

Model Train Diesel & Horn Sound Module

Redesigned by Laurier Gendron (Aug 2006)

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New Design

After many comments by interested hobbyists not being able to obtain parts like the LM566 (VCO) and others I decided to redesign and bench test new circuitry for the Diesel train and the Horn sounds . Without using a computer chip this analog design is still a challenging task and of course it still lacks that realistic sound created by the natural effect elements of reverberation ,sustain and doppler effects that we love to hear at night.

All these effects could be created by additional circuits which of course would increase the complexity of this project and deter many would be hobbyists .

Diesel and Horn Circuit .

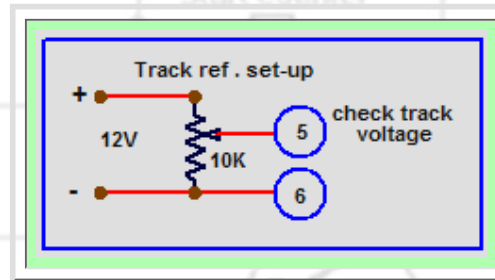
The main power supply to the system must be a regulated 12 volts DC with a minimum input from the train control AC or DC power supply of 13.5 VAC connected to pos 3 and 4 of the rectifier bridge . The ground bus of the regulated 12 volts supply must be connected to the system ground , The independent speed reference voltage is taken directly from the train speed control module or can be taken by connecting directly from the tracks to positions 5 and 6 of the rectifier bridge .The output of this bridge will always be a positive speed voltage signal whichever direction the train is going.

The 555 timer is really a poor replacement for the LM566 as a VCO (Voltage controlled oscillator) although it is linear in function a negative voltage range is needed to activate the timer and produce the RPM to relate to the actual engine speed thus the op-amp is used to invert the track positive voltage .

Resistors R6 , R7 and capacitor C4 determine the oscillator range output for a given voltage reference at pin 5 of the timer .When the reference voltage at the input of the op-amp is at maximum , the voltage reference voltage at pin 5 of the timer is minimum and as mentioned above the op-amp offset voltage of 1.5 volts is reflected at the input pin 5 ,this voltage is used to produce the idling rpm (minimum)as set by C4 .. To simulate the diesel sound the 555 IC output pulses at pin 3 are used to trigger the input pin 14 of the 4017 digital counter . This IC is configured after much trials and errors to provide for the best sound (to my ears) which is filtered with the tone circuit made of C5,RV1,R6,RV2 and C7 which are all interacting and the result is fed to the LM386 amplifier . C10 is 500uF/16v which I recommend to amplify these large low frequencies rumble to be heard . The amplifier is programmed for a gain of 200 with C8 (10uF) in series with R10 (500 ohms) changing the time constant and gain of C8 feed back ,this contributes to further filtering of certain pulses . For best result at least a 5"speaker rated at 5 watts or better in an enclosure should be used sitting on a large wooden surface (Table) helped produce the diesel familiar rumble sound .

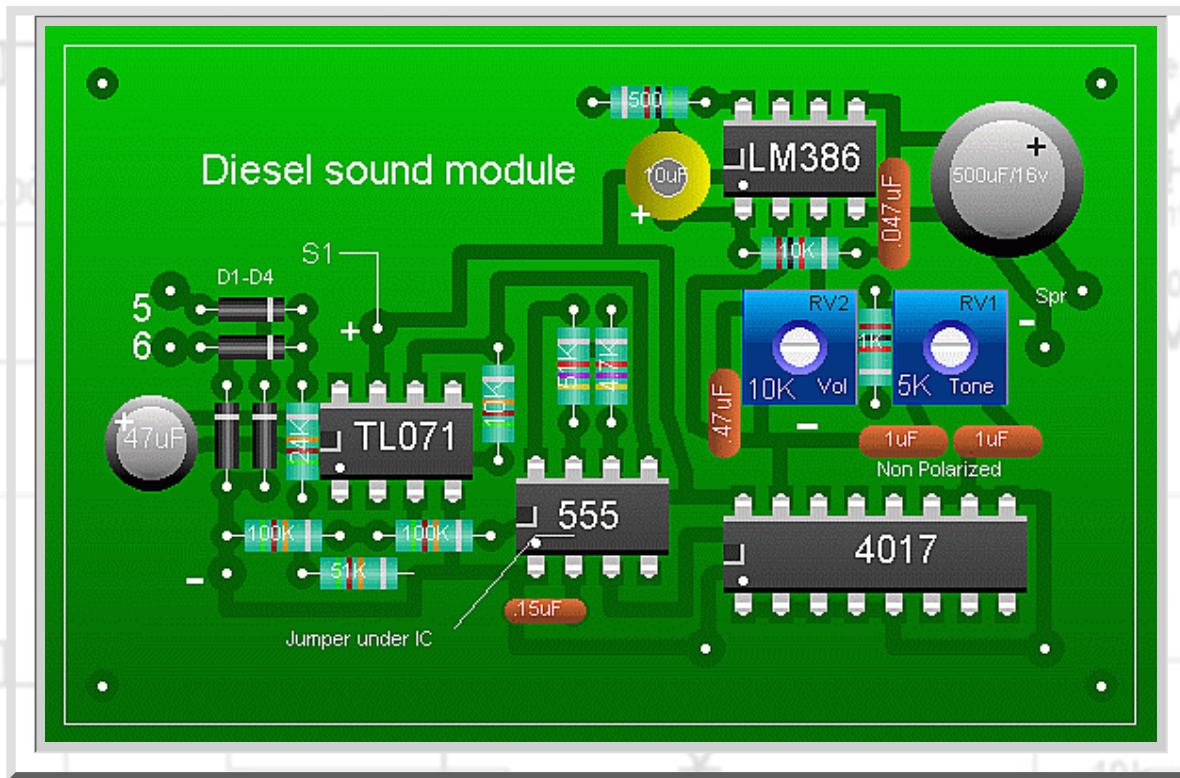
Tuning the Diesel

The output of the 4017 is a complex form of pulses some of wick cannot be heard until RV1,RV2 are set . The choice of C7 value further alter the result . The PCB provides for the use of trimmer for RV1 and RV2 but by bringing out leads , potentiometers and a multiple position switch can be used . Please take note that RV2 not only set the amplifier gain but will also alter the sounds as well so that many different sound settings can be had. For testing purposes a 10K pot or trimmer can be used to simulate the track voltage reference . See drawing set-up below .



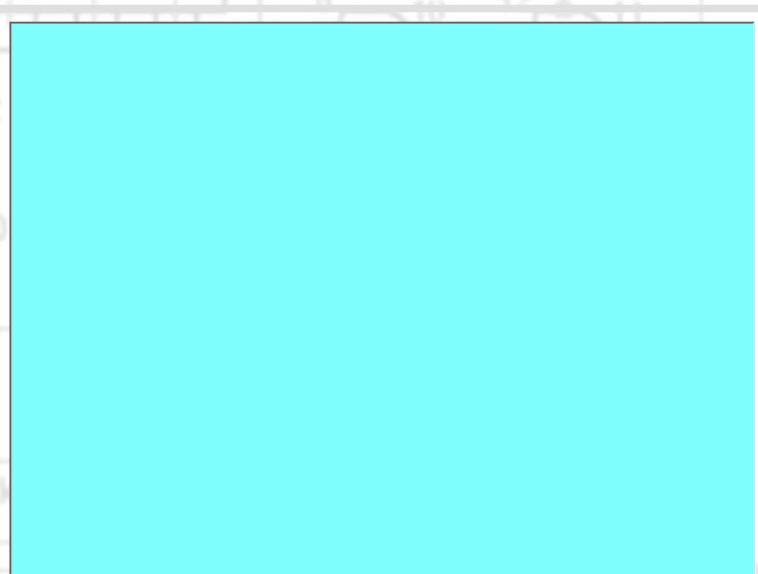
Notes

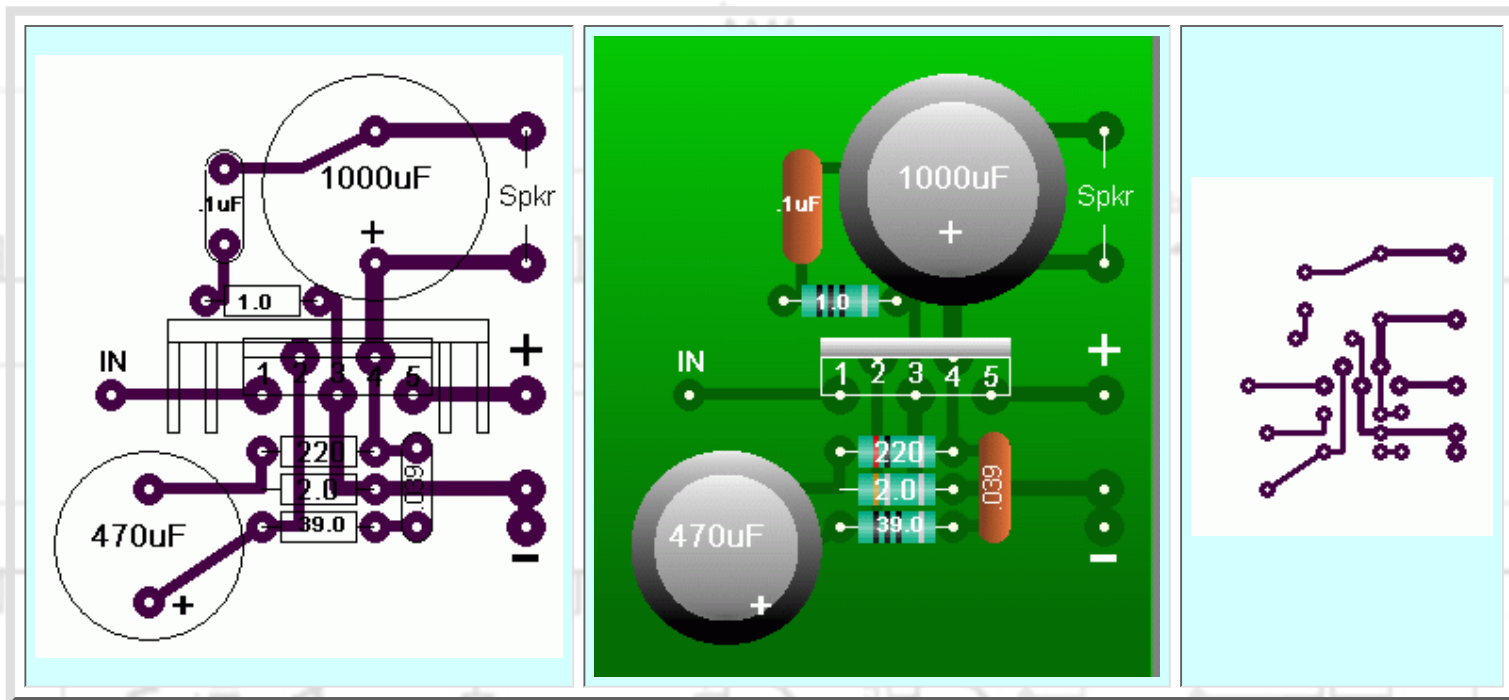
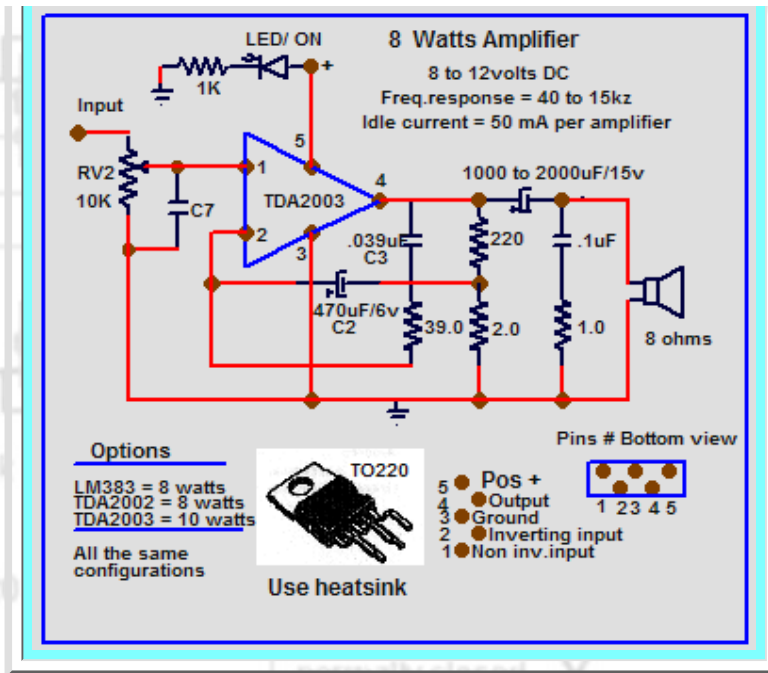
- 1 - C5,C6 are non polarized capacitors (NP) and my preferred valued for C7 is .47uF .
- 2- **555 IC** is a CMOS type used for minimum current and efficiency
- 3 - **solder the jumper** (red trace) before soldering in the IC socket .
- 4 - **The LM386** is rated at 250mw if operated at maximum gain it will get hot and should be cooled with a small makeshift heatsink attached to itsd top with a dab of cement .
- 5 - **The** follwing changes can be made to suit .
 - (a) Reduce R9 to 270 ohms or any values in between but with close attention to amplifier current limit and IC overheating .
 - (b) change C4 from .22uF to any values up to .33uF
 - (c) C7 , any values up to 1uF , keep an eye on amp current .
 - (d) Do not exceed 250 ma amplifier current . Use heat sink .
- 6 - **C3** value is **47uF**

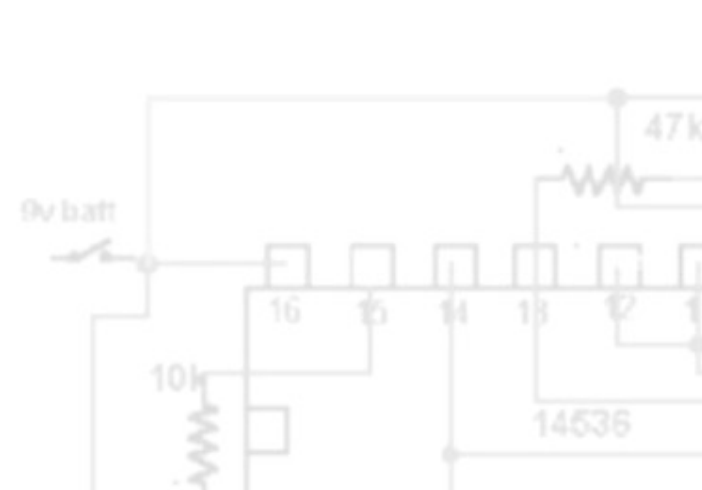
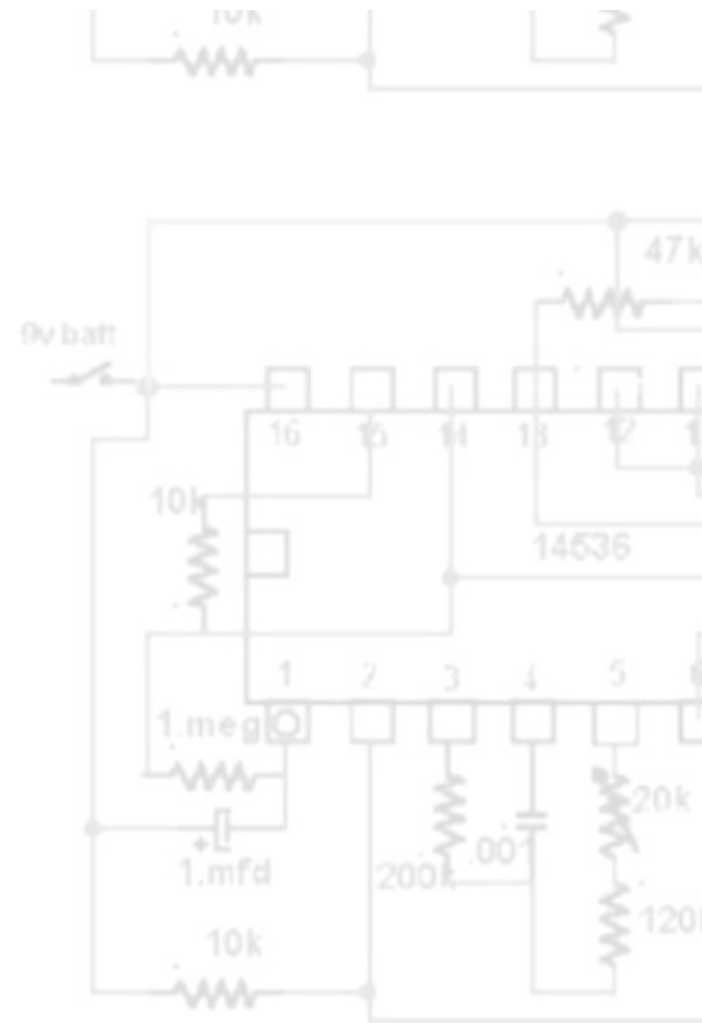
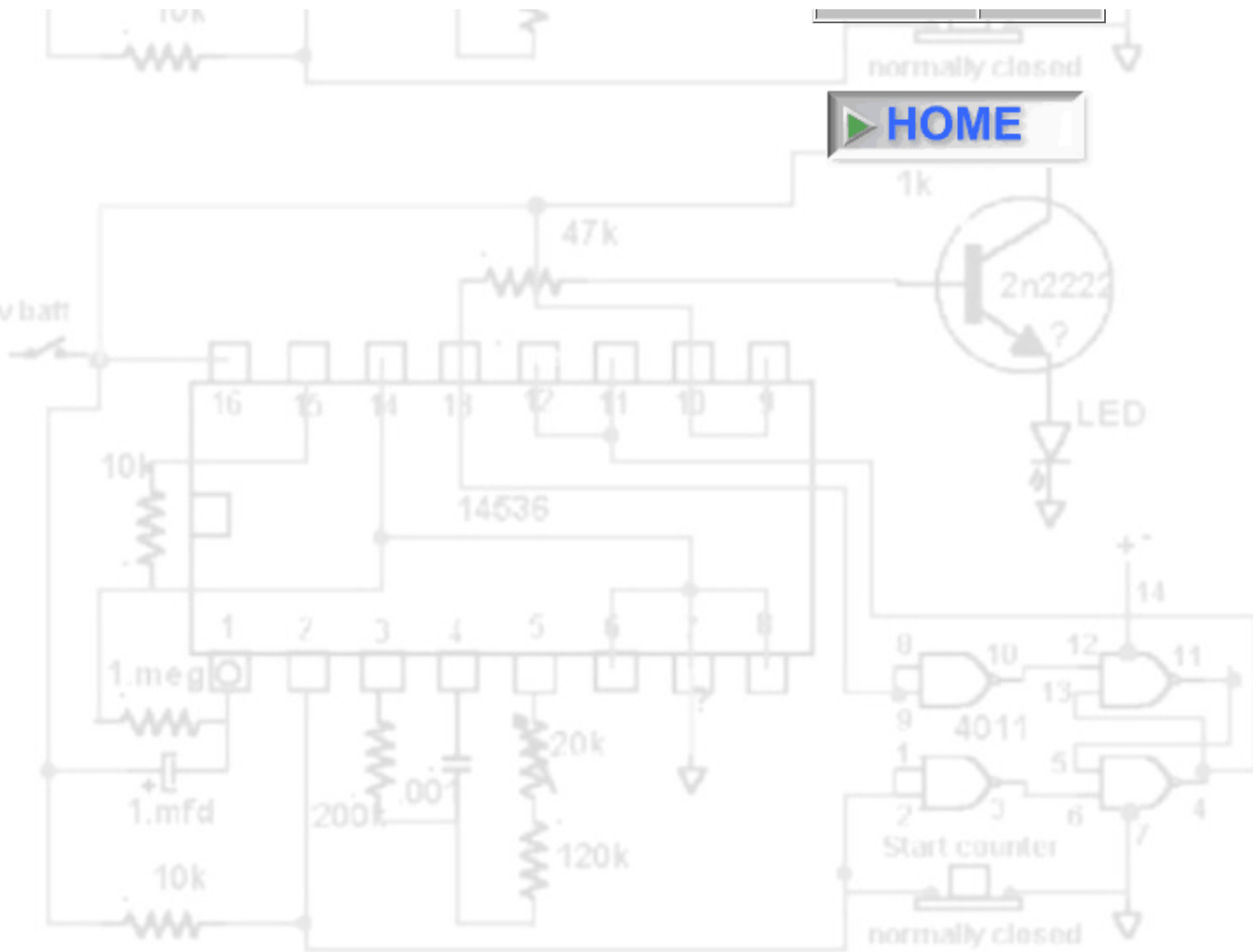


High Power

For those who would like thunder ,you will find below the schematic for a high power amplifier , required current input is 500ma and a heatsink .







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The Horn Section

[All About diesel train horns](#)

I was about to use the 555 IC to redesign the horn section then it occurred to me that some digital ICs now available could possibly do the job just as well and may be better than the last design .

The Horn section as been designed with the least number and basic parts possible. A good simulation is obtained, naturally the larger the speaker used (up to a point) the better the sound.

Experiment

The values shown for the capacitors and resistors used sounded pretty good . Only three gates are used as I found that by adding additional sound circuits interfered . The design allows for using trimmers instead of fixed resistances as well as different capacitance values of your choice for different horn sounds . Use only **non polarized capacitors** polyester types have better sound .

Horn samples

Horn # 1 C11= .15uF , R7 =47K ,C14 = .002uF

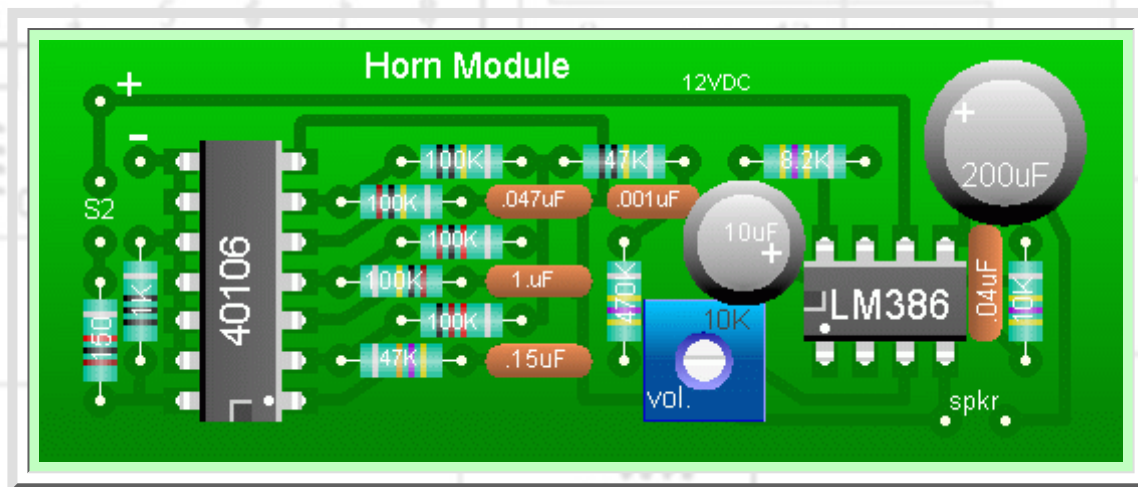
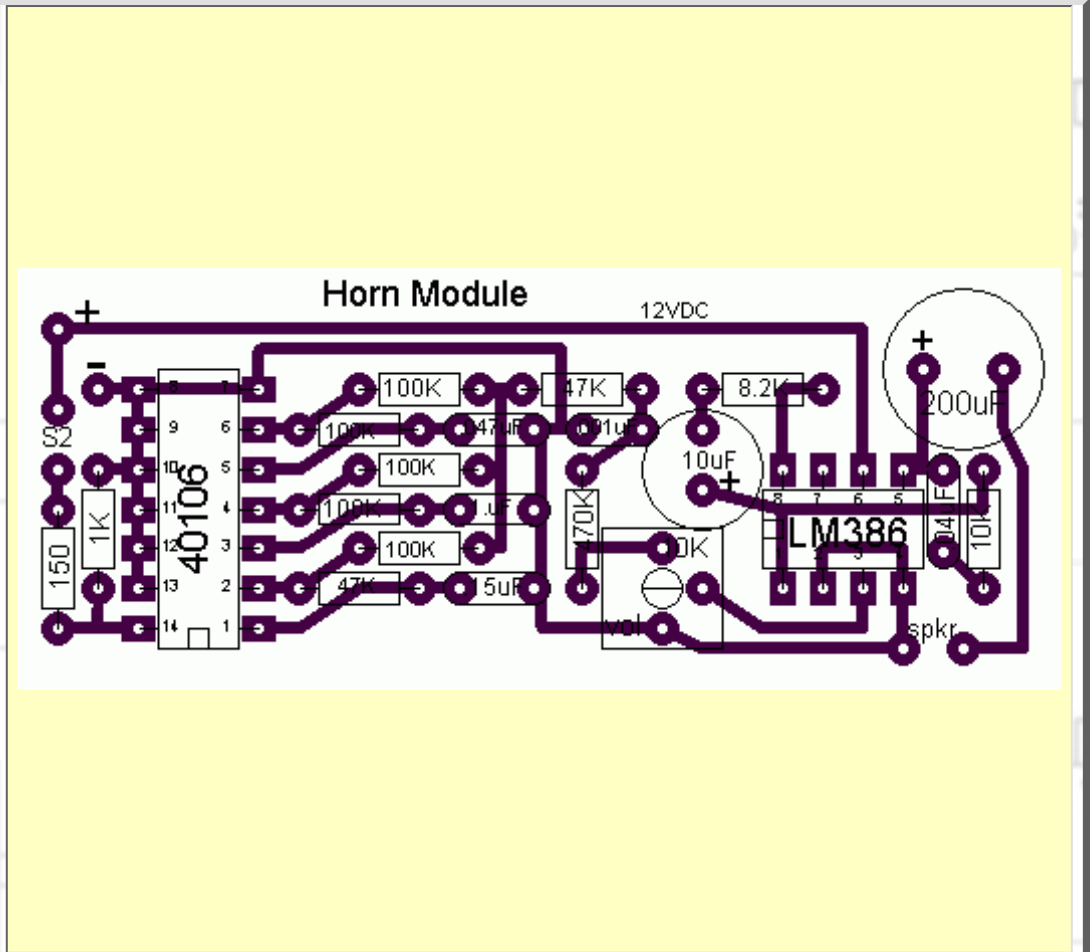
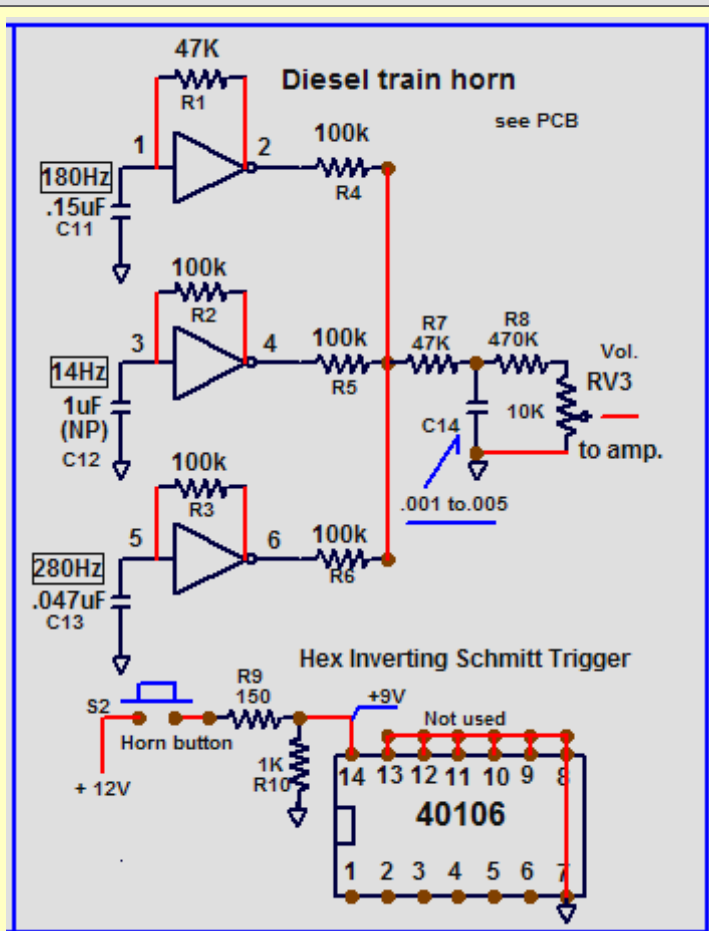
Horn # 2 C11= .33uF

Horn # 3 C11= .15uF , C13=.02uF

Horn # 4 C11= .1uF , C13 = .02uF

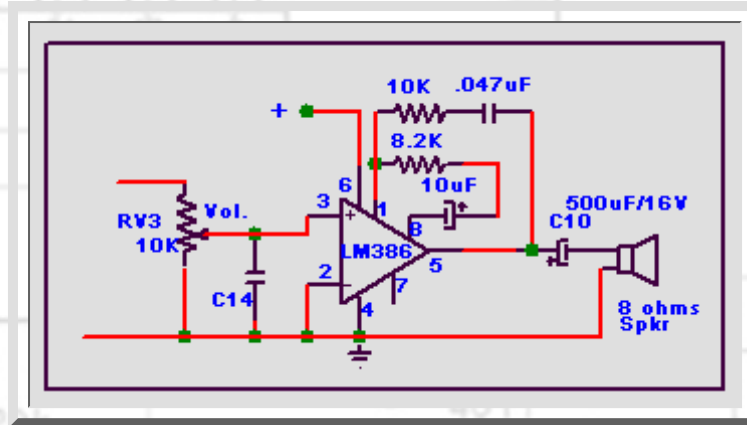
Horn # 5 C11= .15uF , C12 = 1.0uF ,C13 = .1uF , C14 = .001uF

Make sure to connect all unused pins to ground as shown . Pin 14 of the 40106 IC is connected to a push button (N/O) Normally open type which is used to connect the pos. (+)12 volts bus to activate the horn IC (40106)



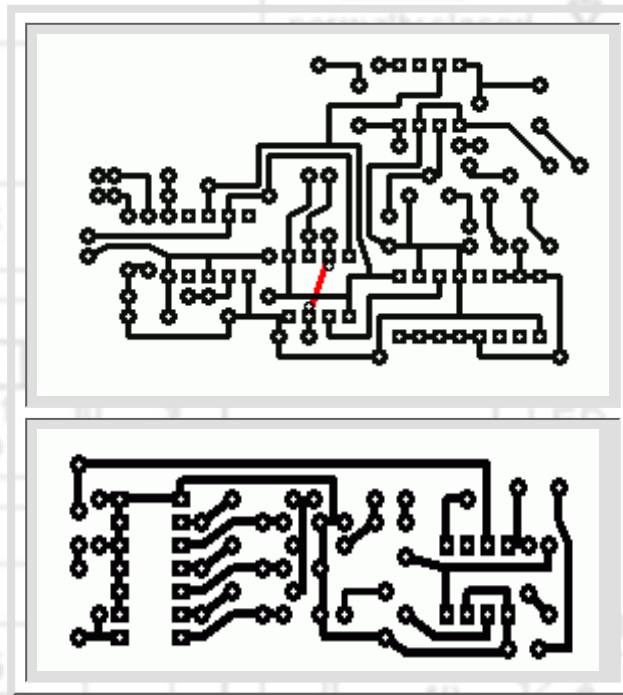
Amplifier

A additional amplifier is used for the horn circuit and is included on the PCB .It is similar to the diesel circuit except for the gain which has been reduced by adding a 8.2K resistor in series with the 10uF between pin 8 and pin 1 . The amplifier LM 386 must be hard wired connected to the positive and negative bus as shown . The gain can be adjusted if desired by adding any resistance value up to 10K or omitted altogether for a total gain of 200.



PCB

The PCB is shown as one circuit but it can be easily divided in two for convenience of enclosure choice and application . Take note of the red trace which is a wire jumper that must installed before the 555 IC socket is soldered in .



Notes

Feel free to experiment with both circuit , But before you do that make sure you install IC sockets . You can also solder pins from which you could temporarily connect different component value to experiment with different sounds .

The horn module can be programmed in its own console by bringing out wire leads to switches and potentiometers to obtain different horn sound for different engines. Before you turn on the power do yourself a favour and trouble shoot your supply lines to the ICs and always reduce the volume controls to minimum to the amplifiers .

Have fun and send me an e-mail .

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