EE2031 Project

Mixtron 3000

The portable dual-channel mixer, equalizer and transmitter station

Done By:
Yaadhav Raaj
Sng Png Chiang

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Introduction

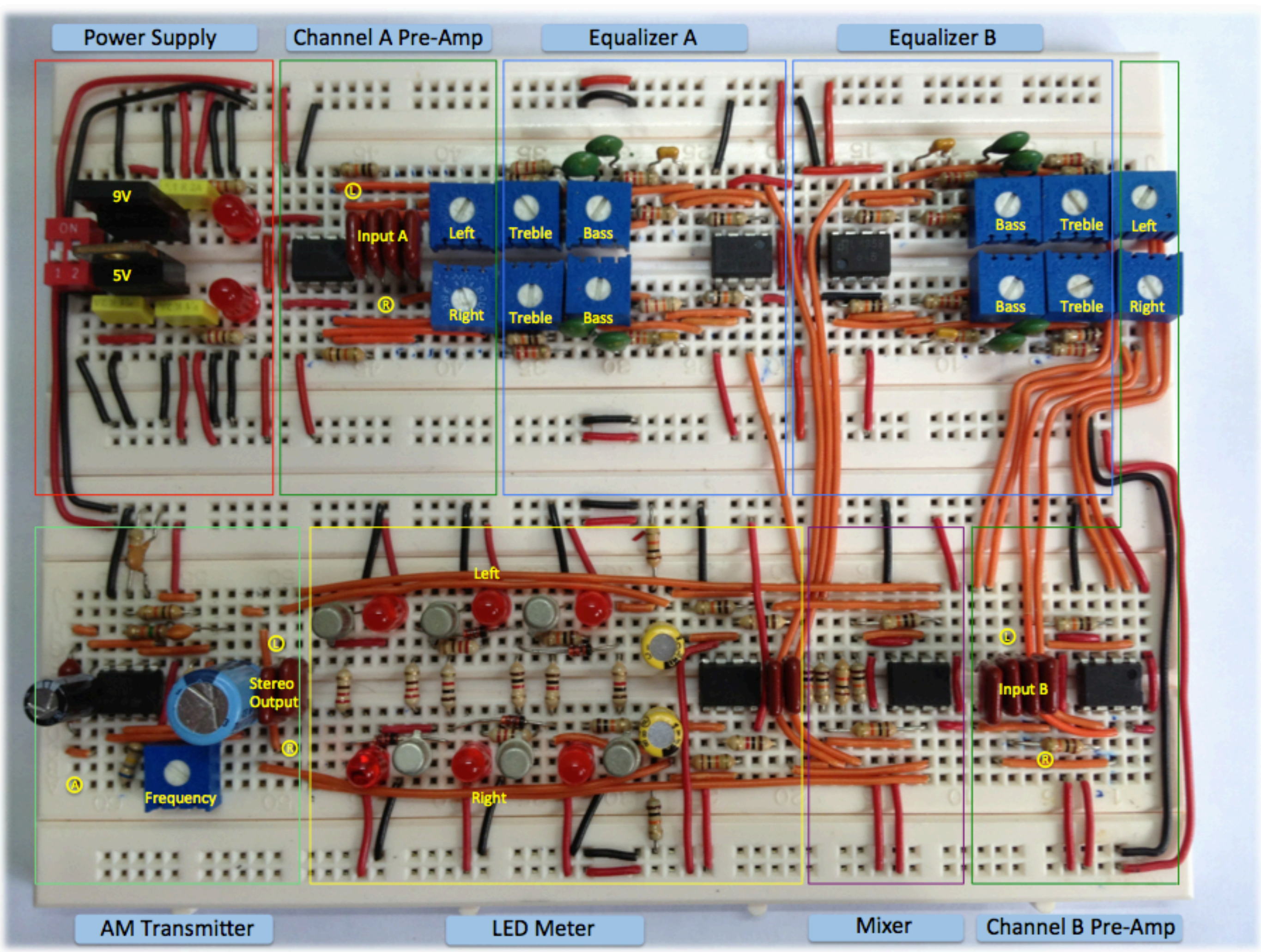
Presenting to you the Mixtron 3000. The Mixtron was created for budding musicians, disc jockeys and just anyone who wishes to have a compact mixer cum equalizer, while maintaining stereo sound quality. The easy to see left and right audio meters help you mix your channels with easy visual reference, and an optional tunable AM transmitter is built in as well to transmit your music to the airwaves.

The motivation was found when me and my friend were jamming; me on guitar and my friend on drums. We wanted an easy way to record and mix our music, in high quality sound, with left right adjustable channels and equalization adjustment. Most of the commercial mixers included too many complex unnecessary options and were expensive. We also wanted the option of transmitting what we were playing to the air to let people around our vicinity hear our music.

This Mixtron 3000 consists of the following parts:

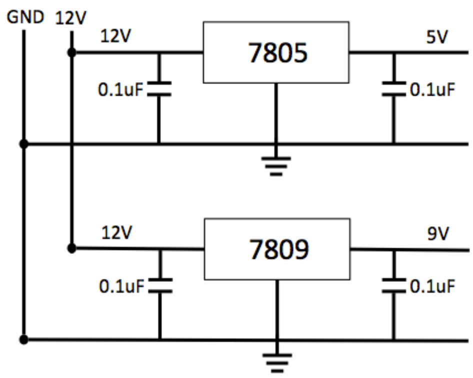
Part	Amount	Explanation
Red and Black wiring	Plenty	Used for 9V and 5V supply and ground
Orange Wiring	Plenty	Used for audio signal
Resistors	Plenty	Used for amplifiers
LEDS	8	Power and VU meter indicators
50K Potentiometer	4	For amplification of audio signal
100K Potentiometer	9	For equalizer and AM Frequency
Capacitors	12	To offset DC signal from audio inputs and op-amps
LM358 Op-Amp	7	General purpose op-amps
BC108 NPN BJT	6	For VU Meter control
Audio jacks	3	For 2 channel inputs and 1 mixed output
Antenna	1	For transmission of AM Signal

Circuit Image



Circuit Diagram

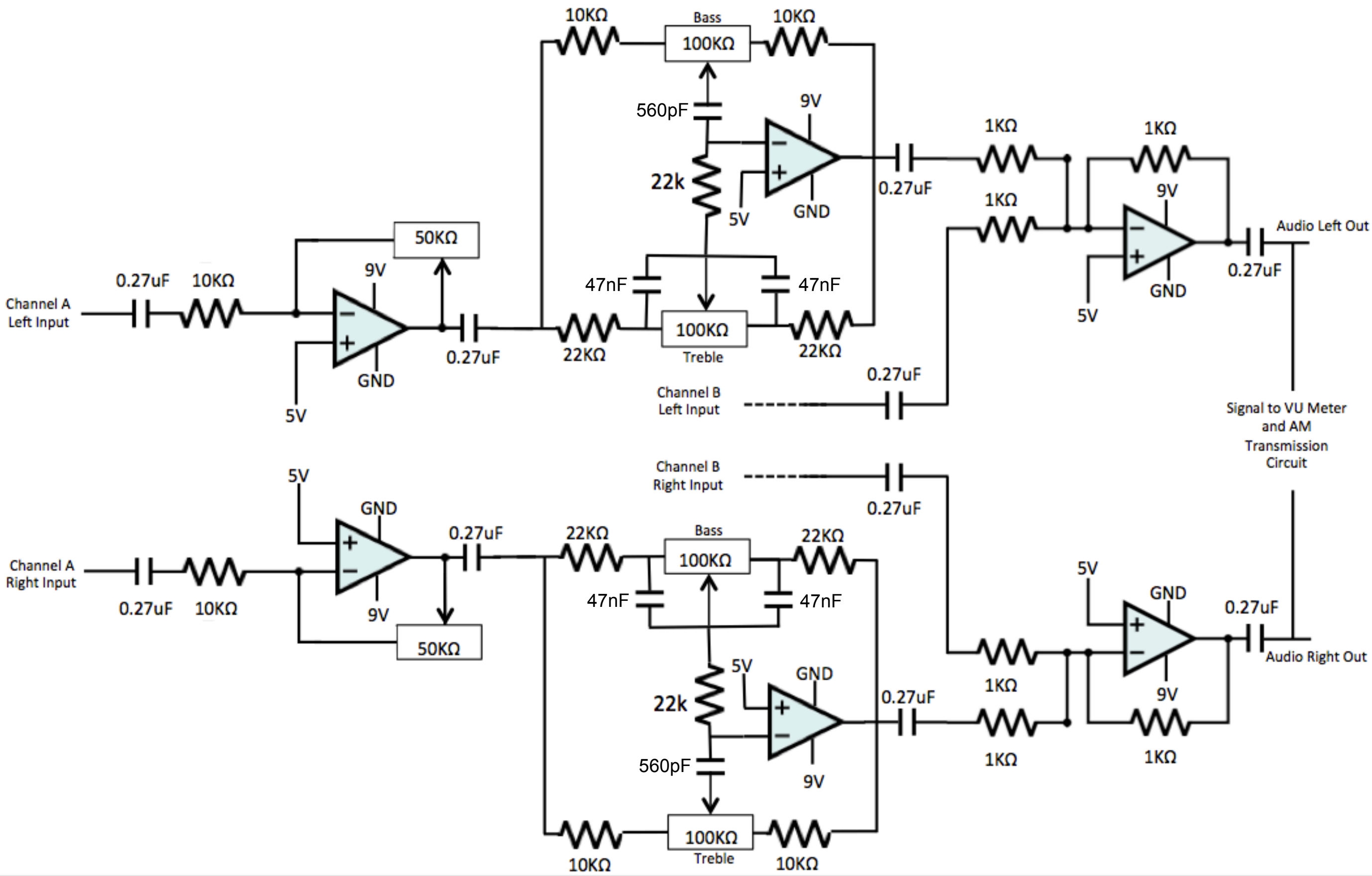
Power Supply (Optional)



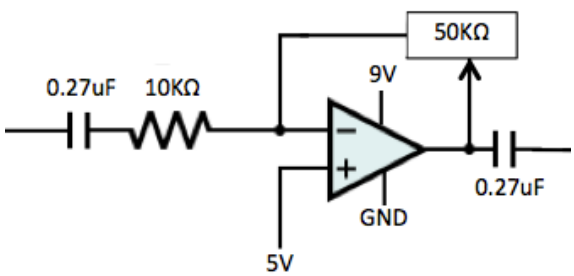
The project instructions clearly state that power regulators are not allowed, however if this was an actual product, it would have the following power supply set-up, to provide 9V Vcc and a 5v reference voltage to the op-amp. It would accept a 12V input.

Nevertheless, the circuit can be powered by one 9V input and one 5v input from a lab power supply and will draw approximately 0.3Amps on full load

Amplifier, Equalizer and Mixer



Stage 1 – Inverting Amplifier

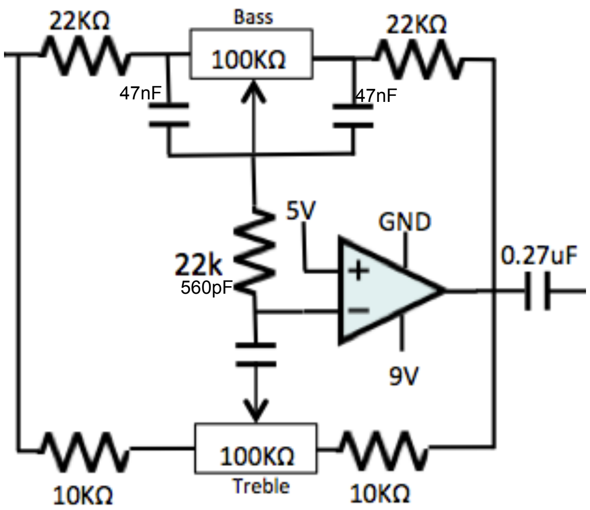


The signal passes through a 0.27uF capacitor first to filter out any DC offset generated from the source. It is then amplified by an inverting amplifier, with a ratio of a maximum of 5:1.

The 50k potentiometer together with the 10k resistor allow the user to tune his left or right input with up to 5 times gain. The op-amp is set a reference voltage of 5v for the signal to oscillate from that point.

The circuit is repeated on the same LM358 chip that contains dual op-amps, for both left and right channels. Due to the simplicity of this stage no experiments were conducted to check it's validity.

Stage 2 – Equalizer

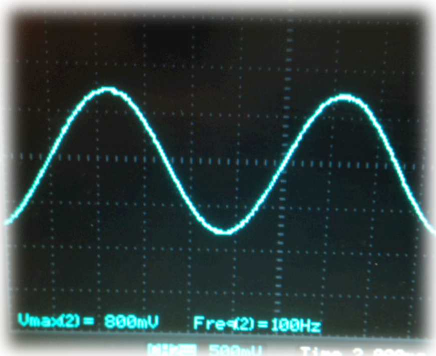


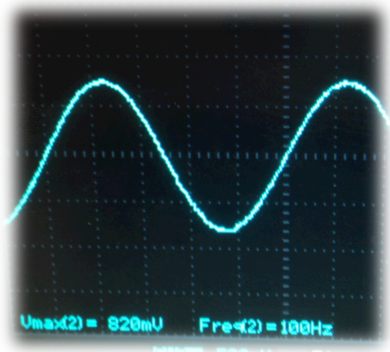
The equalizer unit consists of control of bass and treble frequency ranges through the means of two potentiometers, and is made available for both left and right inputs of both channels. The final signal is then put through a unity buffer to ensure no loss of signal.

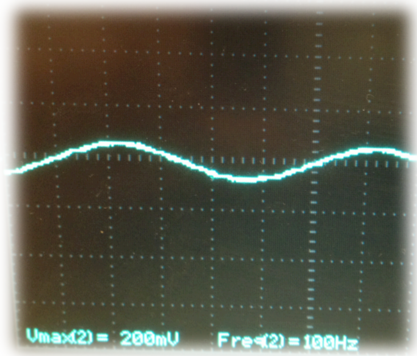
The bass control is essentially a low pass filter, where the signal first passes through a 22K resistor, and 47nF capacitor to do the first low pass cut based on this formula 1/2piRC. Hence the first Fc is around 153Hz.

The circuit then passes through a conventional op-amp low pass filter with the 47nF capacitor and 100K pot that gives an Fc of about 33-112Hz. Hence the cut-off frequency varies from 153+(33-112)Hz

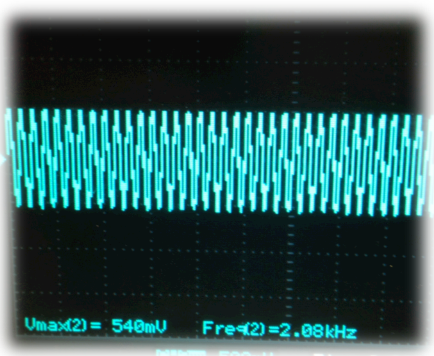
The treble control circuit is essentially an op-amp based high pass filter where the signal passes through a resistor followed by a capacitor. The Fc for this is around 2800-10000Hz due to the 100k potentiometer and 560pF capacitor.

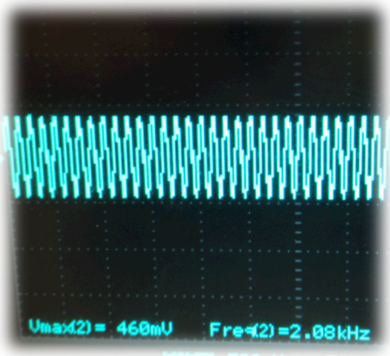


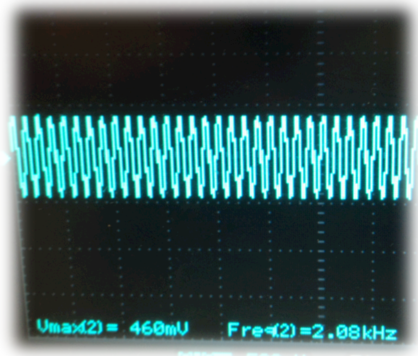




The first graph shows a low frequency 100Hz sin wave with the bass set to low resistance (high bass). The second graph shows when the treble resistance was lowered (increase treble). You can see that there is not much effect on the low frequency sin wave. However, in the second graph, the bass was set to high resistance (decrease bass). This causes the amplitude of the low frequency wave to drop drastically. Hence, as the bass resistance was increased (lower bass), the Fc was lowered, and less of the wave was able to pass through.

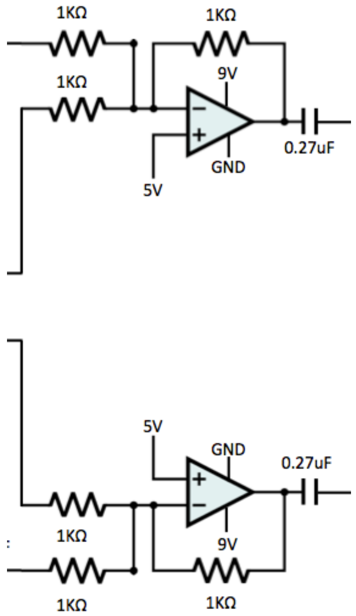






The first graph shows a low frequency 2000Hz sin wave with the treble set to low resistance (high treble). The second graph shows when the treble resistance was increased (decrease treble). You can see that the amplitude of the high frequency wave-form dropped a fair bit. However, there was not too much of a drop as the range is technically suppose to be 2800-10000Hz as calculated above. In the third graph, the bass resistance was increased (decrease bass), but there was no effect on the high frequency wave. Hence, as treble resistance was increased (decrease treble), the Fc was lowered and less of the wave was able to

Stage 3 – Mixer

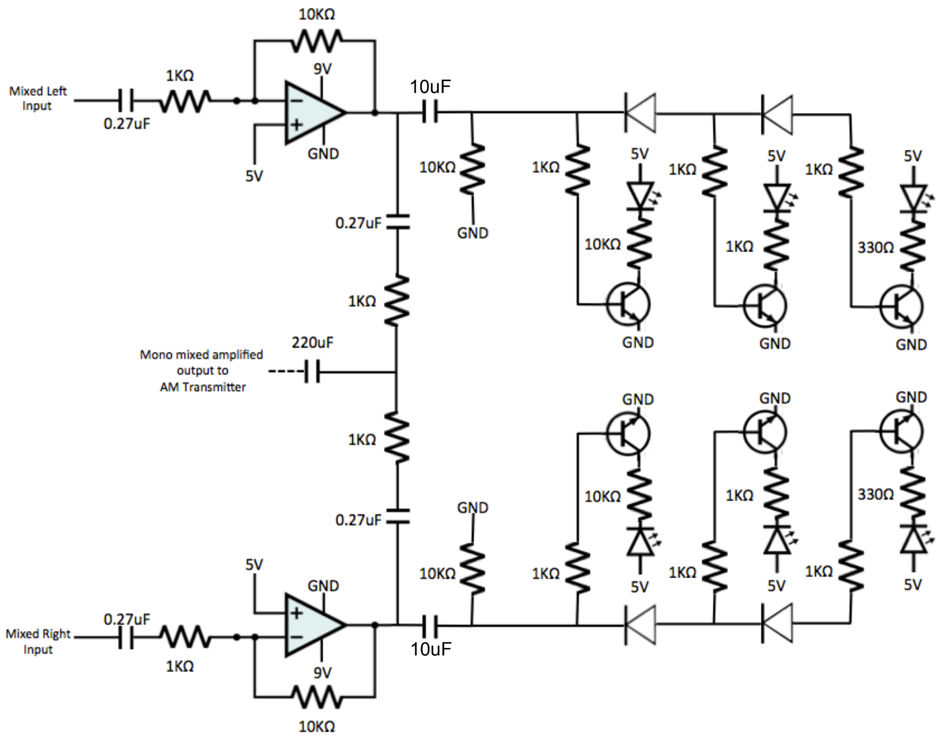


The mixer unit is essentially a summing amplifier, with a unity gain. Both left signals from Channel A and Channel B are fed through a 1K resistor and into the summing op-amp. The 1k resistor across the output and negative input ensures it is a unity buffer gain. The same occurs for the right signals from Channel A and B. The signal was inverted in stage 1 and is un-inverted by the mixer.

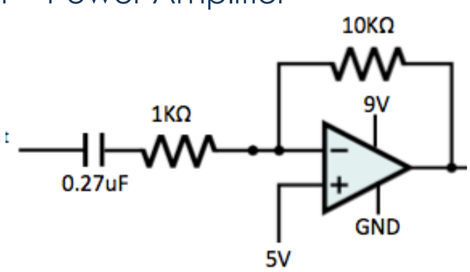
Mixing is controlled from Stage 1, with the left and right potentiometers for each Channel. The mixer requires two op-amps for left and right and one LM358 chip is required.

The mixed signal is then put through a 0.27uF capacitor to filter out the DC signal and is then fed to the rest of the circuit, such as the Stereo Audio out, the VU Meter and the AM Transmitter

VU LED Meter

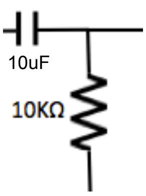


Stage 1 – Power Amplifier



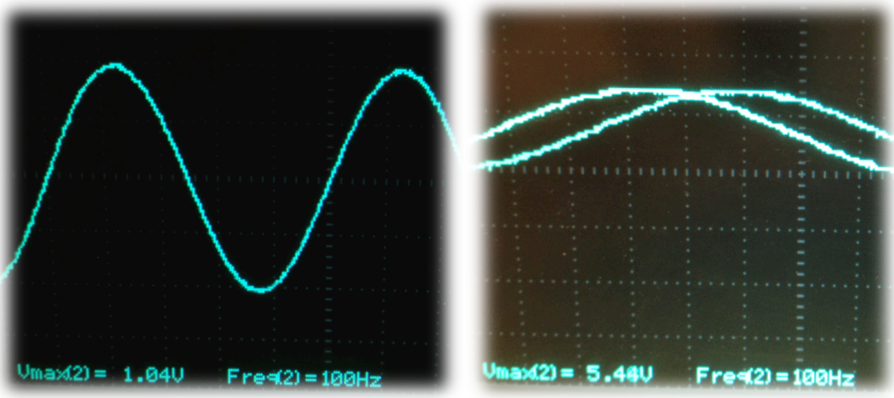
The first stage is to take the left and right signals separately, and pump up the amplification by a factor of 10. This is because the current signal operates at around 0.7-1.2 volts, when amplified slightly by the initial stage pre-amp. This is not enough to power the VU LED Meter or the AM Transmitter, so the signal Vmax is bumped up to about >5V.

Stage 2 – DC Filter



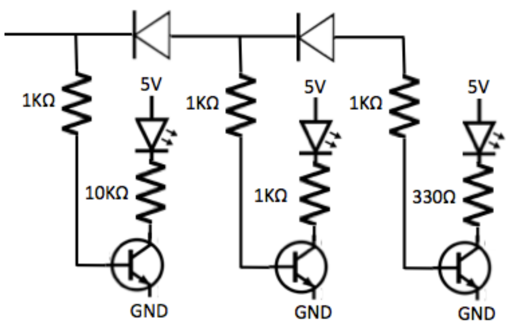
The output from the op-amp will need to have it's DC offset removed in order not to keep the LED's lit up when there is no sound, so a 10uF electrolytic capacitor is used.

A 10K resistor is also added in parallel to limit the



The above graphs show the signal before going through the power amp and after it has gone through. As you can see it has been amplified from about 1V Vmax to about 5V Vmax.

Stage 3 – LED Array

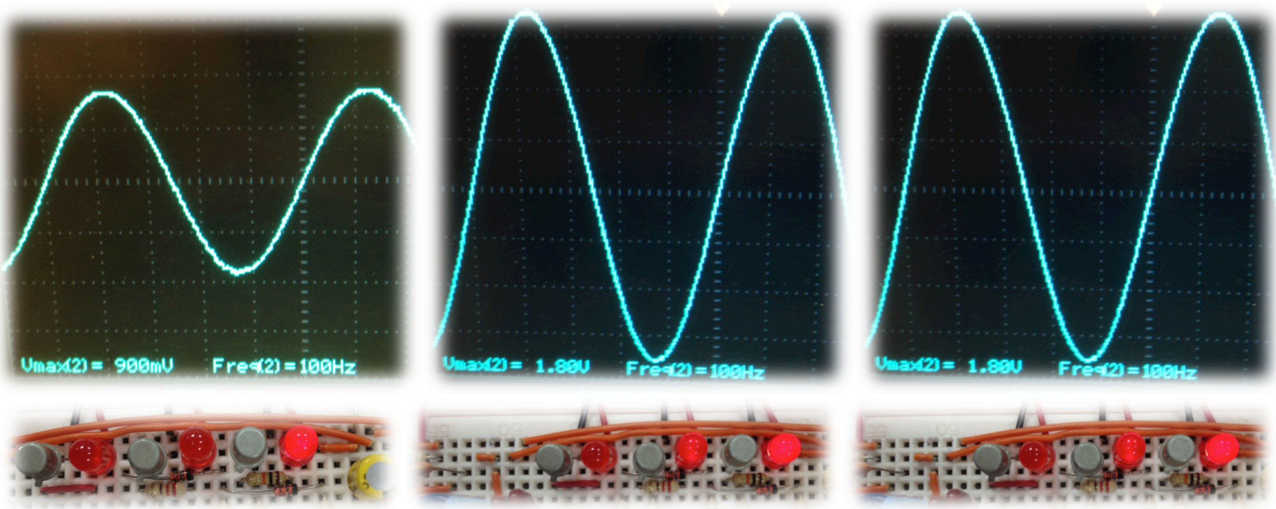


The signal without the DC offset is passed into the LED array, meaning that if there is no sound, there is no current passing through, and none of the LEDS will light up. But if there is a signal, the LEDS will light up.

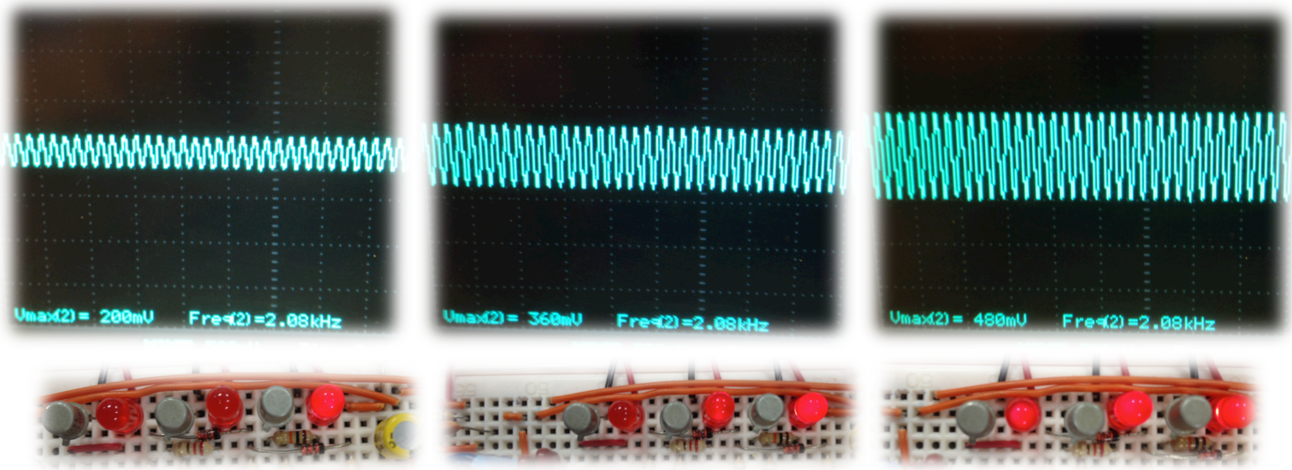
Hence for the first LED, the signal passes through into the BJT, and since it is an NPN BJT, will act as both an amplifier and as a switch, allowing 5V to flow through into ground, lighting up the LED when there is a signal to the Base. The current to the first LED is the highest so a 10K resistor is used to limit the brightness to match the other LEDS

Part of that signal will attempt to go to the next LED stage, but it is blocked by the diode which is in reverse. Hence, only if the current (frequency or volume) is high enough, it will be able to cause the diode to go into reverse voltage for a short period, allowing the signal to light up the second LED.

As the signal passes through the various diodes in reverse, it's current becomes more and more limited. Hence, to match the brightness of the other LEDS, the resistance of the LEDS at the collector is reduced per stage.



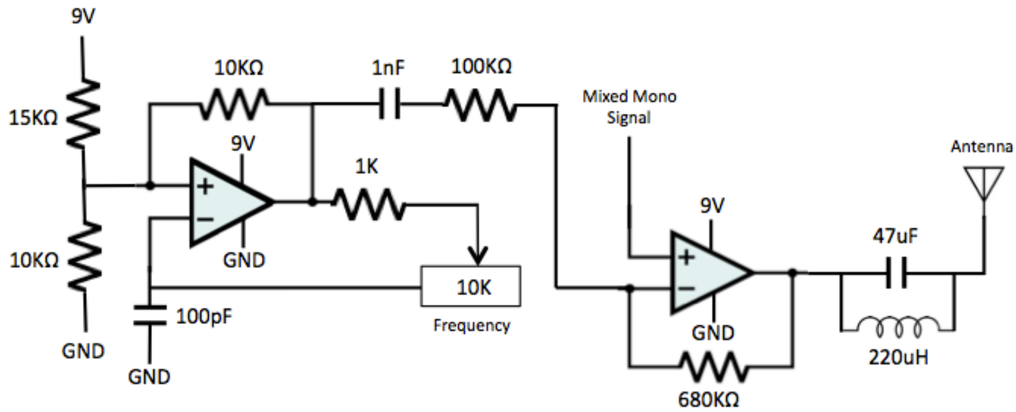
When the input signal was set at low frequency (100Hz), the first LED lit up at around 0.9V while the second lit up when the signal was at 1.8V. Even with further amplification, it was not able to light up the 3rd LED for this frequency. Hence you can see how both frequency and amplitude affect the VU LED meter.



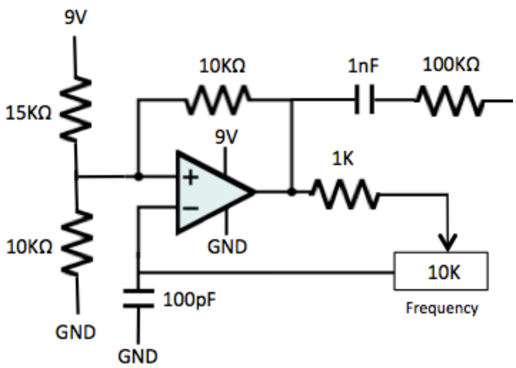
When the input signal was set at high frequency (2000Hz), 200mV amplitude lit up the first one, 360mV the second and 480mV the third. Hence, at a higher frequency, the VU LED meter became more sensitive to changes that occurred in the signal.

Hence in conclusion, we can say that in general, music will constitute of multitudes of sin or cos waves that a mixed together to form a complex signal with multiple frequencies. Hence, the meter can actually differentiate between a snare or a bass, where a higher frequency snare drum will light up more of the meter, while a low frequency bass sound less of it. Adjusting the gain on the left or right channels will allow one to visually control what was the volume of the signal was, depending on the audio complexity.

AM Transmitter



Stage 1 – Sine Wave Carrier Generator

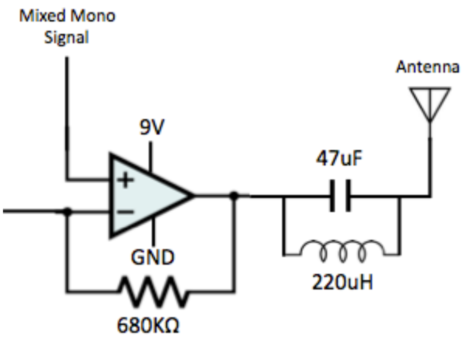


This stage of the circuit is the sine wave generator, and acts as the carrier signal for the AM transmitter. A reference voltage of 5V is set through a resistor voltage divider, and the op-amp is set at 9V.

The frequency of the sine wave can be set by changing the resistance of the potentiometer. By default, the carrier is set at 1000kHz.

(More explanation is needed)

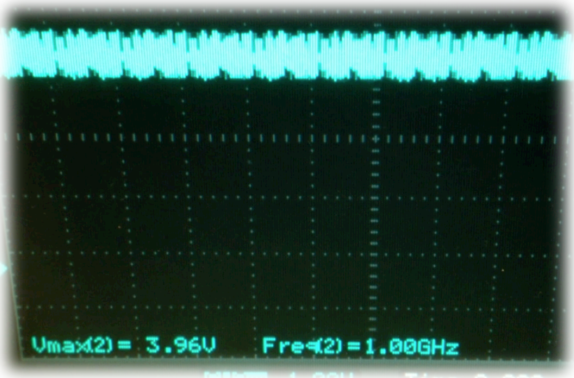
Stage 2 – Modulator

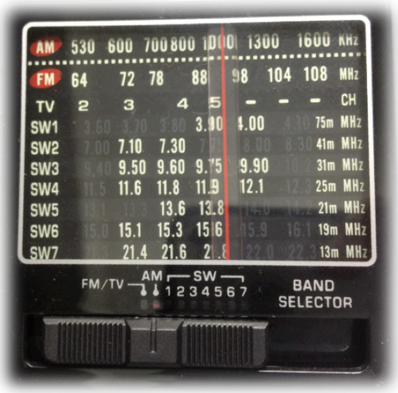


This stage of the circuit essentially modulates the mono signal that mixed the left and right audio signals earlier as seen from the VU meter schematic, with the carrier wave.

The 220uH inductor and 47uF capacitor in parallel, will cause the current in the antenna to resonate, causing more radio waves to be generated.

(More Explanation needed)





As seen above, you can see the modulated output measured from the antenna, and you can see that the modulated wave is resonating at around 1000kHz. This signal can then be picked up by a typical AM radio that is tuned to this frequency.