

ELECTRONIC CIRCUITS DESIGN GUIDE

With Altium Designer

- Common and useful schematics for filters, decoupling filters, noise reduction, power factor correction and ...
- Following circuit schematic diagrams are used for digital circuits including STM32 and NXP ARM microcontrollers (Cortex -M0, M0+, M3) and AVR microcontrollers (ATMEGA16, ATMEGA32, ATMEGA328, ATMEGA2560).
- Filters and techniques mentioned in this file are not commonly used in FPGA, MPU, ,Other professional High-Frequency boards with complicated processing units, Switching PSU circuit boards and ...
- You can contact me if you'd like to help, add or correct any content in this file.

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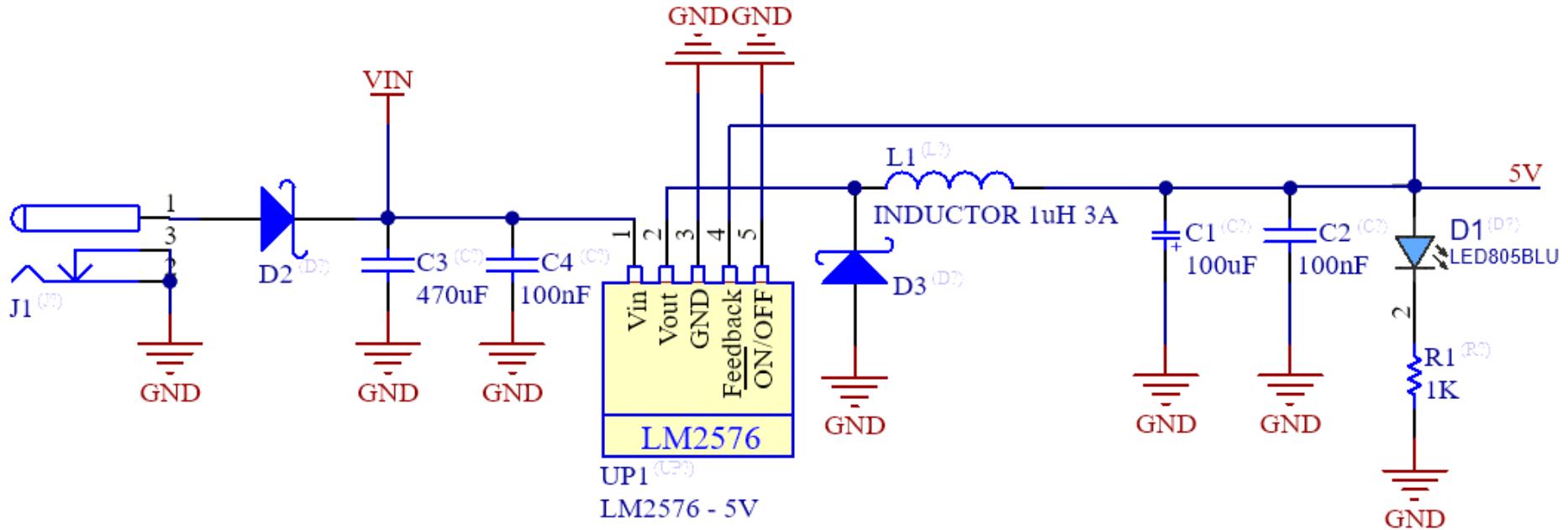
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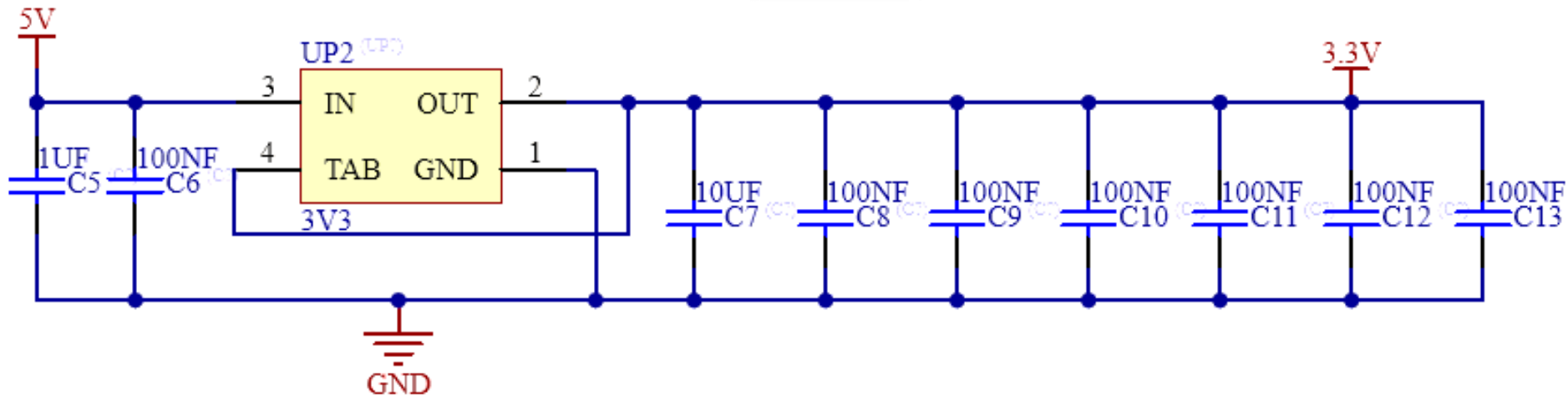
POWER :



12V-5V DC :

- Regulator : LM2576 SMD (in some circuits you can use LM2576-ADJ which is adjustable)
- Res/LED/Cap : SMD 805
- Diode : 1N5822 SMD (1N5819, SM5822)
- Inductor : 1uH 3A SMD (You can use smaller inductors if you're sure your PCB is not going to pass more than 2/3A)
- Cap Tantalum Size D : 100uF
- Cap Pol SMD : 470uF
- DC Power Jack

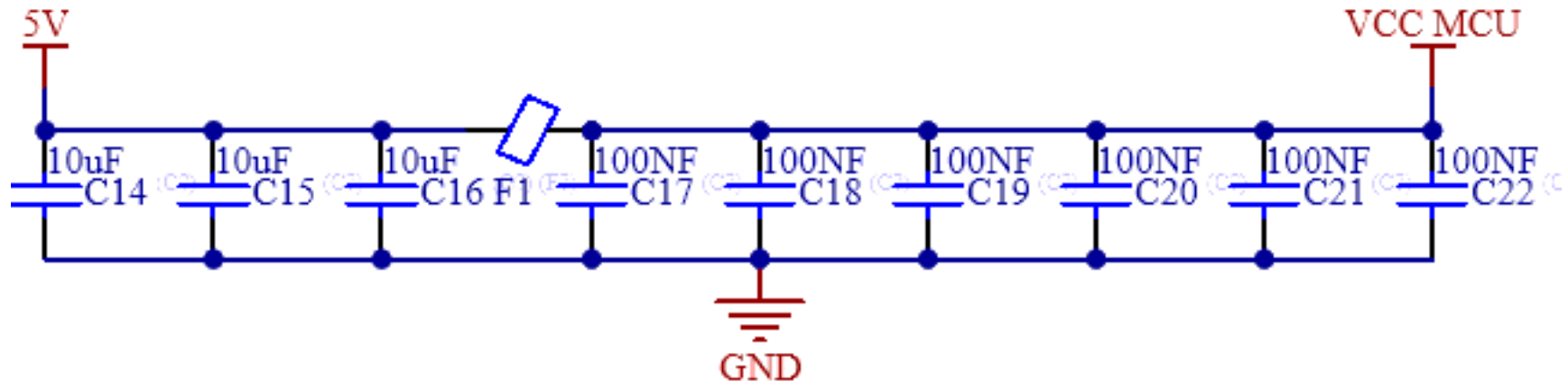
POWER :



5V-3.3V DC :

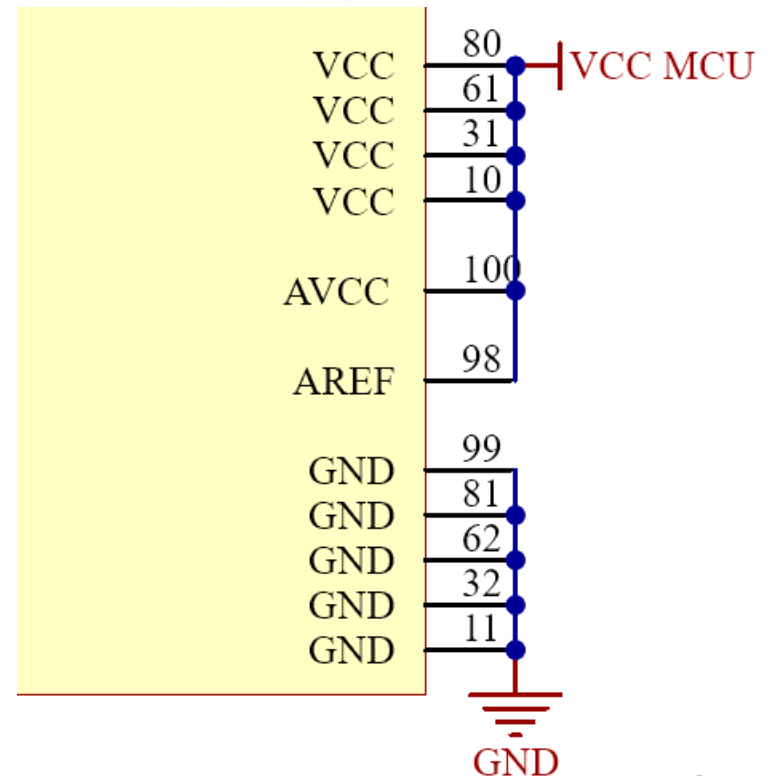
- Regulator : AMS1117 3.3V (LM1117-x.x)
- Cap : SMD 805 (1uF,10uF,100nF)
- Usable in AVR and Arduino Boards
- Usable in STM32 Boards (not filtered well for MCU power)

POWER :

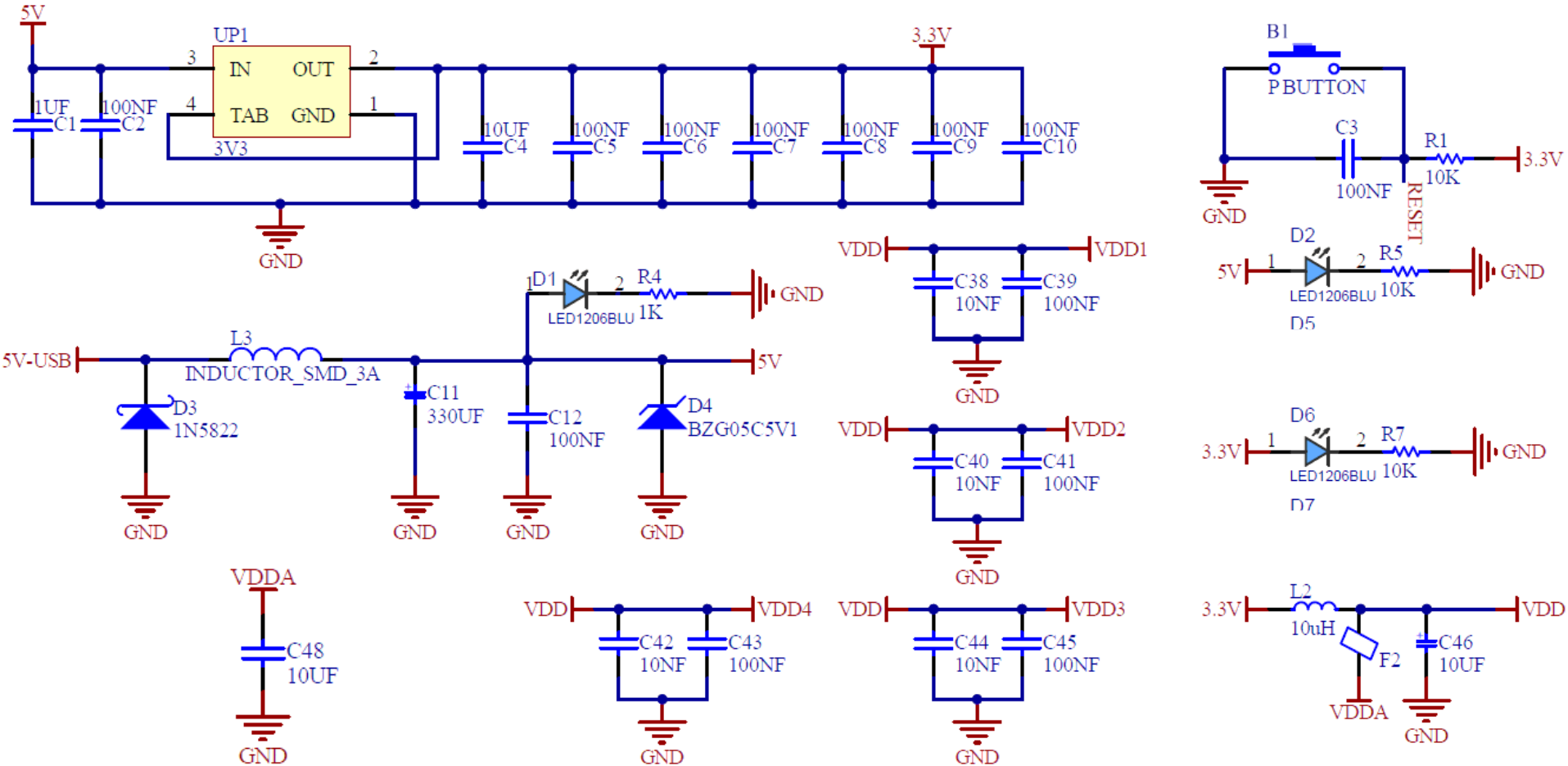


5V Filtering for MCU (AVR ATMEGA)

- Ferrit Bead SMD
- CAP 805 SMD
- Both input and output are 5V
- Adding 1uH-10uH inductor will help correcting your MCU power
- Tantalum Caps are recommended for 10uF (C14,C15,C16 in picture)
- It is recommended in some AVR mcu datasheets to connect a 100nF cap to AREF and GND

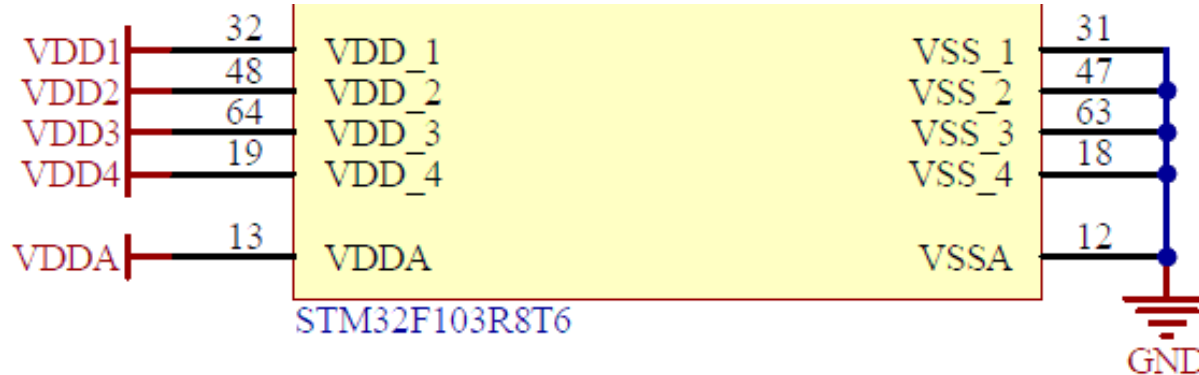


POWER :



- STM32 and NXP Power Supply (Cortex M0,M0+,M3...)
- All parts are SMD and Mostly 0805 footprint (C11,C46 : TAN-D)
- LM1117 3.3V Regulator
- 5V Power is supplied by USB

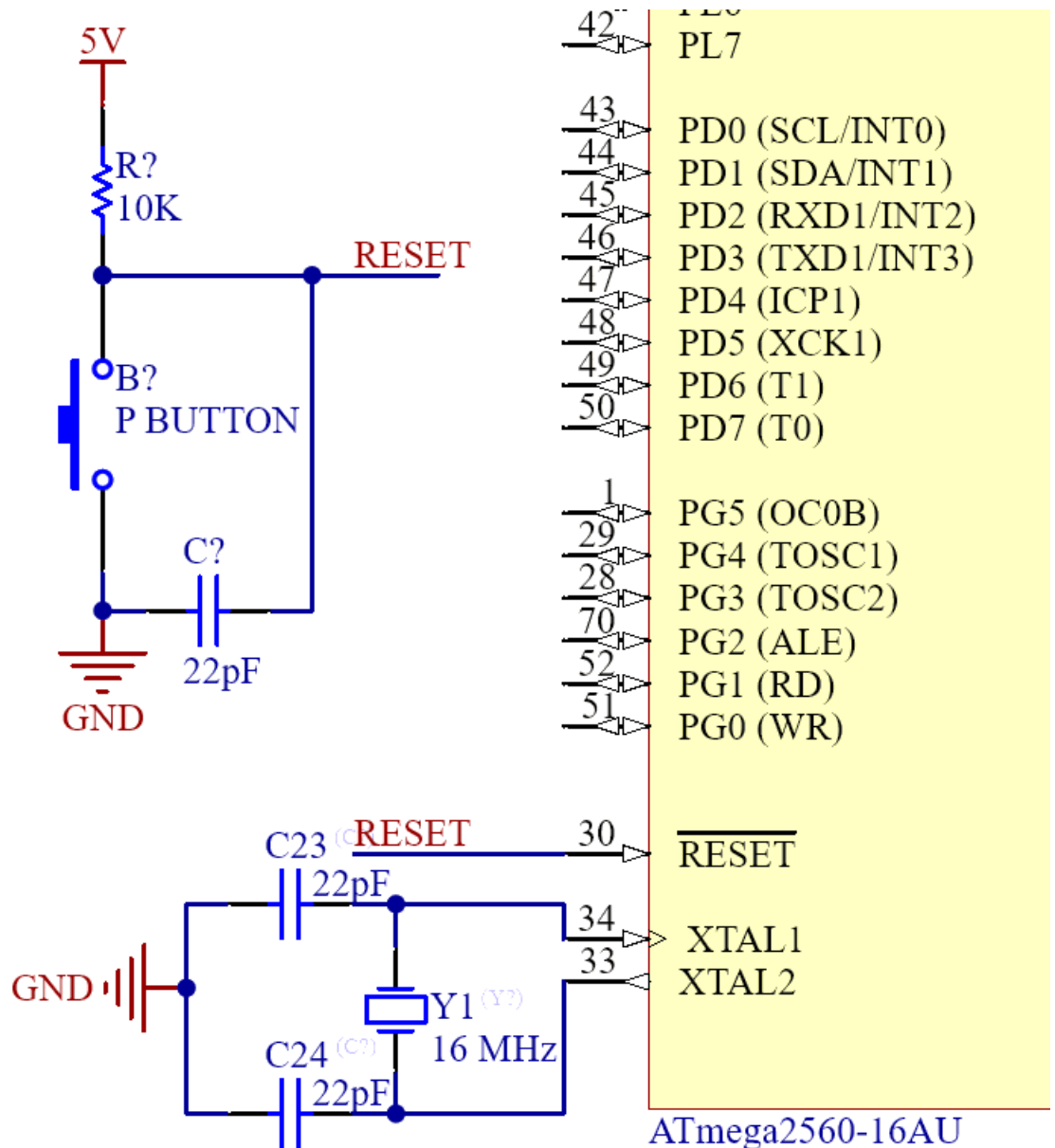
POWER :



- 10uH Inductor is SMD 0805
- Each VDD(3.3V) input must be filtered separately
- LEDs are just for checking and tracking board power design
- Push button is for disconnecting and resetting board
- 100nF and 10nF capacitors MUST be close to microcontroller in PCB layout
- BZG05C5V1 is a very good choice to use in this circuit but may be hard to find in market. You can use 1N5822 instead

MCU Pins :

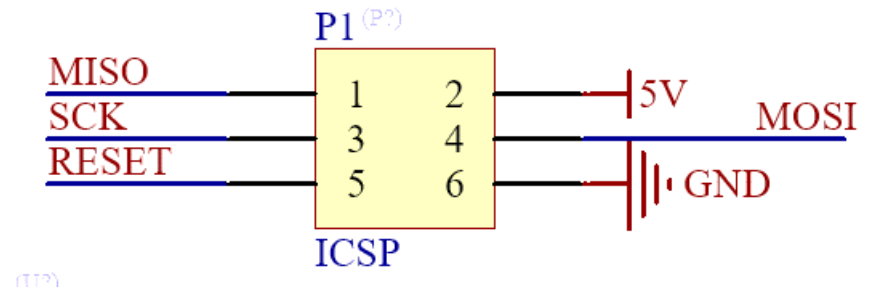
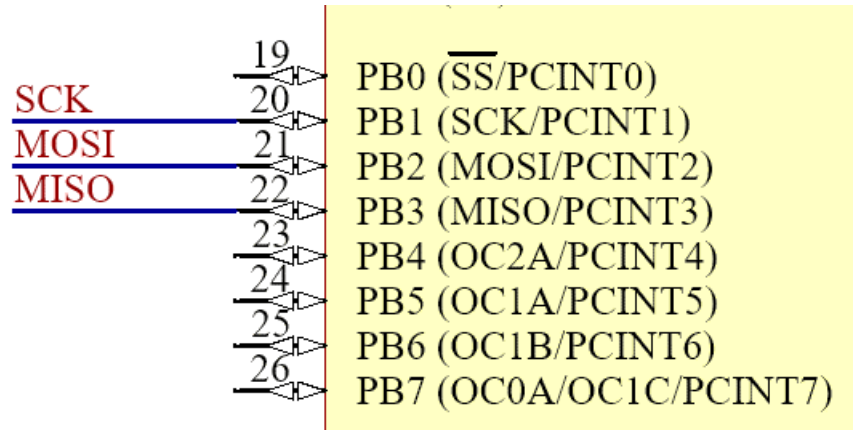
- 2 Pin SMD Push Button
- RES/CAP SMD 0805
- RESET Pin on MCU



- 16MHz Crystal SMD
- 22pF CAP SMD 0805
- Crystal oscillator must be close to mcu in PCB layout

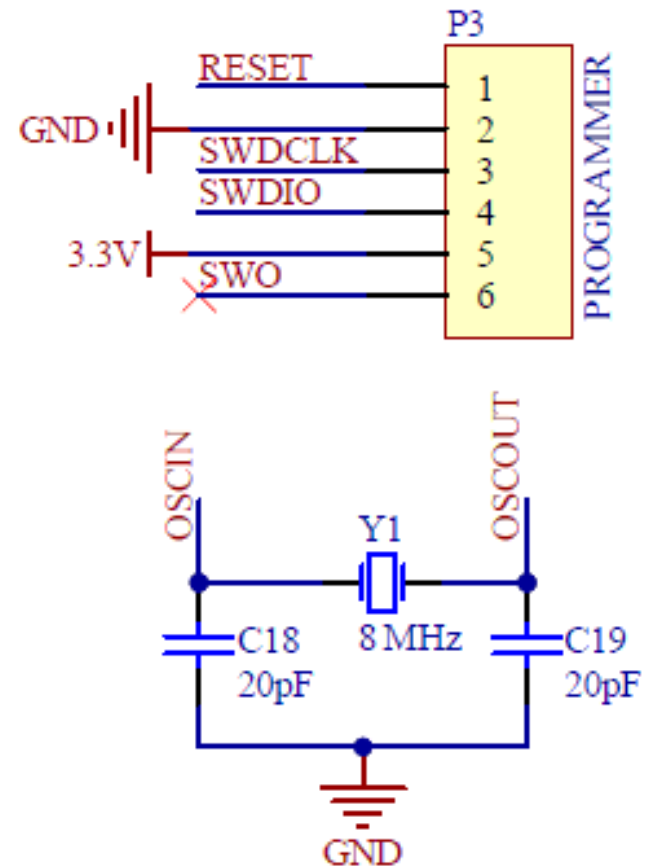
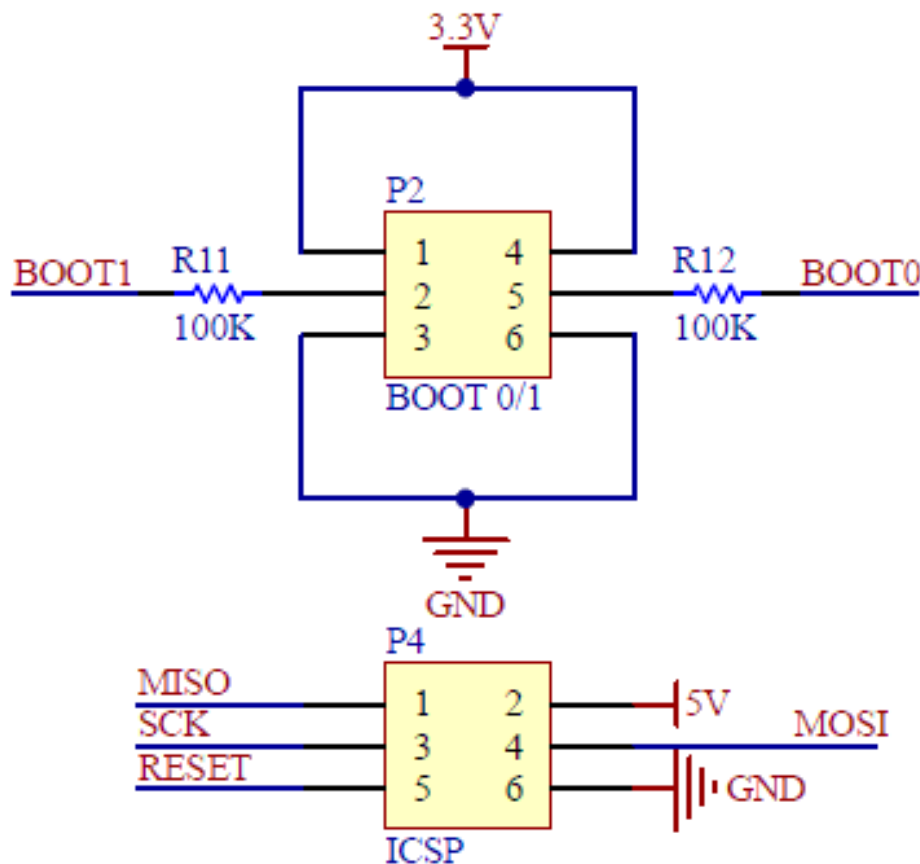
MCU Pins :

- ICSP pins are necessary in boards which you may need to install bootloader on MCU.
- ICSP pins use you SPI line on microcontroller so before connecting the 6 pin header, check your mcu datasheet carefully and find, SCK, MISO and MOSI pin.
- Pin header in the following picture is the standard sorted array used in electronic boards

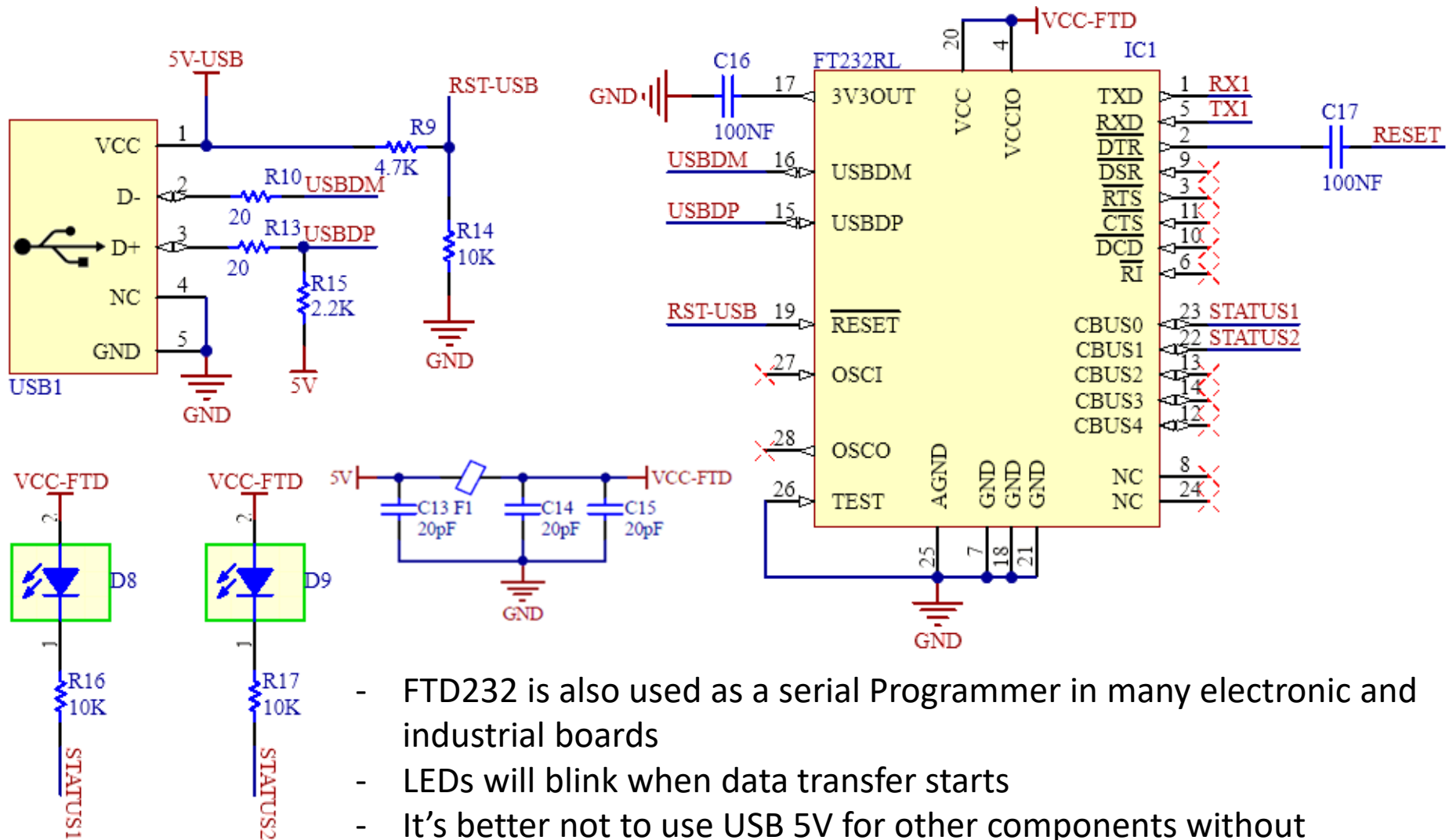


MCU Pins :

- Crystal, ICSP and ST-Link Programmer pins for STM32 microcontrollers
- BOOT0/BOOT1 Pin for STM32 Pins
- Cortex M0 boards usually don't have BOOT1 or not necessary to connect.
- Crystal Value changes for different microcontrollers with different clocks
- Check each MCU datasheet you choose for pinouts
- You can use CubeMX for STM32 microcontrollers to check pinout too



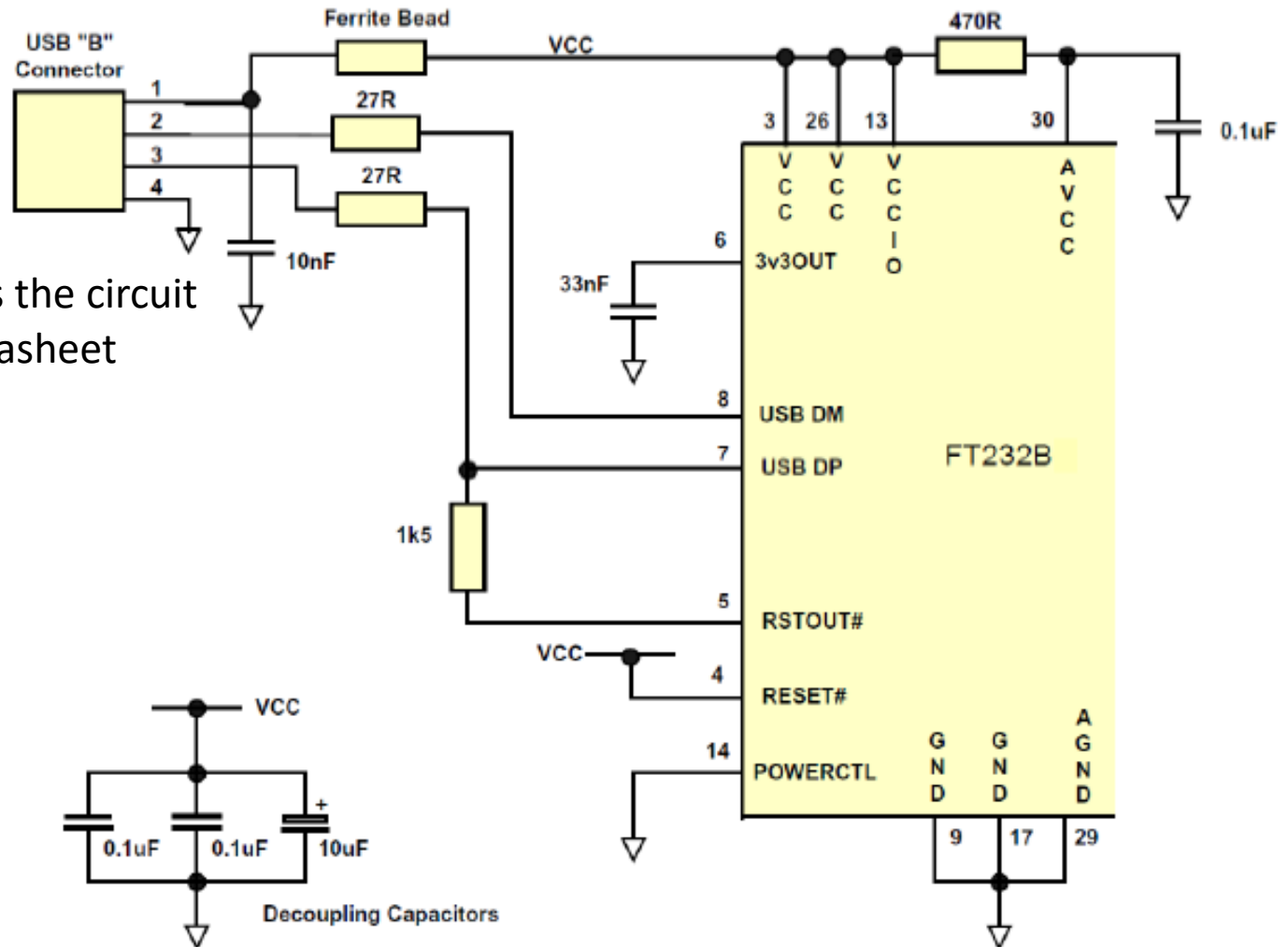
USB to Serial:



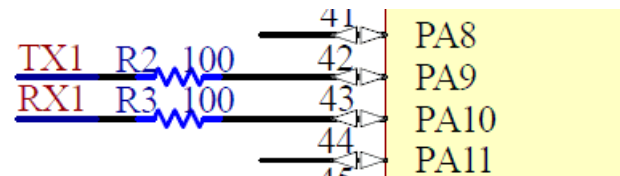
- FTD232 is also used as a serial Programmer in many electronic and industrial boards
- LEDs will blink when data transfer starts
- It's better not to use USB 5V for other components without filtering
- D+/D- are differential pairs (Must have the same length and better to be mirrored)

USB to Serial:

- Following picture is the circuit suggested in IC datasheet

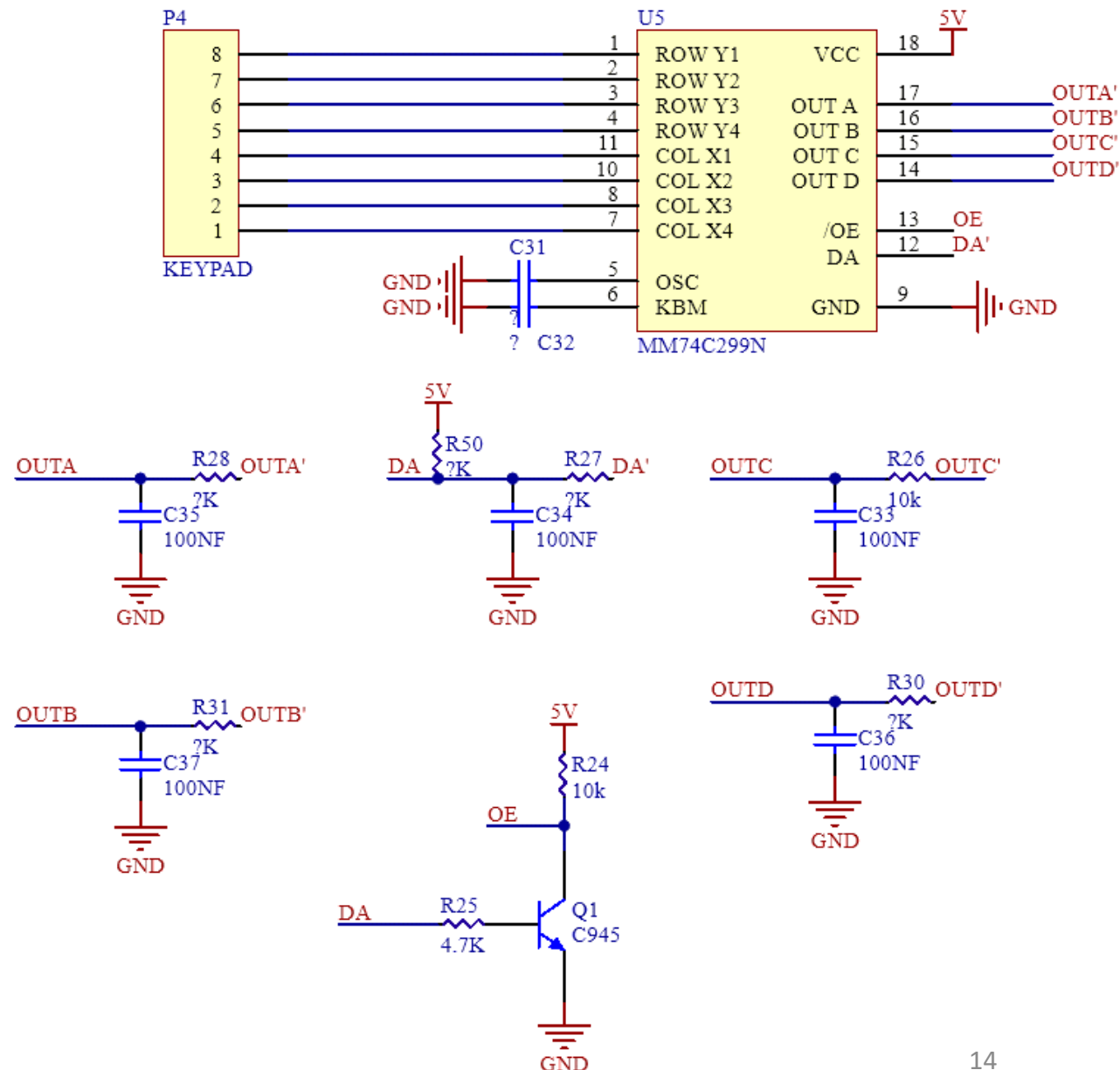


- Add pulse proof resistors (TX/RX Pins)



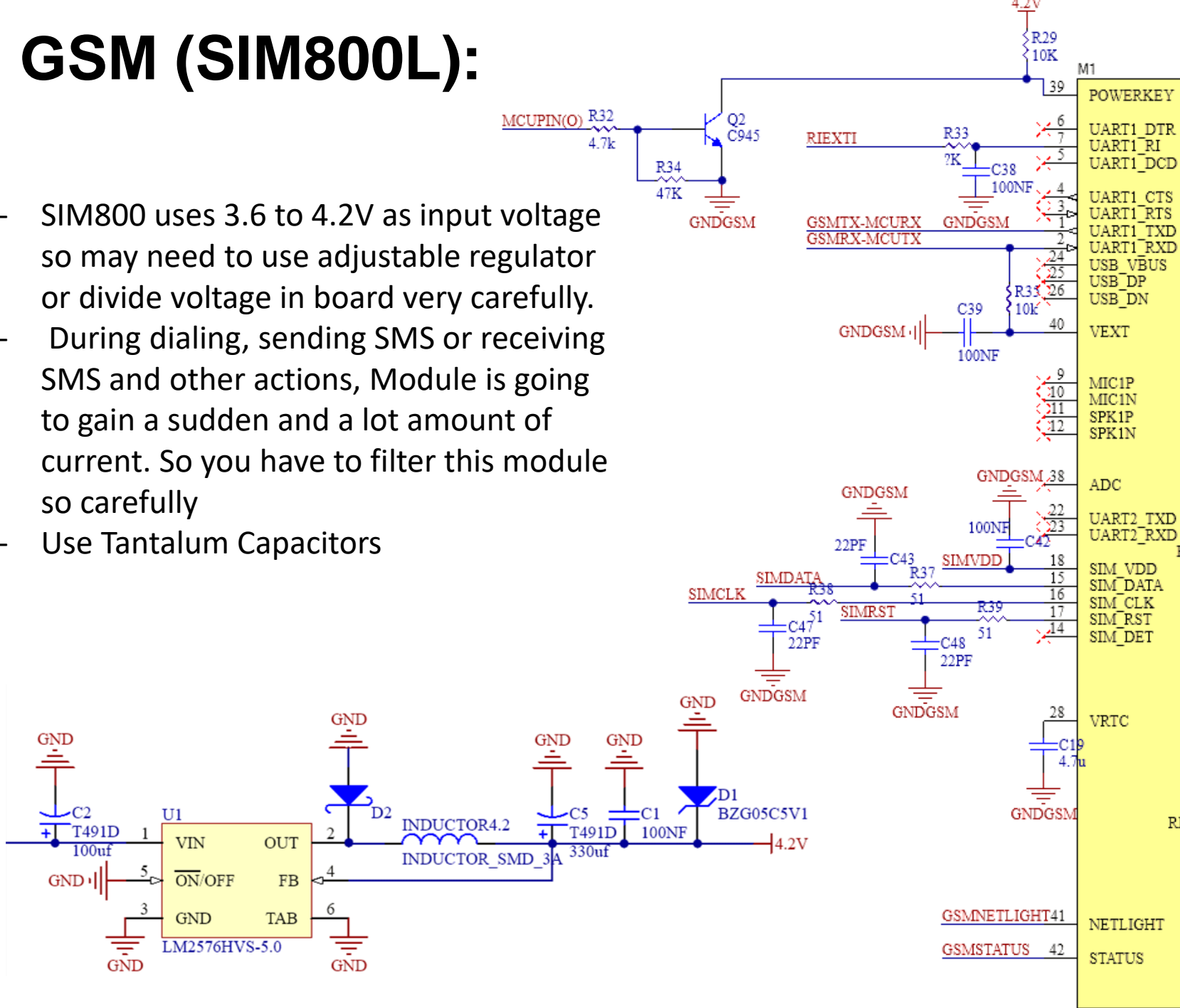
KEYPAD:

- 74C922 IC (interrupt key)
- C945 SMD Transistor
- Matrix Keypad connector
- In ARM microcontrollers which usually have higher clock and frequency than AVR microcontrollers, you cant debounce keypad buttons by only putting pull-up/down resistors and capacitors. You will need to use this IC or similar parts

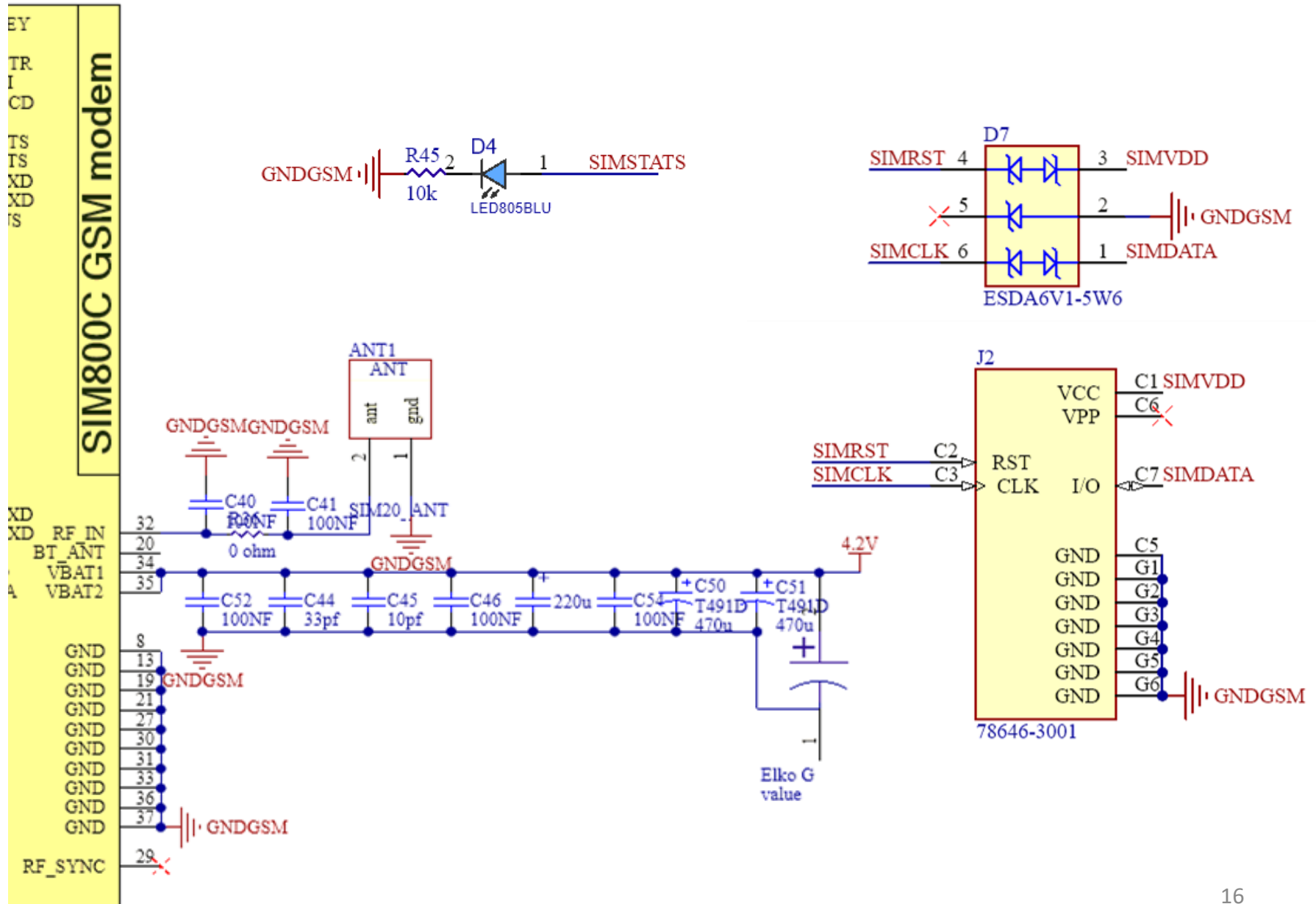


GSM (SIM800L):

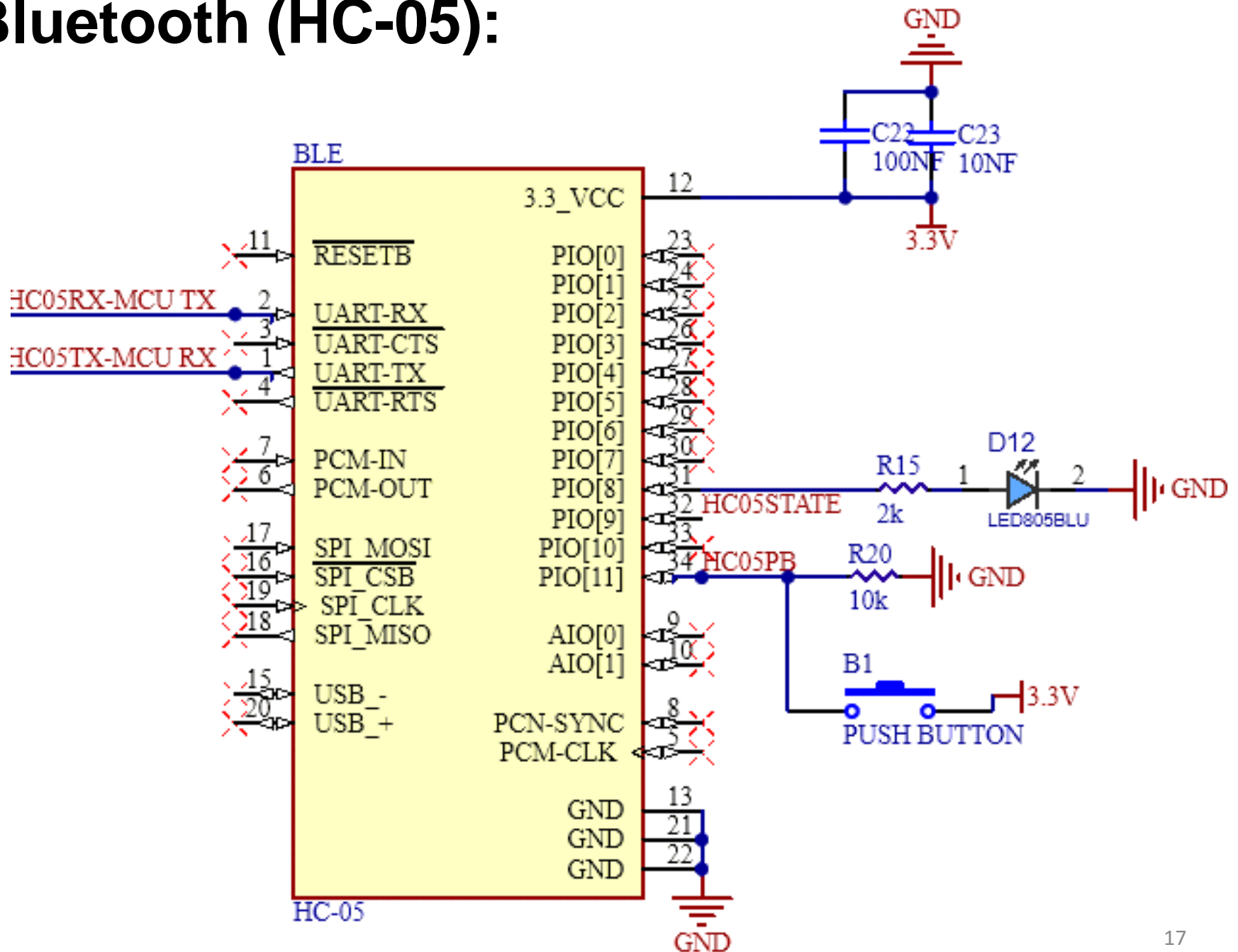
- SIM800 uses 3.6 to 4.2V as input voltage so may need to use adjustable regulator or divide voltage in board very carefully.
- During dialing, sending SMS or receiving SMS and other actions, Module is going to gain a sudden and a lot amount of current. So you have to filter this module so carefully
- Use Tantalum Capacitors



GSM (SIM800L):



Bluetooth (HC-05):



USB :

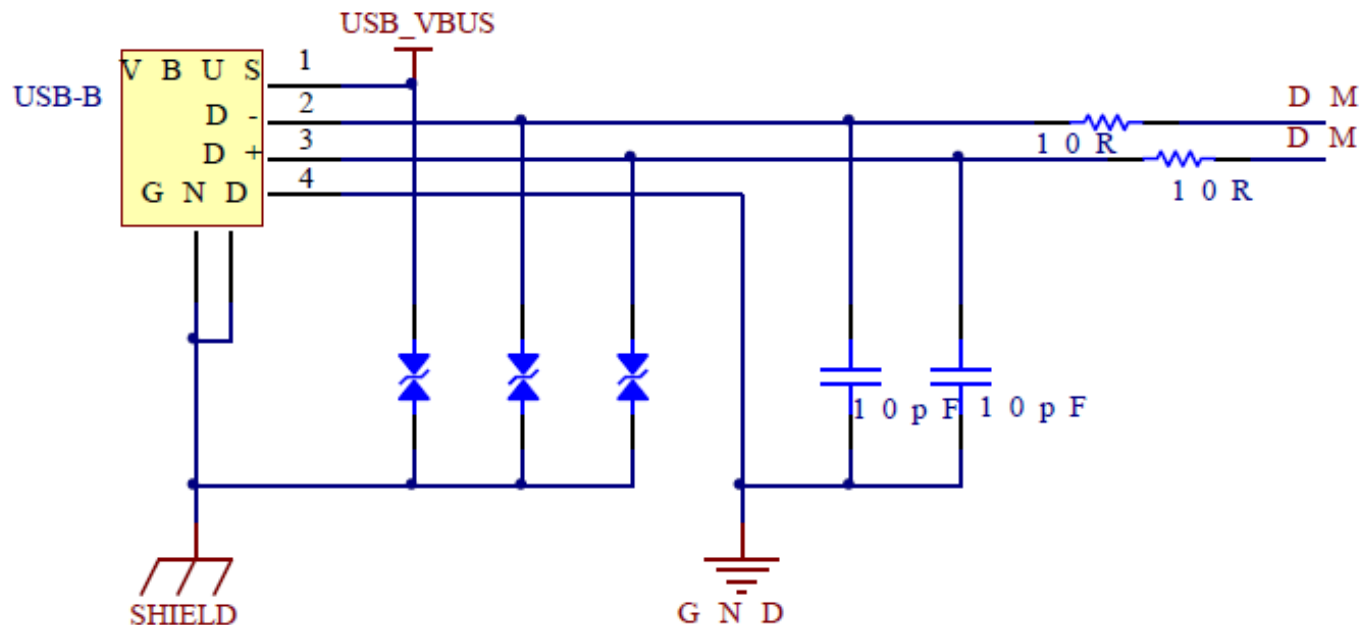
VBUS (+5V power), Ground and USB DP and

DM. **DP and DM are the differential pair**. As with twisted pair cabling, these two signals must be closely

matched with the following characteristics:

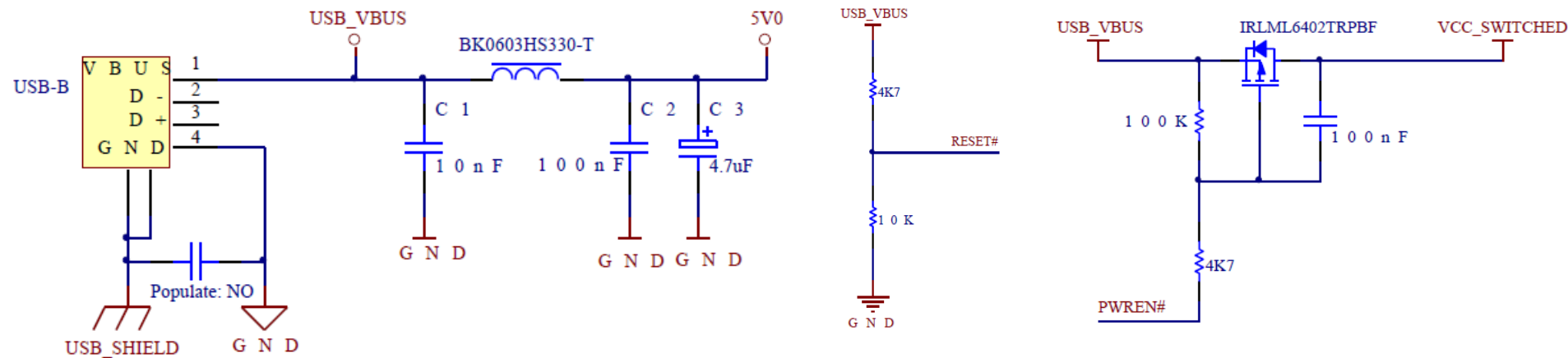
- Equal length: Both DP and DM signals must travel the same distance. If one trace ends up longer, then the timing of the signals can be adversely affected and cause data errors.
- Controlled impedance: The impedance of the twisted pair cabling must be matched on the PCB in

order to minimize signal reflections. USB signals are 90Ω differential to each other / 45Ω each to Signal Ground. Most modern PCB layout software can be configured to route both of these signals together with these characteristics.



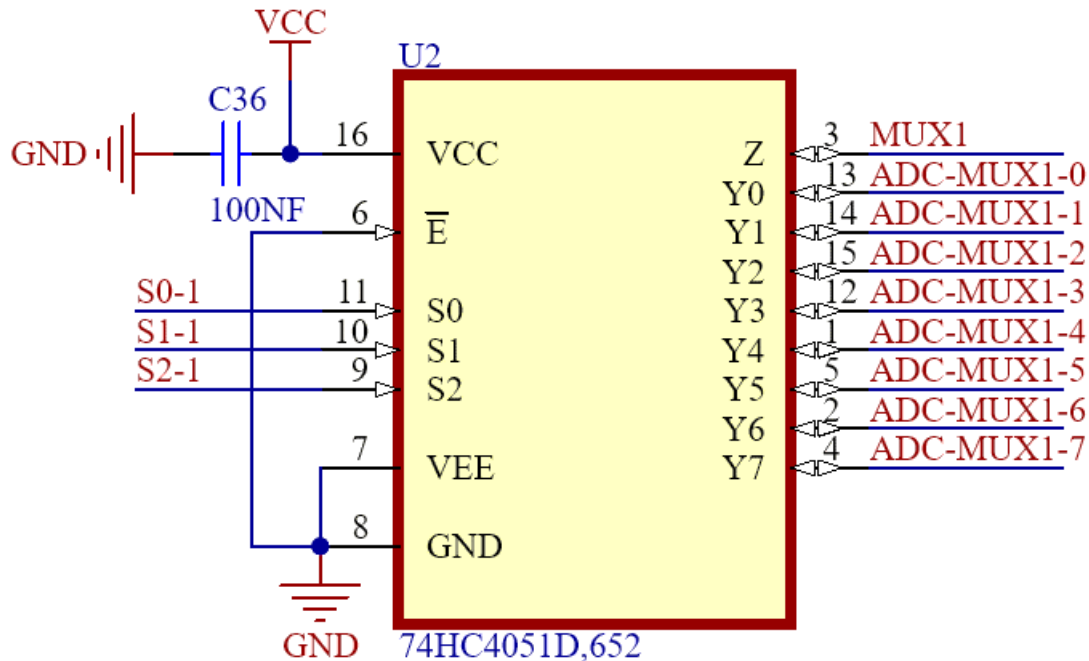
USB :

- No stubs: When adding components such as transient voltage protection or additional capacitance for edge rate control, the DP and DM signals should not have any “T”s in order to minimize signal reflections.
- Ground planes: With DP and DM being controlled impedance, they should consistently run over the USB Signal Ground plane. There should not be any splits in the plane directly under DP and DM.
- Overall length: The DP and DM signals should be made as short as possible. For very short runs, less than 1cm, it may not be possible to observe the controlled impedance specification. In practice, this is usually acceptable provided the other practices are followed

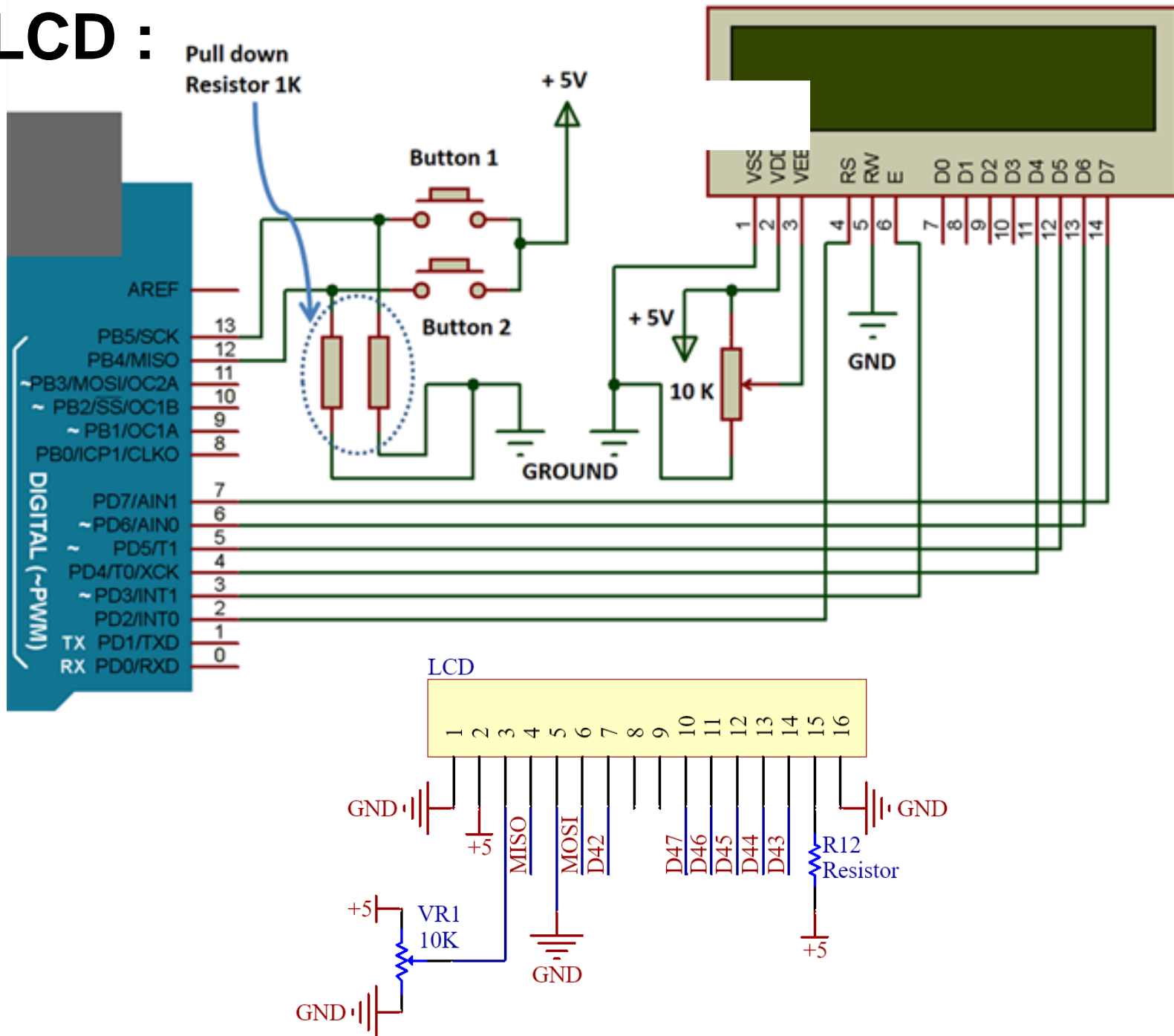


MUX/DEMUX (8 CHANNEL) :

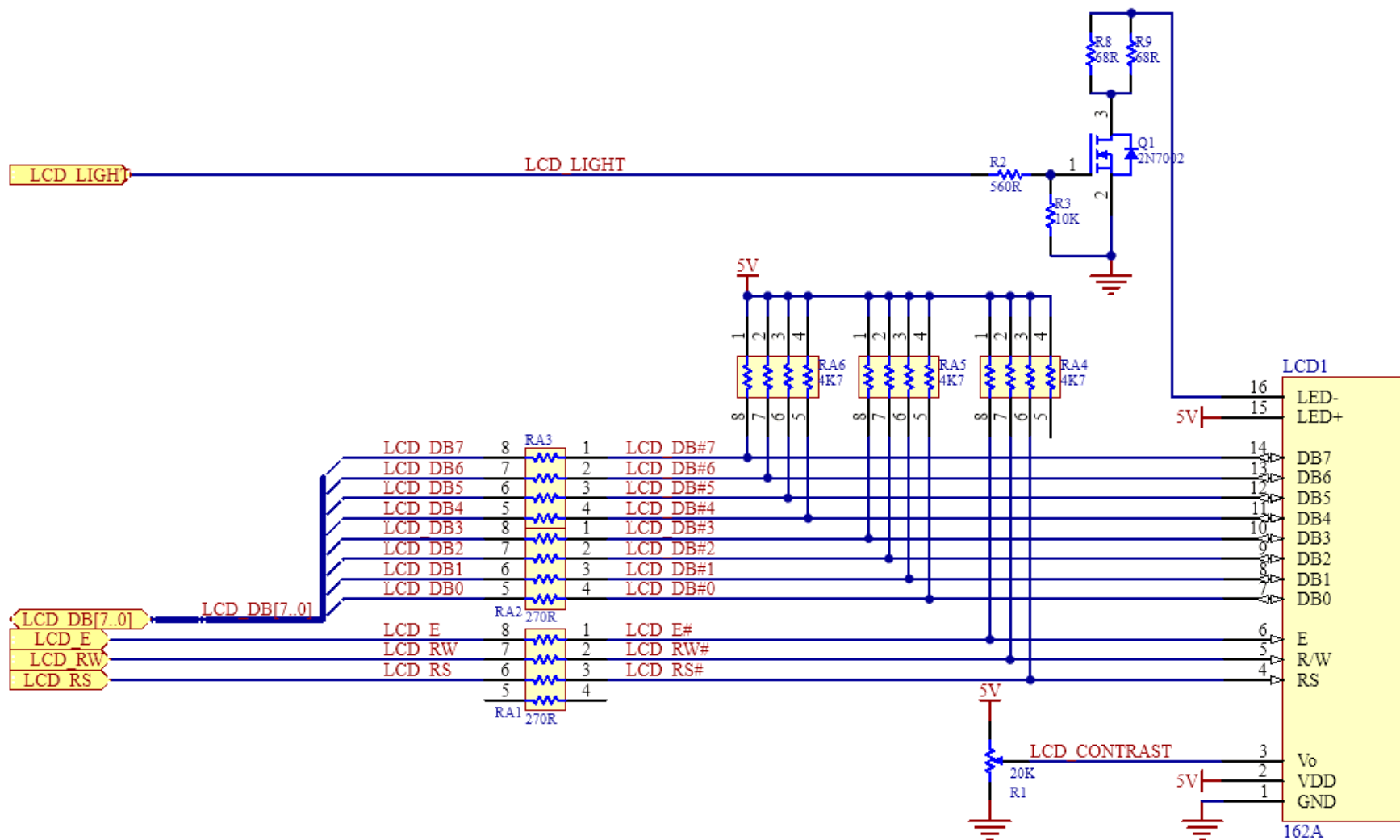
- 8 Channel MUX/DEMUX
- 74HC4051 IC
- Analog and digital pin expander
- You can add ADC pin with this IC
- S0, S1, S2 Pins must be connected to digital pins (HIGH/LOW state)
- Z can be connected to analog/digital pins



LCD :

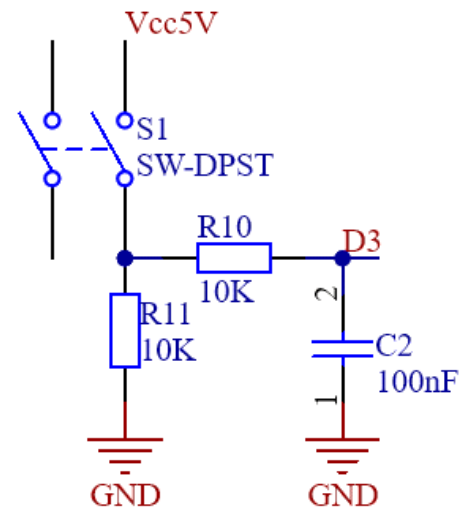
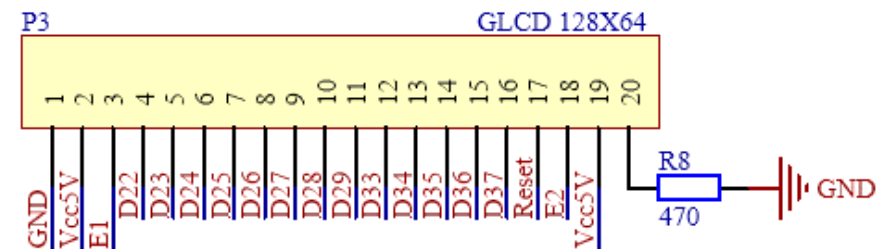
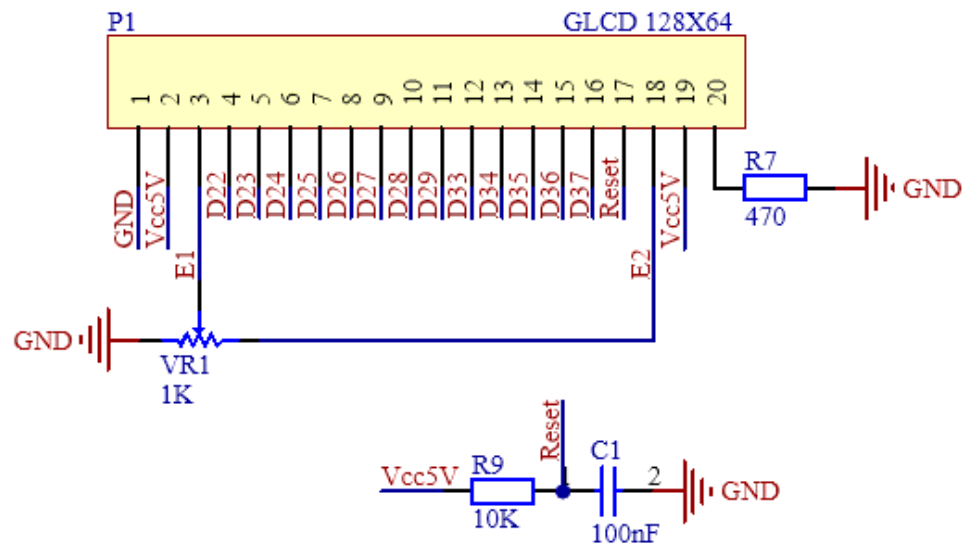


LCD :



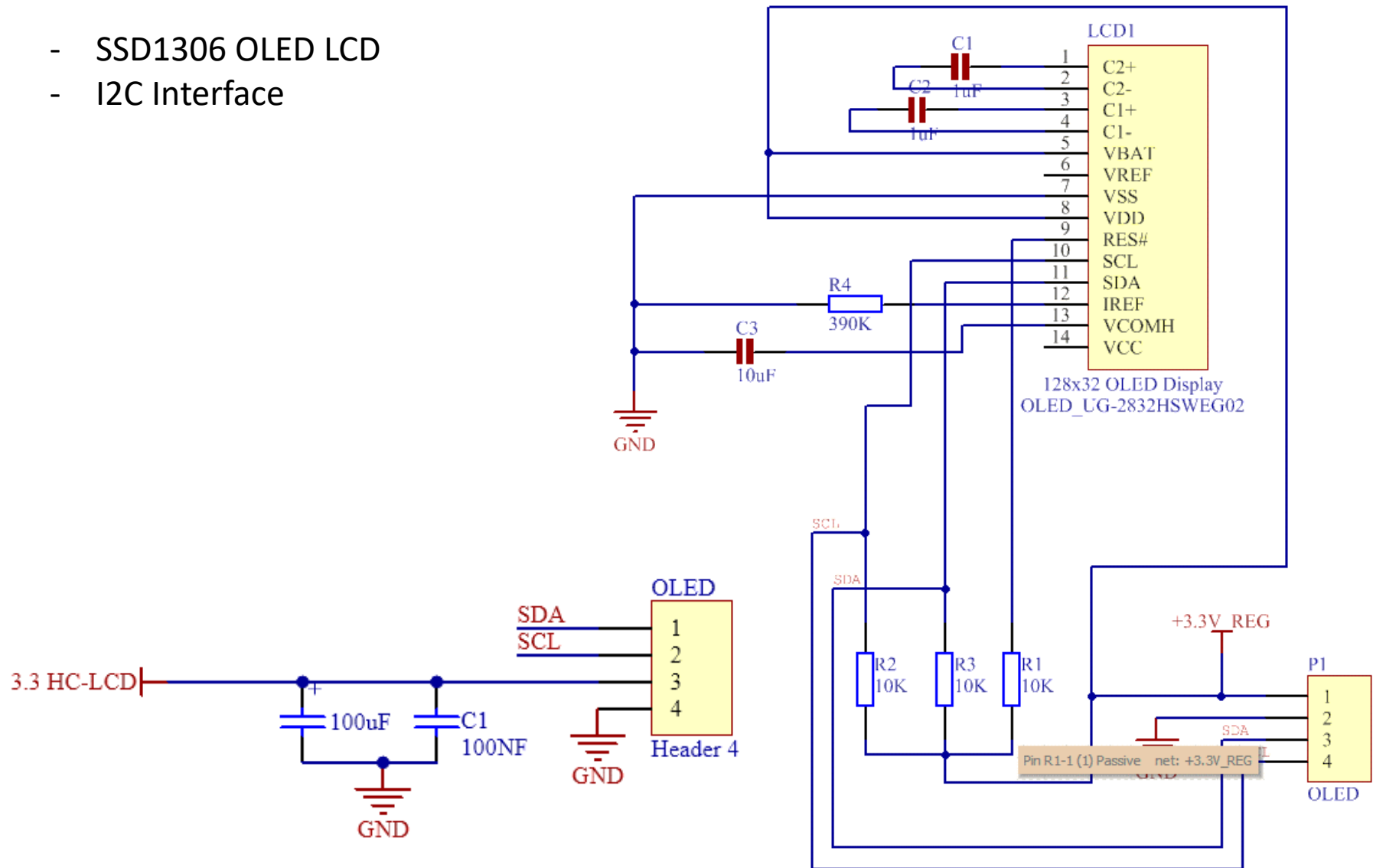
LCD :

- Graphic LCD (128x64)

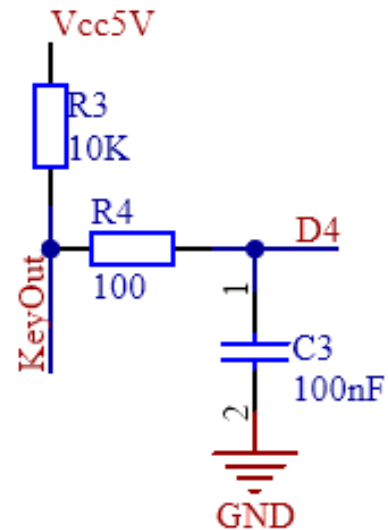
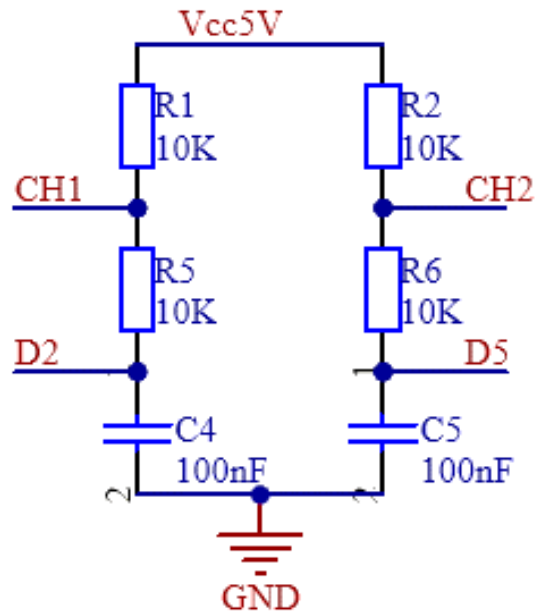
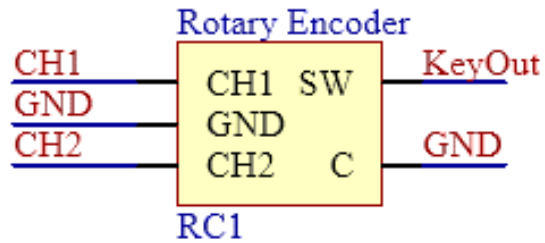


LCD :

- SSD1306 OLED LCD
- I2C Interface

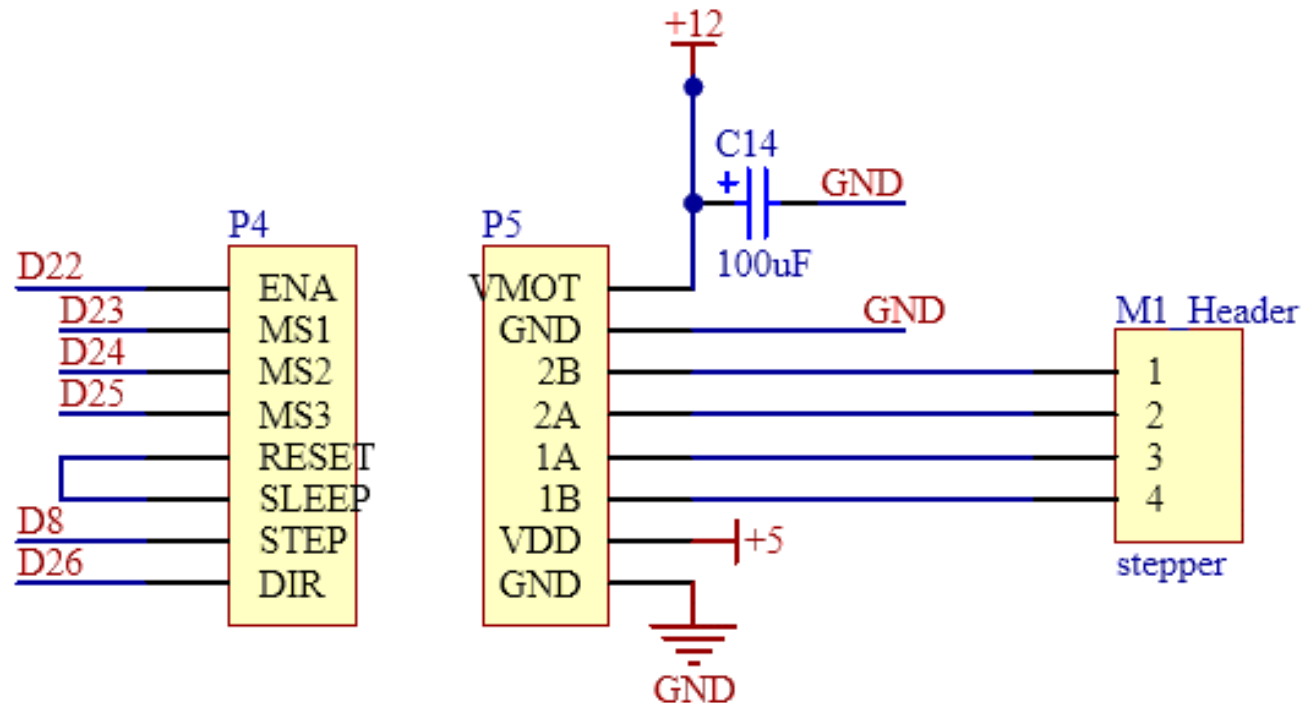


ROTARY ENCODER :

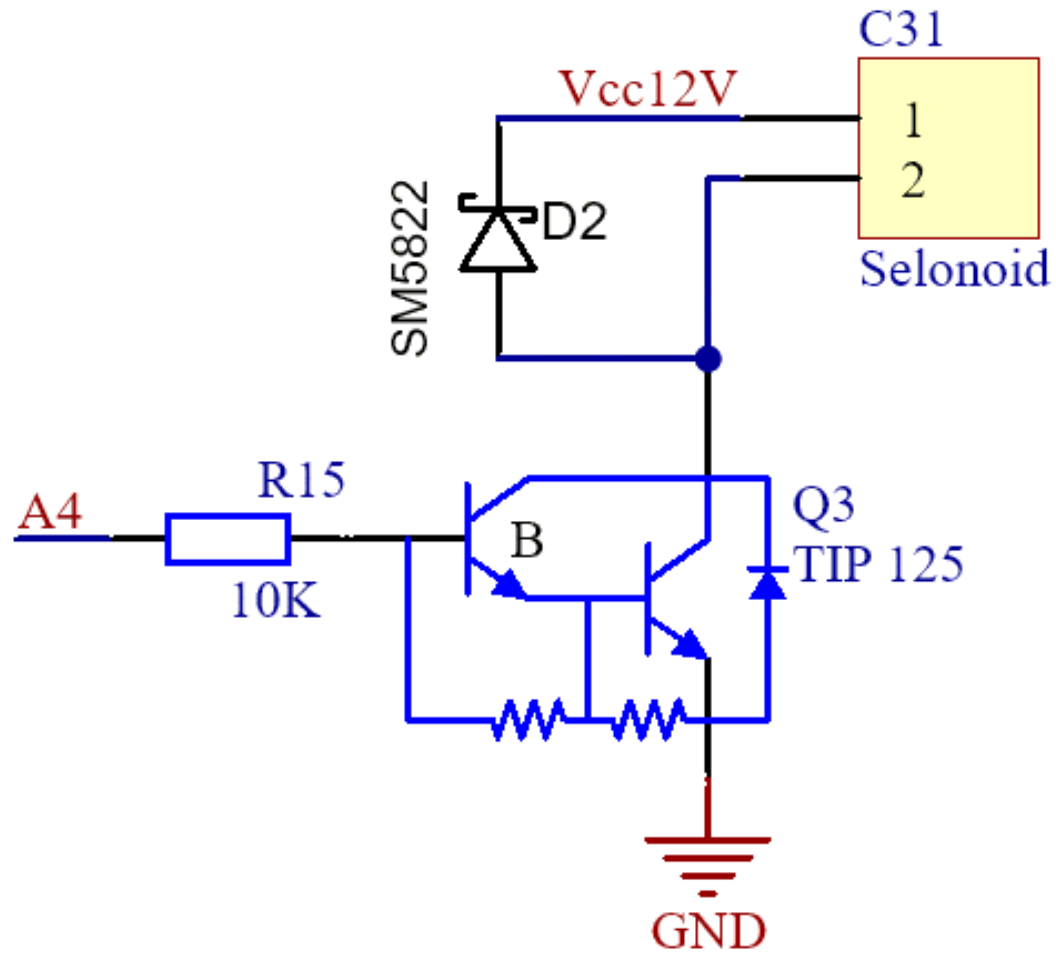


STEPPER MOTOR :

- This Motor driver pin was designed for A4899, LV8729 and some other similar stepper motor drivers which support from different range of steps (32 steps to 128 steps)
- NEMA17 Stepper motor
- Used in 3D Printers (RAMPS RepRap boards), CNC Shields
- Read datasheets carefully; there are several better and accurate ways to filter motor driver (especially in power part).

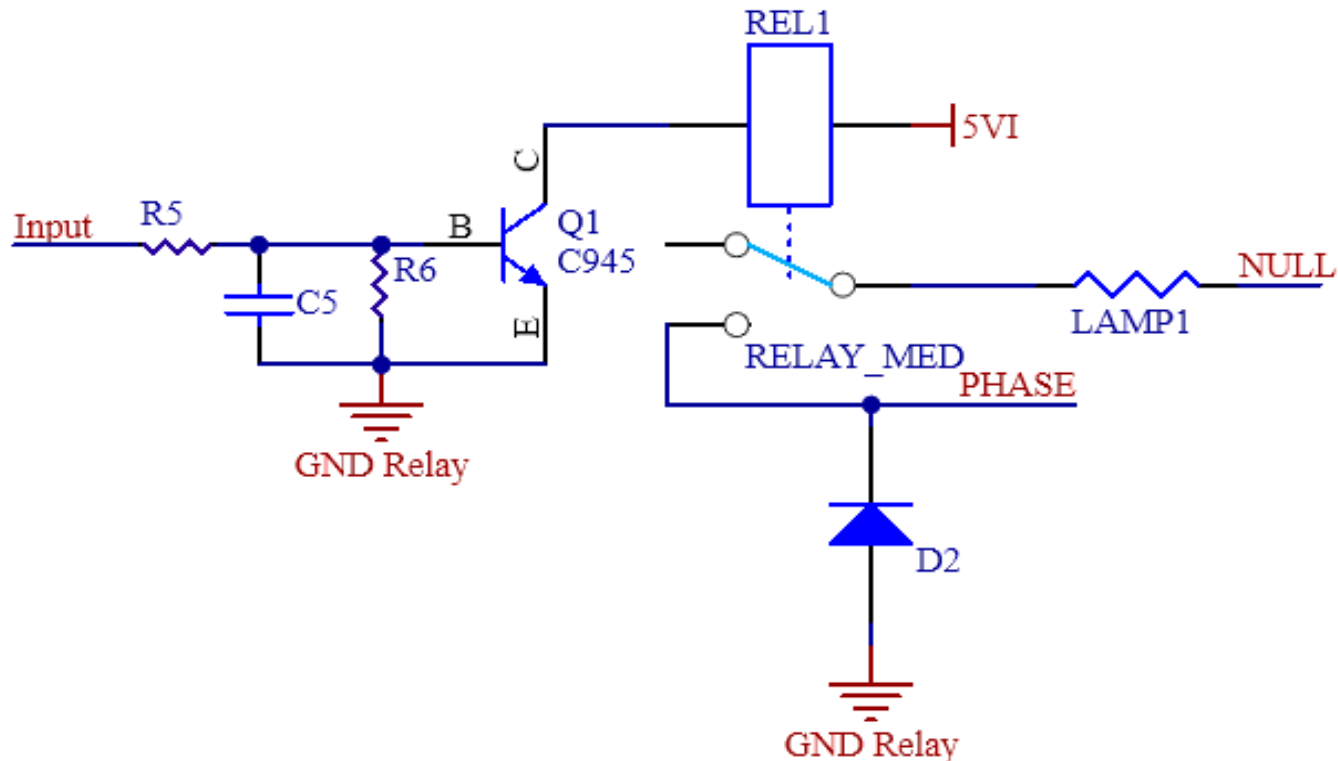


SELENOID :



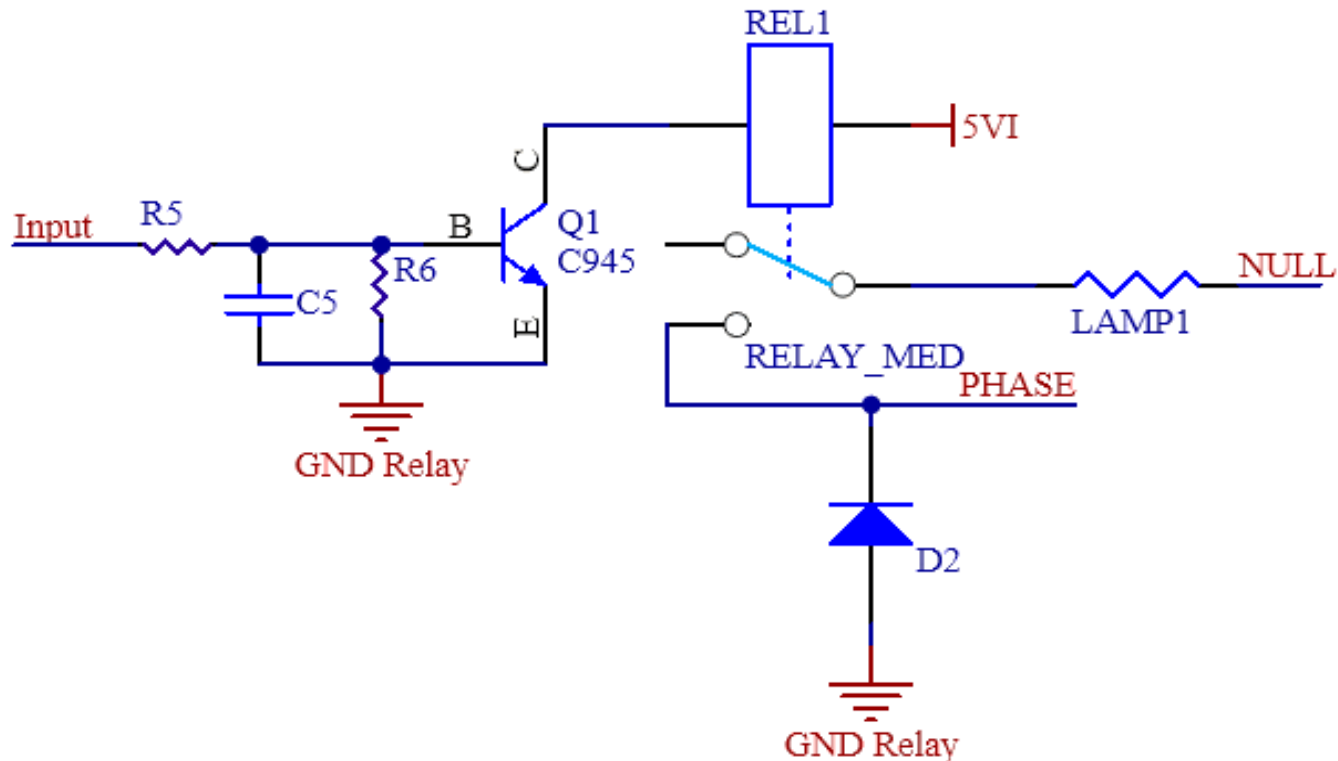
RELAY :

- 5V Relay
- 1N5822 Diode
- Be careful with 220 AC input voltage
- C945 Transistor
- You can add another diode from 5VI to transistor Collector pin



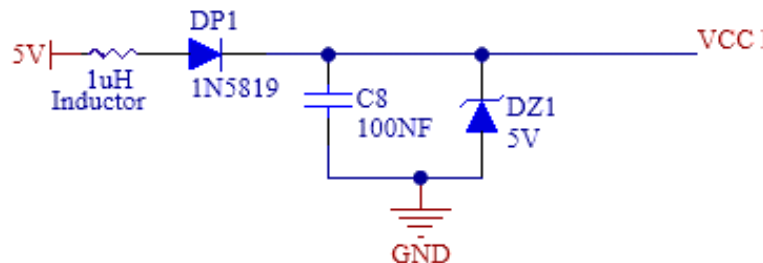
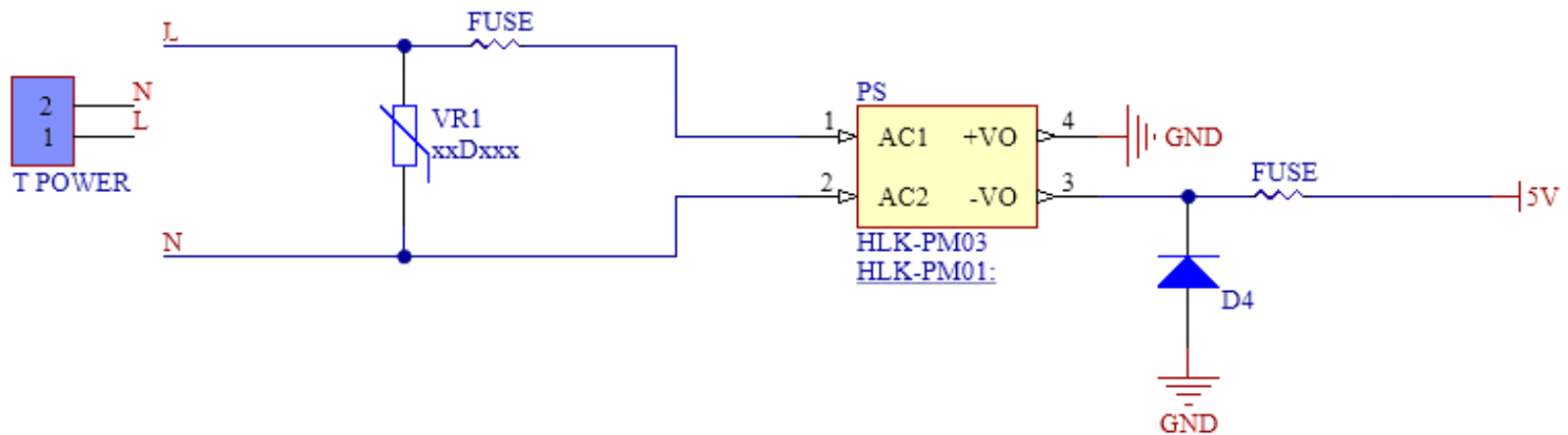
RELAY :

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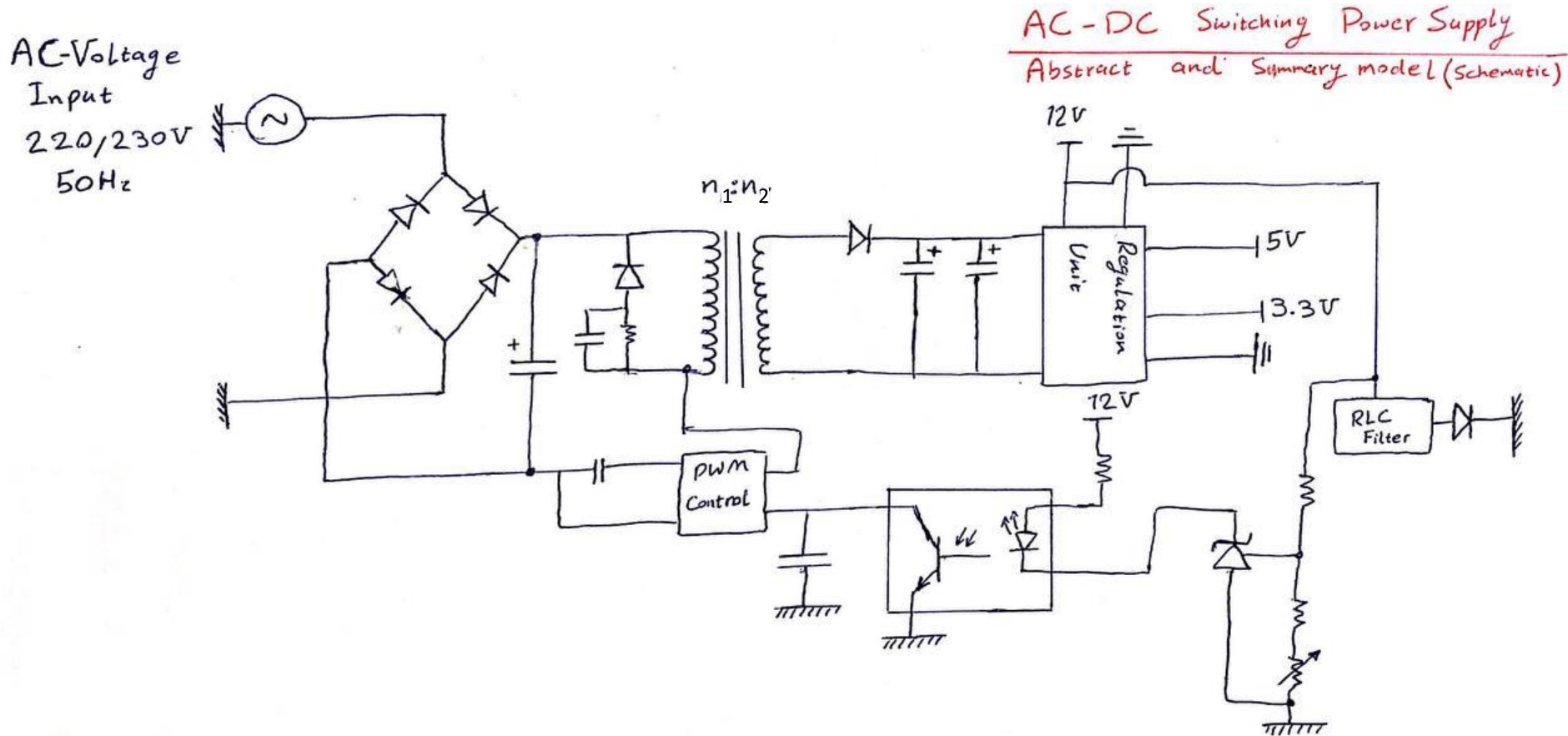
220-5V (AC-DC) :

- 220/230 AC Input voltage
- Switching BUCK Convertor
- HLK-PM01 (Current 3-5A)
- Diodes : 1N5819, 1N5822, Zener Diode
- Varistor + Fuse must be added in 220 Phase input
- ** NO POLYGAN POUR UNDER 220V AREAS IN PCB

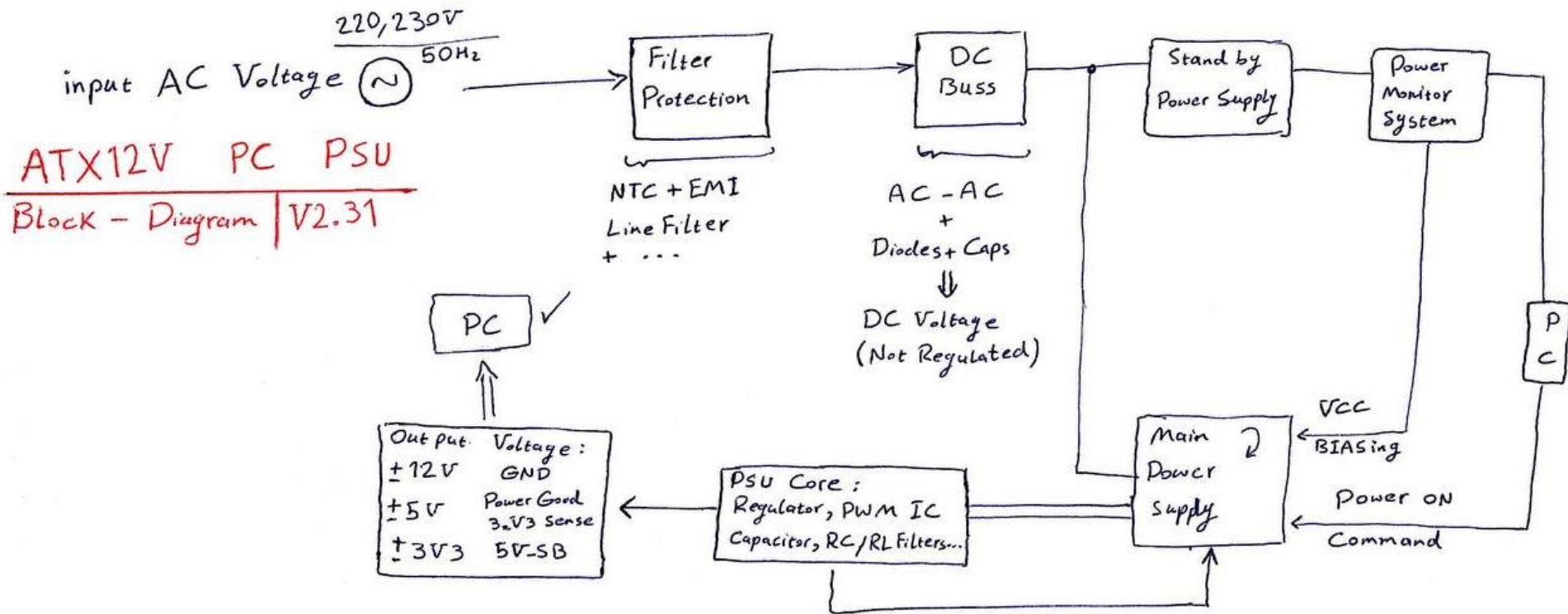


SWITCHING POWER SUPPLY SIMPLE :

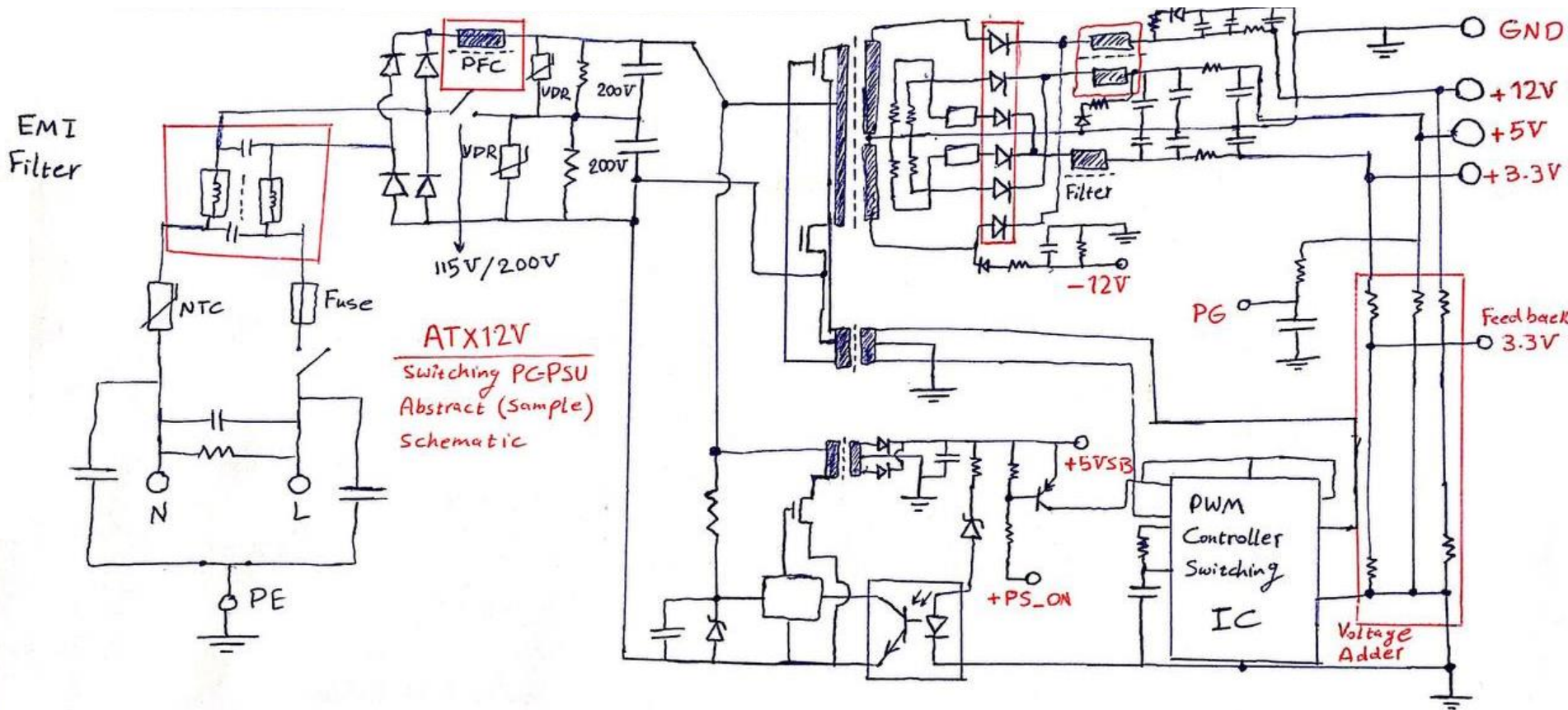
- This Schematic is not complete. You can complete it by choosing your desired regulated voltage and using right regulation IC and chip for your Switching power supply but this diagram, helps you to start your switching design.



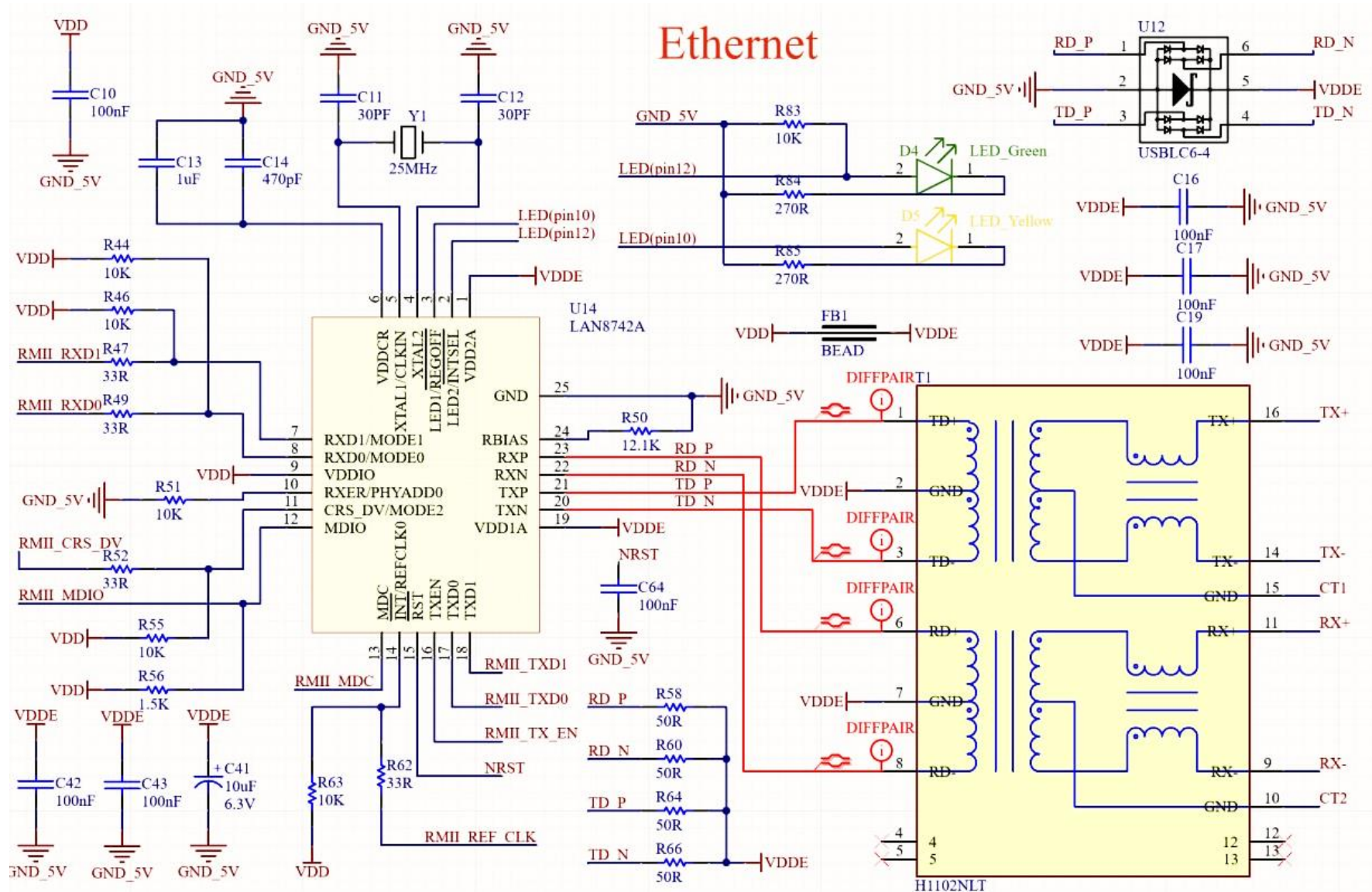
ATX SWITCHING DIAGRAMS :



ATX SWITCHING DIAGRAMS :

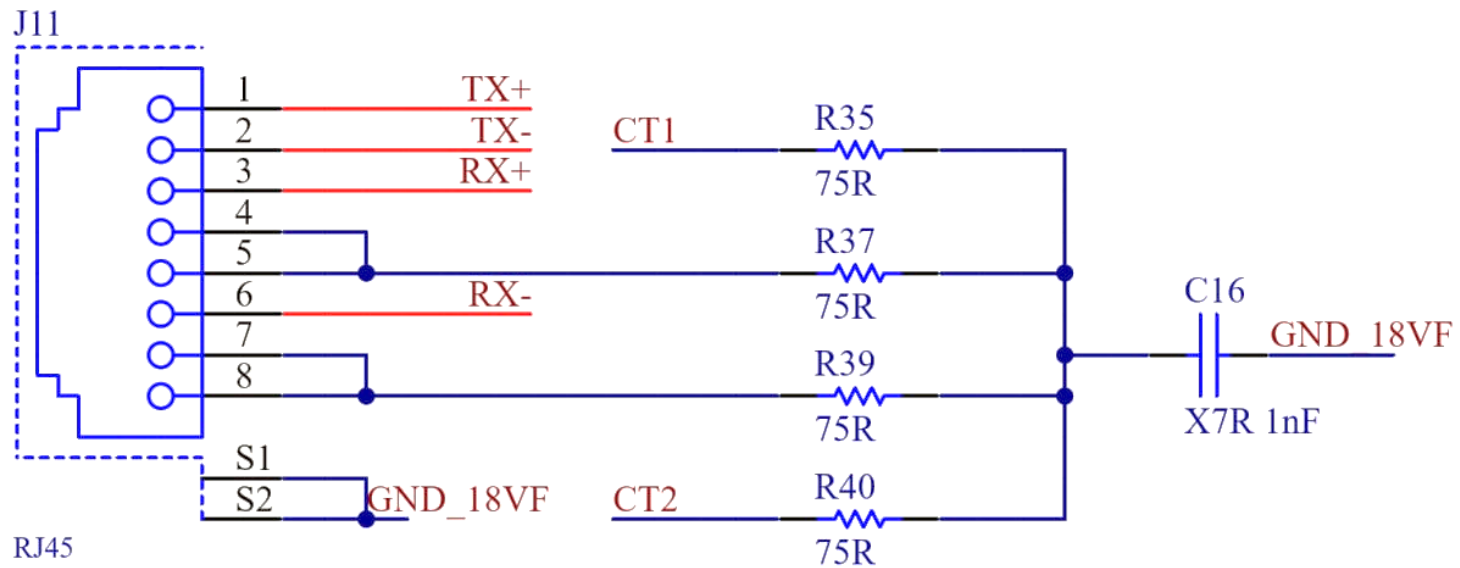


ETHERNET :

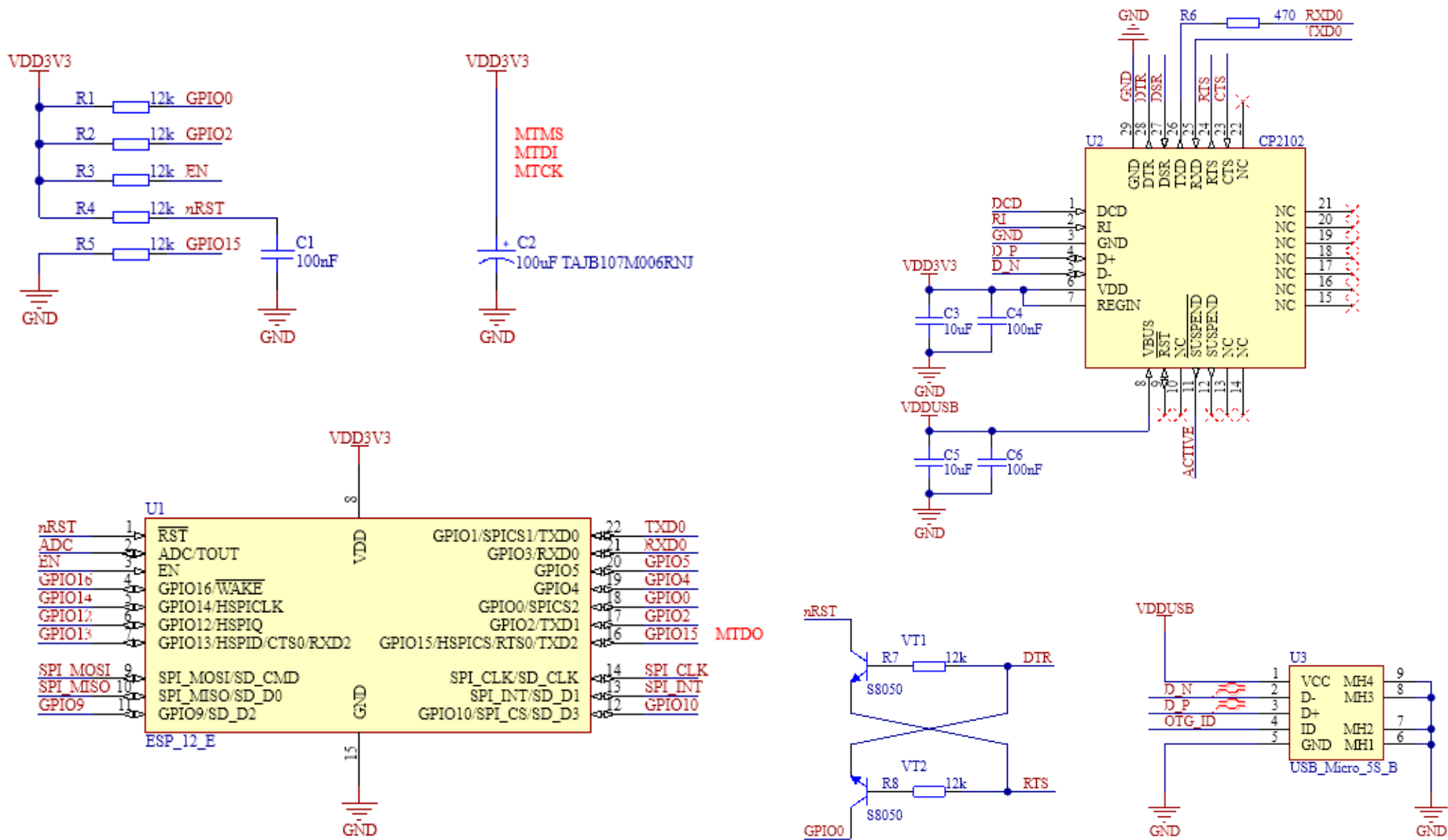


ETHERNET :

- Check Datasheet carefully (There are key instructions mentioned in datasheet especially for PCB layout and routing)



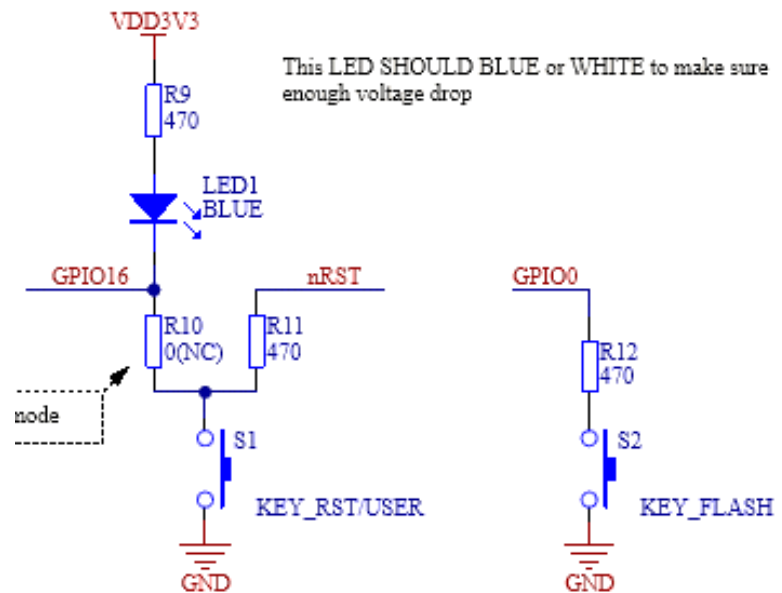
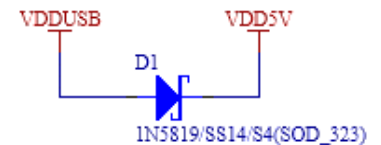
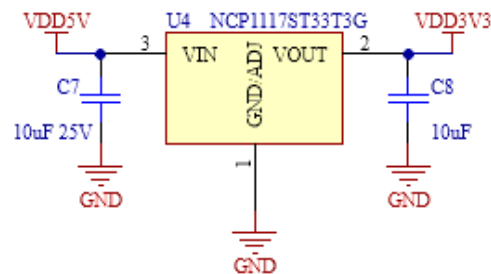
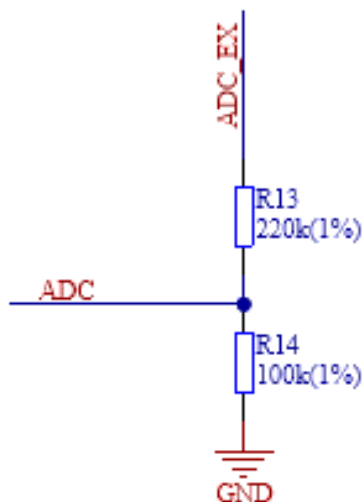
ESP8266 :



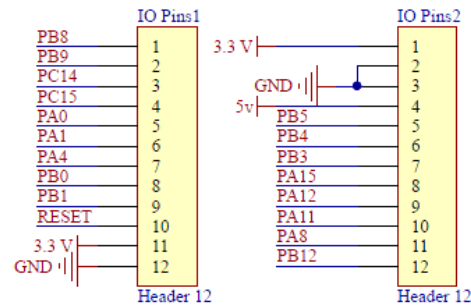
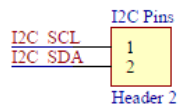
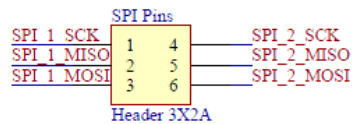
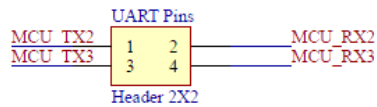
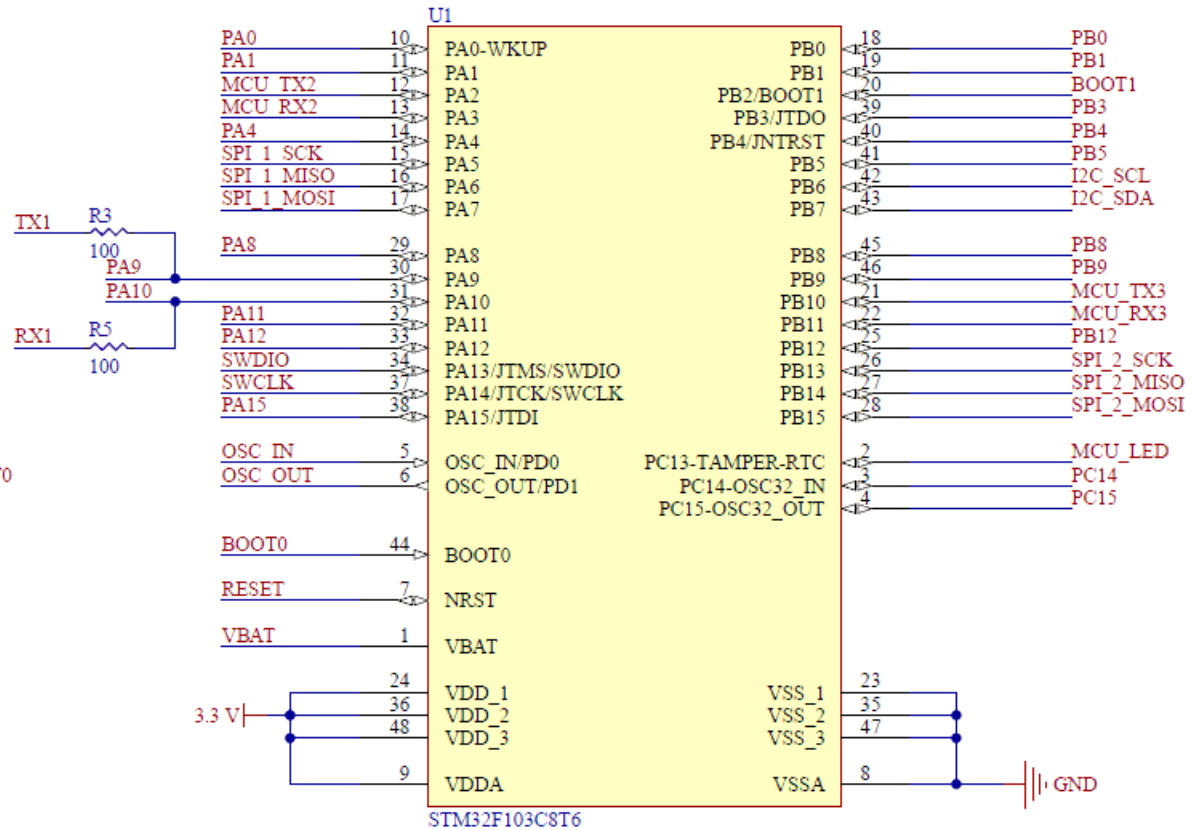
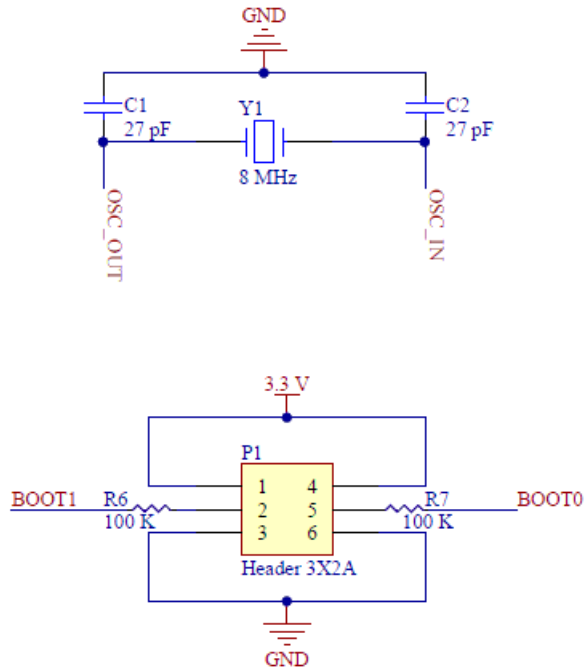
ESP8266 :

J1			J2		
ADC_EX	A0	1	PIN1	1	D0 GPIO16
ADC		2	PIN2	2	D1 GPIO5
RESV		3	PIN3	3	D2 GPIO4
SD_D3	GPIO10	D12	4	D3 GPIO0	
SD_D2	GPIO9	D11	5	D4 GPIO2	TXD1
SD_D1	SPI_INT		6	VDD3V3	
SD_CMD	SPI_MOSI		7	GND	
SD_D0	SPI_MISO		8	D5 GPIO14	HSPICLK
SD_CLK	SPI_CLK		9	D6 GPIO12	HSPIO
GND		10	10	D7 GPIO13	RXD2 HSPID
VDD3V3		11	11	D8 GPIO15	TXD2 HSPICS
EN		12	12	D9 RXD0	GPIO3
nRST		13	13	D10 TXD0	GPIO1
GND		14	14	GND	
VDD5V		15	15	VDD3V3	

THT_Male_P_1x15 THT_Male_P_1x15

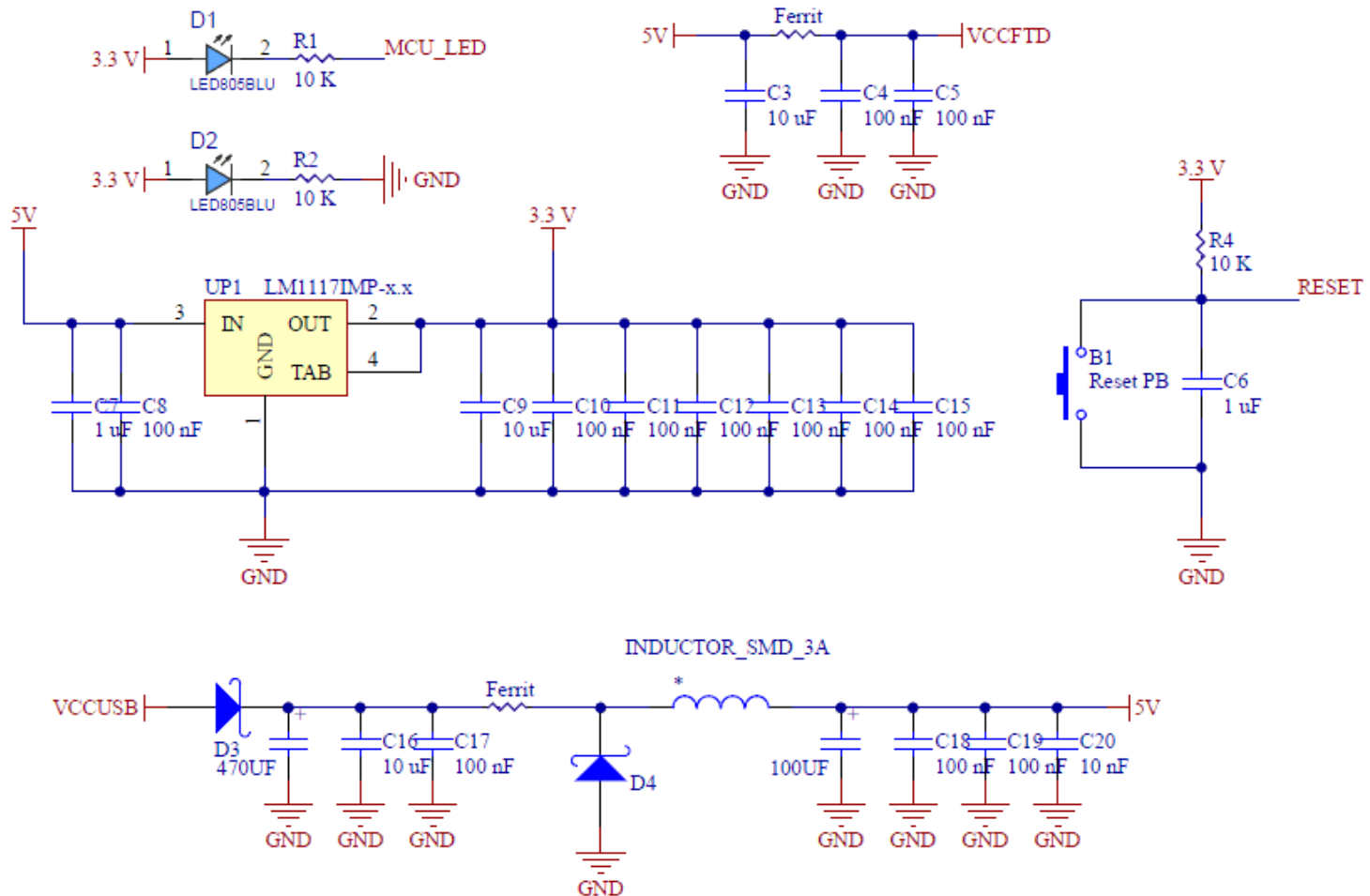


STM32 F103C8T6 (DevKit) :



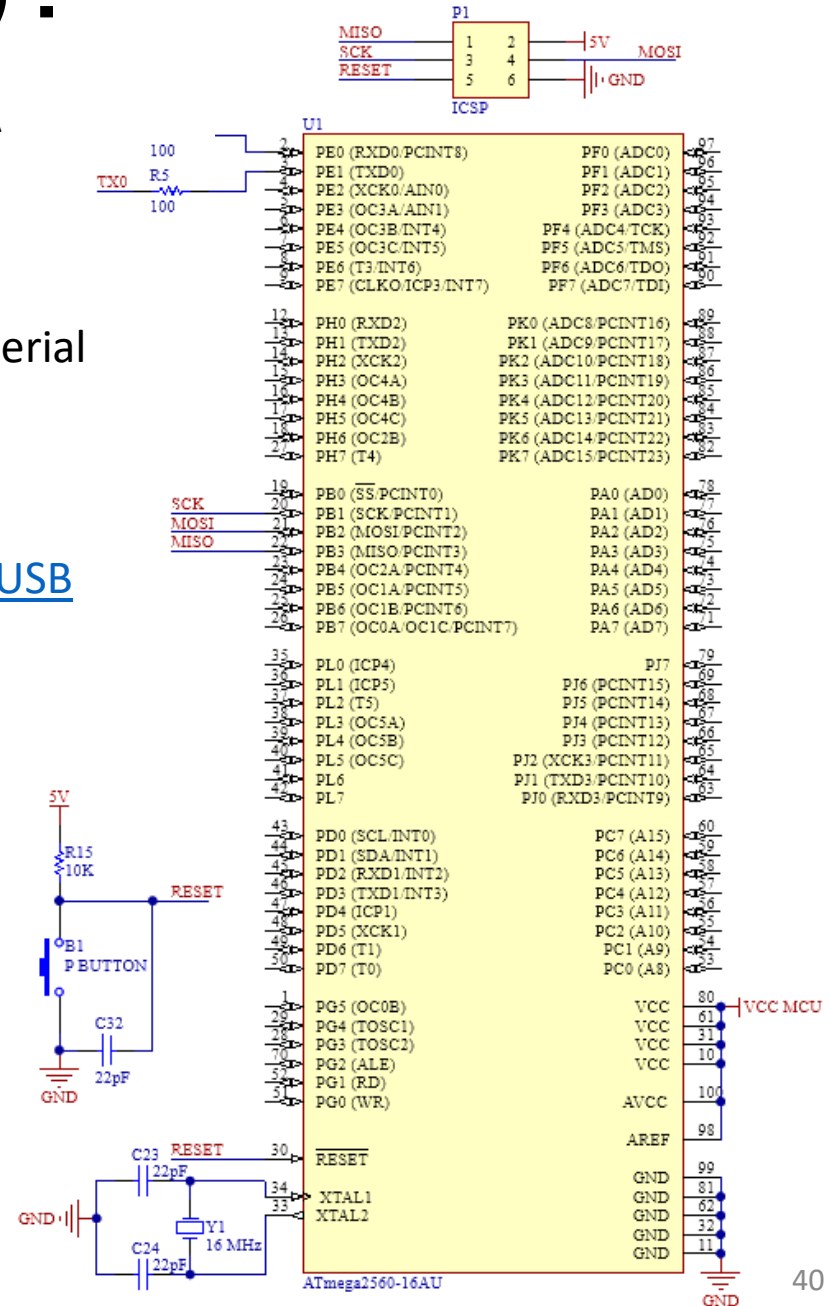
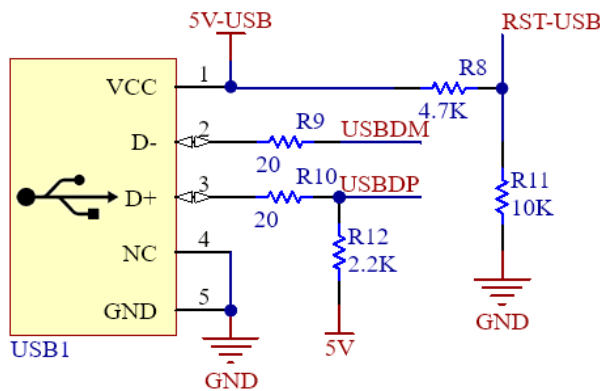
STM32 F103C8T6 (DevKit) :

- This filter is the suggested filter in STM32 BluePill open-source Schematic
- I don't recommend to design your MCU power like this
- Check recommended and stable filters in [POWER](#) part

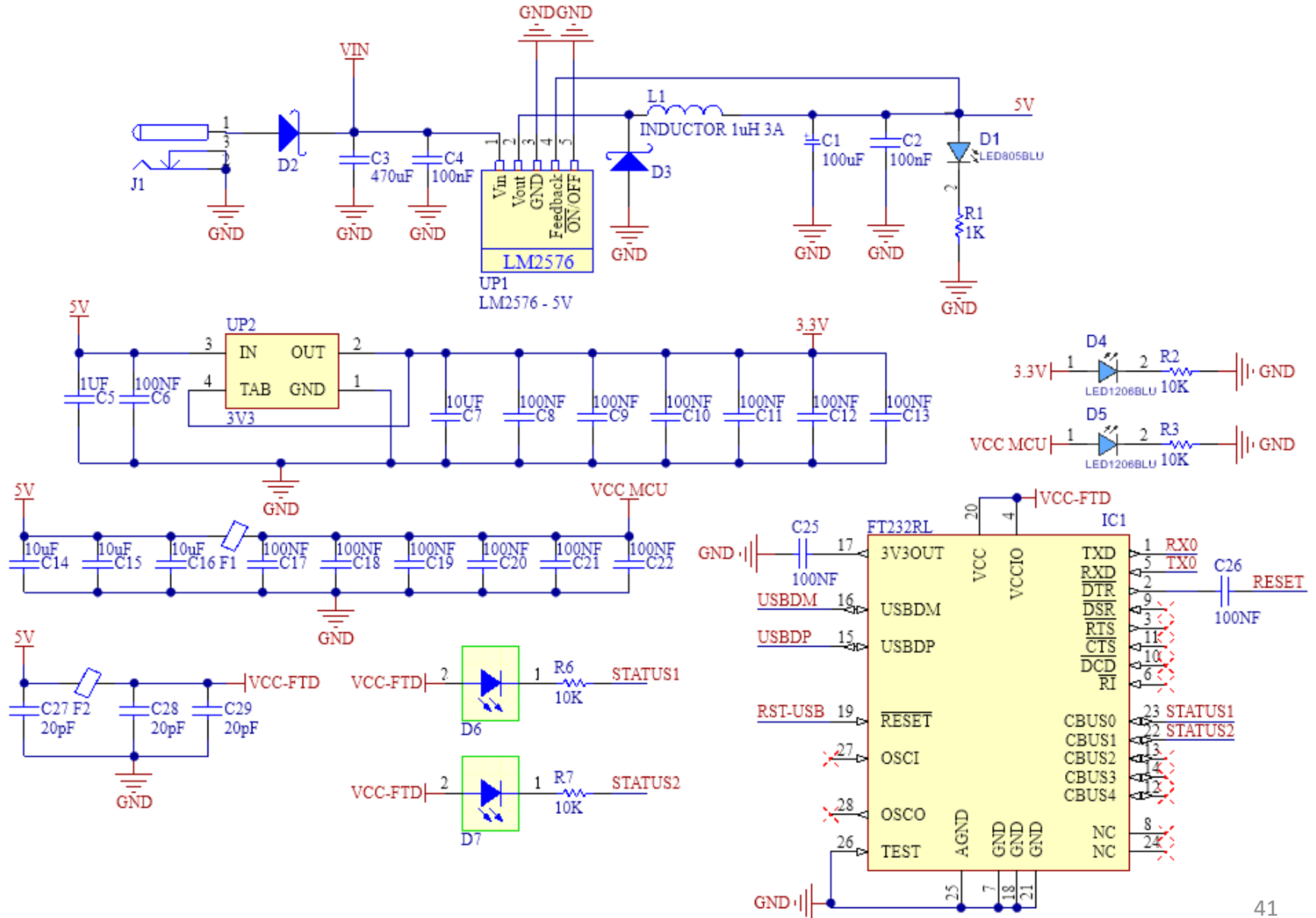


ATMEGA2560 (DevKit) :

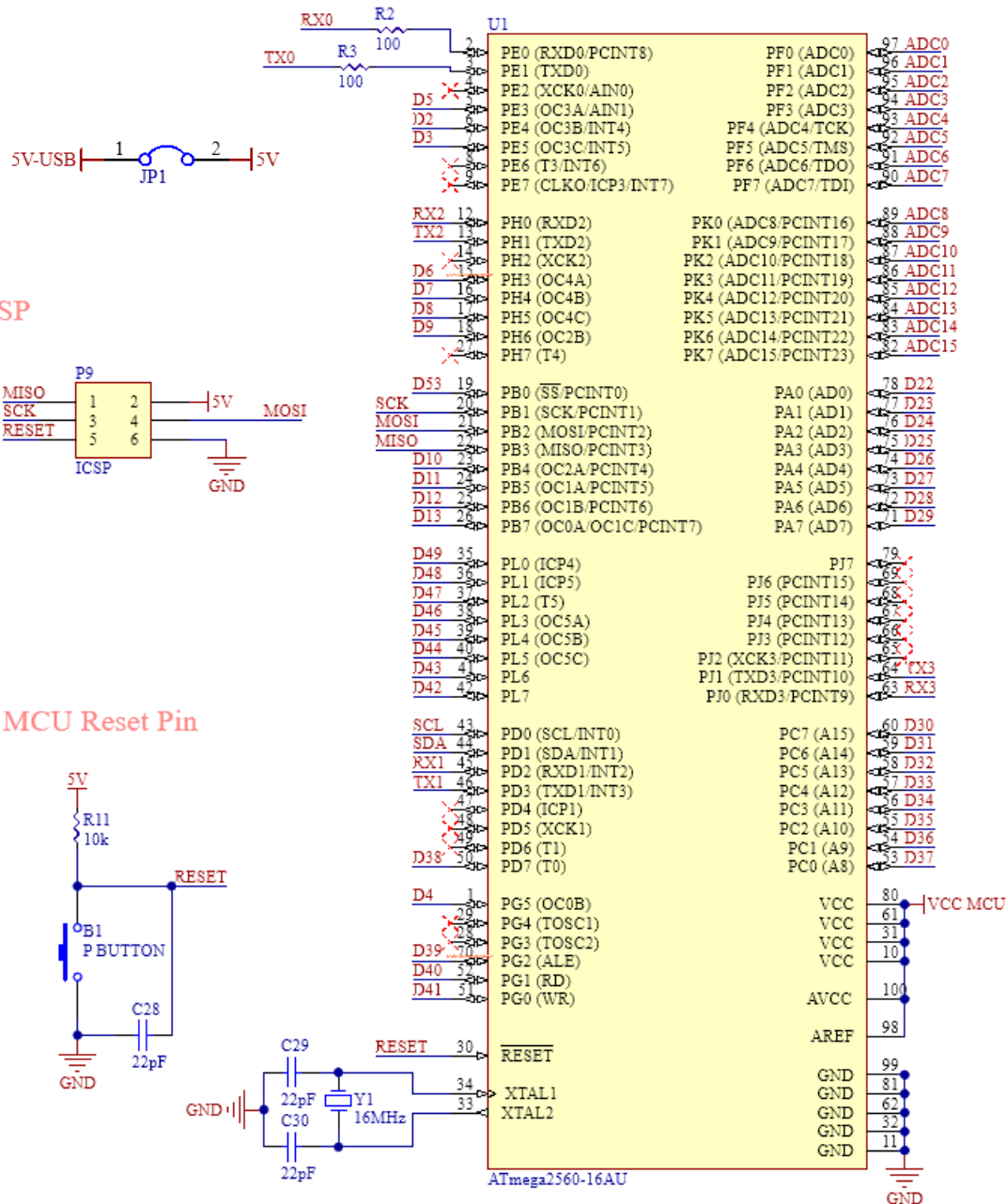
- This schematic is based on Arduino MEGA Board
- Arduino MEGA uses ATMEGA16 microcontroller as a programmer
- In this designed I have chosen an USB to serial convertor IC as a programmer
- Check recommended and stable filters in [POWER](#) part
- Check recommended and stable filters in [USB to Serial](#) part



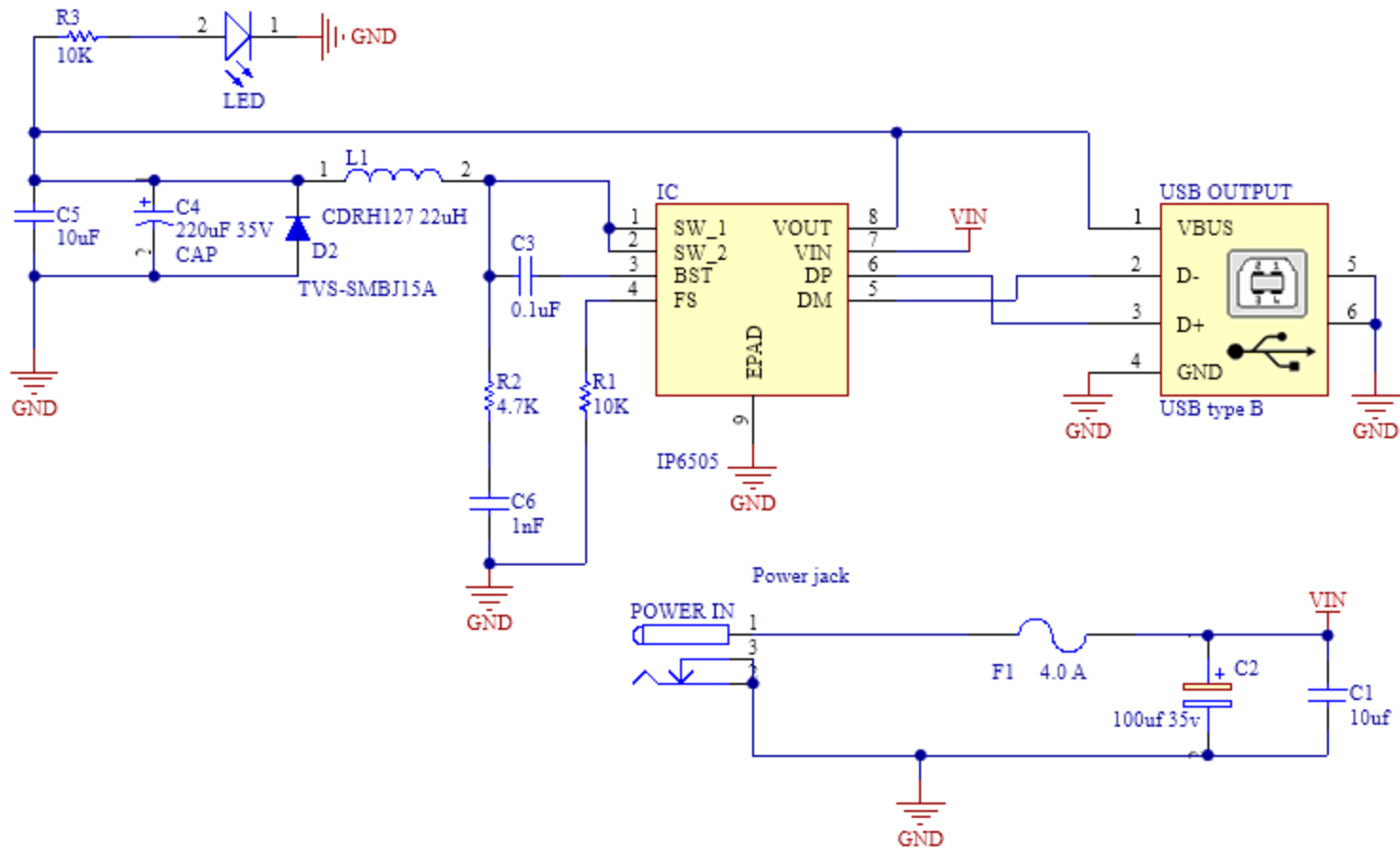
ATMEGA2560 (DevKit) :



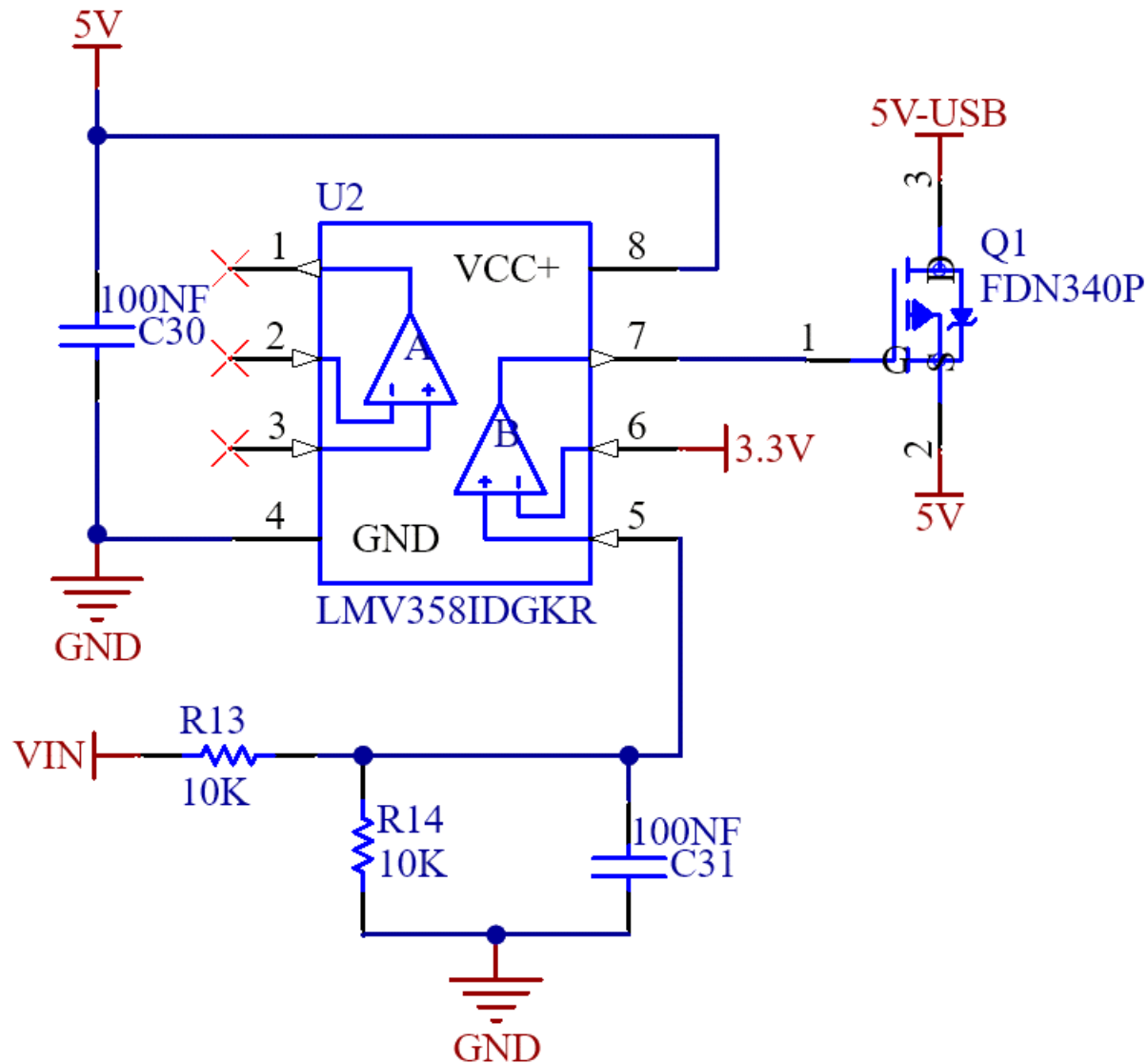
ATMEGA2560 (DevKit) :



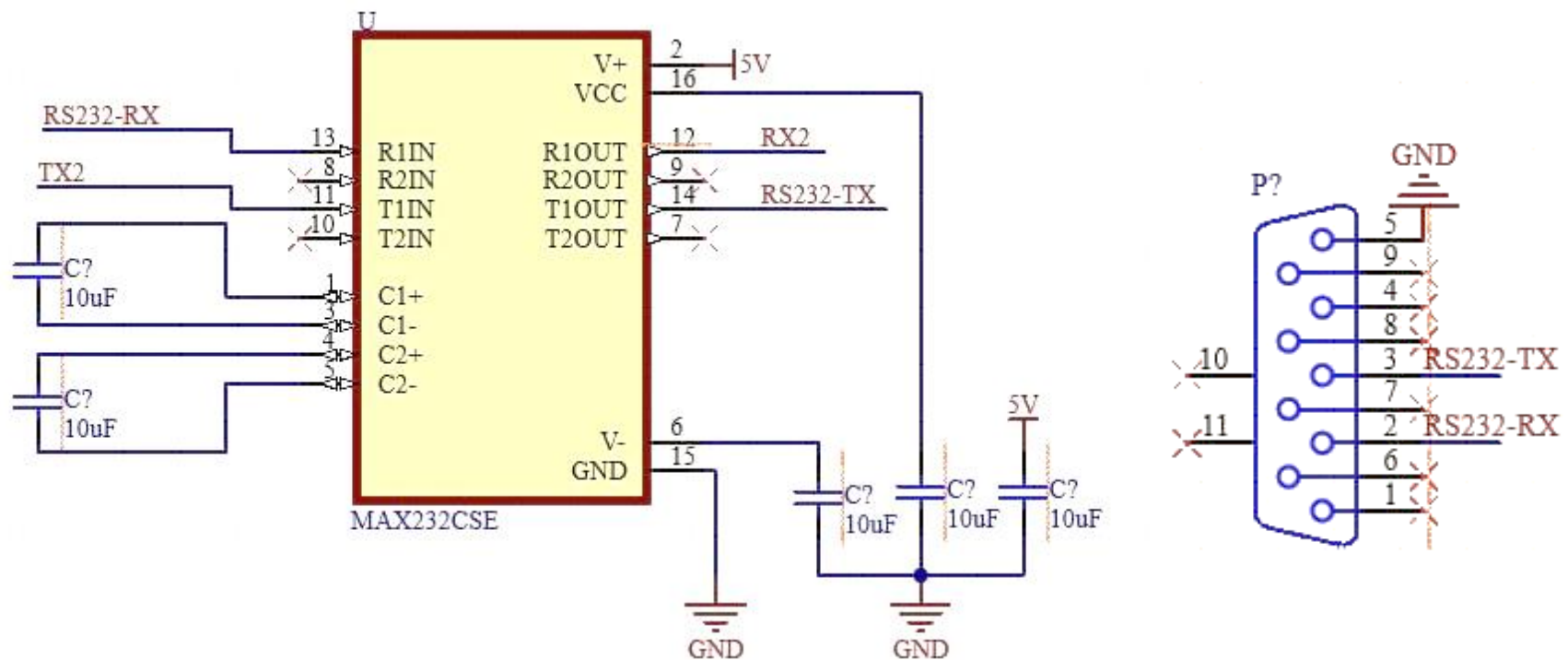
QUICK CHARGE :



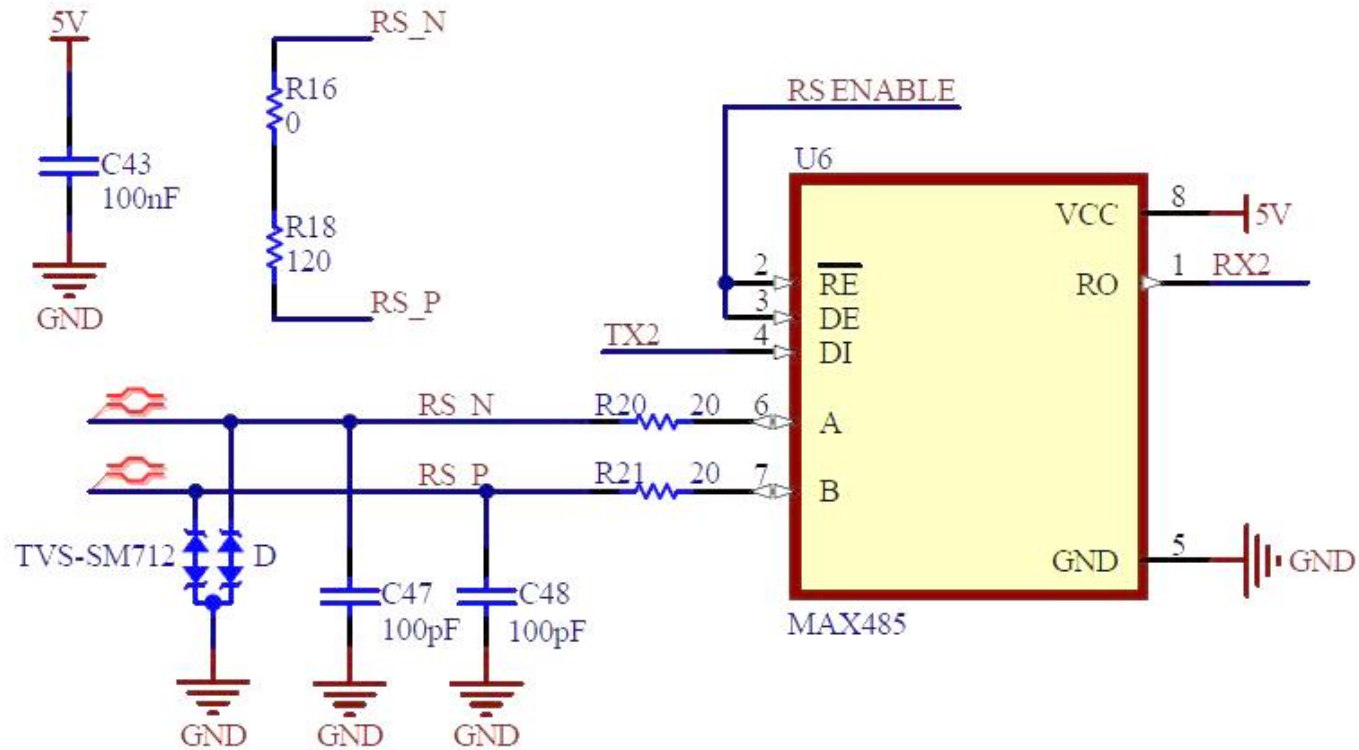
DUAL-INPUT POWER SWITCH :



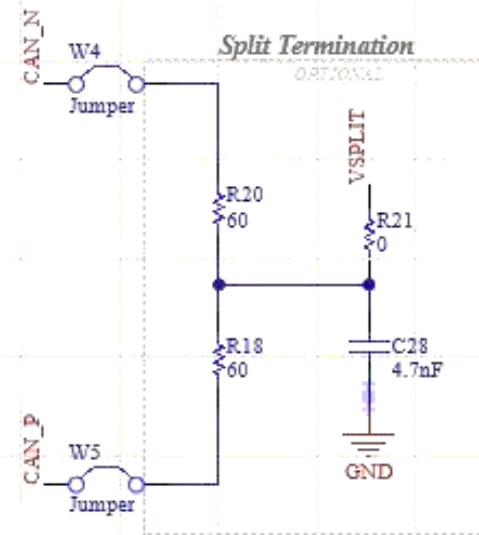
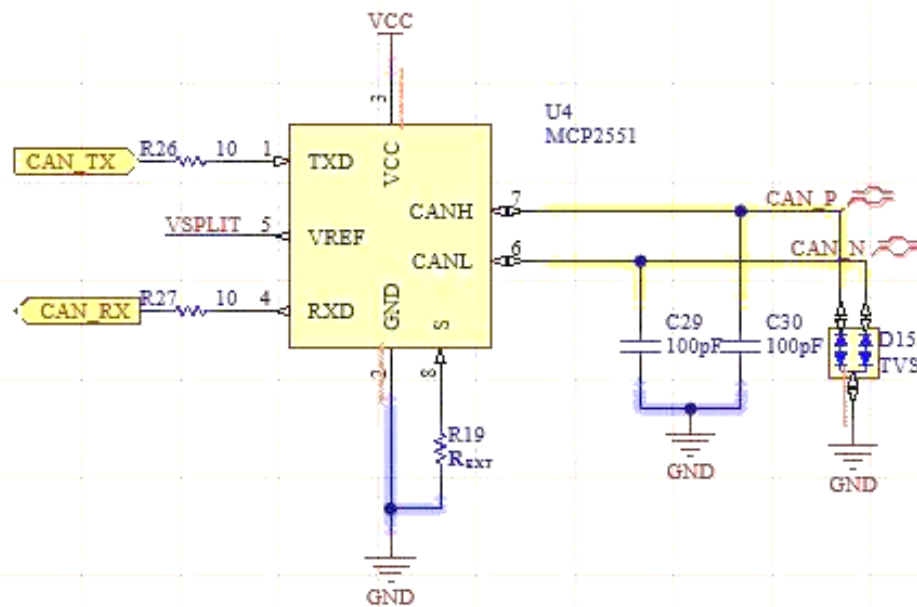
RS232 :



RS485 :



CAN :



***NOTE**
when C_{SPLIT} and jumper R_{SPLIT} both are not connected; then in *Standard Termination* one resistor should be 0 (works as a the latter must be 120Ω)

