UM2155
User manual

SPC574K-DISP Discovery Board

Introduction

The SPC574K-DISP discovery+ board is a development discovery board to evaluate and to develop applications with the microcontroller SPC574K72E5 package at budget price.

The discovery board is based on the microcontroller SPC574K72E5 in eTQFP 144 pin package, a device with three processor cores, two main 32-bit Power Architecture® VLE compliant CPU cores (e200z4), dual issue, running in lockstep and one 32-bit Power Architecture VLE compliant I/O processor core (e200z2).

The SPC574K72E5 is a microcontroller targeted at automotive powertrain controller applications chassis, control applications, transmission control applications, steering and braking applications, as well as hybrid applications.

More information about the microcontroller is reported in the datasheet (DS9223), and in the Reference Manual (RM0334) (see *Section B.1: Document references*).

This document describes the hardware architecture and in what manner configuring the jumpers is possible to enable specific functions.

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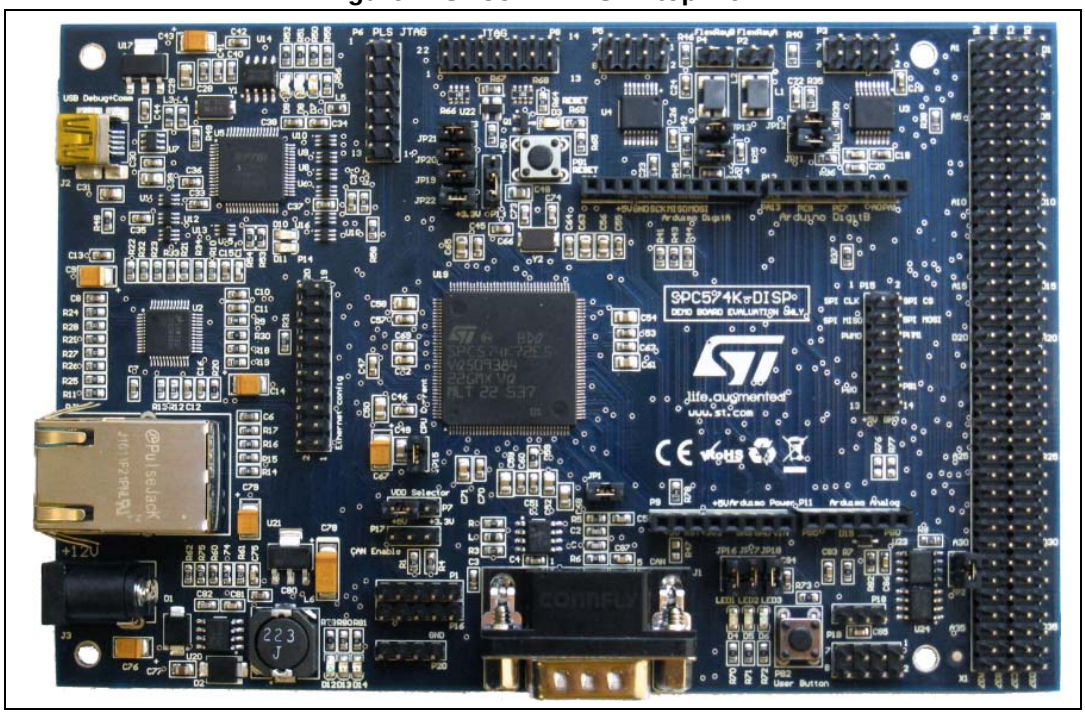
Figure 1. SPC574K-DISP - top view



The several interfaces including GPI/O's, 12-bit SAR analog converter, peripherals such as DSPI, LINFlexD (LIN and UART), FlexRay, Ethernet controller and JTAG port make the SPC574K-DISP an excellent starter kit for the customer to quick evaluate the microcontroller as well as to develop and to debug application.

An integrated programmer debugger allows the debugging and programming the microcontroller. The same section allows enabling a USB Virtual COM port.

Dedicated connectors allow plugging shields Arduino UNO R3-compatible. This feature makes it easier to expand the functionality of the SPC574K-DISP with a wide variety of shields and boards available on the market.

2 Hardware overview

2.1 Power Supply section

The input voltage level is $12V_{DC}$.

The main regulator is a buck converter based on the device A7985A (*Figure 2*); it is used to generate 5V. A linear regulator (LD1117S33TR, see *Figure 3*) generates 3.3 V.

Three LEDs D12, D13 and D14 provide the feedback about the status of the power supply section.

Figure 2. 12V - 5V Buck converter

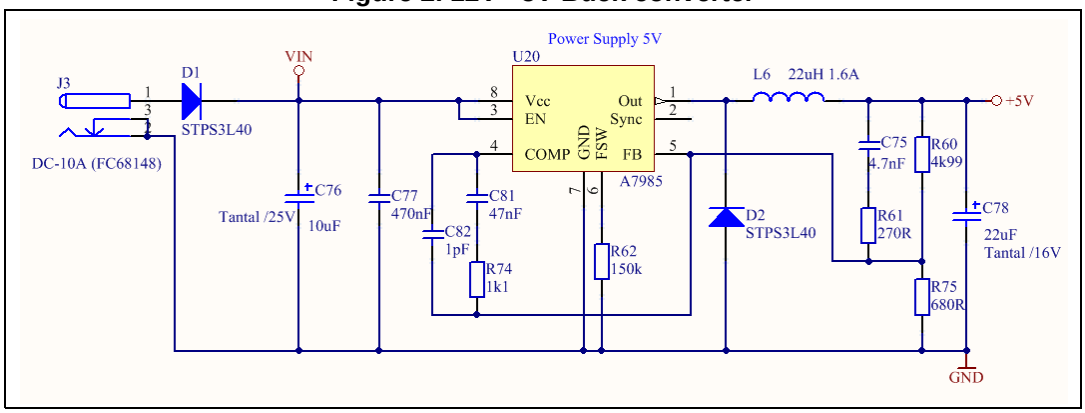


Figure 3. 5V - 3.3V linear regulator

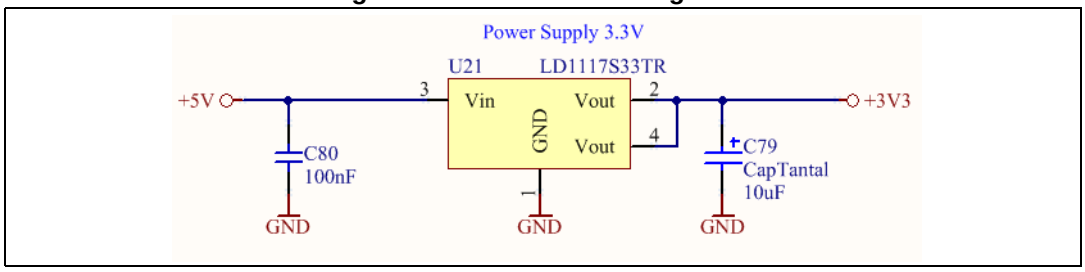
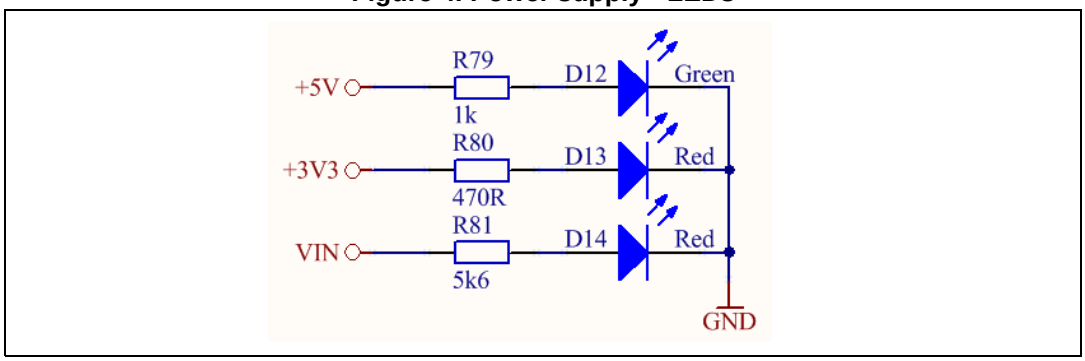


Figure 4. Power supply - LEDs

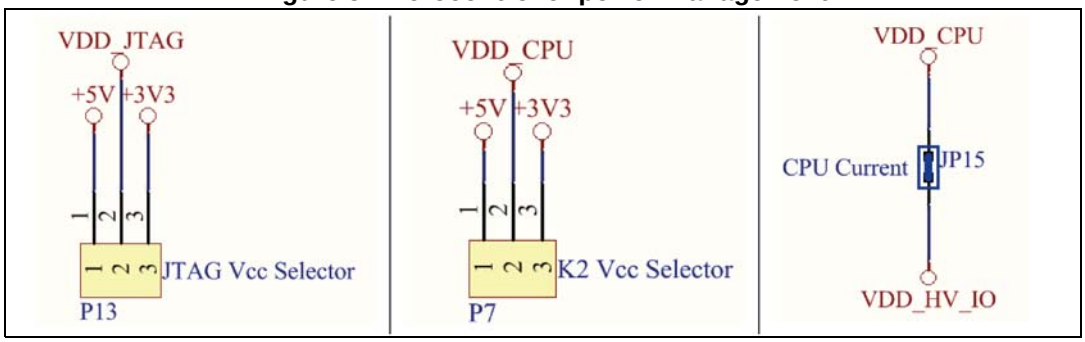


2.2 Microcontroller power management

A jumper plugged in the P13 (3 male pins) allows selecting t the VDD_JTAG voltage level as well as the VDD_CPU source is set with a jumper in P7.

A DC mA-meter connected in place of JP5 allows measuring the current of VDD_HV_IO supply

Figure 5. Microcontroller power management



2.3 Integrated Programmer/Debugger

The board includes an integrated programmer/debugger; it allows the user to program the microcontroller, to build and to debug the software applications. The debugger works with the UDE PLS software.

The SPC574K-DISP discovery board includes a full-featured, perpetual code-limited PLS software license (256 kBytes).

The debugger serial number is reported on the label applied on the PCB (bottom side).

The integrated debugger SW is accessible via ST's free integrated development environment, SPC5Studio (www.st.com/spc5studio). To download the debugger software and to activate license refer to the PLS website.

The core of the debugger is a single chip USB to dual serial / parallel ports. A portion of the device is used to manage the JTAG signals and the second part is used to implement a UART communication channel; some level shifters are used to equalize the signal amplitude.

The supply comes from PC through the USB cable and a 3.3V linear regulator supplies the IC.

The microcontroller can be the programmed and debugged also by using external tools connected to a JTAG port. The resistor array R66 and R68 allows disconnecting the JTAG signal from the integrated debugger[(a)].

The SPC574K-DISP board comes with the integrated programmer enabled.

a. If the USB cable is not connected to a PC, the integrated debugger will not be supplied. Under this condition an external debugger could not be able to work properly, it is necessary to remove the resistor arrays R66 and R68. It is suggested to perform some tests before removing R66 and R68.

Figure 6. Integrated programmer/debugger - part 1 (USB Port, USART and Level shifters)

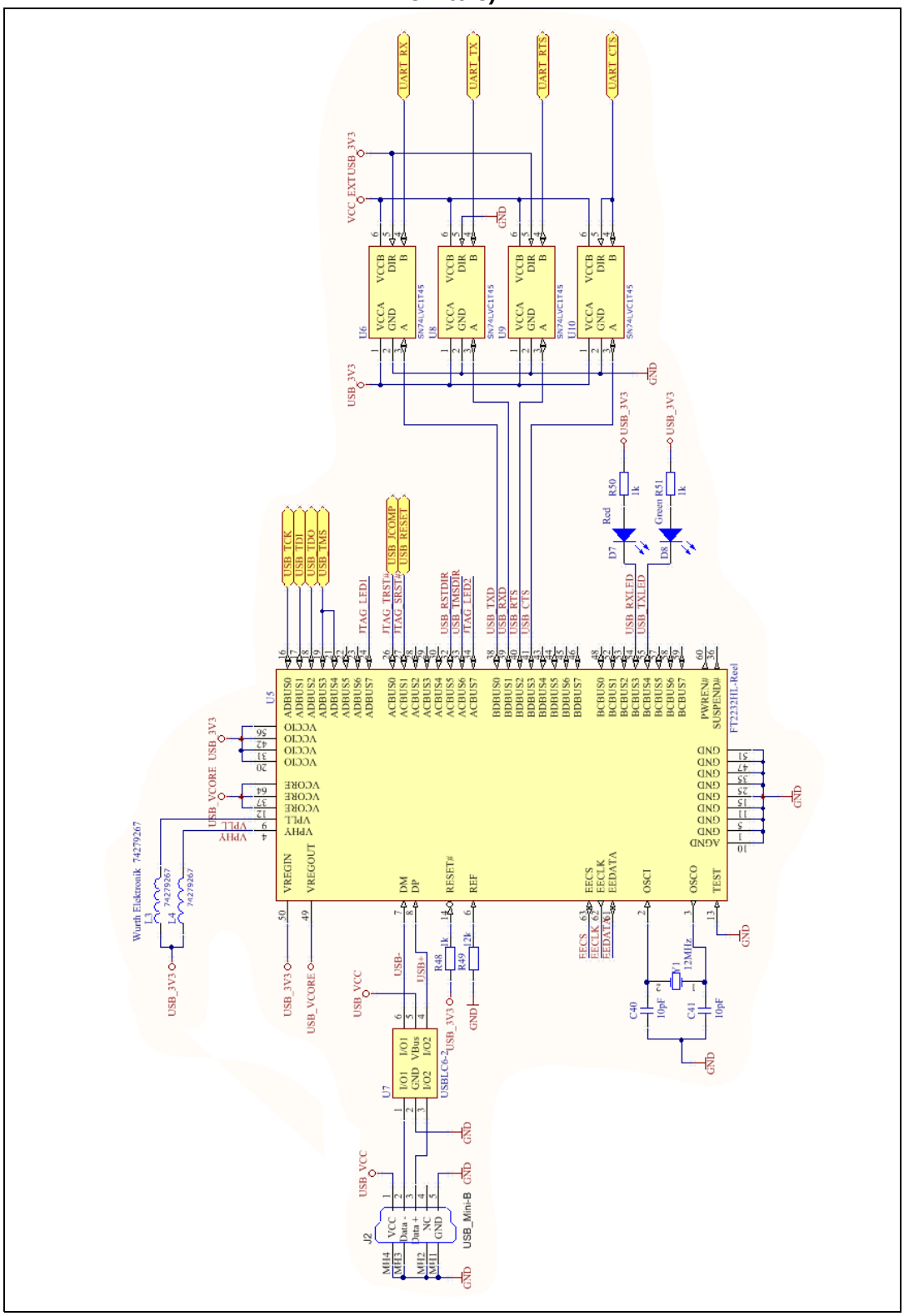


Figure 7. Integrated programmer/debugger - part 2 (JTAG signal and level shifters)

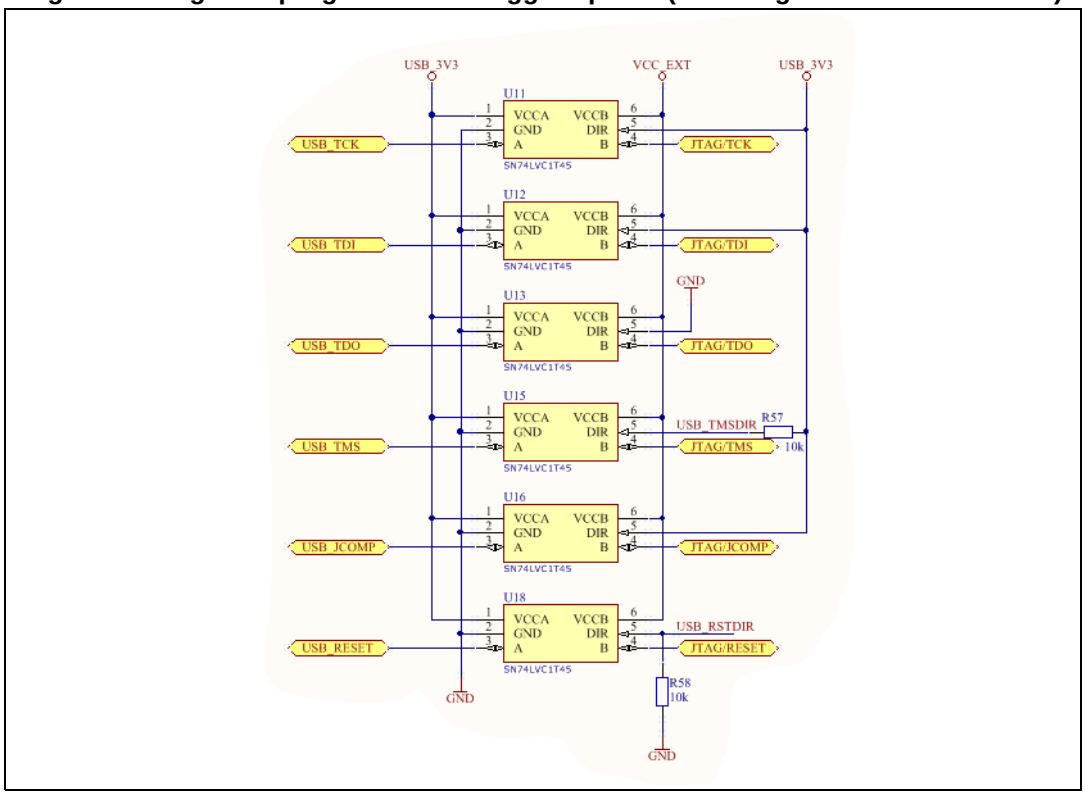


Figure 8. Integrated programmer/debugger - part 3 (EEPROM and Voltage regulator)

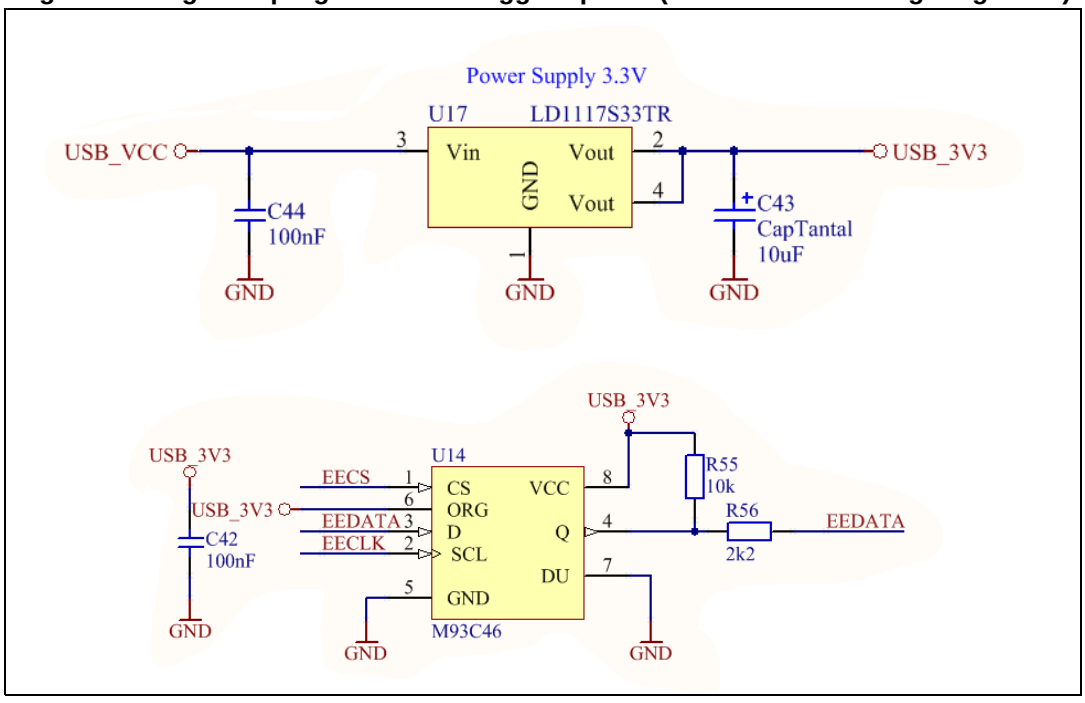
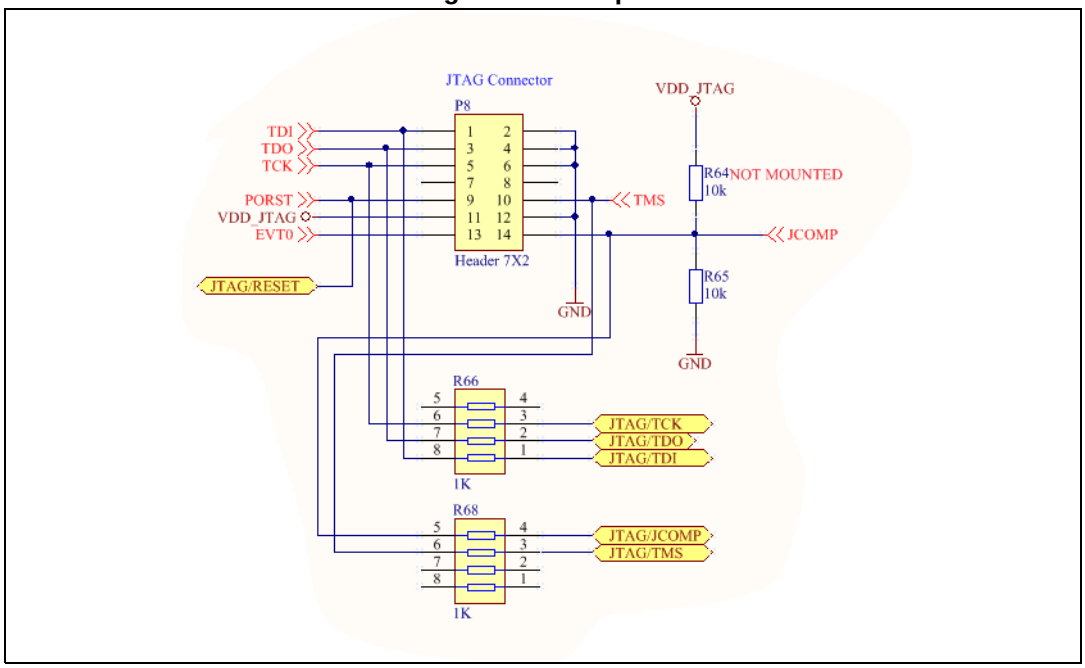


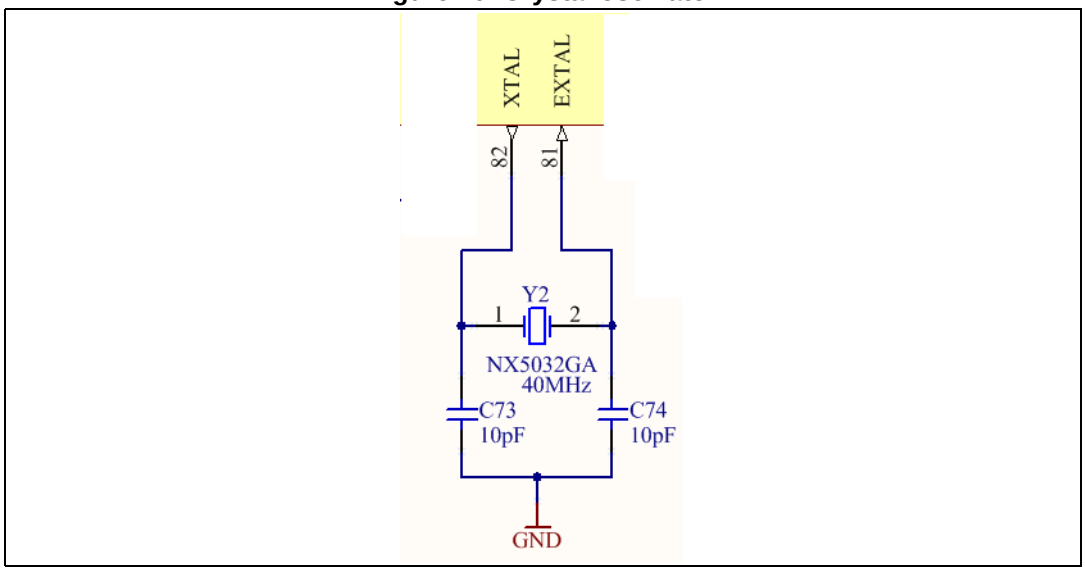
Figure 9. JTAG port



2.4 Crystal oscillator

Figure 10 shows the external oscillator circuit; the frequency is 40MHz.

Figure 10. Crystal oscillator



2.5 Reset circuit

The core of the reset circuit is the device STM6315.

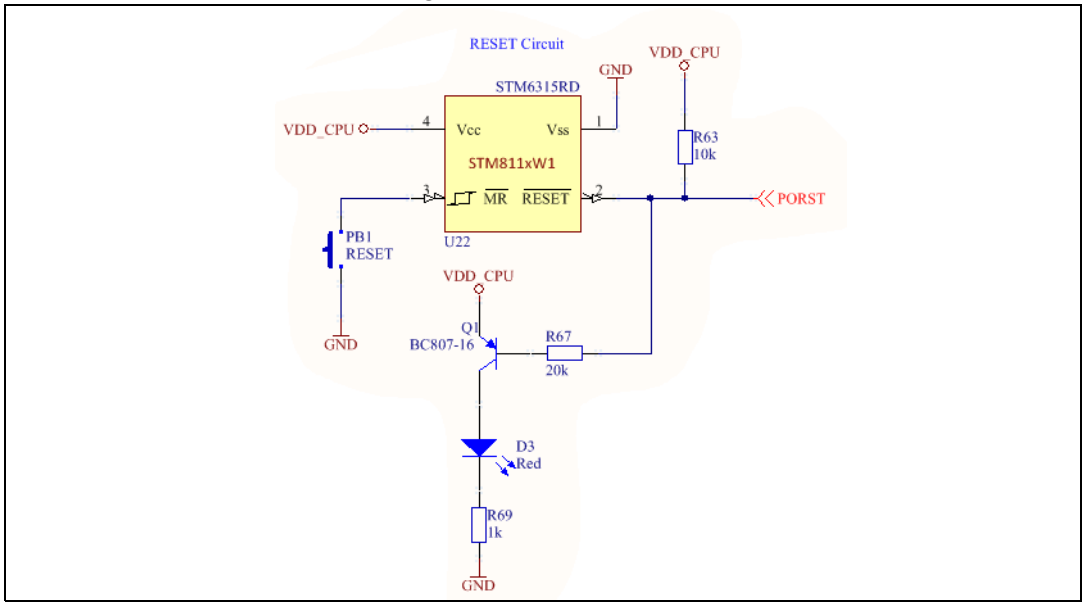
The U22 asserts a reset signal whenever the VCC pin drops below a fixed value (2.63V) and keeping it asserted until VCC has risen above the threshold for a minimum period of time (210ms).

The device provides also a reset signal when the push-button is pressed.

The reset output is an open drain pin and it must be pulled up to VDD_CPU voltage level (R63).

The LED D3 provides a visual feedback and it is switched on when the reset pulse is generated.

Figure 11. Reset circuit



2.6 FlexRay

Two FlexRay channels are available; the HW configuration is the same for both channels (see *Figure 12*).

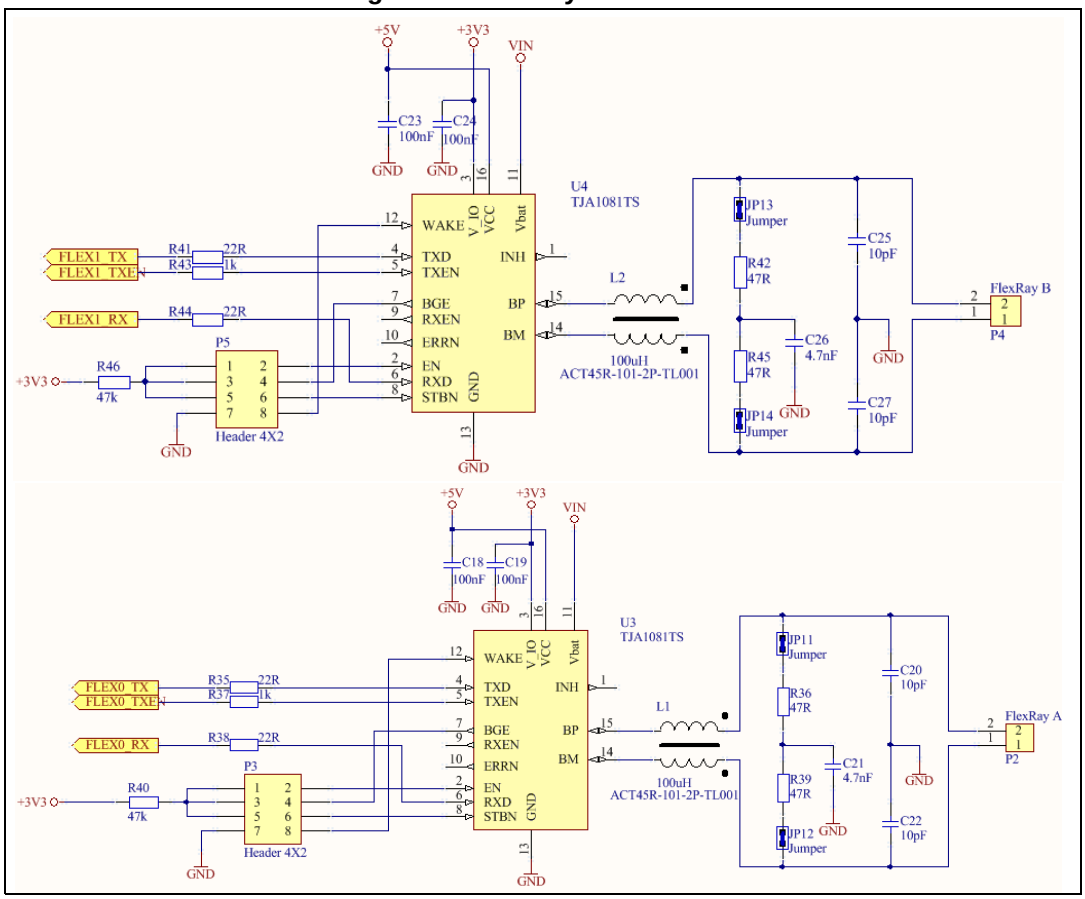
Jumpers JP11-JP 12 and JP13-JP14 are used to connect the load terminations (47Ω). The pin arrays P3 and P5 allow to configure the transceivers plugging jumpers.

In *Table 1* summarizes the information about the transceiver signals and the microcontroller ports for both the channels.

Table 1. FlexRay transceiver signals and uC ports

FlexRay Channel 0	uC Port	FlexRay Channel 1	uC Port
FLEX0_TX	PA10	FLEX1_TX	PC9
FLEX0_RX	PA11	FLEX1_RX	PC8
FLEX0_TXEN	PC7	FLEX1_TXEN	PC6

Figure 12. FlexRay transceivers



2.7 Ethernet.

Figure 13 shows the Ethernet section; the resistors R14, R15, R16 and R17 are the load termination.

The jumpers in P14 (2x10 male pins) enable the signals from the microcontroller to drive the transceiver (see *Figure 14* and *Table 2*).

RJ1 is a RJ45 connector, *Figure 15* shows the internal schematic diagram.

Note: The transceiver supply voltage is 3.3 v; the microcontroller supply level must be set consequently.

Figure 13. Ethenet Physical Layer Transceiver

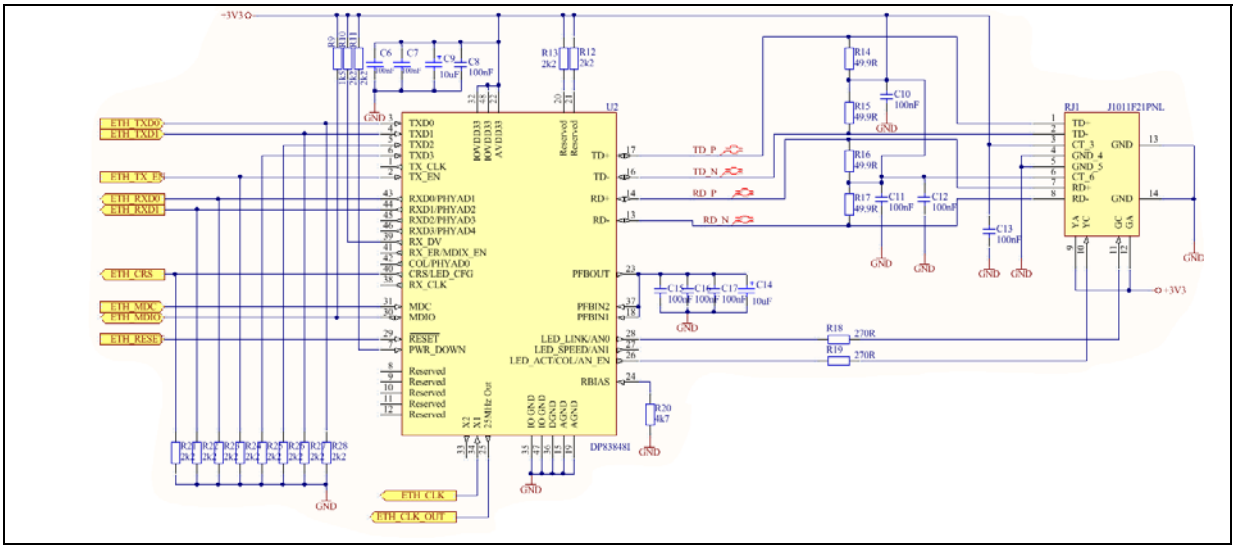


Figure 14. Ethernet Transceiver - Jumpers

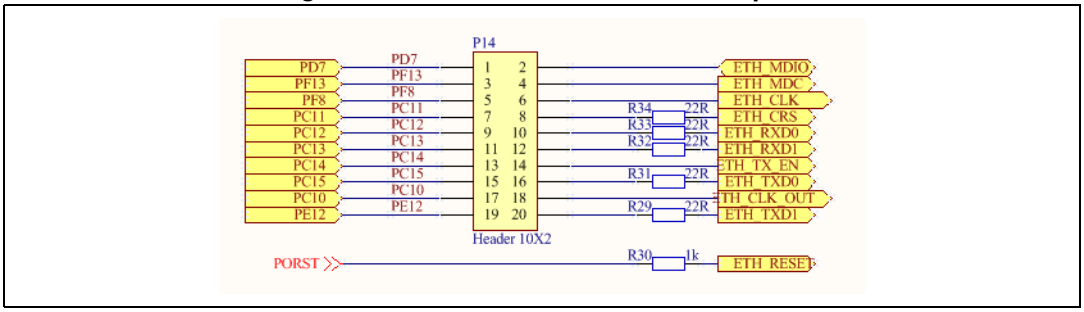
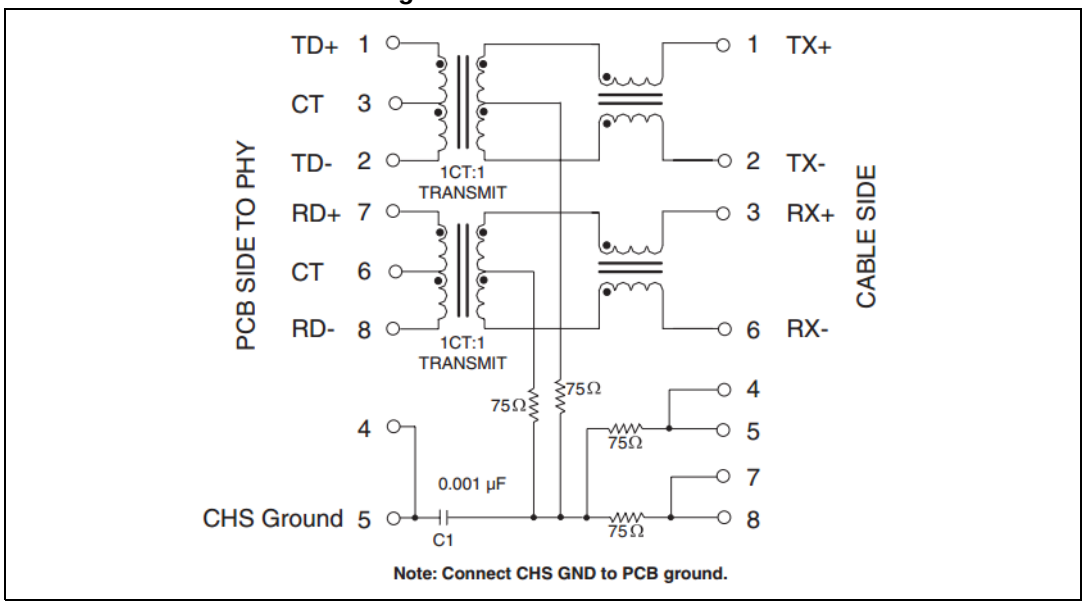


Table 2. Ethernet Transceiver - Jumpers

P14 pin	uController Port	Ethernel Transceiver signal
1-2	PD7	ETH_MDIO
3-4	PF13	ETH_MDC
5-6	PF8	ETH_CLK
7-8	PC11	ETH_CRS
9-10	PC12	ETH_RXD0
11-12	PC13	ETH_RXD1
13-14	PC14	ETH_TX_EN
15-16	PC15	ETH_TXD0
17-18	PC10	ETH_CLK_OUT
19-20	PE12	ETH_TXD1

Figure 15. RJ45 Connector



2.8 CAN

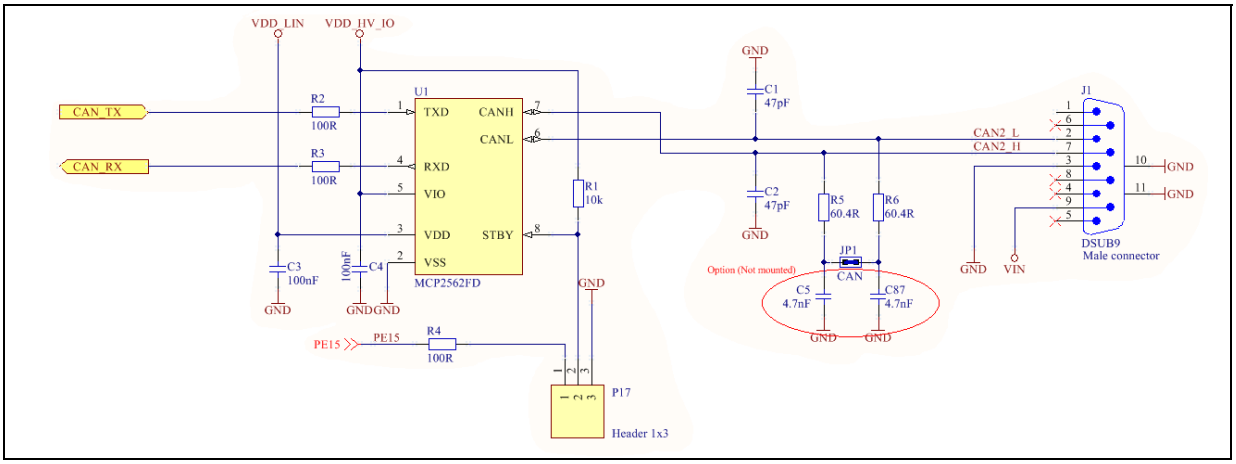
The CAN section is based on a fast transceiver and the solution is compatible with CAN-FD operation mode.

A jumper connected in P17 allows selection normal o standby mode:

- No jumper: normal operation[b]
- Jumper 2-3: device in standby mode (manual or fixed selection)
- Jumper 1-2: the port PE15 controls the stand by pin is (dynamic configuration).

Jumper JP1 enables the load termination.

Figure 16. CAN transceiver



b. In the transceiver an internal pull-up resistor is already present and R1 could be removed

Table 3. CAN - Transceiver signals and uC Ports

Transceiver Signals	uController Port
CAN_TX	PA12
CAN_RX	PA13
STBY	PE15(1)

1. P17: jumper 1-2 shorted

2.9 LIN and K-Line

Figure 17 shows the LIN and K-Line section. Two pin arrays (P1 and P6) and jumpers allow configuring the signals. If the JP2 is present, PE9 drives the NSPL (LIN transceiver).

Figure 17. LIN and K-Line

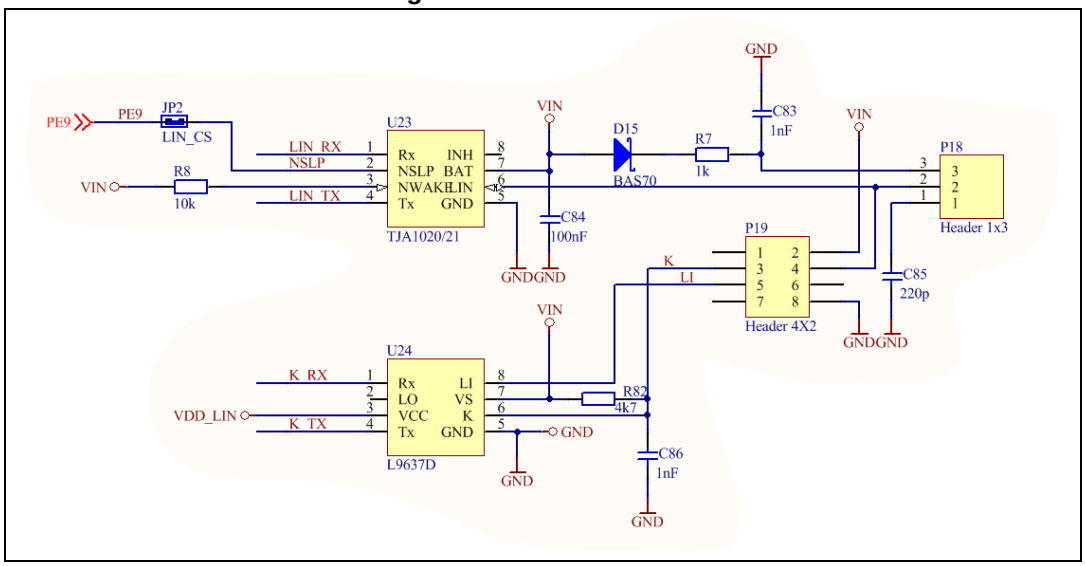


Figure 18. LIN and K-Line - jumper selection

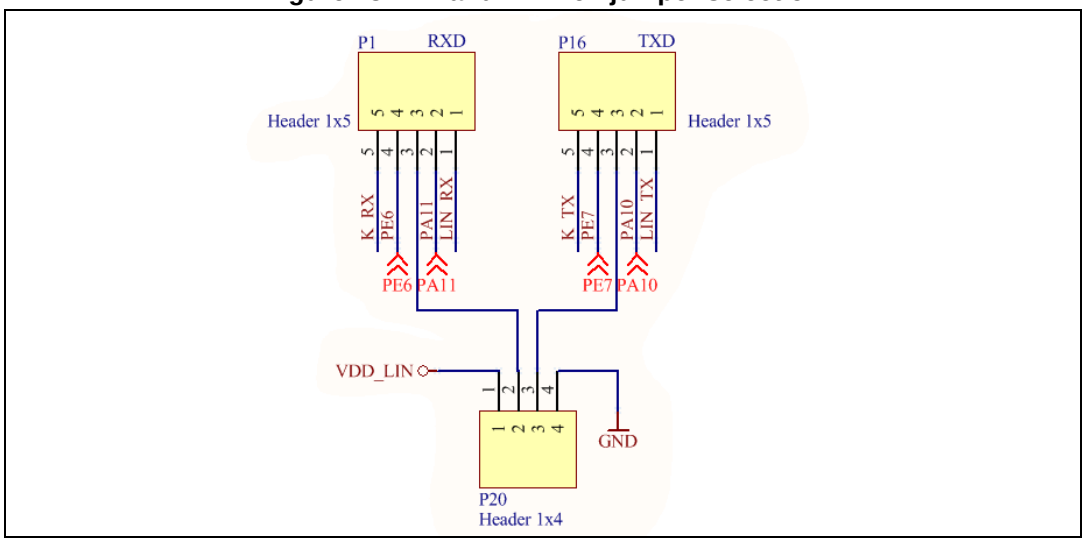


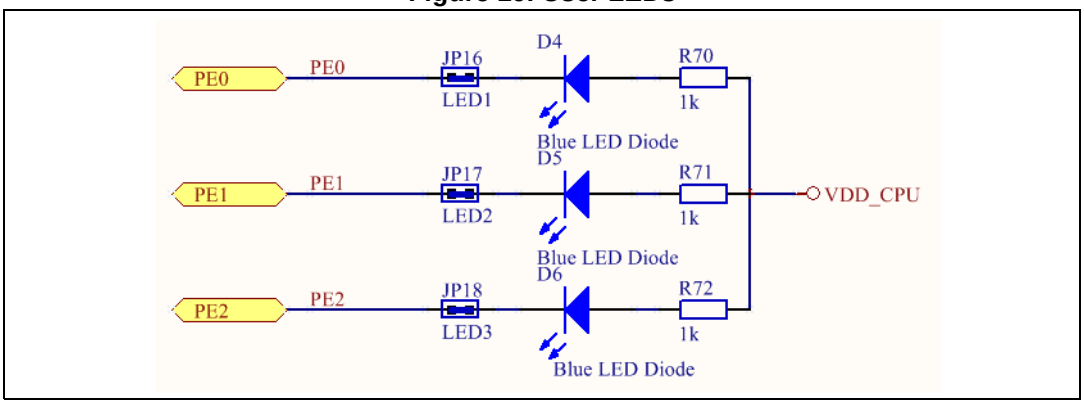
Table 4. LIN and K-Line - jumper selection

P1	Signal connection	P16	Signal connection
1-2	LIN_RX - PA11	1-2	LIN_TX - PA10
2-3	PA11 - P20, pin 2	2-3	PA10 - P20, pin 3
3-4	PE6 - P20, pin 2	3-4	PE7 - P20, pin 3
4-5	K_RX - P20, pin 2	4-5	K_TX - PE7

2.10 User LEDs, User Button

Three LEDs are present for user purpose (i.e. debug, or monitoring). Removing the jumper JP16, JP17 and JP18 the signals PE0, PE1 and PE2 can be dedicated for a different function.

Figure 19. User LEDs



2.10.1 Arduino Connectors

The connectors P9, P10, P11 and P12 are female connectors Arduino-Uno R3 compatible. These headers make it easy to expand the functionality of the board with a wide choice of shields available on the market.

Figure 20. Connectors Arduino UNO compatible

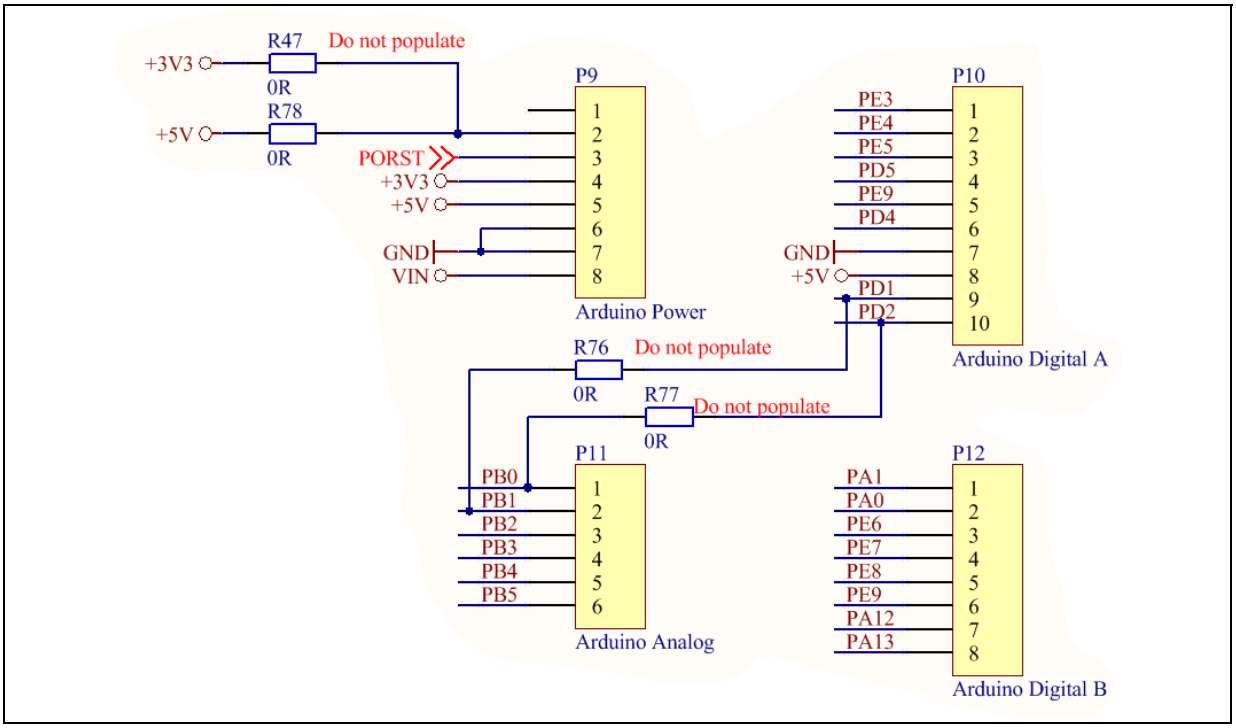


Table 5. Connector Arduino Compatible - Analog inputs

Arduino - Analog Connector	P11	uController Port
A0	6	PB5
A1	5	PB4
A2	4	PB3
A3	3	PB2
A4	2	PB1
A5	1	PB0

Table 6. Connector Arduino Compatible - Power

Arduino - Power Connector	P9	Signal Description
-	1	-
IOREF	2	3.3V (R77) or 5V (R78)
NRST	3	PORST
3V3	4	3.3V
5V	5	5V
GND	6	GND
GND	7	GND
VIN	8	VIN

Table 7. Connector Arduino Compatible - Digital

Arduino - Digital Connector (IOH)	P10	Signal Description
D15/SCL	10	PD2
D14/SDA	9	PD1
AVDD	8	+5V
GND	7	GND
D13	6	PD4
D12	5	PE9
D11	4	PD5
D10	3	PE5
D9	2	PE4
D8	1	PE3
Arduino - Digital Connector (IOL)	**P9**	**Signal Description**
D7	8	PA13
D6	7	PA12
D5	6	PE9
D4	5	PE8
D3	4	PE7
D2	3	PE6
D1	2	PA0
D0	1	PA1

2.10.2 User connector

P15 is 2x7 male pin array reserved for user purpose; Extended Connectors (I/O Headers) summarizes the function/signal of each pin.

Figure 21. User connector

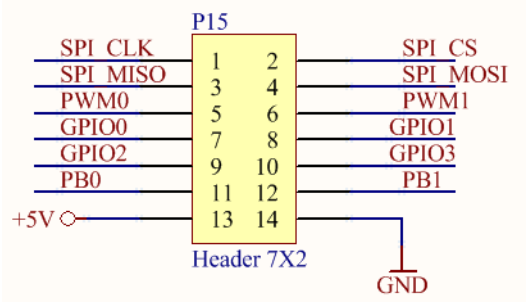


Table 8. User connector

P15 - pin	Function	Port	P15 - pin	Function	Port
1	SPI_CLK	PD4	2	SPI_CS	PE5
3	SPI_MISO	PE9	4	SPI_MOSI	PD5
5	PWM0	PE8	6	PWM1	PF6
7	GPIO0	PE6	8	GPIO1	PE7
9	GPIO2	PD1	10	GPIO3	PD2
11	PB0	PB0	12	PB1	PB1
13	+5V	5V	14	GND	GND

2.10.3 Extended Connectors (I/O Headers)

Table 9. X1 (part I) - Extended Connectors (I/O Headers)

X1 pin	Function / Port	X1 pin	Function / Port
A1	GND	B1	GND
A2	PF0	B2	PD9
A3	PD10	B3	PE14
A4	PG6	B4	PG7
A5	PG8	B5	PG9
A6	PF4	B6	PD6
A7	PA14	B7	PA15
A8	PD8	B8	PE10
A9	PH4	B9	PH2
A10	PB9	B10	PH1
A11	PH0	B11	PA13
A12	PORST	B12	-
A13	-	B13	-
A14	PG15	B14	-
A15	PE5	B15	PF5
A16	PF1	B16	PF13
A17	PA12	B17	PC0
A18	PF6	B18	PF7
A19	PF8	B19	PF9
A20	PB10	B20	-
A21	PC5	B21	PA10
A22	PB11	B22	PD3

Table 9. X1 (part I) - Extended Connectors (I/O Headers) (continued)

X1 pin	Function / Port	X1 pin	Function / Port
A23	PD2	B23	PE3
A24	PE11	B24	PE12
A25	PG14	B25	PF3
A26	PB2	B26	PB1
A27	PB12	B27	PB3
A28	PB4	B28	PB5
A29	PB6	B29	PB7
A30	PG10	B30	PB13
A31	PB0	B31	PB15
A32	PB14	B32	PG11
A33	PG12	B33	PD11
A34	GND	B34	GND
A35	GND	B35	PC10
A36	PC3	B36	PC11
A37	VIN	B37	VIN

Table 10. X1 (part II) - Extended Connectors (I/O Headers)

X1 pin	Function / Port	X1 pin	Function / Port
C1	GND	D1	5V
C2	PA1	D2	PG1
C3	PG2	D3	PG3
C4	PG4	D4	PG5
C5	-	D5	PF12
C6	PF10	D6	PF11
C7	-	D7	-
C8	-	D8	-
C9	-	D9	PC7
C10	-	D10	PE4
C11	PA0	D11	PF15
C12	-	D12	-
C13	-	D13	-
C14	PA4	D14	PD15
C15	PA11	D15	PC8

Table 10. X1 (part II) - Extended Connectors (I/O Headers) (continued)

X1 pin	Function / Port	X1 pin	Function / Port
C16	PH3	D16	PC9
C17	PD12	D17	PC6
C18	PA3	D18	PC1
C19	PB8	D19	PC2
C20	PA8	D20	-
C21	PA9	D21	PG13
C22	PE1	D22	PD0
C23	PE2	D23	PD1
C24	PE6	D24	PA2
C25	PC4	D25	PD4
C26	PE9	D26	PD5
C27	PD14	D27	PE8
C28	PD7	D28	PE0
C29	PE7	D29	-
C30	PD13	D30	-
C31	PE13	D31	-
C32	GND	D32	GND
C33	5V	D33	5V
C34	GND	D34	5V
C35	PC12	D35	PC14
C36	PC13	D36	PC15
C37	3V3	D37	VDD_LV

Appendix A Schematic diagram

A.1 Schematic diagram

Figure 22. Schematic diagram - Power supply (Page 1 of 7)

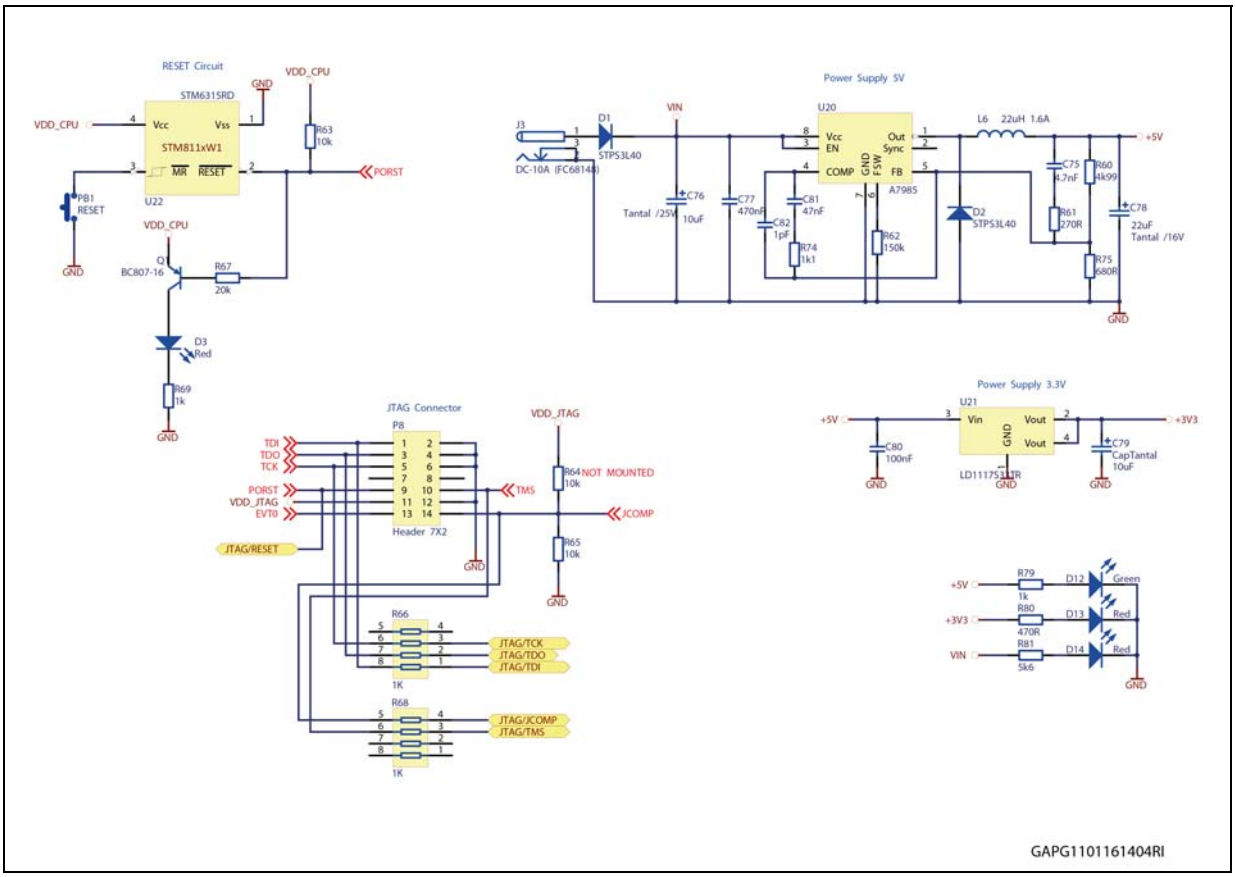


Figure 23. Schematic diagram - SPC574K Microcontroller (Page 2 of 7)

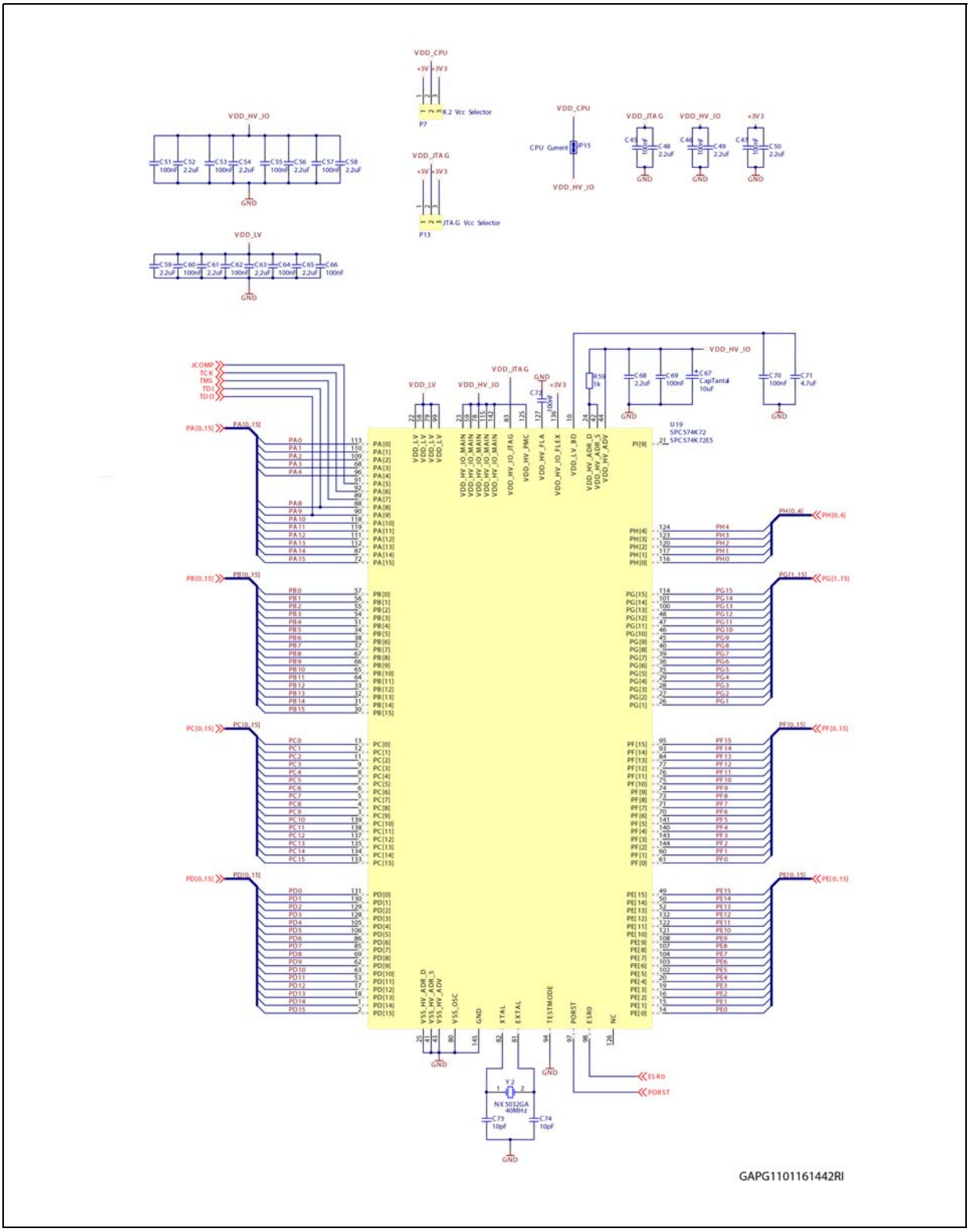


Figure 24. Schematic diagram - Debugger-Programmer (Page 3 of 7)

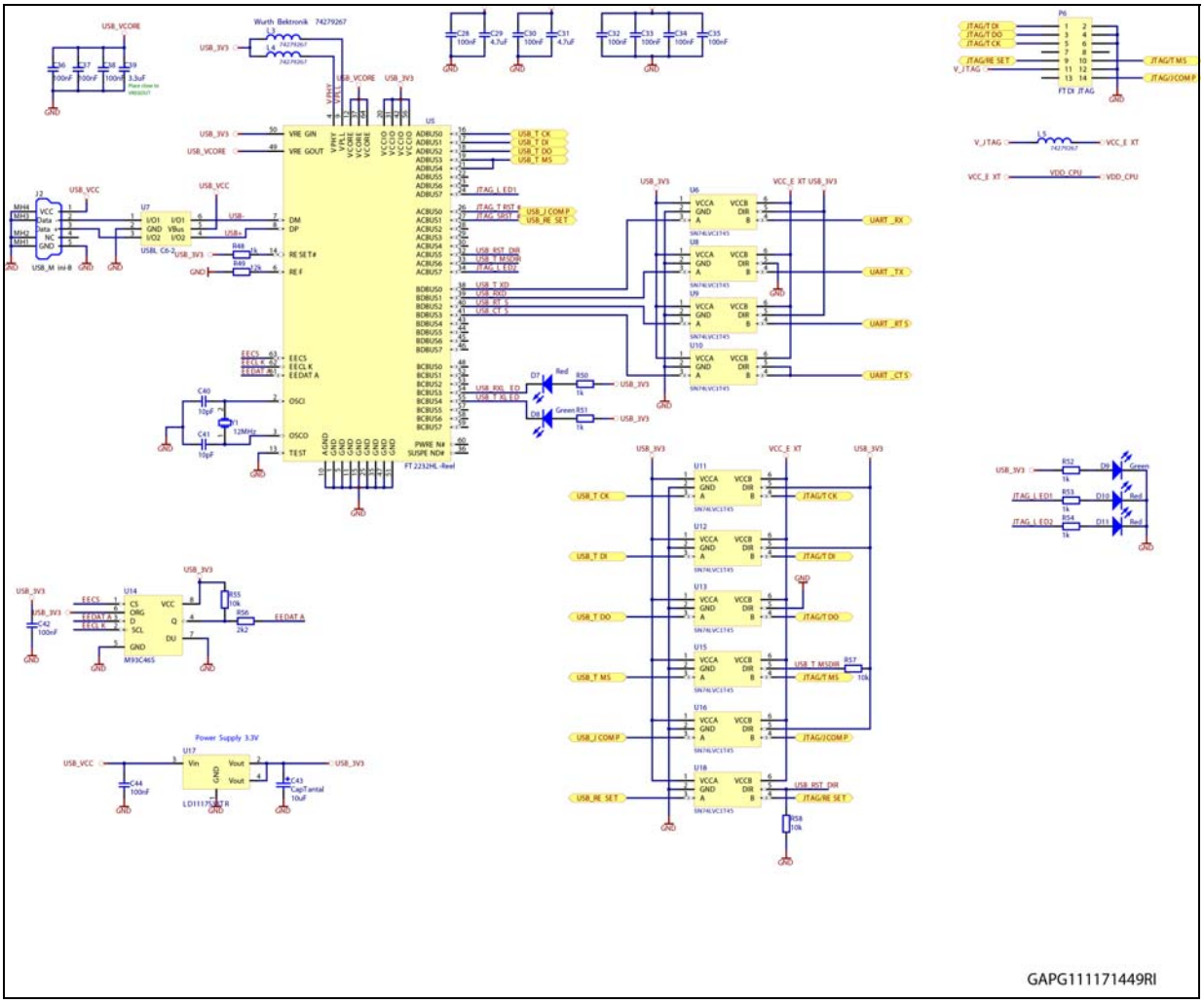


Figure 25. Schematic diagram - FlexRay (Page 4 of 7)

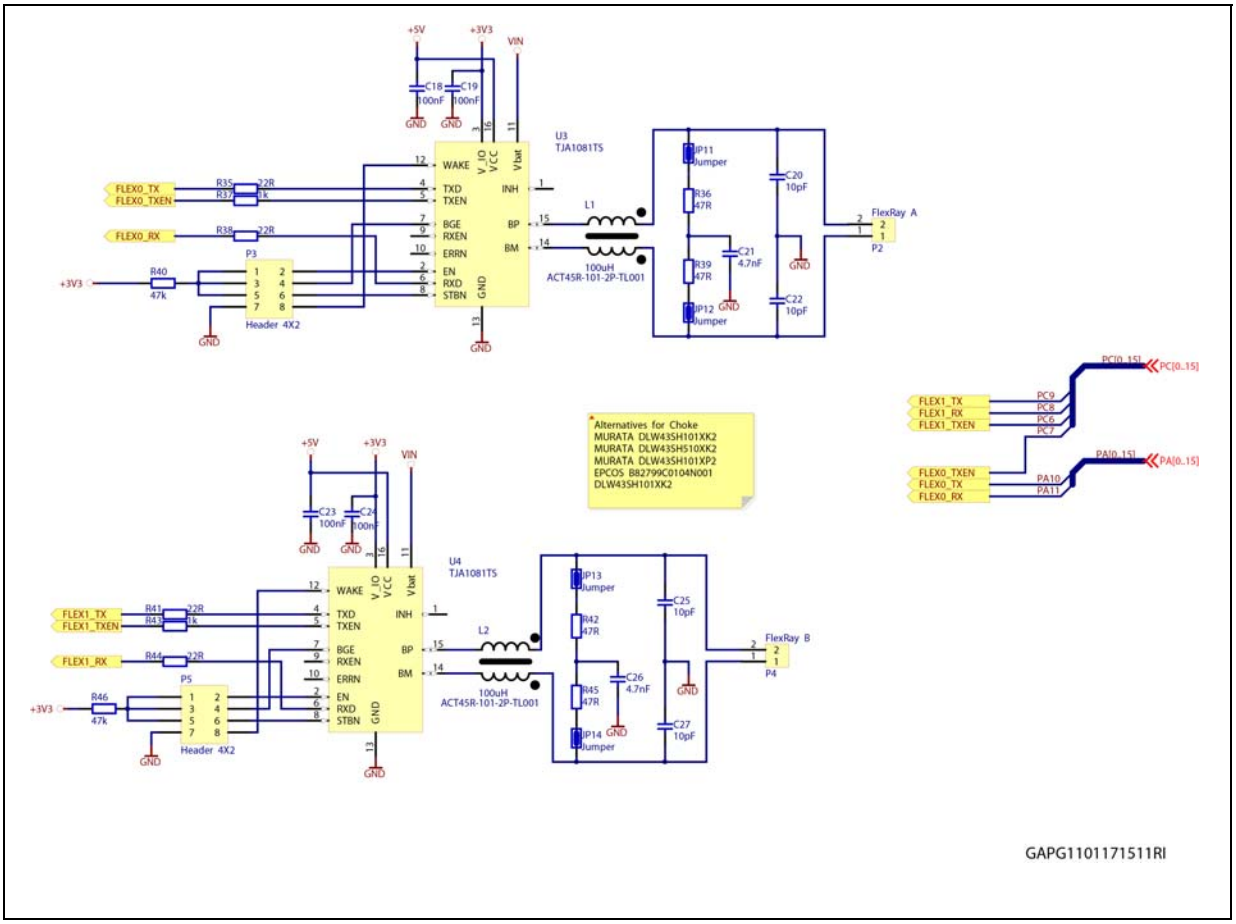


Figure 26. Schematic diagram - CAN-LIN (Page 5 of 7)

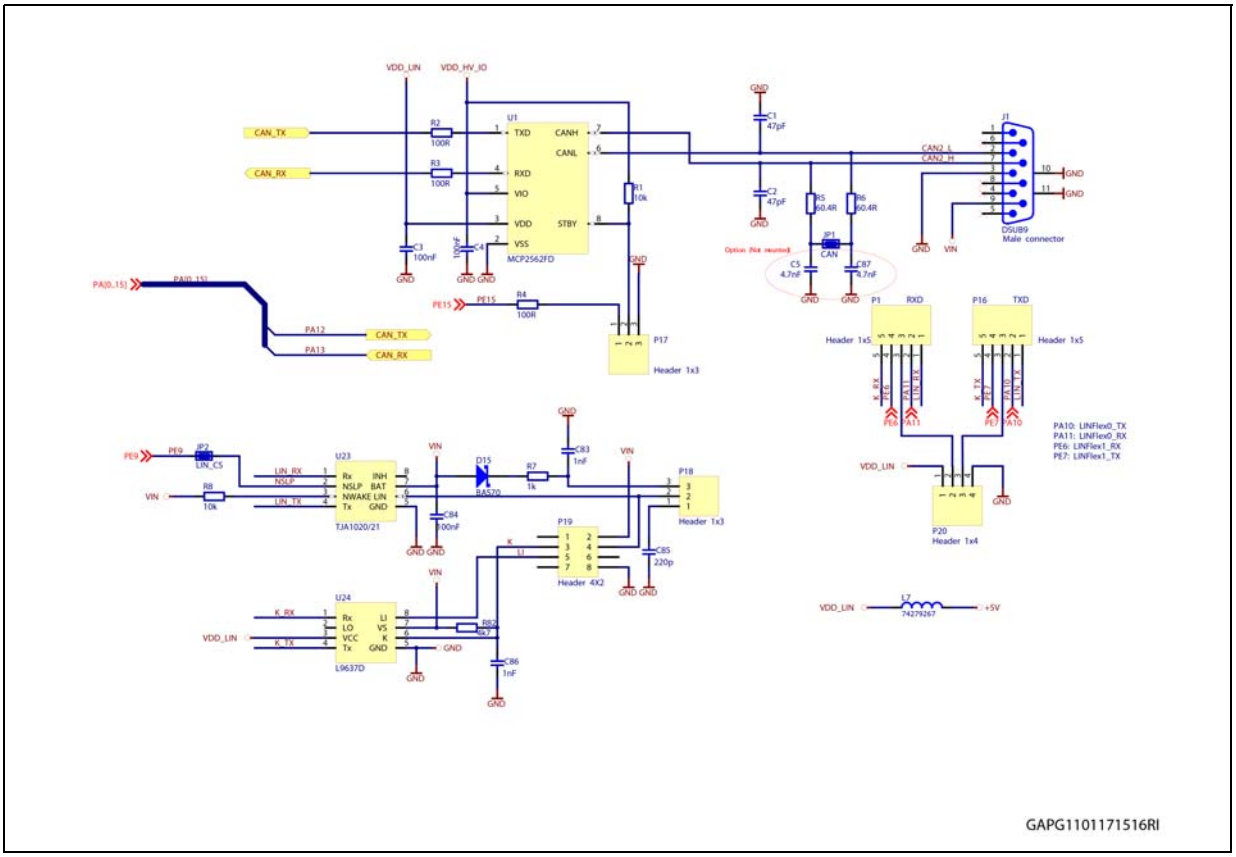


Figure 27. Schematic diagram - Ethernet (Page 6 of 7)

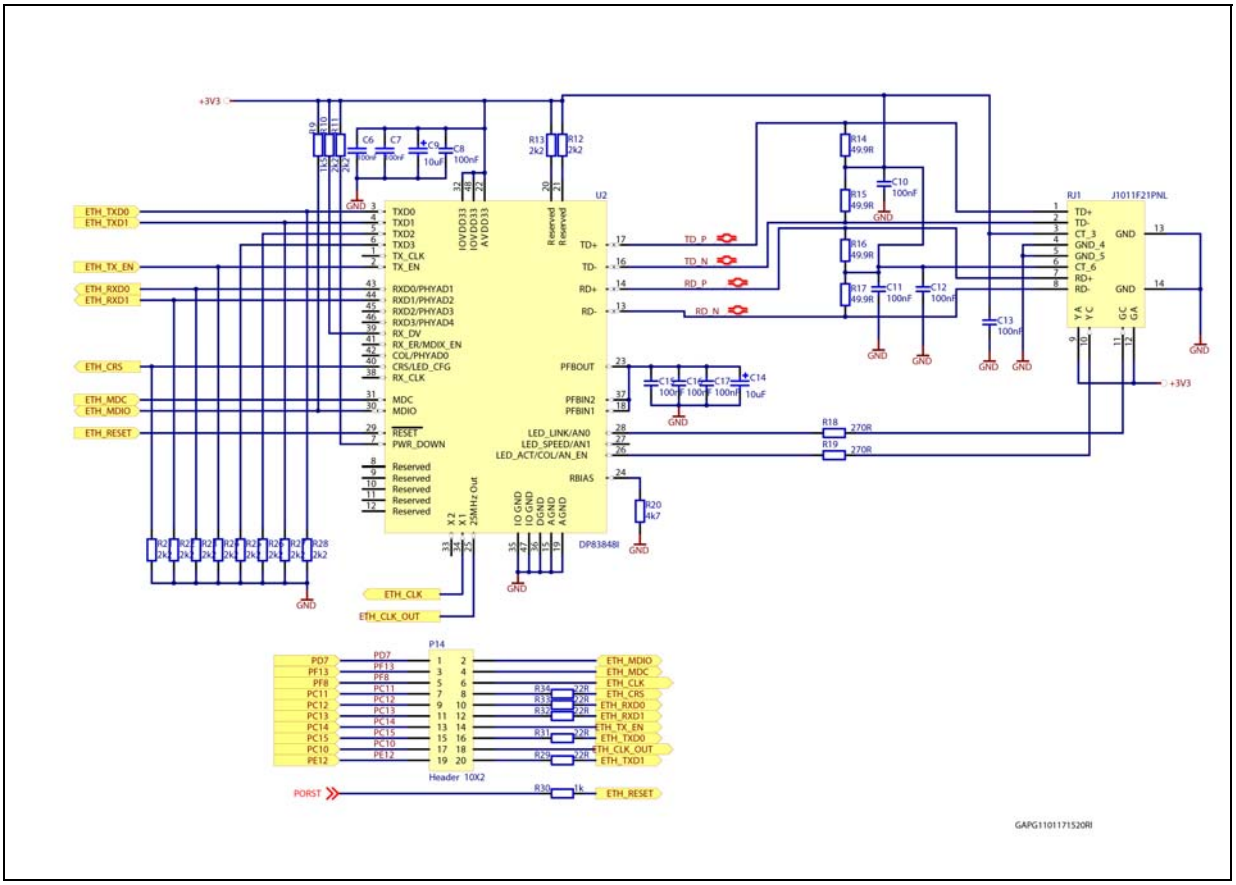
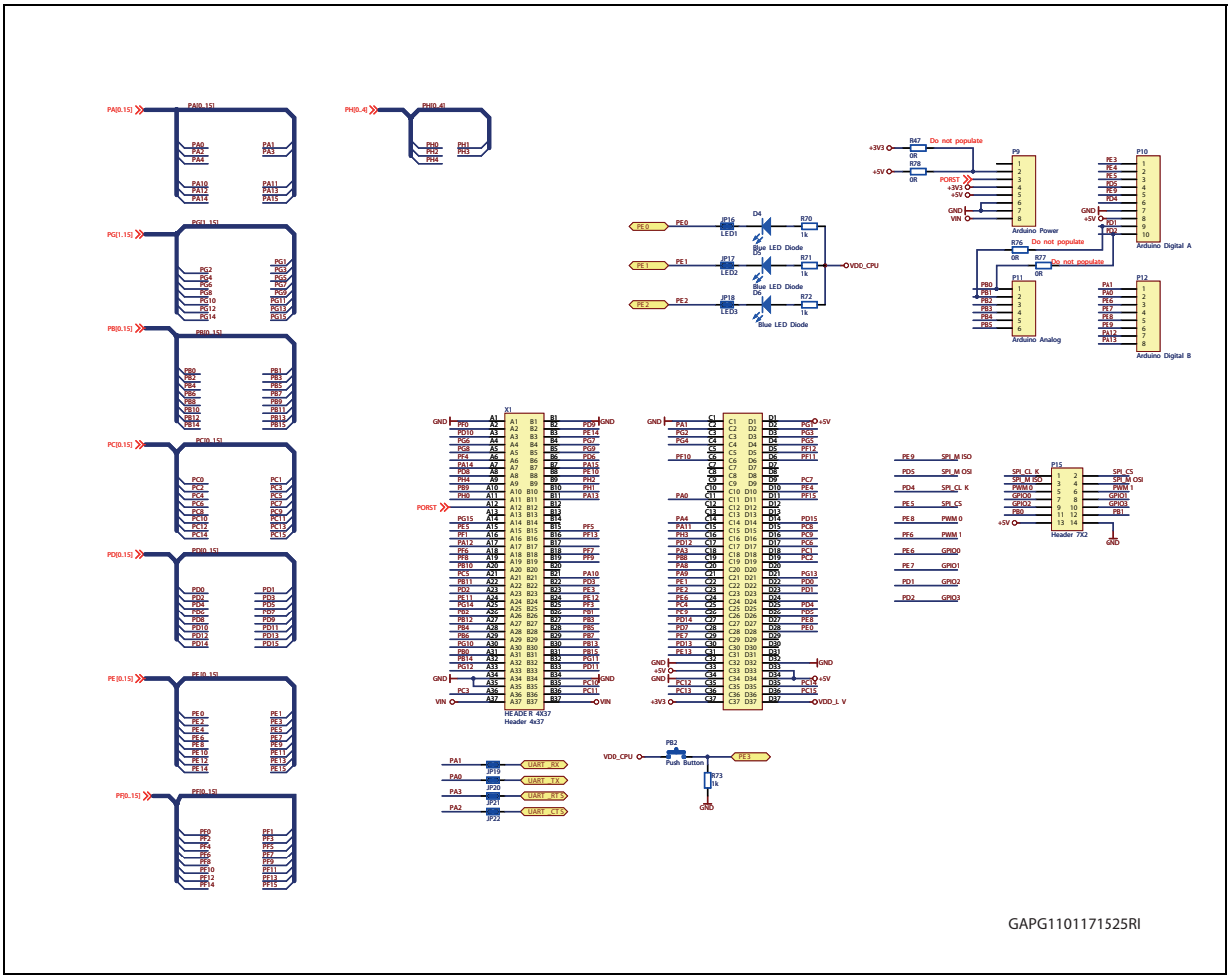


Figure 28. Schematic diagram - GPIO (Page 7 of 7)



A.2 PCB Layout

Figure 29. SPC574K-DISP - PCB Top side

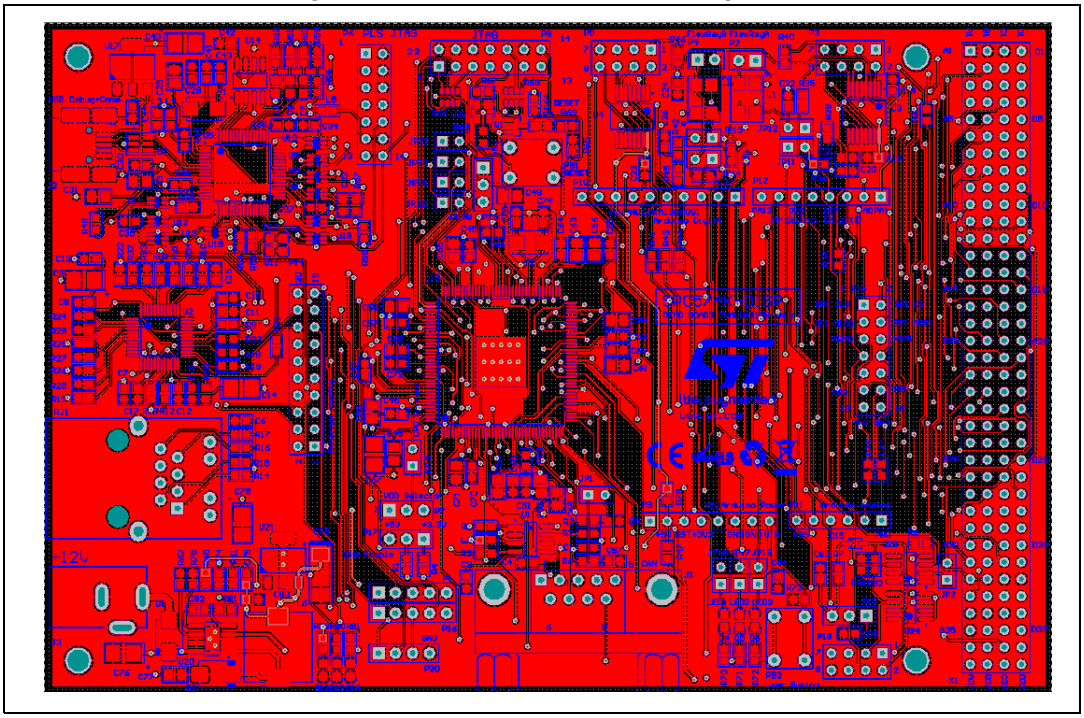
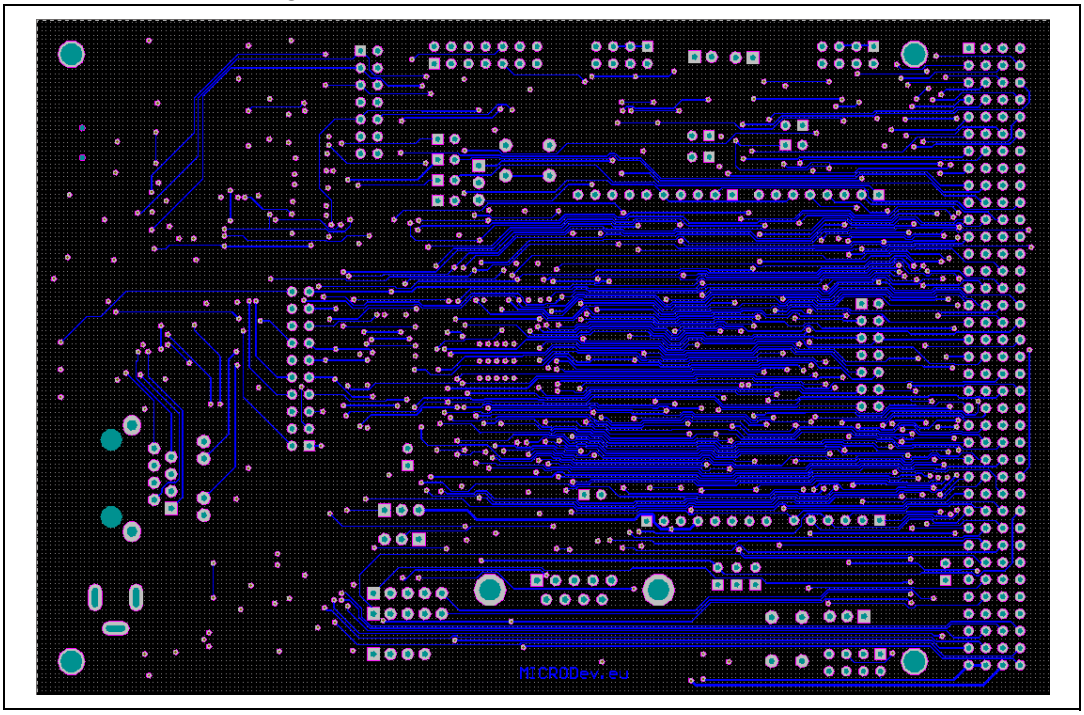


Figure 30. SPC574K-DISP - PCB Bottom side



Appendix B Further information

B.1 Document references

- *SPC574Kxx - 32-bit Power Architecture® based MCU for automotive applications* (RM0334, DocID023671)

- *32-bit Power Architecture® based MCU for automotive applications* (DocID023601)

Revision history

Table 11. Document revision history

Date	Revision	Changes
20-Jan-2017	1	Initial release.