UM1681
User manual

SPC560D-DIS discovery board

Introduction

This document describes the hardware architecture of the board, how to configure the jumpers and to enable specific functions.

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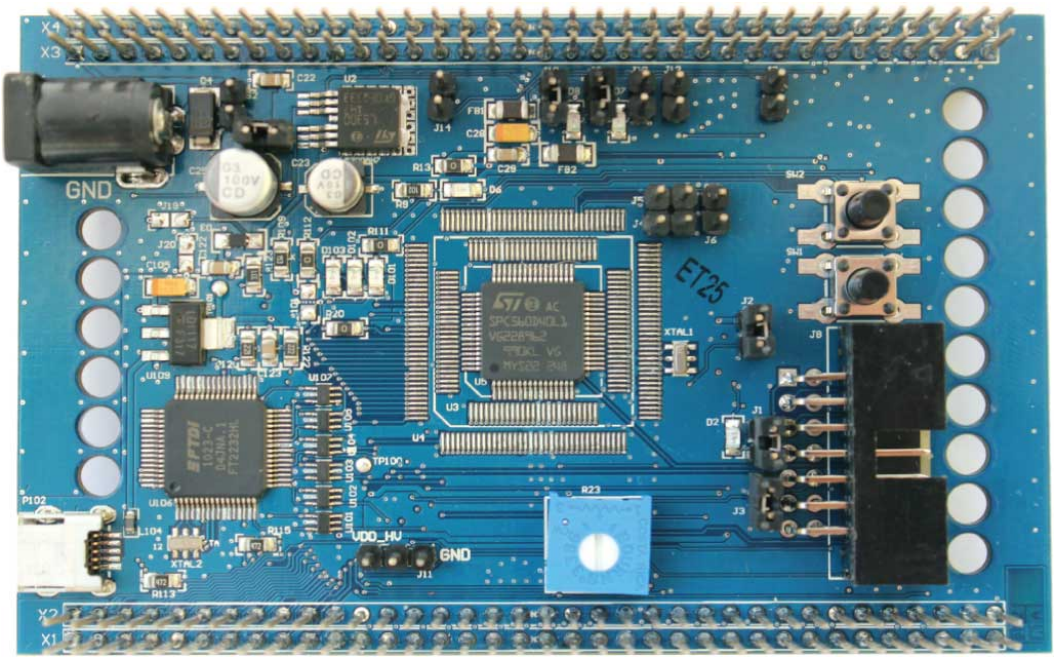
1 SPC560D-DIS discovery board with SPC560D40L1

1.1 SPC560D-DIS discovery board

The SPC560D-DIS discovery board is an evaluation tool supporting STMicroelectronics SPC56 D line microcontrollers. The evaluation board allows full access to all CPUs I/O signals and to peripherals.

Figure 1. SPC560D-DIS discovery board with SPC560D40L1



The SPC56 D line is STMicroelectronics state of the art MCU based on 32-bit microcotrollers Power Architecture® Cores specifically addressing all Automotive Applications but as well suitable for industrial safety oriented applications. Such line is optimized for Body applications as Body Control Modules, Door Modules, Seat controls, HVAC, Comfort Modules, Security Access and they are suitable for ASIL B/SIL requirements.

SPC560D-DIS discovery board is supported by a specific application project inside SPC5Studio (a visual integrated software development environment to easily develop software for SPC56 MCU's), that embeds micro start-up routines, I/O mapping and a simple test codes SPC5Studio is available for download www.st.com/spc5studio.

The PCB, the components and all HW parts meet requirements of the applicable RoHS directives.

1.2 Debug interface

The microcontroller can be debugged using both

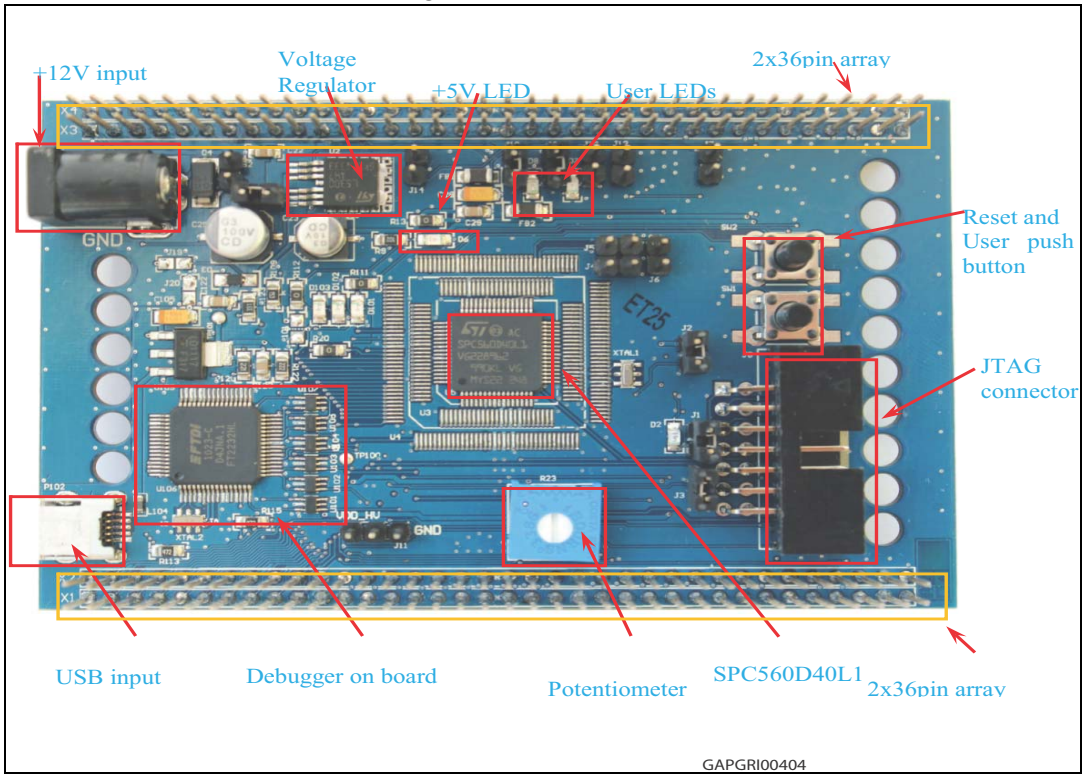
- JTAG standard 14 pins interface, for using external debugger tools
- USB mini-B, through the PLS debugger integrated on board

1.3 Microcontroller I/Os

All microcontroller IOs are available on the two 2 x 36 headers with exception of JTAG, TCK, TMS, TDI, TDO, XTAL, EXTAL and VDD_LV pins.

2 Hardware overview

Figure 2. HW overview



2.1 Power supply

The discovery board allows wide supply configurations, such as: 12 V (external PSU) or 5 V (USB supply).

2.1.1 12 V power supply

12 V voltage can be used to supply the board[(a)] using the PSU output barrel connector (+12 V) or directly from 2 x 36 headers.

The PSU connector shall be center positive with 2.1 mm inner diameters.

The diode D4 protects the boards against the battery reverse connection.
The jumpers S1 and S2 allow choosing the desired 12 V supply. *Table 1* depicts the jumper configuration:

a. If the board is supplied with +12 V, the SMD solder jumpers J19 and J20 can be left opened.

Table 1. + 12 V Supply configuration, S1 and S2 jumpers configuration

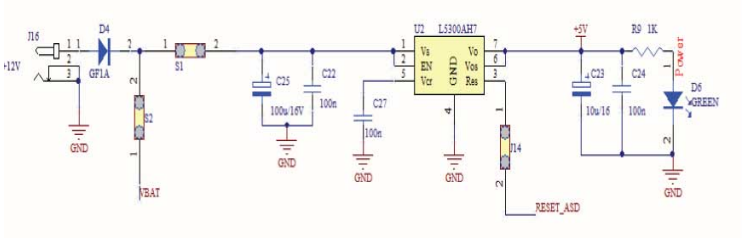
S1	S2	+12 V Supply configuration
OPEN	OPEN	The board is not supplied with 12 V
CLOSE	OPEN	The board is supplied by the external PSU
CLOSE	CLOSE(1)	The discovery board supplies the daughter board (+12 V connected to the discovery board) or the daughters supplies the discovery (+12 V connected to the daughter board) (2)
OPEN	CLOSE	Not used

1. No supply voltage has to be connected to the daughter board.
2. Only one of these HW configurations is allowed.

The jumper S1 can be used as switch to turn on and off the board.

A linear regulator is used to generate +5 V_{DC} needed for the microcontroller. D4 (green LED) is connected to voltage regulator output for revealing 5 V presence.

Figure 3. +5 V supply section



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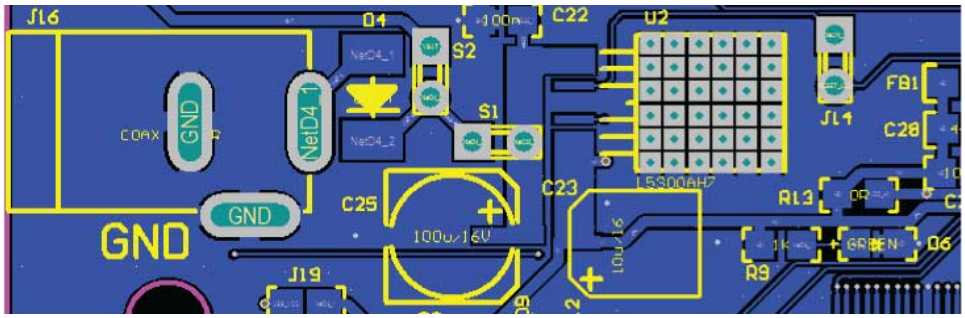
2.1.2 Supply from USB port

The board can be fed using the +5V from the USB cable. To enable this function both jumpers J19 and J20 have to be closed and the PSU plug can be removed, together with S1 and S2 jumpers.

Figure 4. Power supply section



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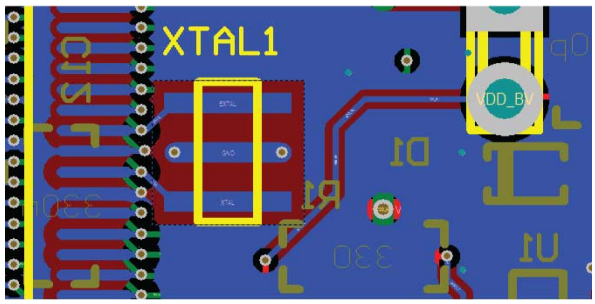
2.2 Crystal oscillator

The SPC560D-DIS board could be populated either with 8 or 16MHz crystal to clock the SPC560D40L1.

Default configuration is with 16 MHz crystal.

Figure 5. Crystal (PCB)



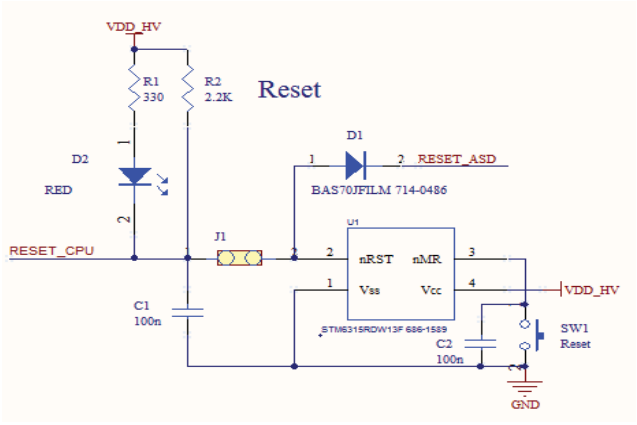
2.3 Reset section

In order to generate a clean reset signal for the microcontroller, STM6315RDW13F is used. SW1 button triggers such device generating a reset signal.

D8 is powered on as soon as reset pulse is generated.

The reset signal can be propagated to the on board linear voltage regulator via RESET_ASD line closing the jumper J14 (see *Figure 3: +5 V supply section*).

Figure 6. Reset section



2.4 Programming and debug

The microcontroller in the discovery board can be programmed and debugged using two methods[(b)]:

- Standard JTAG connector (male 2 x 7 100 mil - 90°)
- USB port with integrated debugger.

A further configuration in addition to the previous configurations allows configuring the board as a standalone PLS adapter; in this case, the JTAG connector has to be connected to the target board adding a passive male-female 2 x 7 pin adaptor.

2.4.1 JTAG connector

Figure 7. JTAG connectors (Schematic and PCB)

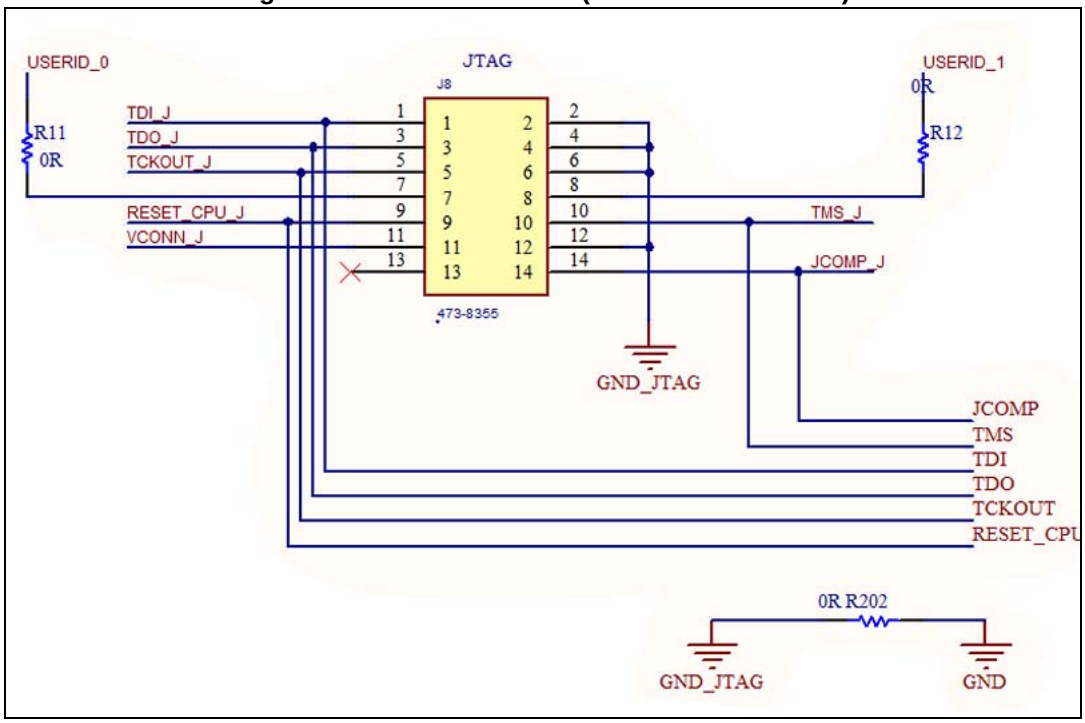


Table 2. JTAG connector (pin out)

Pin num.	Name	Pin num.	Name
1	TDI	2	GND
3	TDO	4	GND
5	TCK	6	GND
7	EVTI	8	NC
9	RESET	10	TMS

b. A single configuration can be enabled at a time. The jumper setting to enable the configuration is described in the *Section 2.4.4: HW configuration*.

Table 2. JTAG connector (pin out) (continued)

Pin num.	Name	Pin num.	Name
11	VDDE7	12	GND
13	RDY	14	JCOMP

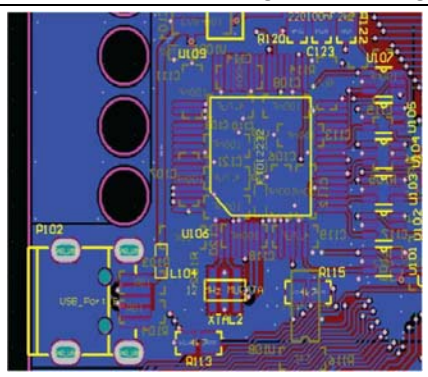
2.4.2 USB with integrated debugger from PLS (default configuration)

The integrated debugger, based on the device FTDI2232H and UDE PLS software, allows the user to build, run and debug the software applications. The SPC560D-DIS discovery kit includes a full-featured, perpetual code-limited (128 Kbytes) PLS software license; the debugger serial number is reported on a label applied on bottom side of the board.

To download the debugger software and to activate license go to the PLS website.

The integrated debugger is accessible via ST's free integrated development environment, SPC5Studio (www.st.com/spc5studio).

Figure 8. USB connector with integrated debugger from PLS



2.4.3 Board configured as PLS adapter

The discovery board can be configured to work as standalone PLS adapter, configuring jumpers as described below (see *Table 3: Programming and debug - Jumper setting*). The board serial number is reported in a label on the board.

Using such configuration the JTAG connector is connected to the JTAG application board; a passive adapter can be added to converter from male to female the 2 x 7 JTAG port soldered on the board. The 3.3 V or 5 V compatibility is achieved by using level shifters array.

2.4.4 HW configuration

In order to enable one of the previous described functionalities, the board has to be properly set. The USB integrated debugger is the default configuration.

Table 3 shows how to configure the jumpers also to enable the board as PLS adapter.

Table 3. Programming and debug - Jumper setting

Jumper name	JTAG	USB (Integrated debugger)	PLS Adapter
J101	Open	Close	Close
J102	Open	Close	Close
J103	Open	Close	Close
J105	Open	Close	Close
J109	Open	Close	Close
J110	Open	Close	Close
J111	Open	Close	Close
J114	Open	Close	Close
J19	Open	Open	Close
J20(1)	Close	Close	Close
S1(2)	Close	Close	Open
S2(3)	Open	Open	Open
J1	Close	Close	Close
J2	Close	Close	Close
J3	Close	Close	Close

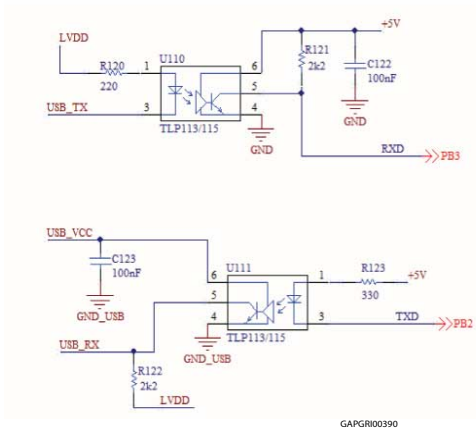
1. J20 connect the GND of the board to the GND of the USB input. This jumper should be removed when the USB section must be electrically insulated
2. S1 is used as power switch; if S1 is left open, the 12 V form external source does not supply the board
3. If S2 is present and the 12 V supply comes from the daughters boards, J16 must be left unconnected (no external PSU must be powered and connected).

2.5 USB and Graphic User Interface (GUI)

One of the two FTDI2232 channels has been configured for implementing a serial communication between PC USB and microcontroller UART, both for serial booting or for controlling the microcontroller using a dedicated GUI.

The USB section (serial communication) is electrical insulated with respect to all the circuitry adding opto-couplers in series to the path of TX and SX signals (see *Figure 9: GUI: TX and RX signals with optocoupler*).

Figure 9. GUI: TX and RX signals with optocoupler



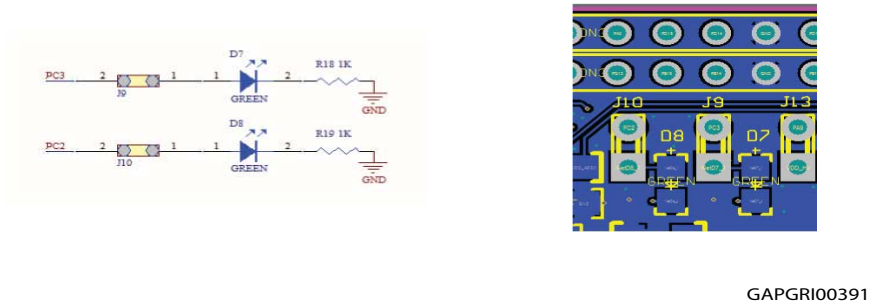
2.6 User I/O pins

Some microcontroller GPIOs are dedicated for user purpose. Here below details about to each group.

2.6.1 User LEDs

The LEDs D7 and D8 are available for user purpose; the jumpers J9, J10 connect the 2 LEDs to the microcontroller I/O PC3 and PC2 respectively. The HW connection is reported in *Figure 10: User D7 and D8 LEDs*.

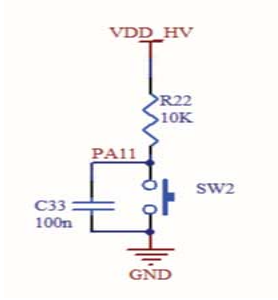
Figure 10. User D7 and D8 LEDs



2.6.2 Push button

A push button is connected to GPIO PA11. The pin is connected to High level by a 10 kΩ pull-up resistor and it is set to Low (GND) when the button is pushed; a low pass filter has been added to reduce the noise and clean spurious signals.

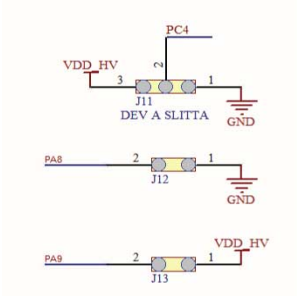
Figure 11. User push button



2.6.3 User I/O pins

Pin PC4 can be set to Low or High configuring J11.

Figure 12. User I/O pins PC4, PA8 and PA9



2.6.4 Boot configuration

It is possible to reprogram microcontroller internal flash programming using Boot Assist Mode (BAM) via SCI. The pins PA8 and PA9, (see *Figure 12: User I/O pins PC4, PA8 and PA9*) have to be configured to enable the BAM functionality as following:

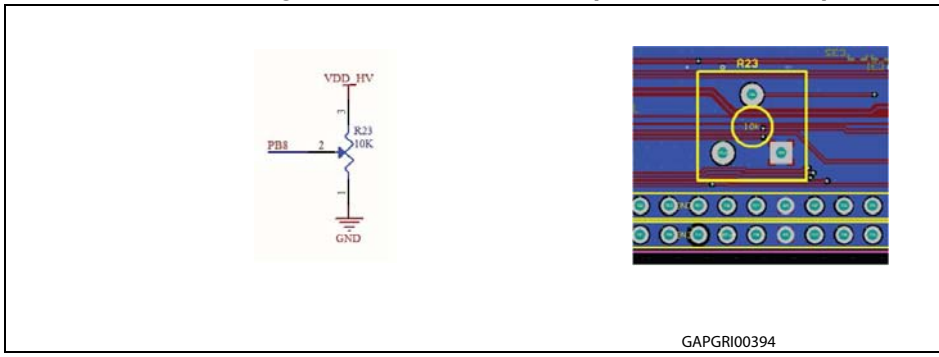
- FABM (PA9) has to be connected to VDD_HV to enable serial boot (J13 jumper closed).
- ABS (PA8) has to be physically grounded to flash via SCI (J12 jumper closed).

If the BAM function is not used, these pins can be configured as normal I/O according to the functions reported in the datasheet (see *Section Appendix B: Reference documents*).

2.6.5 ADC input

A trimmer connected to the microcontroller PB8 input allows the user to check ADC. The analog input voltage range is 0 V ÷ +V_{DD_HV}.

Figure 13. Potentiometers (Schematic & PCB)



2.7 Daughter board connector and I/O headers

The I/O microcontroller pins are connected to a double 2x36 pin array (connectors X1-X2 and X3-X4).

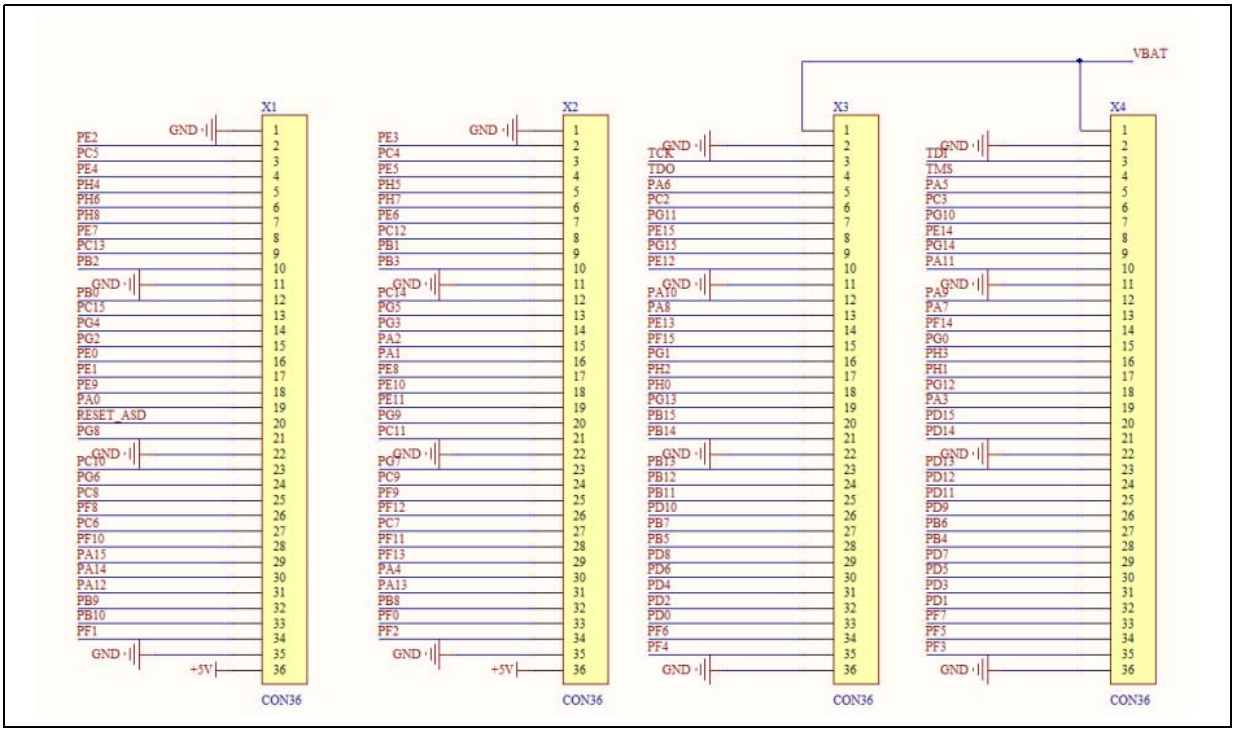
Table 4. I/O headers

Pin number	X1	X2	X3	X4
1	GND	GND	VBAT	VBAT
2	PE[2]	PE[3]	GND	GND
3	PC[5]	PC[4]	TCK	TDI
4	PE[4]	PE[5]	TDO	TMS
5	PH[4]	PH[5]	PA[6]	PA[5]
6	PH[6]	PH[7]	PC[2]	PC[3]
7	PH[8]	PE[6]	PG[11]	PG[10]
8	PE[7]	PC[12]	PE[15]	PE[14]
9	PC[13]	PB[1]	PG[15]	PG[14]
10	PB[2]	PB[3]	PE[12]	PA[11]

Table 4. I/O headers (continued)

Pin number	X1	X2	X3	X4
11	GND	GND	GND	GND
12	PB[0]	PC[14]	PA[10]	PA[9]
13	PC[15]	PG[5]	PA[8]	PA[7]
14	PG[4]	PG[3]	PE[13]	PF[14]
15	PG[2]	PA[2]	PF[15]	PG[0]
16	PE[0]	PA[1]	PG[1]	PH[3]
17	PE[1]	PE[8]	PH[2]	PH[1]
18	PE[9]	PE[10]	PH[0]	PG[12]
19	PA[0]	PE[11]	PG[13]	PA[3]
20	Reset ASD	PG[9]	PB[15]	PD[15]
21	PG[8]	PC[11]	PB[14]	PD[14]
22	GND	GND	GND	GND
23	PC[10]	PG[7]	PB[13]	PD[13]
24	PG[6]	PC[9]	PB[12]	PD[12]
25	PC[8]	PF[9]	PB[11]	PD[11]
26	PF[8]	PF[12]	PD[10]	PD[9]
27	PC[6]	PC[7]	PB[7]	PB[6]
28	PF[10]	PF[11]	PB[5]	PB[4]
29	PA[15]	PF[13]	PD[8]	PD[7]
30	PA[14]	PA[4]	PD[6]	PD[5]
31	PA[13]	PF[13]	PD[4]	PD[3]
32	PB[9]	PB[8]	PD[2]	PD[1]
33	PB[10]	PF[0]	PD[0]	PF[7]
34	PF[1]	PF[2]	PF[6]	PF[5]
35	GND	GND	PF[4]	PF[3]
36	5V	5V	GND	GND

Figure 14. I/O headers (schematic diagram)



2.8 PCB layout

Figure 15. PCB - Top Layer

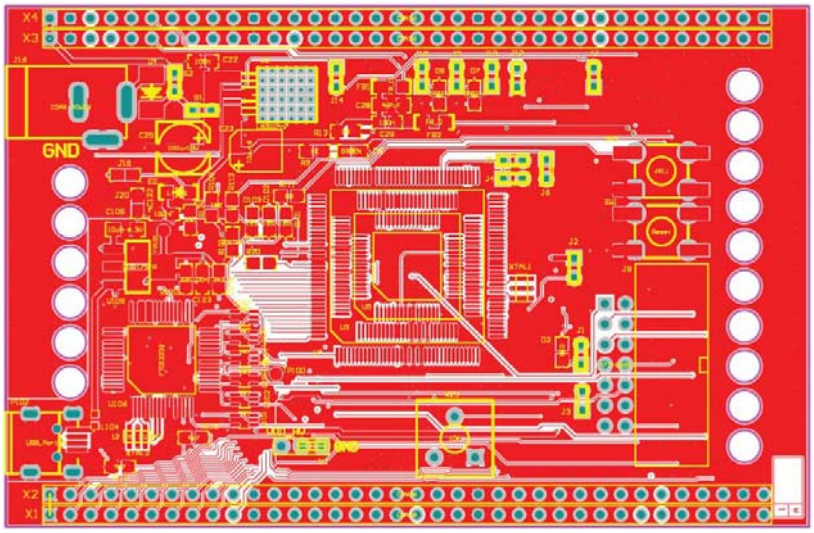


Figure 16. PCB – Inner Layer 2

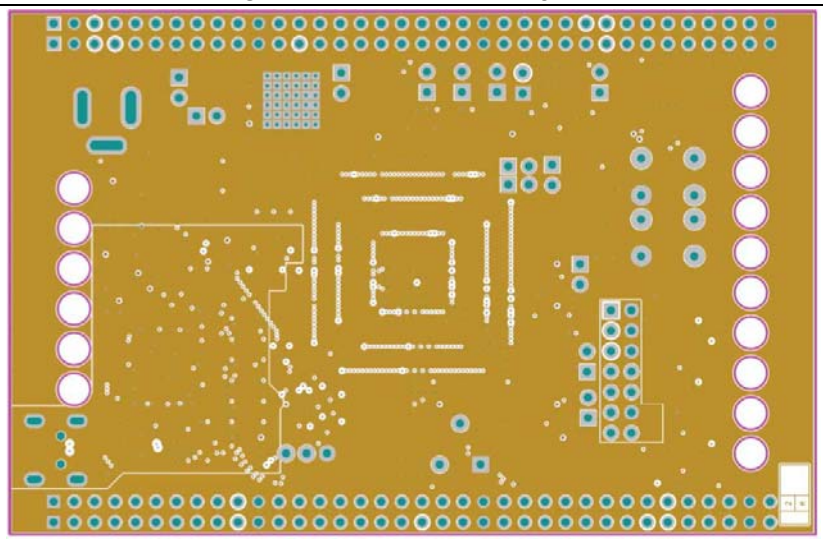


Figure 17. PCB – Inner Layer 3

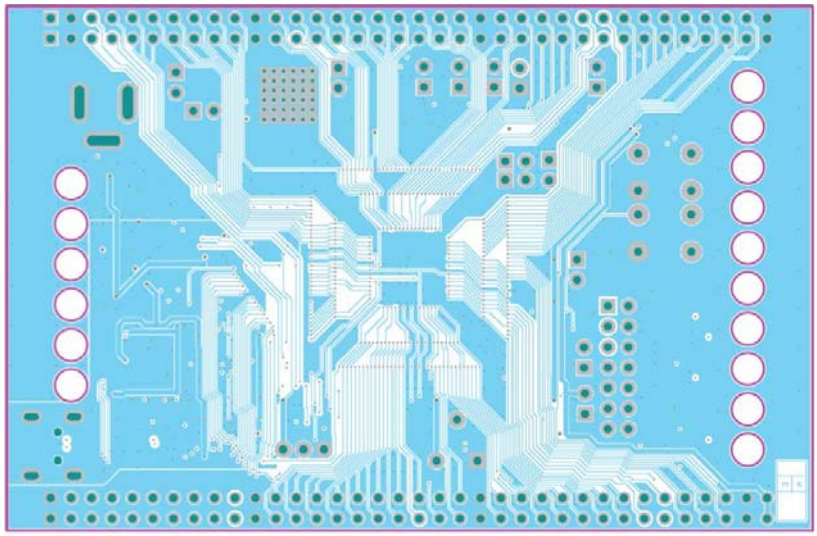


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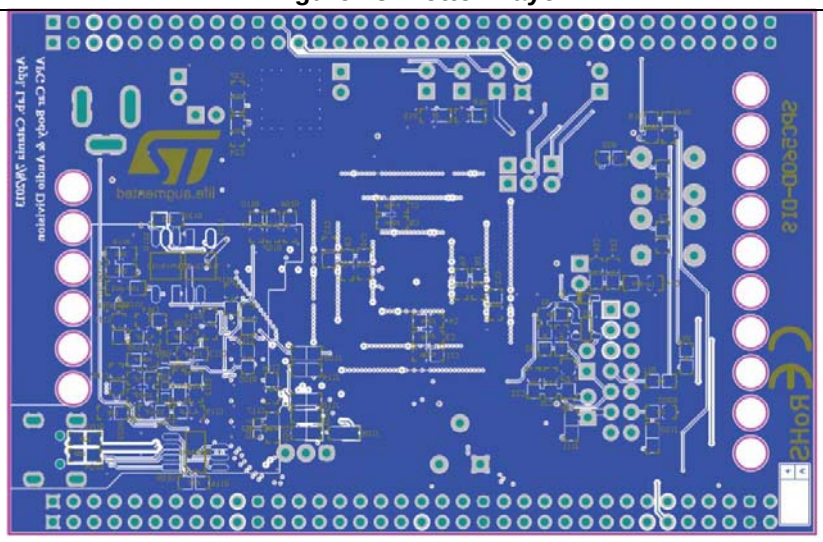
Figure 18. Bottom layer



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Appendix A General handling precautions

The following precautions are recommended when using the SPC560D-DIS, Discovery board:

- Do not modify or manipulate the board when the external PSU supply is powered and connected to the board.
- Do not open and tamper the PSU. Use AC plug adaptor if the main socket is not compatible with the PSU plug.
- Do not supply the board with a DC source higher than 12V.
- Any equipment or tool used for any manipulation of the semiconductor devices or board modification should be shielded and connected to ground.
- The connectors and cables should be plugged and removed when the board is not supplied.
- It is recommended to use antistatic tools.

Appendix B Reference documents

32-bit MCU family built on the Power Architecture® for automotive body electronics applications (Datasheet, Doc ID 16315).

Revision history

Table 5. Document revision history

Date	Revision	Changes
04-Nov-2013	1	Initial release.
24-Mar-2014	2	Updated wrong types.

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