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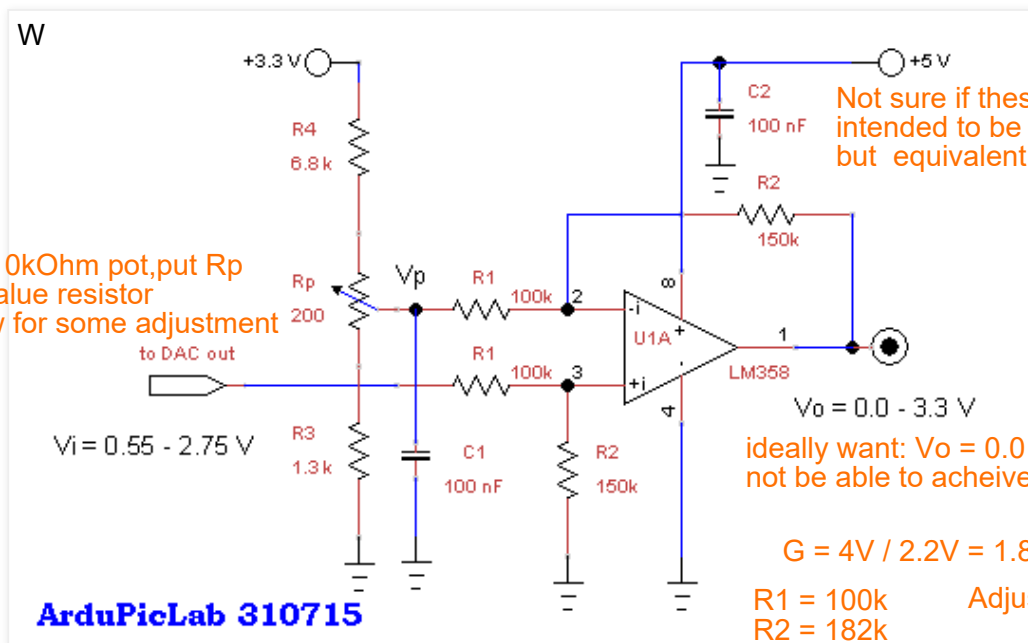
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Monday, 27 July 2015

How to modify analog output range of Arduino Due

Arduino Due does not have an analog output voltage from 0 V to Vref, but from 1/6 to 5/6 of the reference voltage, that is, 0.55 V and 2.75V with Vref = 3.3 V. This is also confirmed by the Atmel (see bibliography). The output voltage range of the DAC is only $2.75 - 0.55 = 2.2$ V, with a resolution of $2.2/4095 = 0.5372$ mV. A simple differential amplifier, realized with an op amp, is used to remove the 0.55 V offset and to amplify the output signal in order to reach the desired value. The following figure shows the scheme of this circuit:



To generate the voltage $V_p = 0.55\text{ V}$, that is, the minimum value of the DAC, is used the divider formed by R_3 , R_4 and R_p . The trimmer pot R_p is used to adjust V_p in order to have an output value close to 0 V in correspondence with the number 0 sent to the DAC. With a single power supply you can never get exactly 0V but you approach some mV, about 8 in my prototype.

The differential amplifier has the following gain:

$$G = V_o/(V_i - V_p) = R_2 / R_1$$

Just change the gain, for a different output voltage, but less than 4 V .

With a gain $G = 3.3 / 2.2 = 1.5$, the output of this circuit has the desired range from 0 to 3.3V .

It is recommended to use resistors with a tolerance of 1% or less, particularly for the four resistors of the amplifier. Don't use operational amplifier as LM741, LM1458, TL081 and other that are not suitable for single-supply.

References

- 1) "Atmel ARM Cortex-M3 Product Family (SAM3)", Atmel application note 42187A-SAM-10/2013

Posted by [Giovanni Carrera](#) at 15:49



Labels: [Arduino Due](#), [DAC](#)

7 comments:



Osqui 12 August 2015 at 23:03

This should be placed somewhere in Arduino's site. If not in a official page, in Playground at least. Thanks for your job

[Reply](#)



Giovanni Carrera  13 August 2015 at 07:09

Yes, I did it yesterday, in Megatopic (in Italian) and replying to some questions in the Arduino Due Forum, inserting this link, Thanks for your interest

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Unknown 10 April 2019 at 12:12

my problem input voltage 0.7V-4.3V output voltage 0-5V how to analysis circuit,

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Brian_vz 29 April 2019 at 21:24

It's the same principle.

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Brian_vz 29 April 2019 at 21:29

Interesting article!, I've worked with the LM741 Very well, i didn't understand the "single-supply" thing you said.

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Lalaggn 10 June 2019 at 12:08

Hello,
What is the formula for a voltage divider and a potentiometer ?
Because the resistor from the potentiometer should appear in the formula ..

Thanks

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Unknown 15 January 2020 at 11:01

hi,
i am working on a simple circuit in which i use ADC's output as DAC's input. since the voltage range is different for both i wanted to use this concept to modify the offset voltage so that the range of DAC is same as ADC's (0v - 3.3V). but i used the differtial amplifier without capacitor's and pot (instead used 0.55V input as suggested $V_p = 0.55V$ and $V_i(DACout) = 0.55V$), which gave output $V_0 = 0.03V$. when $DACout = 2.75$ then $V_0 = 2.62V$ but the reuired $V_0 = 3.3V$. is this because of not using capacitors? i am ataaching the circuit diagram link i used with its values please let me know the changes to be done and if i have to use capacitors will 100nF work with these resistors?

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Op Amp used is LM324N

$V_1 = V_p = 0.55V$; $V_2 = DACout(0.55V - 2.75V)$

$R_1 = 22K$ ohms ; $R_2 = 10K$ ohms ; $R_f = 33K$ ohms ; $R_g = 10K$ ohms

have given Vcc and ground connections too (+12V).

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