Homework 6

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1) ADS5481 16-bit ADC by TI will be used.
2) The connections are done after reading its datasheet.

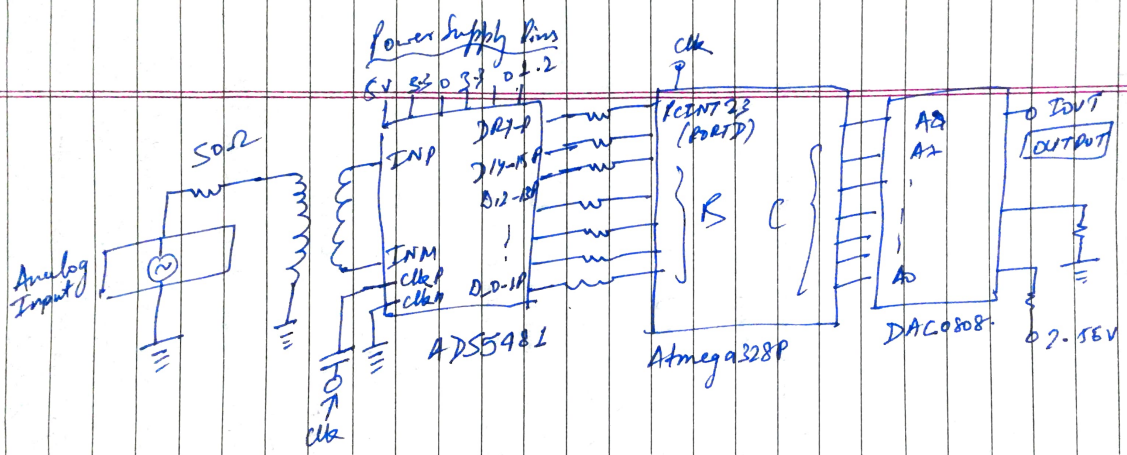
The only important point to understand is its o/p scheme:

i) Pin DRY-P becomes high
   Pin DE_O-P have output bits
   14, 12, 10 ... 0
ii) Pin DRY-P becomes low
   Pins DE_O-P have output bits
   15, 13, 11 ... 1.

where

E = even nos. from 0-15.
O = odd nos. from 0-15.

∴ Output comes in 2 cycles, first bits 14, 12, 10, ... 0, then bits 15, 13, 11 ..., 1.


Power Supply Pins
5V
3.3V
1.2V
50Ω
Analog Input
INP
INM
CLKP
CLKN
D13-D4
D3-D0
ADS5481
CLK
CLK
PCINT23 (PORTD)
Atmega328P
A3
A2
A1
A0
DAC0808
IOUT
OUTPUT
2.5V

Schematics:

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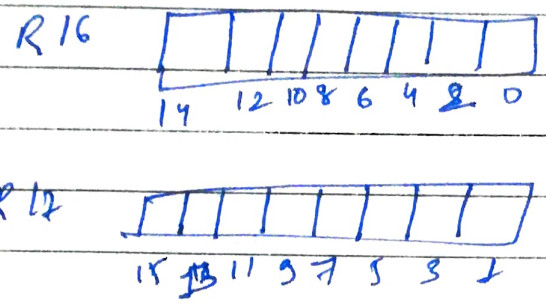
Algorithm:

i) Read the AC output into using PCINT23 toggle external interrupt.



ii) Discard LSB 4 bits from each register as we only want 8 bits. So, we take MSB 8 bits (R15-R8)

iii) Take R18 as 10000000, R19 = 00000000

Eg. R16 = 1010 0000
R17 = 0101 0000

a) Left shift R17. Carry flag 0.
Right Shift R18 (01000000)

b) Left shift R16, Carry flag = 1
R16 = (01000000)
R19 = R19 | R18 = 01000000
Right shift R18.

c) Continuous alternating b/w R17 & R16 till R16 = 0

* Essentially we are copying bits 15, 14, 13, 12, ... 8 from R16 and R17 to R19 in that sequence.

iv) R19 now contains output values. Send it to the 8 bit DAC via port C.

Code

```
.INCLUDE "m32DEF.INC"       ;Header file for directives
.ORG 0X00                           ;Beginning of the address
.ORG 0X000A
       JMP PCINT_2INTERRUPT ;calling ISR
LDI R22, 255 ;This is a flag used to decide whether input to be taken in R16 or R17
in ISR

;Setting the Microcontroller to call ISR when Pin PCINT23 of it toggles.
SBI PCICR, PCIE2
SBI PCIFR, PCIF2
SBI PCMSK2, PCINT23

;Port D: Input Conversion flag. Port B: Input ADC input (8+8 bits in 2 cycles). Port C:
output to DAC
LDI R16, 0
OUT DDRD, R16
OUT DDRB, R16

LDI R16, 255
OUT DDRC, R16

SEI           ;Set I=1 in SREG

;main function
LOOP:
       BREQ DAC      ;When R20=0 (After ISR is called 2nd time), perform operations to
store DAC input in R19 (MSB 8 bits of the 16-bit ADC output)
       OUT PORTC, R19 ;Send output to DAC
       RJMP LOOP ;Loop

DAC:
       ;removing LSB 4 bits as they are not considered in output
       ANDI R16, 0b11110000
       ANDI R17, 0b11110000
       LDI R18, 0b10000000 ;used to mask R19
       LDI R21, 0 ;Flag to perform operation on R17 or R16
       AGAIN:
              BRNE LSB
              LSL R17 ;Left Shift
              RJMP HERE
              LSB:
                     LSL R16 ;Left Shift
              HERE:
                     BRCS Operation ;if carry is 1, set the corresponding set bit of R18
in R19
                     BACK:
                     MOV R24, R16 ;if R16==0, stop DAC subroutine and return to Loop
                     BRNE REPEAT
                     RJMP LOOP
              REPEAT:
                     COM R21
                     RJMP AGAIN

Operation:
       SBR R19, R18 ;set the corresponding set bit of R18 in R19
       LSR R18 ;right shift R18
```

```
	RJMP BACK

PCINT2_INTERRUPT:
	RCALL FLAG ;Flag to select which register (R16 or R17) to take input in
	BRNE Second
	IN R16, PINC ;Input D14 D12, .... , D0 in R16
	RJMP EXIT
	Second:
		IN R17, PINC ;Input D15 D13, .... , D1 in R16
		LDI R20, 0 ;Flag to signal R16 and R17 are loaded with ADC output and DAC
subroutine can be called
	EXIT:
		RETI
FLAG:
	COM R22 ;Flag which toggles R22 to help select which register (R16 or R17) to take
input in
	RET
```

Q.2 What is SNR (Signal to Noise) ratio? Explain how SNR will vary in case of an ADC when 1 bit of ADC is increased/decreased.

Signal-to-noise ratio (**SNR** or **S/N**) is defined as the ratio of signal power to the noise power, often expressed in decibels. A ratio higher than 1:1 (greater than 0 dB) indicates more signal than noise.

When the bit of ADC is increased SNR ratio increases.
When the bit of ADC is decreased SNR ratio decreases.