AN-1883 LM7705 Evaluation Board

1 General Description

This evaluation board is designed to demonstrate the functionality of Texas Instruments LM7705 Low Noise Negative Bias Generator. The board has a dual Operational Amplifier that can be connected to ground or biased with the on board LM7705. In the last case a True zero amplifier is demonstrated.

2 Basic Operation

The LM7705 is a switched capacitor voltage inverter with a low noise, −0.23V fixed negative voltage regulator. This device is designed to be used with low voltage amplifiers to enable the amplifiers output to swing to zero volts, having a single supply. The -0.23 Volts is used to supply the negative supply pin of an amplifier. Rail-to-rail output amplifiers cannot output zero voltage when operating from a single supply voltage and can result in error accumulation due to amplifier output saturation voltage being amplified by following gain stages. A small negative supply voltage will prevent the amplifiers output from saturating at zero volts and will help maintain an accurate zero through a signal processing chain. This is illustrated in Figure 1.

Additionally when an amplifier is used to drive an ADC's input, it can output a zero voltage signal and the full input range of an ADC can be used. The LM7705 has a shutdown pin to minimize standby power consumption.

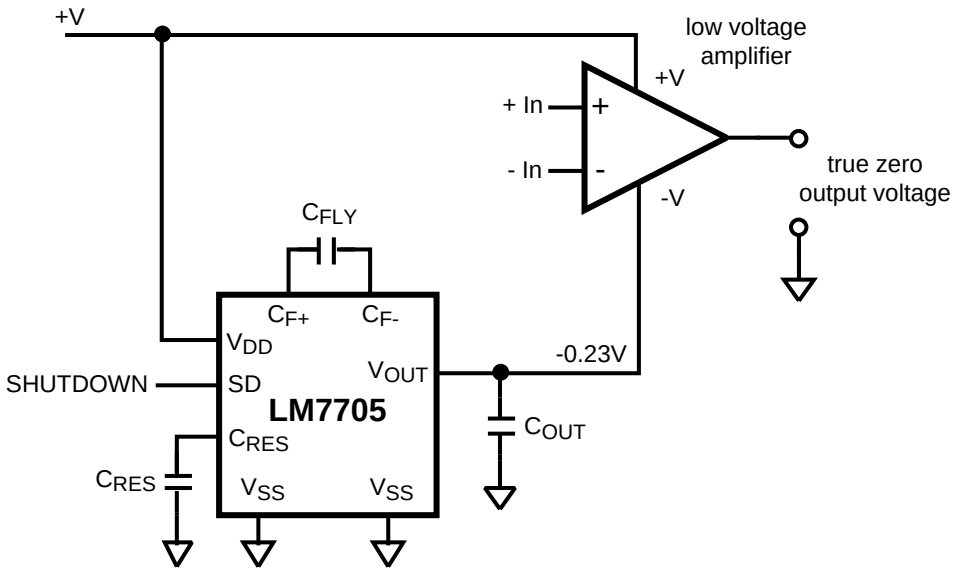

Figure 1. Typical LM7705 Application

3 Layout Considerations

Careful consideration for circuitry design and PCB layout will eliminate problems and will optimize the performance of the LM7705.

To ensure a clean supply voltage it is best to place decoupling capacitors close to the LM7705, between V_{DD} and V_{SS}. Another important issue is the value of the capacitors C_{FLY}, C_{RES} and C_{OUT}. In order to minimize the output voltage ripple low ESR capacitors are recommended.

4 LM7705 Evaluation Board Schematic

Figure 2 shows the schematic of the evaluation board.

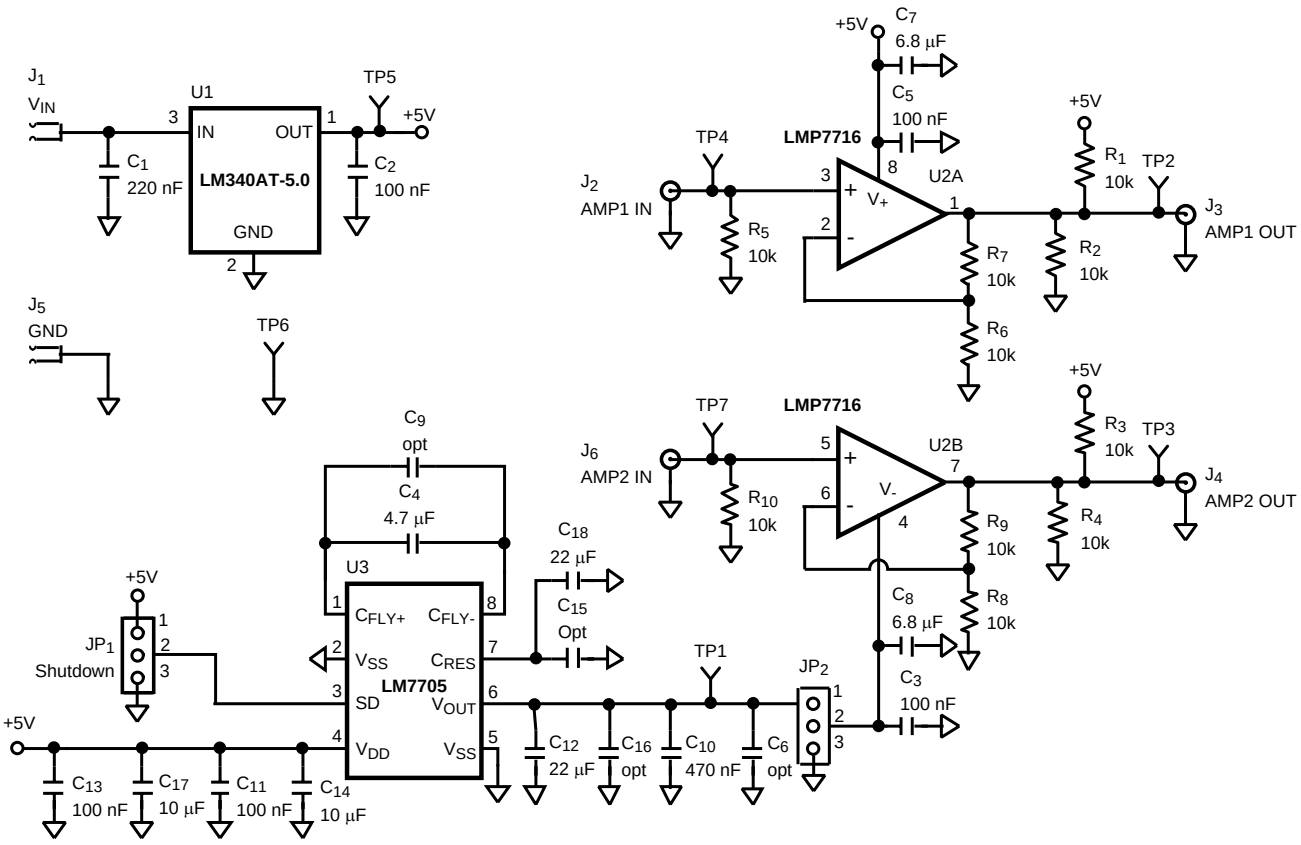

Figure 2. Schematic of the LM7705 Evaluation Board

5 LM7705 Evaluation Board Layout

The layout of the evaluation board is given in Figure 3.

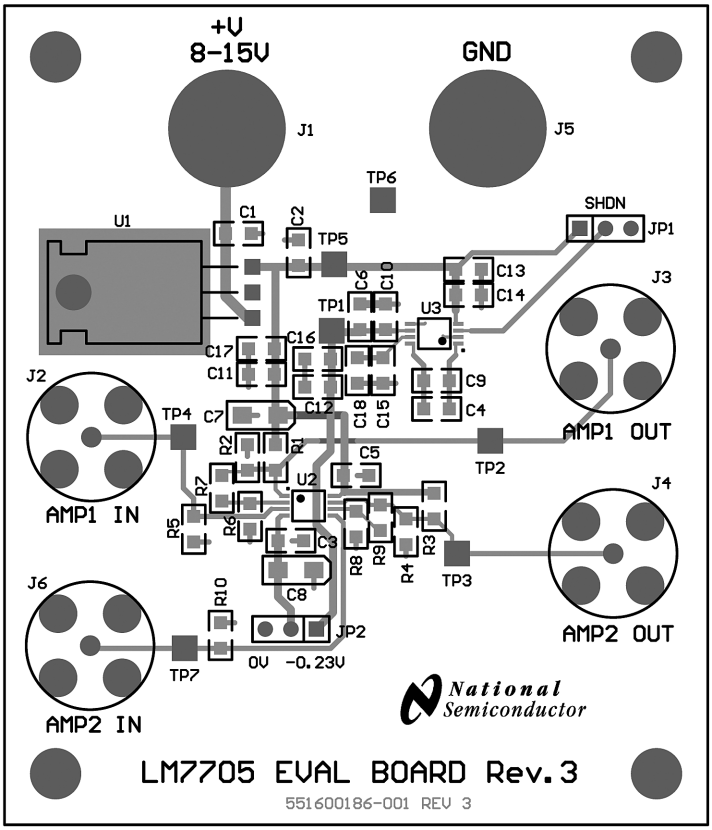

Figure 3. Layout of the LM7705 Evaluation Board

6 Bill of Materials

Table 1 lists the Bill of Materials of the evaluation board.

Table 1. Bill of Materials

Designator	Description	Comment
R1, R2, R3, R4, R5, R6, R7, R8, R9, R10	0805 Resistor	10 kΩ
TP1, TP2, TP3, TP4, TP5, TP7	testpoint	white
TP6	testpoint	black
JP1, JP2	3 PIN header	
J1, J5	Jack connector	staking .350
J2, J3, J4,J6	BNC	
U1	LM340	TO-220
U2	LM7716	VSSOP-8
U3	LM7705	VSSOP-8
C1	0805 capacitor	220 nF
C2, C3, C5, C11, C13	0805 capacitor	100 nF
C4	0805 capacitor	4.7 uF
C14, C17	0805 capacitor	10 uF
C12, C18	0805 capacitor	22 uF
C6, C9, C15, C16	Not Stuffed	
C7, C8	3216 capacitor	6.8 uF
C10	0805 capacitor	470 nF

7 Measurement Procedure

The performance improvement of an op amp (the device acts as a real True-zero amplifier, using the LM7705 for the biasing of the negative supply pin of the op amp), is shown in this section. The setup used for these measurements is given in Figure 4.

A supply voltage between 8V to 16V is provided to connector J1. The ground connection is wired to J5. The on board 5V regulator provides a constant supply voltage for the op amps and the LM7705. The LM7705 can be activated by placing jumper JP1 in position 2-3. A signal generator is connected to J6 and generates a DC signal varying with a low frequency, with an amplitude of 25 mV_{PP}, and an offset of 12.5 mV. Both amplifier U2A and U2B have a fixed gain setting of 2x. The output signal of the amplifier (J4) can be observed with a digitizing oscilloscope or an Analog to digital Converter board and processing software. The voltage level of the negative supply voltage pin of the op amps can be selected with jumper JP2. Placing JP2 in position 1-2, will provide a voltage of −0.23 to the negative supply voltage pin of the op amp. Placing JP2 in position 2-3 will connect the negative supply voltage pin of the op amp to ground. In this way only the output behavior of amplifier U2B is observed.

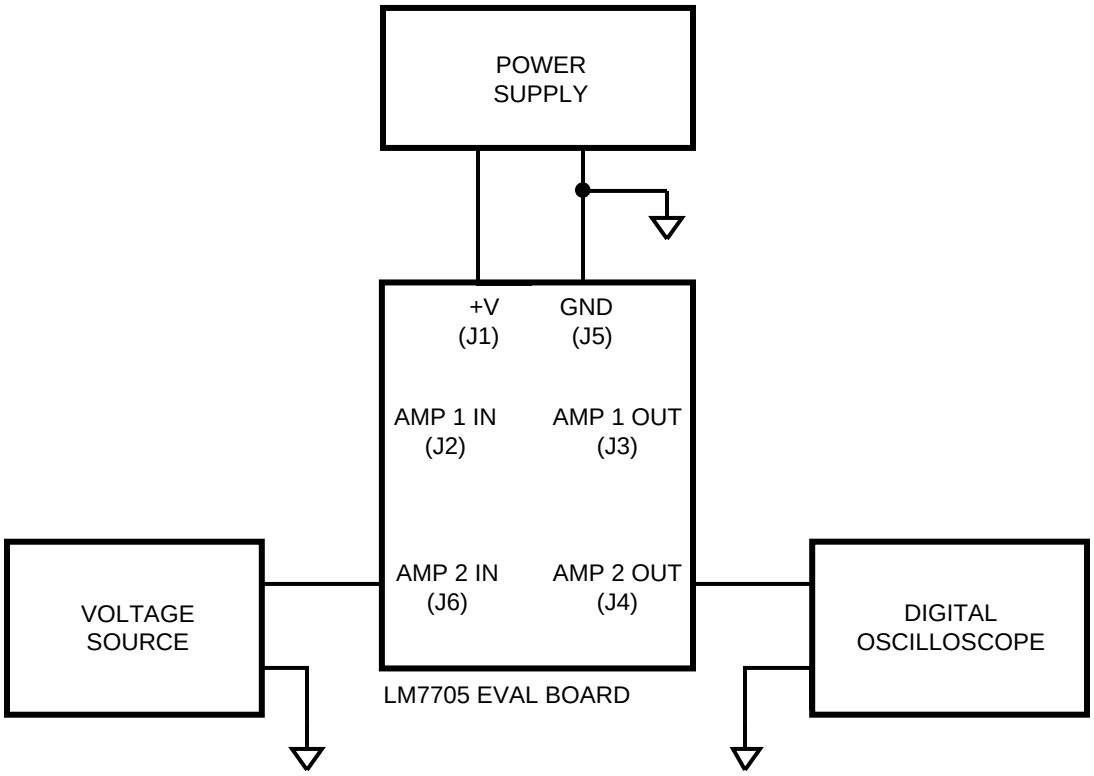

Figure 4. Measurement Setup

8 Measurement Results

Figure 5 and Figure 6 shows the output voltage of op amp U2B without and with the LM7705. Output voltage measurement is performed with a 12 bit ADC.

Figure 5 shows the output voltage of amplifier U2B, when the negative supply pin is connected to ground level. The voltage swing at the low side is limited by the saturation voltage of the amplifier. Figure 6 shows the output voltage swing of amplifier U2B when the negative supply pin is connected to the fixed negative output voltage of the LM7705. Using the LM7705 amplifier U2B can act as a True-zero amplifier.

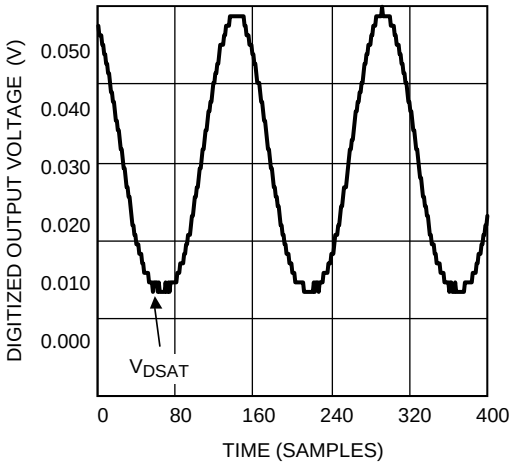

Figure 5. Amplifier Output Voltage without LM7705

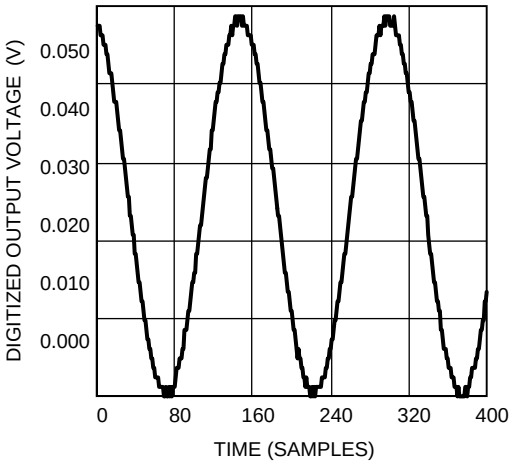

Figure 6. Amplifier Output Voltage with LM7705

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