

Op Amp Gain and Offset Trim Using Renesas Digitally Controlled Potentiometers (XDCPs)

Introduction

Many system configurations require multiple transducers to be normalized for gain or offset, prior to further A to D conversion or signal processing. The Renesas X9241A quad XDCPs can provide an elegant and efficient solution for performing these tasks under microprocessor control.

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1. Configurations

The configuration in Figure 1 shows two dual op amps being controlled by a single quad XDCP. The gain range in this configuration can be trimmed between -0.5 to -2.0 over 64 steps. Increasing R5 and R6 (for example, the feedback determining network in U2a) to 100k Ω change the gain trim range to between -0.91 to -1.1. The inverting configuration shown is suitable as this allows input signals to vary from $\pm 6V$ without violating the digital pots terminal voltage specifications of $\pm 5V/-3V$.

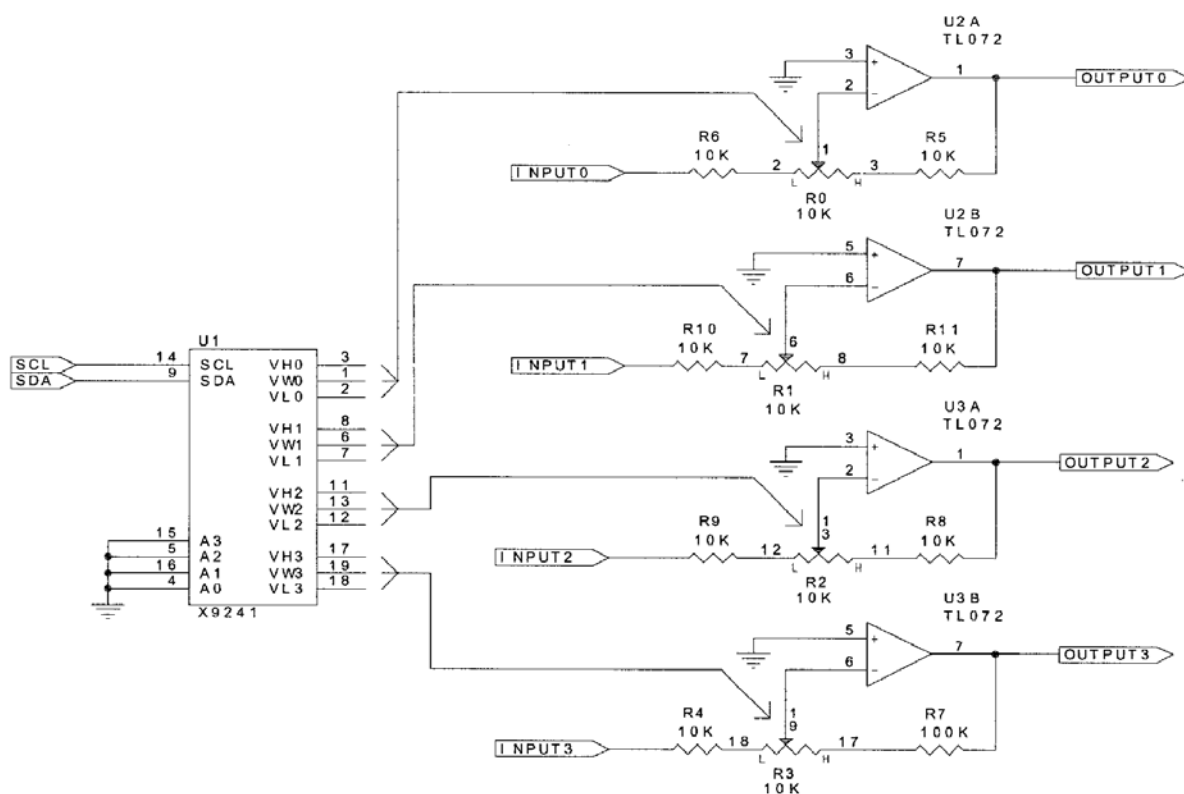


Figure 1. X9241A Controlled Gain Adjust

Figure 2 shows an offset trimming configuration for the same pair of dual op amps. This configuration yields an offset trimming range of $\pm 300\text{mV}$ over 64 steps. The offset range can be increased or decreased by changing the value of R13 (in amplifier U2a for example). To decrease the offset range to $\pm 40\text{mV}$ with finer resolution, but less range change R13 to $1\text{m}\Omega$. This configuration ensures that the X9241A operates within the specified terminal voltage range of less than $\pm 5\text{V}/-3\text{V}$.

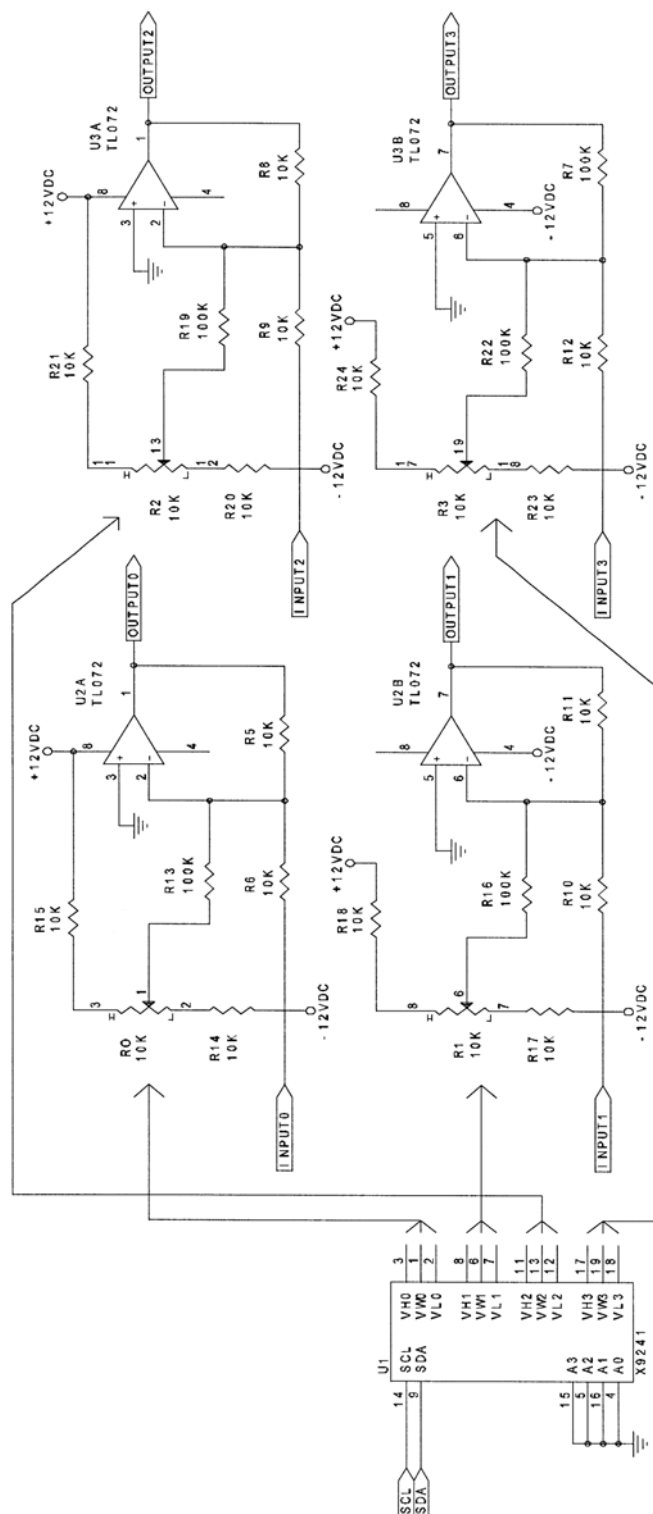


Figure 2. X9241A Controlled Offset Adjust

2. Potpourri Amplifier

Figure 3 illustrates a microprocessor controlled circuit that can provide adjustable gain from -1 to infinity with two of the pots of the quad X9241AW XDCP. The other two pots can be ganged together using the cascade mode for extended offset range. The purpose of this circuit is not to solve a particular analog signal processing problem, but rather to demonstrate the analog control flexibility that can be attained with the X9241A.

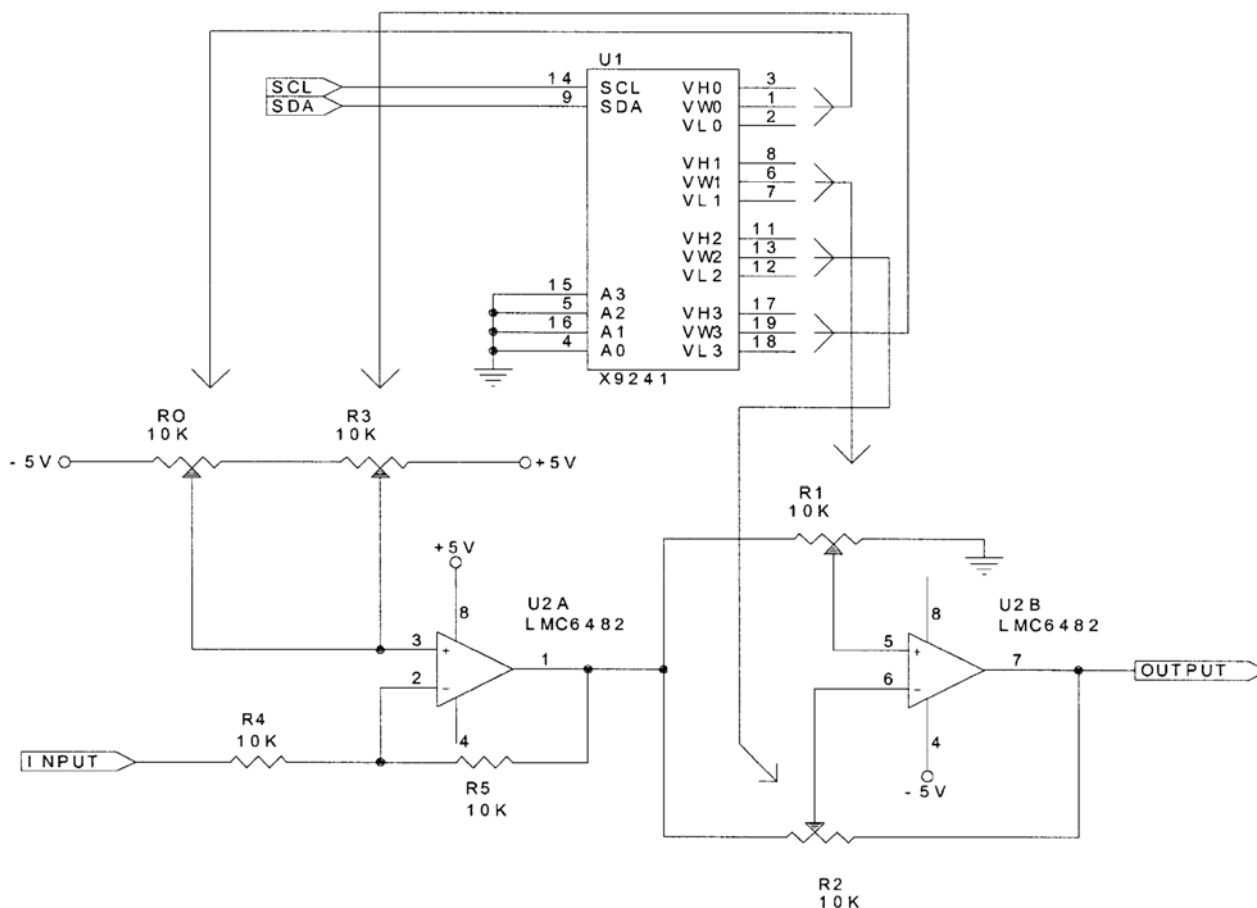


Figure 3. Extended Range Gain Adjust

With R2 set to 0 and R1 set to 63, the overall gain from input to output is -1. Gain values in the range 0 to -1 can be set over 64 steps by incrementing the value of R1. Setting R1 back to 0 and setting R2 to 32 results in an overall gain of +1. Increasing R2 to 63 yields a gain of plus infinity. This is a positive comparator with the threshold level set by the cascade combination of R0 and R3. National Semiconductor's LMC6482 is a good amplifier for this application because of its rail-to-rail input and output range.

3. Revision History

Revision	Date	Description
1.00	Oct 22, 2026	<ul style="list-style-type: none">▪ Applied latest template▪ Added Revision History section
0.00	Jun 28, 2005	Initial release

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