TMS320 DSP
DESIGNER'S NOTEBOOK

TMS320C5x DSK Analog I/O

APPLICATION BRIEF: SPRA246

Gerald Capwell
Digital Signal Processing Products
Semiconductor Group

Texas Instruments
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TEXAS INSTRUMENTS

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CONTACT INFORMATION

US TMS320 HOTLINE	(281) 274-2320
US TMS320 FAX	(281) 274-2324
US TMS320 BBS	(281) 274-2323
US TMS320 email	dsph@ti.com

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Abstract

The ’C5x DSK is designed to directly connect to a microphone and an 8 Ω speaker via RCA jacks. The I/O RCA jacks are directly connected to the dual A/D and D/A converter called the Analog Interface Circuit (AIC). In some instances, the microphone does not generate the signal level required for the AIC to detect and convert the signal. It is suggested that a dynamic or amplified (pre-amp) microphone be used to ensure the appropriate signal level is achieved. The output signal from the AIC can be heard if the connected speaker is small, low power, and easy to drive

An inexpensive option is to build a pre-amp for the input and a speaker driver for the output using a few operational amplifiers and other components. This document explains how to do this, with schematics and output waveforms.

Design Problem

Sometimes the TMS320C5x DSK does not respond to a microphone input. Does the DSK require a pre-amp on the input and an output driver?

Solution

The ’C5x DSK is designed to directly connect to a microphone and an 8 Ω speaker via RCA jacks. The I/O RCA jacks are directly connected to the dual A/D and D/A converter called the Analog Interface Circuit (AIC). In some instances, the microphone does not generate the signal level required for the AIC to detect and convert the signal. It is suggested that a dynamic or amplified (pre-amp) microphone be used to ensure the appropriate signal level is achieved. The output signal from the AIC can be heard if the connected speaker is small, low power, and easy to drive.

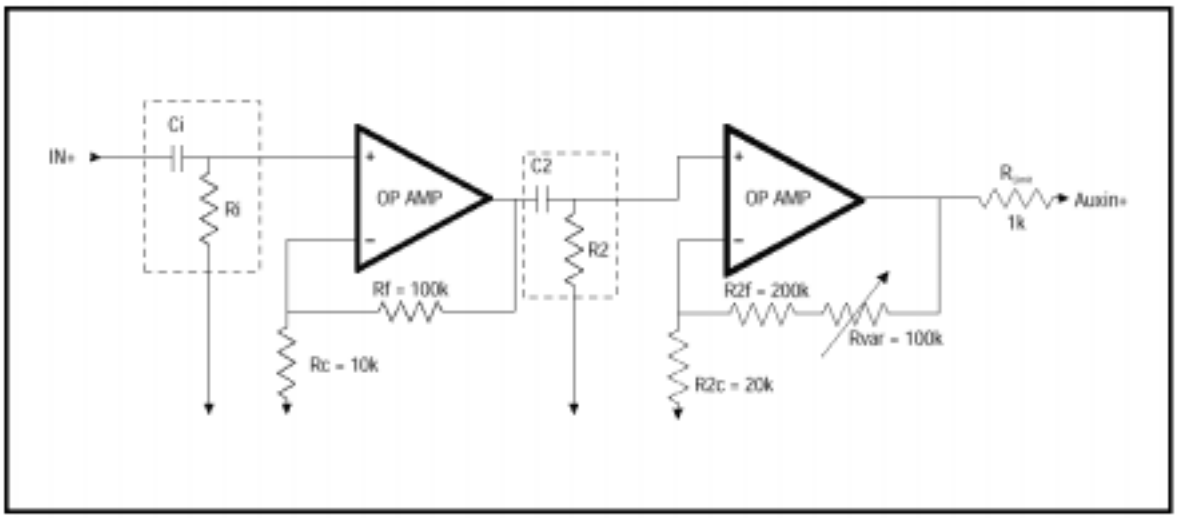
An inexpensive option is to build a pre-amp for the input and a speaker driver for the output using a few operational amplifiers and other components. These are explained below:

Input Pre-Amp

The AIC provides the user with two pairs of inputs called IN+, IN- and AUXIN+, AUXIN- and one pair of outputs called OUT+ OUT-. The AIC also has the option to run in single-ended or differential input modes. The DSK always runs in single-ended mode using the IN+ input, therefore the IN- pin is grounded. The design below takes the signal from the RCA jack (connected to IN+), amplifies the signal, and outputs it to the AUXIN+ pin. Hence, an unamplified (IN+) signal and an amplified (AUXIN+) signal are both available to the AIC by using the same RCA input jack.

The main concern when designing a pre-amp for the ’C5x DSK is not to exceed the maximum input voltage to the AIC. Referencing the AIC data sheet in the ’C5x DSK User’s Guide page B-18, the IN+ and AUXIN+ maximum voltage running in single-ended mode is V_{dd} + 0.3 V. In this case, the supply voltage, V_{dd}, is 5.0 V, making the op-amps drive approximately 4.5 V maximum (rail-to-rail). Typically a dynamic microphone generates a range of 10–30 mV, therefore you can amplify the input by 150 and still remain below the op-amp’s saturation point and the AIC maximum rating. The circuit shown in Figure 1 is a two-stage amplifier with a variable gain of 100 to 150. The first stage gain A_v = 10 is fixed and cascaded with the second stage which has a variable gain A_v = 10 to 15.

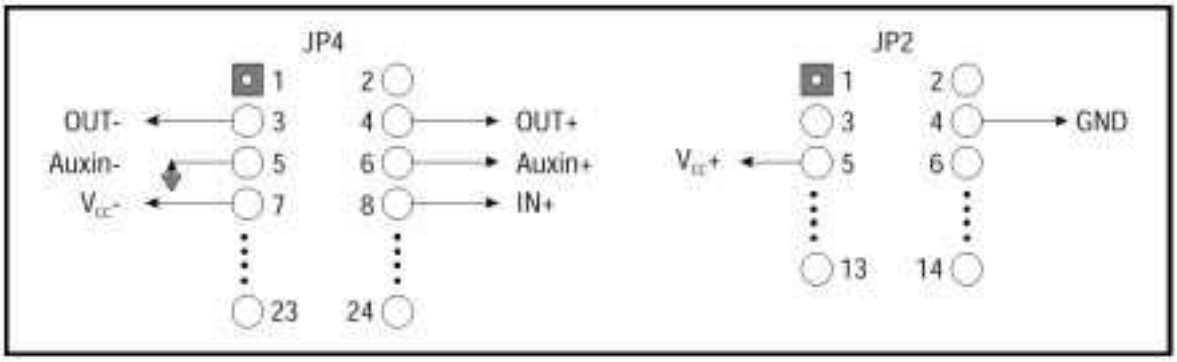
Figure 1. Pre-amp Schematic



The components boxed-in with the dashed lines may be required in order to minimize the effects of the DC offsets associated with the operational amplifirs, especially when cascading them together. Since the circuit multiplies the input by only 150, the effect of the DC offset should be minimal. The offset may vary depending on which op-amp is used. To minimize offset, the user can null the op-amp using the null pins if available, and make sure Ri and R2 are equivalent to $R_c||R_f$ and $R2_c||R2_f$ respectively.

The input of the pre-amp is connected to the RCA input jack which is actually the IN+ pin. Access to the IN+ pin is possible through connecting to pin 8 of the JP4 header on the DSK illustrated in Figure 2. The output of the pre-amp is connected to the AUXIN+ located at pin 6 of the JP4 header. AUXIN- pin located at pin 5 of the JP4 header should be grounded. Power (5.0 V) and ground are available at the pins illustrated in Figure 2.

Figure 2. DSK JP2 and JP4 Header Connections



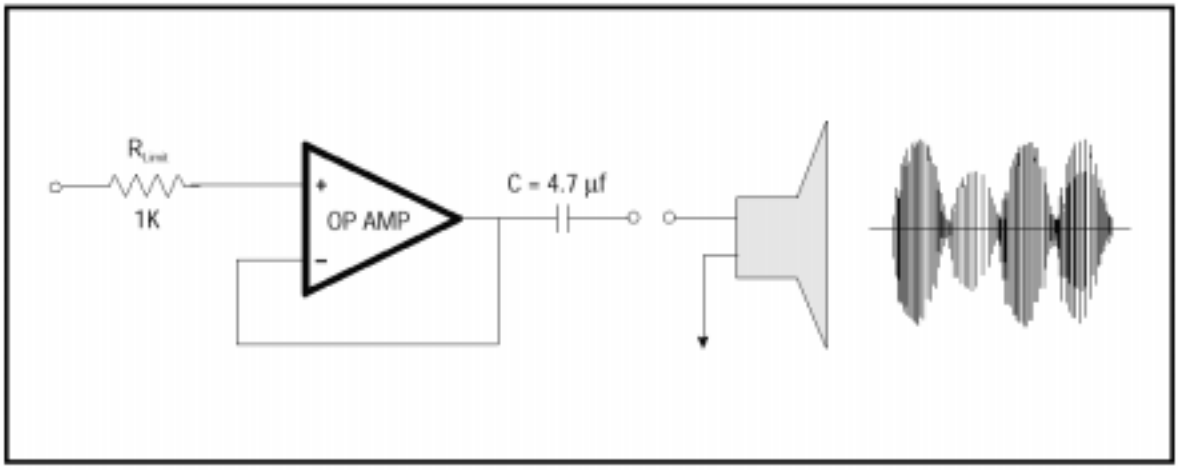
Output Driver

The output driver shown below is a simple buffer or voltage follower. The op-amp output impedance is minimal and is capable of driving an 8 Ω speaker through the decoupling capacitor.

The input to the driver is connected to the OUT+ pin located at pin 4 of the JP4 header. The output of the driver must be connected to an additional RCA jack. You CANNOT use the existing output jack, since it is connected to the OUT+ pin.

NOTE:
Do not connect the driver output to the existing DSK output jack. This may severely damage the DSK.

Figure 3. Output driver schematic



In order for the AIC to select the AUXIN+ amplified signal, you must set bit 4 of the AIC Control Register when initializing the AIC (see page B-14 of the 'C5x DSK User's Guide). The output driver can drive most 8 Ω desktop speakers.