Resolver Excitation Circuitry

Power Flow Systems

Abstract:

This article tries to introduce an analog signal conditioning circuit used to drive a resolver. Here you can learn more about resolver. The main concern is how to drive the resolver excitation, considering the input voltage and acceptable frequency range.

1. **Signal conditioning:**

   Most of the times, a high voltage (generally >= 10 V) is necessary to drive a resolver. Resolver excitation coils can have a very low dc resistance (< 100 Ω), requiring a sink and a source of up to 200 mA from the excitation driver. The op amp on the last stage of the circuitry (connected to the resover excitation coil) should be able to source and sink this amount of current. In addition, using op amps with current-limiting and thermal-shutdown protection in a resolver design can increase the life of the end product. The selected op-amp must have a high-gain bandwidth for filtering, a fast slew rate, and the ability to continuously drive a high output current (sinking and sourcing up to 200 mA). If the chosen op-amp with high output current capability is not fast enough, an additional fast op-amp is required for the filtering stage of the circuit. Please note all the suggested circuitries in this article are based on assumption of using a high-speed op-amp with high output current drive capability.

2. excitation circuitries:

Depending on the input signal, the resolver excitation circuit can be classified to single-to-differential and differential-to-differential catogories.

2.1. single-to-differential:

In case of having a single signal as input, the output of the amplifier is connected to another amplifier for filtering and generating the complimentary output differential signal. To drive a resolver for a given power supply, the schematic described in Fig.1 can be used.

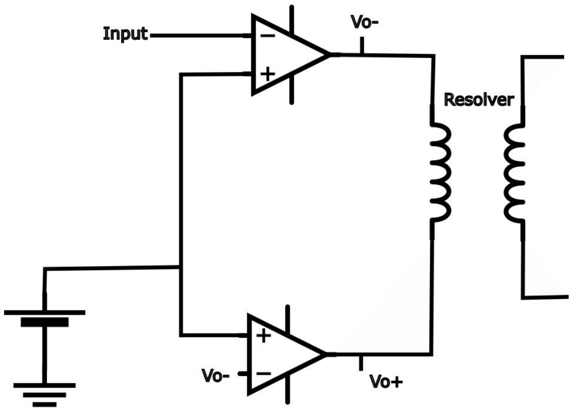

Fig.1. General Single-input and differential-output resolver excitation circuitry

In this case, the input signal is generally in PWM from generated by microcontroller or other forms generated by a R2D IC.

2.1.1. Example 1:

Assuming the single input signal contains fundametal frequency of 10KHz, we consider two scenarios:

- **Scenario 1**: Excitation signal is generated using PWM input with 200KHz switching frequency,
- **Scenario 2**: Excitation signal is generated using sinosoidal input with 150KHz harmonic frequency and 20% of fundamental amplitude.

Using a first order filter to increase the amplitude and to filter the noise, the following circuit is suggested:

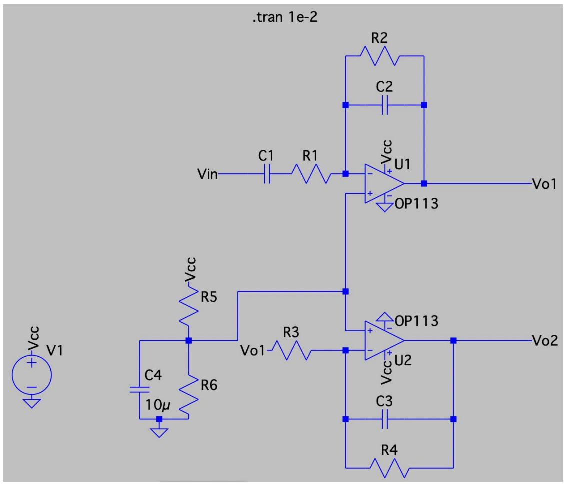

Fig.2. Single- input and differential-output resolver excitation circuitry using a first order filter

Fig.3 and fig.4 are showing the input/output signals for scenario 1 and scenario 2 respectively.

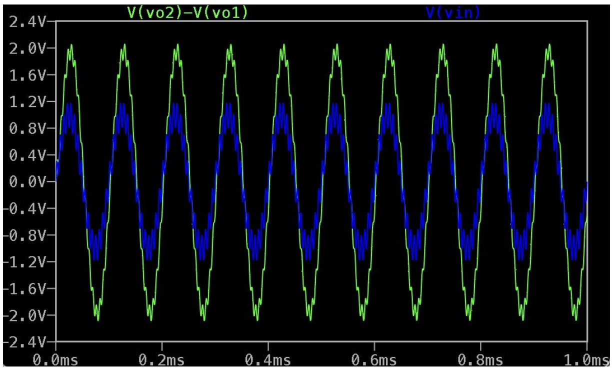

Figure 3. sinosoidal input with 10KHz fundamental and 150KHz switching noise, when using first order filter

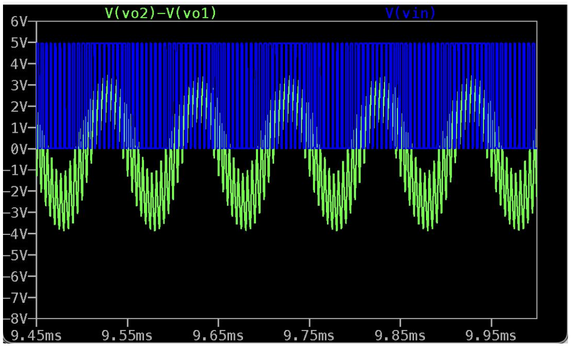

Fig 4. PWM input with 10KHz fundamental and 200KHz switching noise, when using first order filter

2.1.2. Example 2:

For the same requirement as example 1, but using a second order filter to increase the amplitude and to filter the noise, the following circuit is suggested:

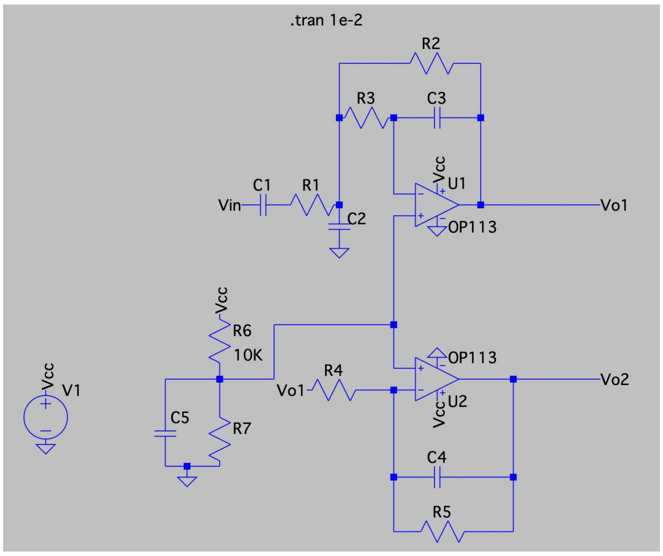

Figure 5. Single- input and differential-output resolver excitation circuitry using a second order filter

Fig.6 and fig.7 are showing the input/output signals for scenario 1 and scenario 2 respectively.

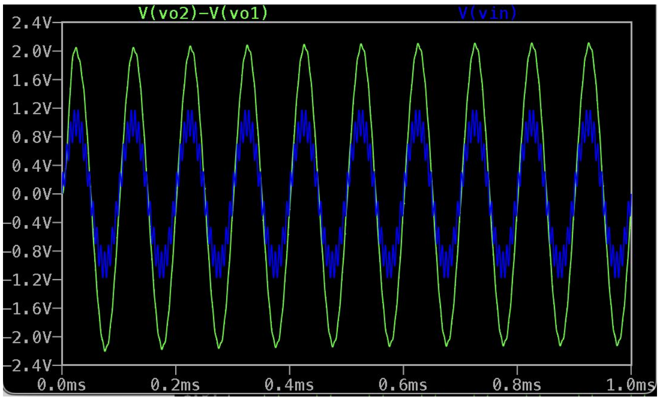

Figure 6. sinosoidal input with 10KHz fundamental and 150KHz noise, when using second order filter

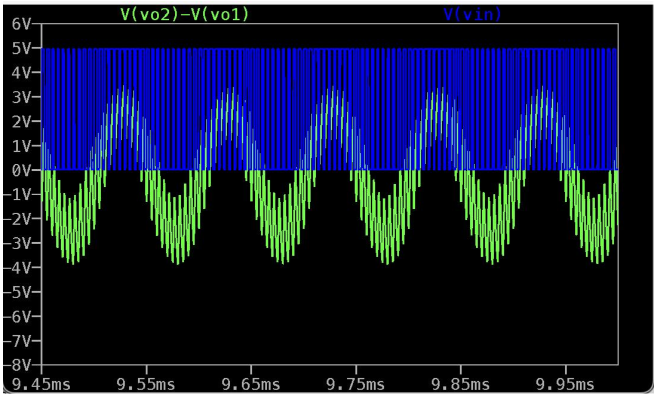

Figure 7. PWM input with 10KHz fundamental and 200KHz switching noise, when using second order filter

2.2. Double-to-differential:

In case of using R2D ICs with complimentary excitation outputs, or complimantry PWM signals from microcontroller (PWMP and PWMN), The following circuit would be useful:

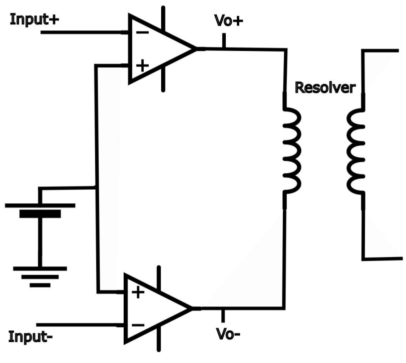

Figure 8. General Double-input and differential-output resolver excitation circuitry

2.2.1. Example 3:

Assuming the differential input signal icontains fundametal frequency of 10KHz and harmonics with 150KHz frequency and 20% of fundamental amplitude. Using a first order filter to increase the amplitude and to filter the switching noise, the following circuit is suggested:

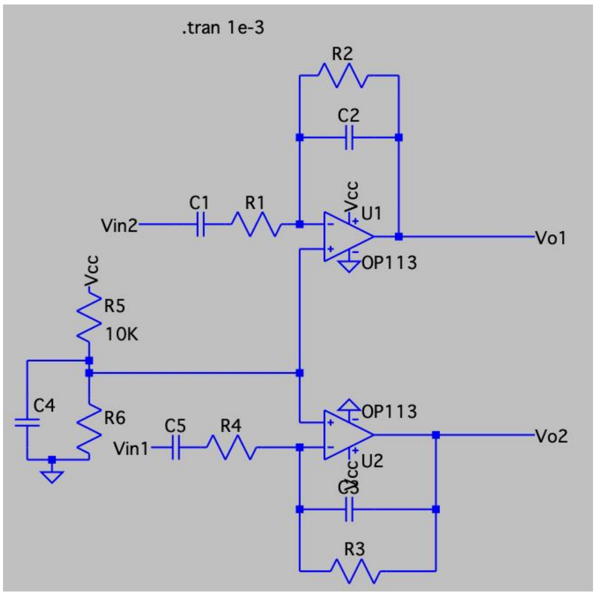

Figure 9. double-input and differential-output resolver excitation circuitry using a first order

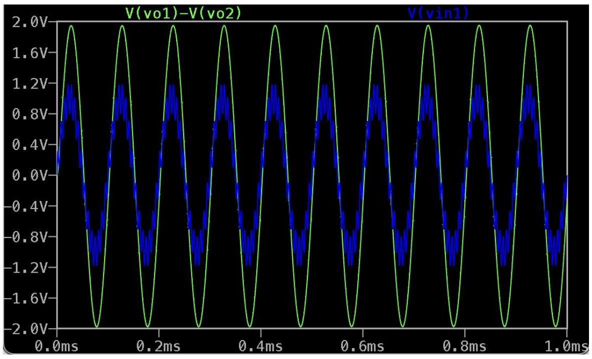

Figure 10. sinosoidal input with 10KHz fundamental and 150KHz noise, when using first order filter

2.2.2. example 4:

For the same requirement as example 3, but using a second order filter to increase the amplitude and to filter the switching noise, the following circuit is suggested:

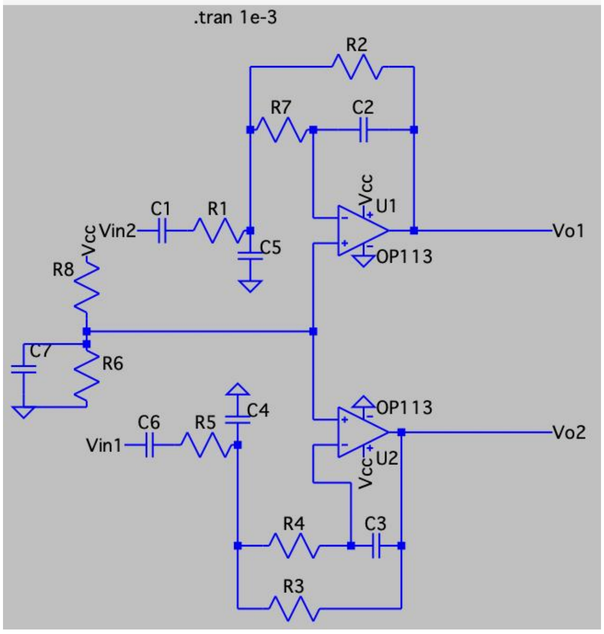

Figure 11. double-input and differential-output resolver excitation circuitry using a second order filter

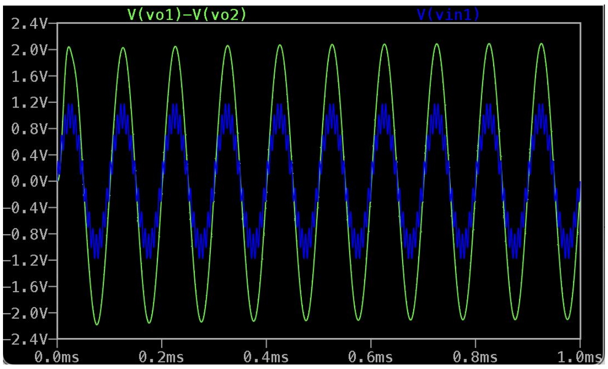

Figure 12. sinosoidal input with 10KHz fundamental and 150KHz noise, when using second order filter

for the simulation file, or more design information, contact us.