

DE0-nano ADC App-Note

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This app-note is a guide on how to properly set-up and use the DE0-nano's integrated ADC. Whilst there are tutorials available from Altera, some details are ignored – This will work as a more detailed tutorial.

Preface:

ADC stands for Analog-to-Digital converter; this device samples an analog signal and converts it into a value. The DE0-nano provides 8 different ADCs, each of which provide converted values of 12-bit accuracy.

Setup ADC:

- [1] Connect device into the right pins.
- [2] Make sure all signals connected into the pins are properly grounded into the ground pin of the board.
- [3] In Qsys, add the ADC subsystem in the library University Program -> Generic IO -> DE0-Nano ADC Controller.
- [4] Add as many channels as needed, to a maximum of 8 channels, and the required frequency.
- [5] Wire the ADC into the rest of the system in Qsys, just like any other subsystem.
- [6] After generation, change the top file and add the required pins: SCLK, CS_N, DOUT, and DIN.
- [7] Altera's tutorial for ADC explains in detail how to use uC/OS-II to take advantage of the ADC. However it fails to specify that every time data is obtained from any channel, only the 12-bits that matter must be masked as follows:

```
Data = alt_up_de0_nano_adc_read(adc, channel) & 0xFFF;
```

To ensure that any extra bits are zeroed out, and a proper value is obtained. As good embedded programming practice, one should always mask any data being obtained from other subsystems to ensure that no garbage values are obtained.

Below is provided an improved example on how to use the ADC properly:

```
#include "altera_up_avalon_parallel_port.h"
#include "altera_up_avalon_de0_nano_adc.h"

int main(void){
    alt_up_de0_nano_adc_dev * adc;
    unsigned int data;
    int channel;

    /* Initialize all the variables */
    data = 0;
    channel = 0;
    adc = alt_up_de0_nano_adc_open("/dev/ADC");

    while (adc != NULL)
    {
        alt_up_de0_nano_adc_update(adc);

        /* Obtain the data and mask the first 12 bits */
        data = alt_up_de0_nano_adc_read(adc, channel) & 0xFFF;
        data = data / 16;

        printf("Channel %d has value %d \n", channel, data);

        if (channel < 8)
            channel++;
        else
            channel = 0;

        OSTimeDlyHMSM(0, 0, 3, 0);
    }

    return 0;
}
```

References:

[1] ftp://ftp.altera.com/up/pub/Altera_Material/12.1/Tutorials/DE0-Nano/Using_DE0-Nano_ADC.pdf

[2] http://en.wikipedia.org/wiki/Analog-to-digital_converter