

Sampling / Reconstruction Demonstration

ELEC3730 - Embedded Systems.

Introduction

This tutorial addresses the use of the analog to digital (A/D) and digital to analog (D/A) converters on the M16C development boards. It demonstrates how to sample a signal using an analog-to-digital converter, do some simple processing (to change the amplitude of the signal), and then use a digital-to-analog converter to output the new signal.

The use of the keypad and LCD display is also illustrated in this tutorial, so that in summary we will cover the following features of the M16C development boards:

- A/D converter to sample the voltage signal you input,
- D/A converter to reconstruct an output waveform,
- Keypad and LED to allow the user to set the gain, thus changing the amplitude of the output,
- Timers, and
- Interrupts.

This demonstration provides a framework with which more complex systems can be constructed, such as required in your final design assignment.

Setting up the Hardware

1. Gather the following items in addition to the M16C board.
 - 2 x BNC to BNC cable,
 - a Waveform Generator, and
 - an Oscilloscope.
1. Turn on the M16C.
2. Connect the output of the Waveform Generator to the A/D input of the M16C.
 1. Set the waveform generator to 100Hz, 1V amplitude.
 2. Connect the D/A output of the M16C to the input of the Oscilloscope.
 3. Set the oscilloscope controls to AC, 500mV/DIV, sweep 20ms/DIV.

Setting up the Software

1. Copy the contents of the /resources directory of the m16c_tut4.zip file to a convenient location.
2. Start the Tool Manager. Start the KD30 debugger. Load the gain.x30 module into KD30 if

- required.
3. Hit Go to start the program.

Using the Tutorial Demonstration

Keypad keys '0' to '3' are used to set the gain of the A/D->D/A transfer to a number between '0' and '3' respectively and inclusively. The currently selected gain will be displayed on the LCD. Experiment with the signal generator output amplitude and frequency to validate that this gain is implemented correctly.

How it Works

On entry the program initialises the hardware then enters an endless loop whereby it checks for keys pressed on the keypad. On finding a key pressed it changes the value of the gain, depending on the key pressed, then displays the current gain on the LCD screen.

Meanwhile an interrupt service routine is being called every 1ms. This service routine reads a sample from the analog to digital converter, multiplies it by the gain, then writes it to the digital to analog converter.

Going Further

You may use the software example in the zip file accompanying this tutorial as a base for beginning your final design assignment. For example, you could now start to experiment with converting the input read via the A/D to a fixed point voltage representation to be displayed on the LCD display – this would achieve the voltmeter component of the design specification. You could then experiment with outputting sine waves, square waves etc out the D/A converter, and then build from there.

Thanks to Jacob Hart, John Dalton and Dale Bates for detailed help in input in the development of this tutorial.