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DAC Interfacing with 8051

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ABSTRACT:
An embedded system was designed using 8051 microcontroller with LCD, keyboard and DAC. Square and triangular waveforms were generated at the output.
Keywords: D*igital to analog converter (DAC).*

1. INTRODUCTION

Digital-to-analog conversion is a process in which signals having a few (usually two) defined levels or states are converted into signals having a theoretically infinite number of states. A common example is the processing, of computer data into audio-frequency (AF) tones that can be transmitted over a twisted pair by a modem of computer data telephone line. The circuit that performs this function is a digital-to-analog converter (DAC).
Basically, digital-to-analog conversion is the opposite of analog-to-digital conversion. In most cases, if an analog-to-digital converter (ADC) is placed in a communications circuit after a DAC, the digital signal output is identical to the digital signal input. Also, in most instances when a DAC is placed after an ADC, the analog signal output is identical to the analog signal input.
Binary digital impulses, all by themselves, appear as long strings of ones and zeroes, and have no apparent meaning to a human observer. But when a DAC is used to decode the binary digital signals, meaningful output appears. This might be a voice, a picture, a musical tune, or mechanical motion. Both the DAC and the ADC are of significance in some applications of digital signal processing. The intelligibility or fidelity of an analog signal can often be improved by converting the analog input to digital form using an ADC, then clarifying the digital signal, and finally converting the "cleaned-up" digital impulses back to analog form using a DAC.
A common use of digital-to-analog converters is generation of audio signals from digital information in music players. Digital video signals are converted to analog in televisions and cell phones to display colors and shades. Digital-to-analog conversion can degrade a signal, so conversion details are normally chosen so that the errors are negligible. Due to cost and the need for matched components DACs are almost exclusively manufactured on integrated circuits (ICs). There are many DAC architectures which have different advantages and disadvantages. The suitability of a particular DAC for an application is determined by a variety of measurements including speed and resolution.

2. THEORY

The digital to analog converter is a device widely used to convert digital pulses to analog signals. The two methods of creating DAC are binary weighted and R-2R ladder. DAC 0808 uses the R-2R method since it can achieve a high degree of precision. The first criterion for judging a DAC is its resolution, which is the function of the number of binary inputs. The common ones are 8, 10 and 12 bits. The number of data bit inputs decides the resolution of the DAC since the number of analog output levels is equal to 2n, where n is the number of data inputs. DAC 0808 provides 256 discrete voltage or current levels of output. In DAC 0808, the digital inputs are converted into current I_{out} and by connecting a resistor to I_{out} pin, we convert the result to voltage. The total current provided by I_{OUT} pin is a function of binary numbers at the D0-D7 pins inputs to DAC 0808 and reference current (Iref) is as follows:
$I_{out}=I_{ref}$ (D7/2+D6/4+D5/8+D4/16+D3/32...+D0/256)
Where D0 is the LSB, D7 is the MSB for the inputs and Iref is the input current that must be applied.

3. IMPLEMENTATION

In case of matrix Keypad both the ends of switches are connected to the port Pin. Over here a 4x4 matrix keypad is considered i.e. four rows and four columns. The keypad is connected to port zero of the microcontrollers. When one of the Column Pins is pulled low & the row pins are checked and if any of the Pin is

low then it is observable that which switch is pressed. Suppose column 1 pin is made low and while checking the rows if Row 3 is low then it will show that switch 7 has been pressed.

LCD's are very simple to interface with the controller as well as are cost effective. The ALPHANUMERIC display used here in Figure1 below is *4x20* (four lines & Twenty characters per line) shown in figure. It is connected to port two. The LCD requires 3 control lines (RS, R/W & EN) & 8 (or 4) data lines. The number on data lines depends on the mode of operation. If operated in 8-bit mode then 8 data lines + 3 control lines i.e. total 11 lines are required. And if operated in 4-bit mode then 4 data lines + 3 control lines i.e. 7 lines are required. How can one decide which mode to use? It's simple if sufficient data lines are available then go for 8 bit mode & if there is a time constrain i.e. display should be faster then it becomes mandatory to use 8-bit mode because basically 4-bit mode takes twice as more time as compared to 8-bit mode.

Fig.1

3.1 ***Algorithm for interface 8051 with DAC:***

Step1: Connect the P1 of 8051 with D0-D7 pins of DAC
Step2: Give +5v to VCC & Vref of DAC
Step3: Connect -12v to VEE of DAC
Step4: Connect OPAMP to OUT pin of the DAC With 5K resistor
Step5: Connect the oscilloscope to the OPAMP to View the output

Fig.2 Algorithm

Digital to Analog converters are required when a digital code must be converted to analog signal. It has eight digital input lines and an output line for analog signal. The number of data bits reduces resolution of DAC. Outputting digital data 00 to FF at regular intervals to DAC, results in generation of different waveforms namely square wave, triangular wave, sine wave etc.

Procedure for interfacing Microcontroller unit with DAC-0808:

3.2 ***Block Diagram***

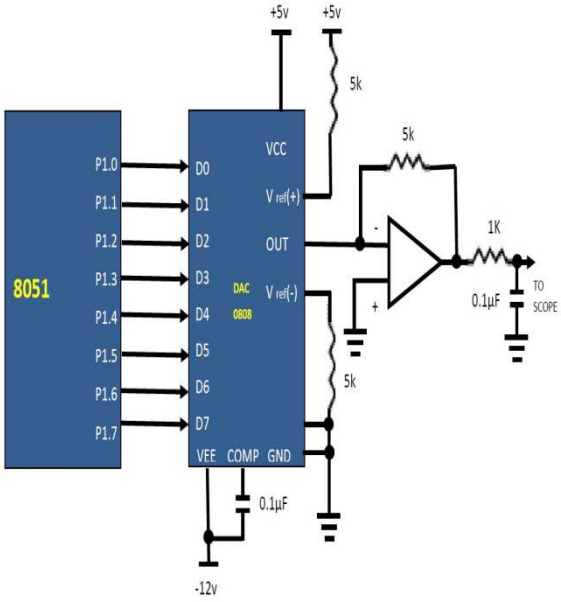

Fig.3 Circuitry of DAC

4. RESULTS

Thus Microcontroller 8051, when interfaced with DAC-0808 and at the output we get Square wave and Triangular wave respectively. It is shown in the figure below.

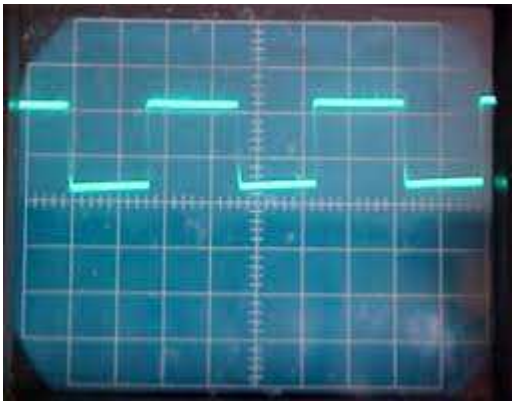

Fig.4 Square Wave

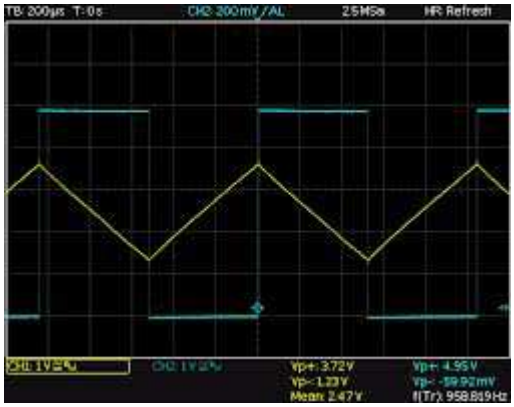

Fig.5. Traingular Wave

5. CONCLUSION

DAC interfacing with microcontroller was successfully implemented which helps to obtain the square and triangular waveforms for a given set of digital inputs.

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