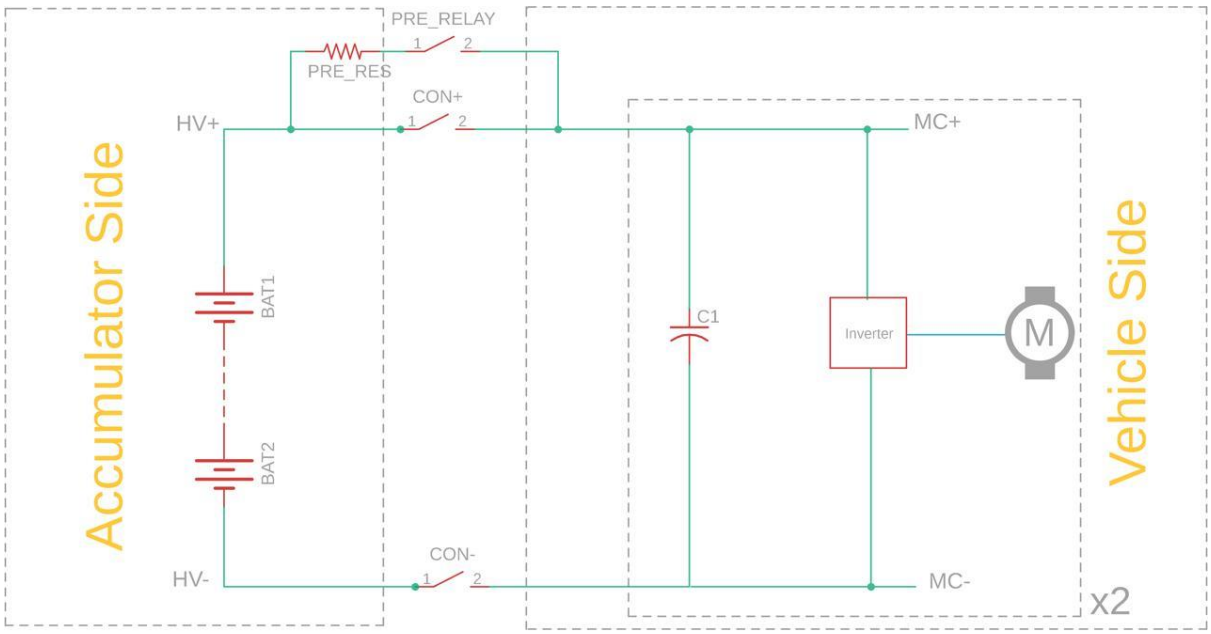
PART 2: USING MICRO-CONTROLLER

You are required to implement the logic for the pre-charge circuit using a microcontroller. The various input and output signals, their pin numbers, and their functions are specified below:

INPUT SIGNALS		
Signal	Pin	Function
CON_SRC	4	Active HIGH signal; Set when the shutdown circuit is complete
BAT_LV	A0	Analog signal; It is a scaled down value of the accumulator voltage mapped from 0-378v to 0-12v
MC_LV	A1	Analog signal; It is a scaled down value of the motor controller voltage from 0-378v to 0-12v
HV_RESET	2	Active LOW signal; Signal to start pre-charging
ERR_SIG_1	6	Active LOW signal; the contactors must be opened upon receiving this error
ERR_SIG_2	7	Active LOW signal; the contactors must be opened upon receiving this error

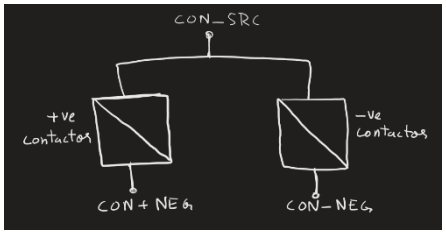
OUTPUT SIGNALS		
Signal	Pin	Function
CON+NEG	13	Active LOW signal; Required for closing the +ve contactor
CON-NEG	12	Active LOW signal; Required for closing the -ve contactor
RELAY_ON	10	Active HIGH signal; Closes the relay

Theory + Problem statement:



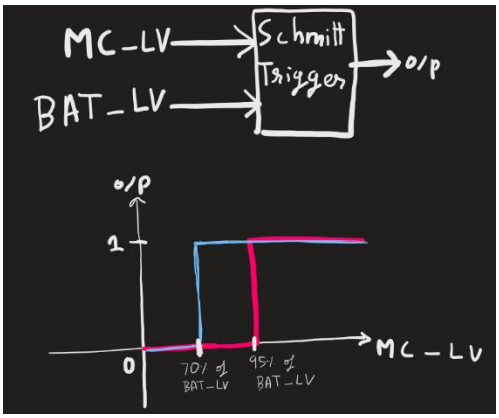
(pre-charge circuit diagram)

Once HV_RESET is triggered, the pre-charging must begin. Until the motor controller(MC) voltage becomes atleast 95% of the accumulator voltage, the charging is done through the -ve contactor and the pre-charge relay along a resistive path to avoid huge in-rush currents. After this, the relay is opened and the +ve contactor is simultaneously closed to provide a low resistance path between the MC and the accumulator.
Whenever an error in the system is encountered, we wish to open the contactors, so that the high voltage supply is cut from the accumulator to the vehicle, to keep the driver and the car safe.
Then once the error has disappeared, we can once again start pre-charging after triggering HV_RESET.



The contactors receive the signals CON_SRC and CON+/-NEG. The contactors are closed only if CON_SRC becomes HIGH and CON+/-NEG becomes LOW.

The -ve contactor is ready to be closed if the BAT_LV is above a nominal value (for our purpose say 8v) and if the shutdown circuit is complete. Once the HV_RST is triggered, the pre-charging must start. HV_RST goes back to HIGH after it is released and a variable called TS_GO is latched to HIGH. This variable indicates that the contactors are allowed to be closed if they are ready to be closed.



For the +ve contactor, we also need to implement a Schmitt trigger logic as specified by the customer. The non-inverting Schmitt trigger has two inputs, MC_LV and BAT_LV and has the upper threshold as 95% of BAT_LV and lower threshold as 70% of BAT_LV. If the output is HIGH, and if the -ve contactor is closed, we can say that the +ve contactor is also ready to be closed. further if TS_GO is HIGH, then +ve contactor is closed.

If any error is generated, then the contactors must be opened.

We wish to use interrupts for the HV_RESET signal. You are required to find out what interrupts are and how to implement it in Arduino.

Print the current state of the relay and the contactors on the serial monitor in each loop. Document your work in detail explaining the logic of your codes and how it is helping you perform the required tasks. If you have made any assumptions do mention it. Submit the assignment as a zip file.

Contact me for any doubts,

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