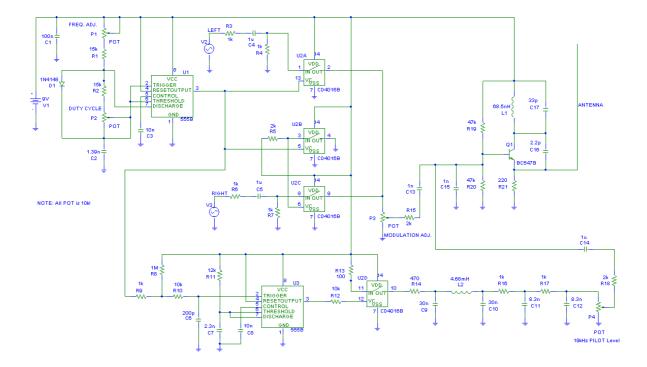
We have made an entry on the 555 contest

by Attila Joubert and Bence Zahalka ©2011

The entry is an NE555 based low power (10mW) stereo FM transmitter. The signal generated by this circuit can be listened on a normal stereo FM radio (up to 100 meters distance). It accomplishes the AM-DSB/SC FM modulation mode.



The main parts of the circuit

- 1. FM modulator (based on a BC547B transistor)
- 2. NE555 based square-wave generator (38 kHz, 50% duty cycle)
- 3. multiplexing circuit, which alternates the input left/right channels' signal (it uses three gates of the CD4016)
- 4. NE555 based monostable with a signal-shaping circuit (with the fourth gate of the CD4016), which generates the 19 kHz pilot signal

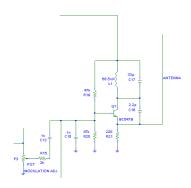
Connections between these parts

The square-wave generator controls the multiplexer, which turns the input signals' channels to the FM modulator alternatively. To that signal it combine with the monostable generated 19 kHz signal, which controls the decoder of the radio receiver. The FM modulator generates the frequency-modulated radio waves, which can be listened on the nearby radios.

The attached schematic contains two NE555 and a CD4016 (or CD4066) IC-s, one transistor and a diode, four trimmer potentiometer, and some resistors and capacitors.

How does it work

FM modulator

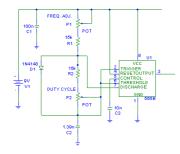


It is a regular oscillator circuit. The working frequency is determined by the oscillating circuit minted from the L1 inductor, the C17 capacitor and the antenna. It is important to begin the calibration the whole circuit with these modul, before anything else. The inductor L1 can be made from five mm diameter, five turns of enameled copper wire 1mm of width. The frequency can be calibrated by drawing that inductor aside. The antenna can be an insulated thin wire of 15-20cm length, connected to the transistor's emitter. If we do not want to send wider than ten meters and the

modulator is not in shielding box, the antenna can be rejected.

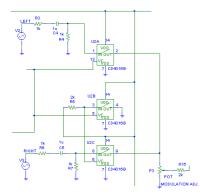
The frequency can be measured with a frequency meter or a radio.

NE555 based 38 kHz, 50% duty cycle square-wave generator



This generator is a regular astable multivibrator. The time of the charge and discharge can be easily changed by the potentiometer P2, thanks to the diode D1. The frequency can be changed by the potentiometer P1. They are in relation with each other, so it takes some steps to get the needed square-wave with suitable precision.

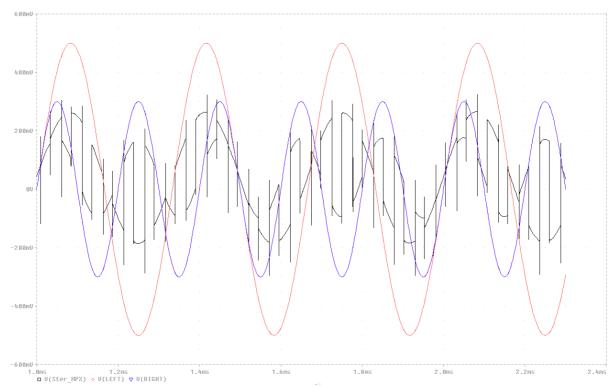
Multiplexer



The soul of this part is the CD4016 switching IC. The multiplexer is switching the input channels' signal to the output alternately. The gate U2B is working like an inverter. We have to use that, because our first idea (an inverter with NE555), has too much delay, it was too slow. The CD 4016 has four gates, in this part we used three of the four gates, and the fourth is used in the monostable circuit to generate the pilot signal.

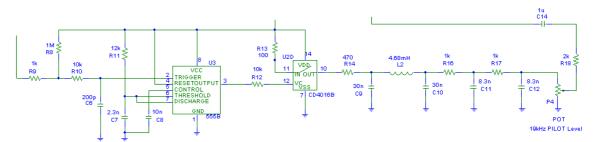
The generated multiplex signal's output level can be controlled with the potentiometer P3 to get distortion-free modulation. That can be

controlled with an URH FM receiver easily. Only we need to be care of that, the potentiometer P4 has to be set to minimum. After we get the distortion free limit, we have to lower the output level with 10%.



The peaks are shown in the simulation program only, on a real scope they are not exists.

Generating the 19 kHz pilot-signal



According to AM-DS/SC mode, the pilot signal's level has to be 8-10% of the maximal modulating input signal level. The left channel is indicated by the pilot-signal's zero transition and the following entering edge to the receiver's stereo decoder (which controls the decoder's alternator circuit), so it is important to work phase-right.

The 38 kHz square-wave (which controls the multiplexer) triggers the NE555 based monostable. The width of the output pulse was set to trigger the monostable on every second edge. The output 19 kHz square-wave's duty cycle is not 50%. The output is separated by the last gate of the CD4016 (U2D) from the signal-shaping stage.

The signal-shaping consist of two segments. The first segment creates the regular sinus waveform, while the second segment pushes it to the correct phase. It is really important for a good quality broadcast, without it the receiver's decoder cannot separate the channels and pereceives it like a mono signal.

The acceptable level of the pilot signal can be set with a properly tuned stereo receiver. First set the potentiometer P4 to minimum, then raise the level until the stereo sign on the receiver is not

showing up. This is the minimal needed level, we have to raise the level a little bit more (5-10%) to safe function. This step must be made after we set the distortion-free mono signal with the potentiometer P3.

Conclusions

While this device works from a 9V battery, it uses around 17mA of current. If we are using an AC adapter, then we have to connect 10nF capacitors in parallel with each diode of the Graetz-bridge, because of the noise and hum of the AC network.