# SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

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Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

## COURSE NAME: 19EEB303 / Microcontroller and its Applications

III YEAR / VI SEMESTER

Unit III – **IOT - ARCHITECTURE REFERENCE MODEL**

# Topic:ADC and DAC

# ADC and DAC

Analog to Digital Converter(ADC) is used to convert analog signal into digital form. LPC2148 has two inbuilt 10-bit ADC i.e. ADC0 & ADC1.

•ADC0 has 6 channels &ADC1 has 8 channels.

•Hence, we can connect 6 distinct types of input analog signals to ADC0 and 8 distinct types of input analog signals to ADC1.

•ADCs in LPC2148 use Successive Approximation technique to convert analog signal into digital form.

•This Successive Approximation process requires a clock less than or equal to 4.5 MHz. We can adjust this clock using clock divider settings.

•Both ADCs in LCP2148 convert analog signals in the range of 0V to VREF (typically 3V; not to exceed VDDA voltage level).

# ADC and DAC

**Steps for Analog to Digital Conversion**

1.Configure the ADxCR (ADC Control Register) according to the need of application.

2.Start ADC conversion by writing appropriate value to START bits in ADxCR. (Example, writing 001 to START bits of the register 26:24, conversion is started immediately).

3.Monitor the DONE bit (bit number 31) of the corresponding ADxDRy (ADC Data Register) till it changes from 0 to 1. This signals completion of conversion. We can also monitor DONE bit of ADGSR or the DONE bit corresponding to the ADC channel in the ADCxSTAT register.

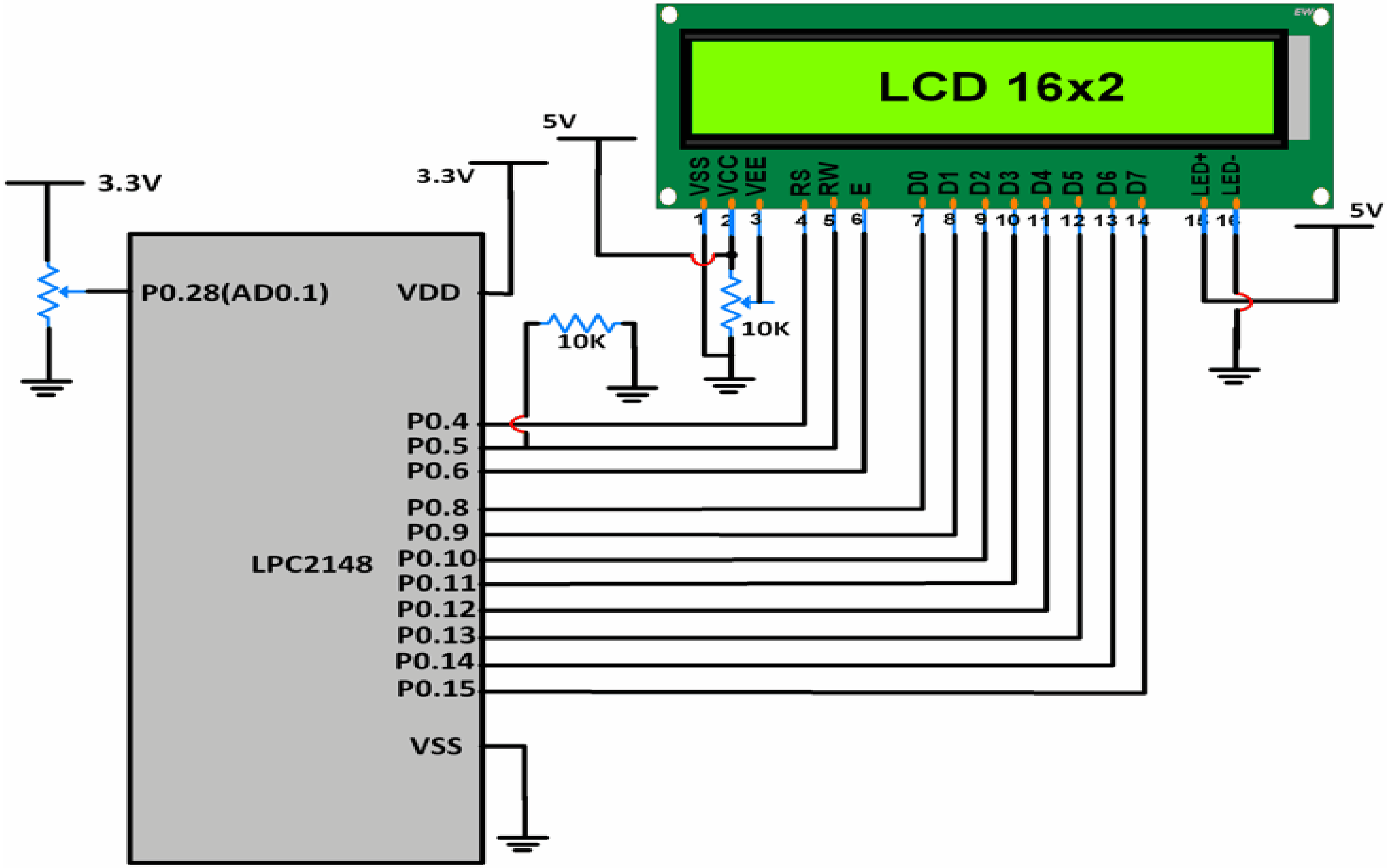
4.Read the ADC result from the corresponding ADC Data Register. ADxDRy. E.g. AD0DR1 contains ADC result of channel 1 of ADC0.

# ADC and DAC

**Read Analog Voltage using LPC2148**

Let's write a program to **convert input voltage signal on AD0.1 (P0.28) into digital signal**. We will convert the digital value to equivalent voltage value and display it on an LCD. We can compare this voltage with actual voltage measured on a digital multimeter.

# ADC and DAC




Potentiometer and LCD16x2 Interfacing with ESP32

# ADC and DAC

Here, input signal is a DC signal which varies from 0 to 3.3V via a potentiometer.

Signal is given on P0.28. P0.28 is configured as AD0.1 using PINSEL register.

10-bit ADC result is stored in a variable and its lower 8 bits are given to P0.8-P0.15. These pins are connected to the data pins of an LCD.

P0.4,5,6 are used as RS, RW, EN pins of the LCD.

As the potentiometer is varied, we can see the variation in equivalent voltage value on the LCD.

# DAC

**Introduction to DAC**

Digital to Analog Converter (DAC) are mostly used to generate analog signals (e.g. sine wave, triangular wave etc.) from digital values.

•LPC2148 has 10-bit DAC with resistor string architecture. It also works in Power down mode.

•LPC2148 has Analog output pin (AOUT) on chip, where we can get digital value in the form of Analog output voltage.

•The Analog voltage on AOUT pin is calculated as ((**VALUE**/1024) * VREF). Hence, we can change voltage by changing **VALUE**(10-bit digital value) field in **DACR** (DAC Register).

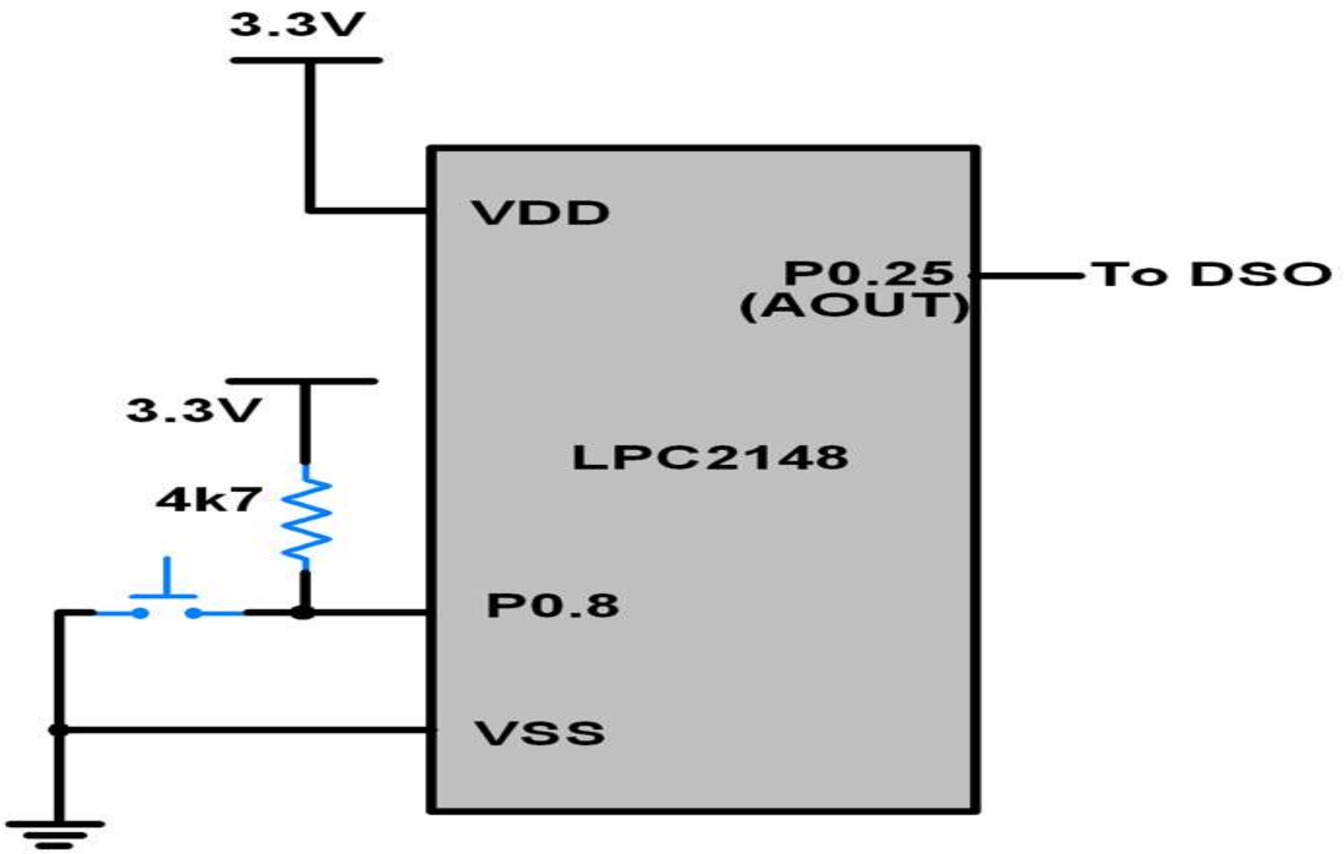
•e.g. if we set **VALUE** = 512,
then, we can get analog voltage on AOUT pin as ((512/1024) * VREF) = VREF/2.

# DAC

**Programming Steps**

- First, configure P0.25/AOUT pin as DAC output using PINSEL Register.
- Then set settling time using BIAS bit in DACR Register.
- Now write 10-bit value (which we want to convert into analog form) in VALUE field of DACR Register.

# DAC



# DAC

Let's write a simple program for LPC2148 DAC.

Here, we will load the DACR value with various values to generate a sine wave, triangular wave, sawtooth wave, square wave and DC wave.

4 switches are used as inputs on P0.8 (for sine wave), P0.9 (for triangular wave), P0.10 (for sawtooth wave), and P0.11 (for square wave) pins.

These pins are connected to 3.3 V through pull-up resistors. The switches are connected as shown below. Only switch for P0.8 is shown in the figure. Switches are connected in a similar manner to the other 3 pins as well.

If we connect the DAC output pin P0.25 to an oscilloscope, we can observe the different waves.