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A simple circuit with an optocoupler creates a “tube” sound

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BY ROBERT GARCIA

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This simple scheme is based on the circuit shown below (**Figure 1**) in my recent article [1].

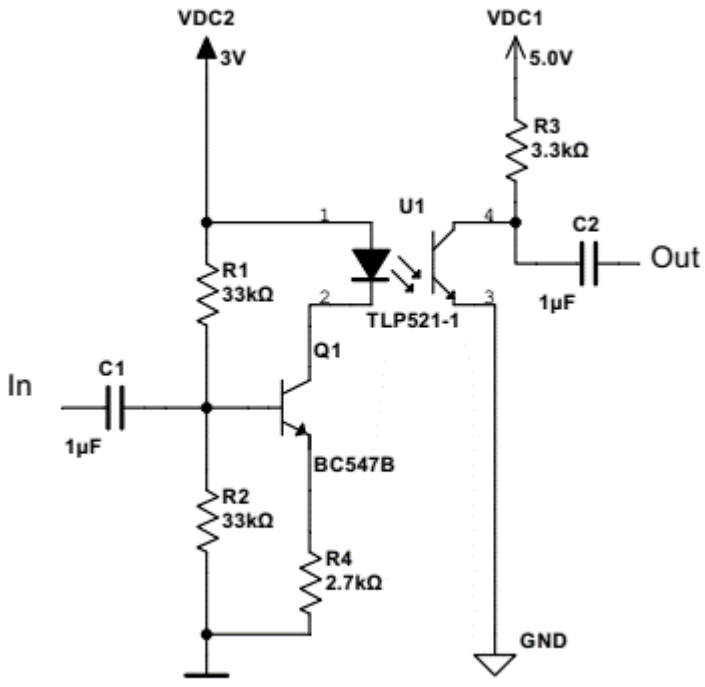


Figure 1 Using common transistor optocoupler to achieve a tube-like sound.

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It is known that the main feature of tube amplifiers is the presence of small distortions. In these distortions, the second harmonic prevails. Some optocouplers have a pass-through

characteristic close to the pass-through characteristic of the electron tube.

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An improved circuit with an optocoupler type TLP621 is shown in **Figure 2**.

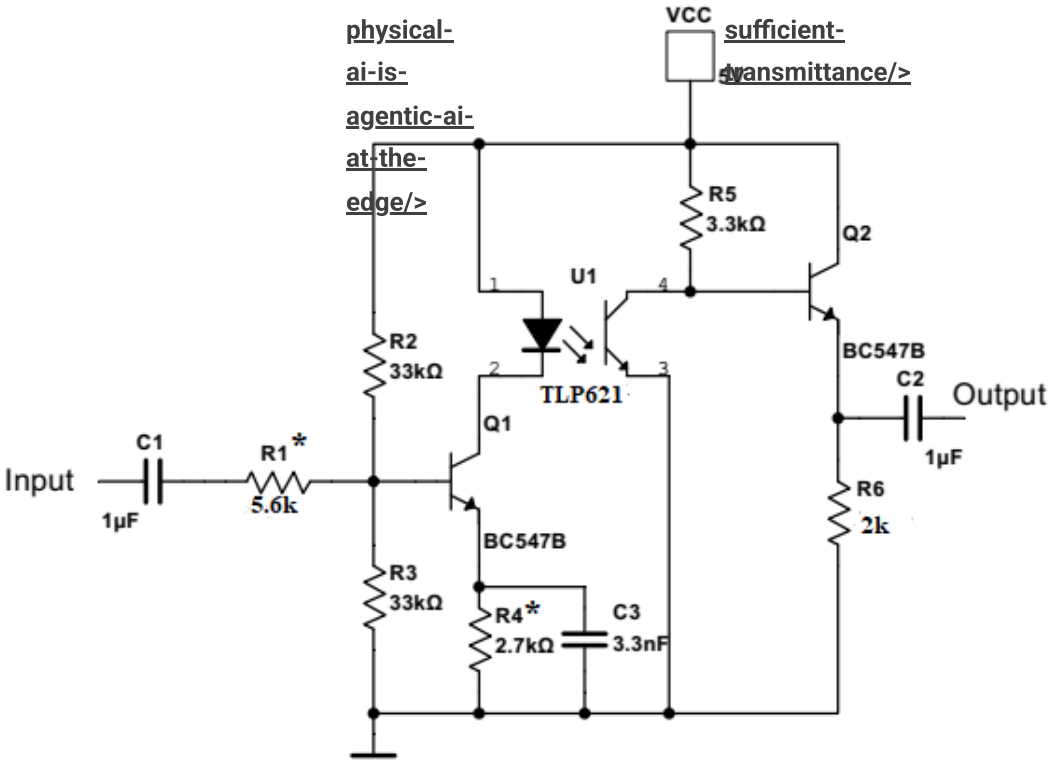


Figure 2 A circuit with an optocoupler (TLP621) which generates higher (even) harmonics that can be added to the original signal to achieve a tube-like sound.

Transistor Q1 creates a current through the optocoupler U1 LED corresponding to the input signal. The collector of the optocoupler phototransistor is connected to the emitter repeater on transistor Q2 and the signal from it is fed to the output of the circuit. The circuit parameters depend on the parameters of a particular optocoupler instance.

To adjust the gain, R1 (3-8 kΩ) is selected, and R3 is selected for the current of the operating point of the optocoupler 1. The value of this current is usually 0.670-0.750 mA.

With an input signal of about 200 mV RMS, the output signal spectrum has the one shown in **Figure 3**.

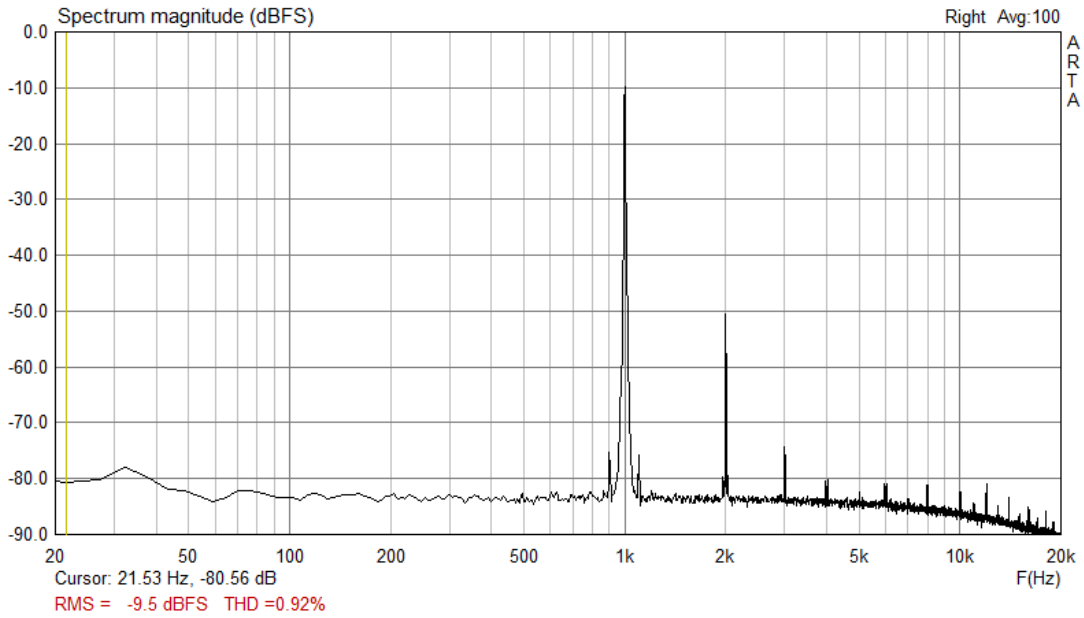


Figure 3 Output spectrum of the optocoupler circuit in Figure 2 with an input signal of 200 mV RMS.

As one can see, the second harmonic of a 5 to 15 W tube amplifier dominates the spectrum, and EL34 type lamps are used in the output stage.

Note: Expert opinion < https://nam04.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.quora.com%2FWhy-do-old-vacuum-tube-amplifiers-sound-so-rich-compared-to-modern-Transistor-FET-amplifiers%2Fanswer%2FVirgil-Sipes-1&data=05%7C01%7CAalyia.Shaukat%40aspencore.com%7C40d345fd40404f35a77e08db3fded4 and a US patent < https://nam04.safelinks.protection.outlook.com/?url=https%3A%2F%2Fpatents.google.com%2Fpatent%2FUS5424488A%2Fen&data=05%7C01%7CA are useful links on the topic of distortion.

Robert Garcia is a former audio electronic and electroacoustic engineer.

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Reference

1. Garcia, Robert. “Tube sound: about the benefits of the second harmonic.”habr. 4 Nov. 2022, https://habr.com/ru/articles/697508/ < https://habr.com/ru/articles/697508/>

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4 COMMENTS ON “A SIMPLE CIRCUIT WITH AN OPTOCOUPLER CRI A “TUBE” SOUND”



D.A. (Tony) Stewart

April 4, 2023

This design is a bit over-complicated because, any Class A amplifier can have 2nd harmor distortion based on the ratio quadratic effect of Vbe on Ic and the ratio of output current max/min, peak to peak.

This can easily be seen AC-coupled as the asymmetric gain or difference in AC coupled pe over the average in %.

Consider 10% distortion being 10% difference in the peak amplitudes for a THD ~ -20dB somewhat like illustrated below in the red plot. **https://tinyurl.com/2lknzlfc < https://tinyurl.com/2lknzlfc>** and peaks display for you to compute.

↪ **Log in to Reply**



WStephenWoodward

April 5, 2023

Exactly right. Imagine how surprised Harold Black (the inventor of negative feedback) wou
to hear that some folks actually think of amplifier nonlinearity and distortion as good thing

↳ **Log in to Reply**



Paul Perry

April 6, 2023

I wonder if the patent examiner who refused to give Mr Black a patent for negative feedba
would have given one for a circuit that INCREASED distortion!

↳ **Log in to Reply**



WStephenWoodward

April 12, 2023

You know, if you made the 12Ohm resistor variable (say from 0 to 500 Ohms), you could si
dial in (or out) any desired amount of “tubishness” and hear exactly how much guano you
your glucose!

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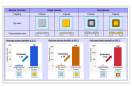
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