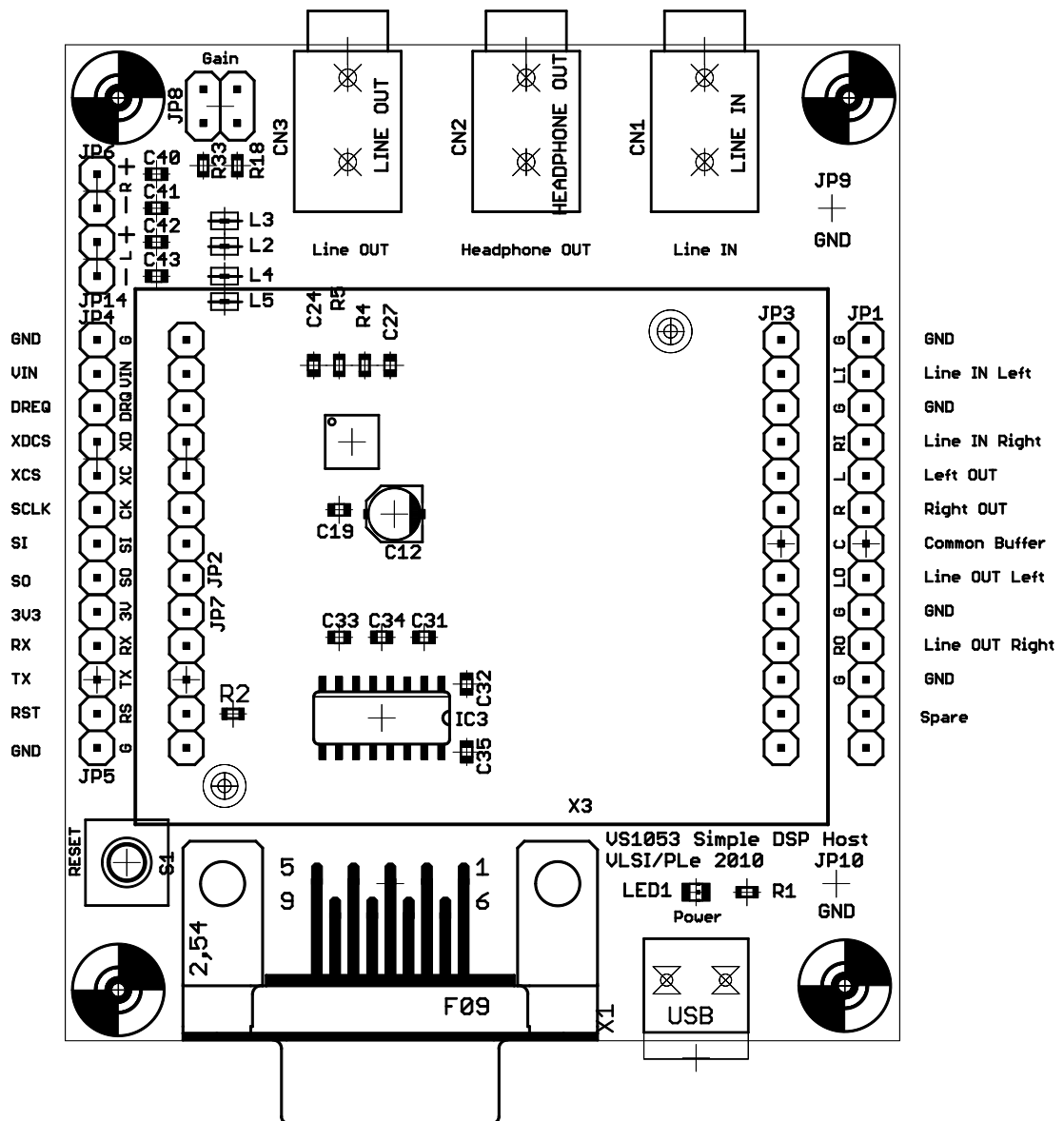Note the orientation of the Board. Holes on the Board and the Host Board must align!

Figure 8: Layout of the VSx053 Simple DSP Host Board

3   Connecting to PC and VSIDE

Host Board is connected to PC Serial port by direct RS232 cable. The Host Board is then connected to USB to power up the board. LED1 should light up

Serial port connection can also be made with the "VSIDE USB UART Cable". See more from VLSI Solution Oy Web Shop. If this cable is used then USB connection is not needed.

The VSx053 Simple DSP Board can now be used through VSIDE. For more info see VSIDE examples and help.

4 Contact Information

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