Handy Dandy Little Circuits #28

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Super Mike

History

- Back in the olden days , over 20 years ago , an article appeared in the Popular Electronic magazine titled "Shotgun Microphone" which detailed its construction and its superior sensitivity due to its unusual use of tubes cut to half wave lenght of different frequencies and its ability to detect distant sounds.

Before discarding the publication I cut out the article for future reference and eventually it got buried among the large amount of accumulated files but to my dismay never surfaced when I did a search for it .
I always wanted to experiment with this project but never found the time , but I did remember the details of the "Shotgun" construction and now I undertook to investigate and build this part of the project .

As for the amplifier , well ! forget it . I was now on my own and had to design a brand new concept for its application , the details of which is described further on .

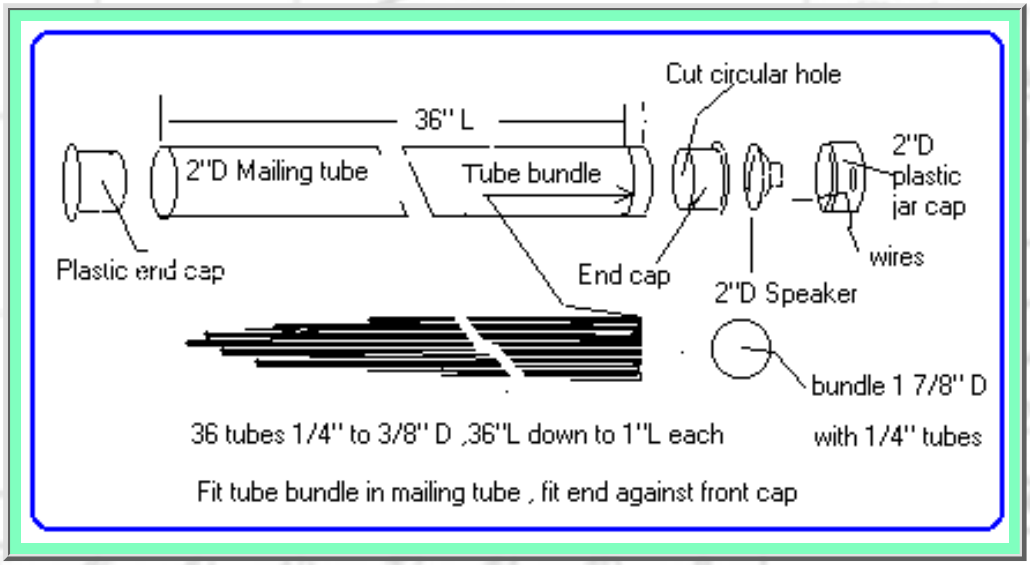
The Microphone

- Below is the mechanical details of the construction of the Shotgun as I remember it . The original Shotgun as described in the article used 36 aluminin tubes of 3/8" diameter each from one inch in lenght to 36 inches .
I was not about to spend a fortune to invest into a project that may not work , so , instead of aluminium I went in search of large drinking straws of at least 1/4 " dia. and bought a box which contained enought for the project .

With great patience and a roll of Scotch tape I proceeded to tape straws end to end to make tubes each cut to the length required from 1 " to 36 " plus one more 1 " lenght to complete a simetrical diameter when bundled together with tape .
The total diameter of the bundle was measure to be 1 7/8 ' dia. and too fragile to be of any use as is . It then occurred to me to use a cardboard mailing tube of 2 " dia . 38 " in lenght which I found at a local mailing supply store .

Using a two inch wide wrapping of thin foam as a filler around the tubes bundle I inserted the bundle into the tube for a snug fit with the end of the longest tube even with one end of the mailing tube . The mailing tube came with two plastic end caps , one cap is use to cover the front of the mailing tube when not in used , in the face of the other cap I cut a hole large enought for the sound to acces a 2" good quality miniature speaker wich was cemented to the cap as shown in the drawing , a twelve inches lenght of dual lead wire was soldered to the the speaker . I used a plastic cap from a small glass jar that fit the back end of the speaker , drilled a small hole on the edge of the cap and inserted the wire

through it then cemented the speaker to the tube cap then the jar cap to the edges of the speaker to form a sealed unit that can be inserted into and removed easily into the mailing tubes .



Super Mike Amplifier

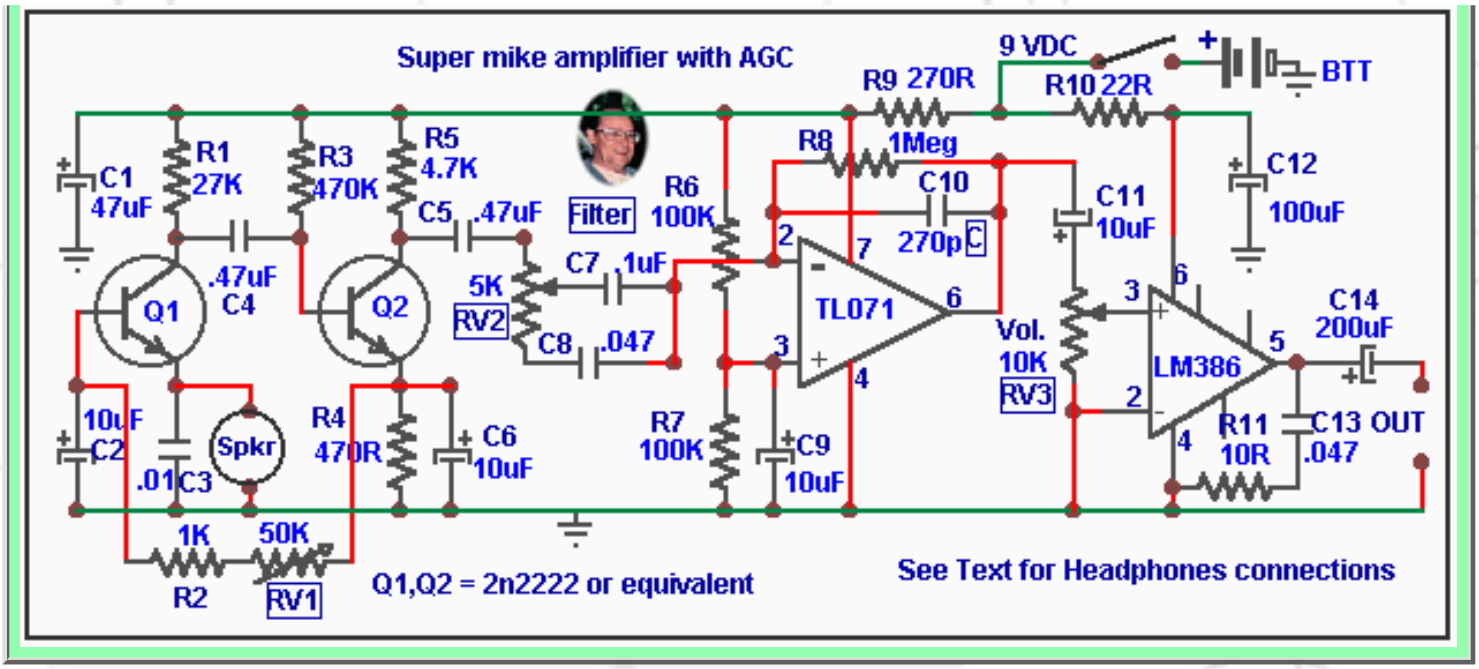
Designed by L . Gendron (Aug , 2001)
As a reference you may wish to open up a new window to view the circuit while reading the description. **Resize as required** .

Circuit Description

- Modern long range microphones amplifiers are a work of art incorporating miniature circuitry and digital filters which are behond the average hobbyist like me and I had to make do with common parts available in my junk box and easily accessible to all . After much experimentation I came up with a fairly basic circuit , simple in concept and easy to put together .

Odd as it may sound ,to start with I chosed a small speaker because of its limitations . Because of its low response to higher frequency I had a built-in filter against high frequency noise . The speaker has a very low impedance output and Q1 is used as a comon emitter which will readily couple the speaker to Q2 high impedance input for high gain amplification .
But Q1 does a lot more , it is also used as the stage which provides automatic gain control (AGC) and first stage filtering as follows ;

RV1and R2 provide feed back from the emitter of Q2 along with C2 to bias the base of Q1 , setting RV1 adjusts the limit of amplication of Q1. As C2 is fully charged this feed back voltage will discharge C2 to ground at a rate determined by RV1 setting . Any aditional feedback voltage above C2 voltage level will be discharged through C2 to ground thus maintaining Q1 gain level .



When RV1 resistance is high C1 time constant is low (slow discharge) and allows lower frequencies which have a higher signal amplitude to be amplified and when RV1 is set to its lower resistance setting limited by R2 , C1 discharge very fast allowing only higher frequencies to be amplified , thus we have frequency filtering and automatic gain control . Please note that R1 and R4 values are critical and must not be changed for the AGC to work as designed .

To test the function of the AGC once the circuit is completed , apply power to the circuit and with an oscilloscope or simply the headphone connected , monitor the output of the amplifier by disconnecting the speaker at the input and reinserting it , there should be a high gain rush at the output diminishing to a lower level , experience the effect with RV1 at different settings with each test

The signal is taken from Q1 collector and fed through C4 to the base of Q2 for amplication then from its collector through C5 and fed to the second stage of filtering made of RV2 , C7 and C8 then on to pin 2 of the TL071 op-amp . C10 is the final stage of filtering removing high frequency noise from the output at pin 6 .
At this point C10 can be any capacitor from 100pf up to 470pf . A three position switch can be use to select 100pf, 270pf or 470pf in parallel with R8 for more flexibility , a worthwhile implementation . From the op-amp the signal is passed on to RV3 the volume control then to the LM386 power amplifier .

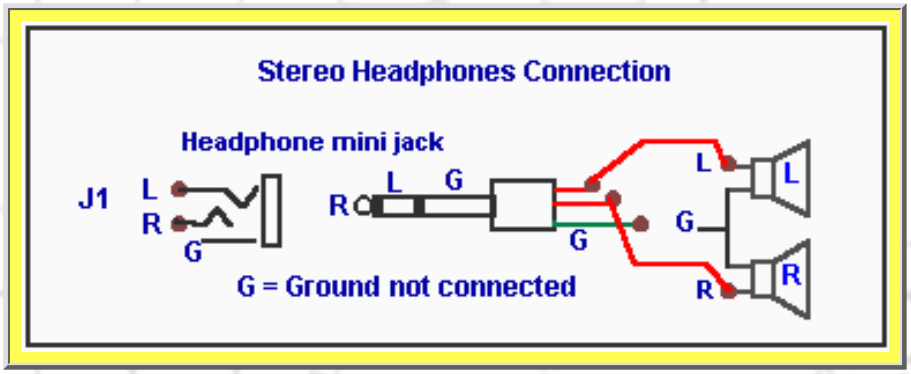
The amplified signal is taken from C14 for connection to headphones . See details below for making sterero headphones connections.

Construction

- Point to point wiring or a PCB can be used . Use sockets for the ICs, and keep all leads short . All resistances are 1/4 w rated , electrolitics or cadmium capacitors can be used rated at 16V. all other capacitors are ceramic types but using polyester types will give better performance and lower noise . Construction is not critical but keeping capacitor leads as short as possible will minimise circuit noise . Use a small enclosure large enought for the circuit and a small 9 volts battery . I used a small phone receptacle with matching input jack for the speaker connection to the circuit and the same for the headphone connection except that I used a stereo type miniature jack as detailed below . RV1,RV2 and RV3 are mounted on the box cover as well as a miniature single pole switch for the battery power ON/OFF to the circuit .

The circuit consumes very little current averaging about 10 miliamps , you may add an LED "ON" indicator connected across the supply with a 1K resistor in series for an additional 8 miliamps of current

. With 8 ohms stereo headphones connected in series the impedance will be 16 ohms at the output of the amplifier .

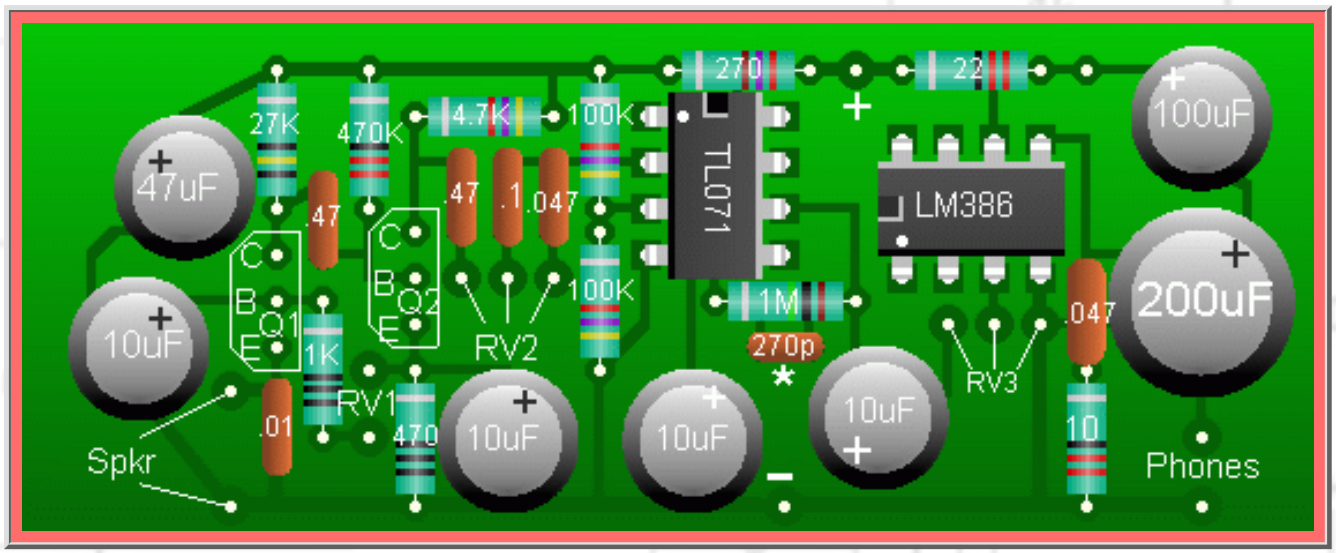


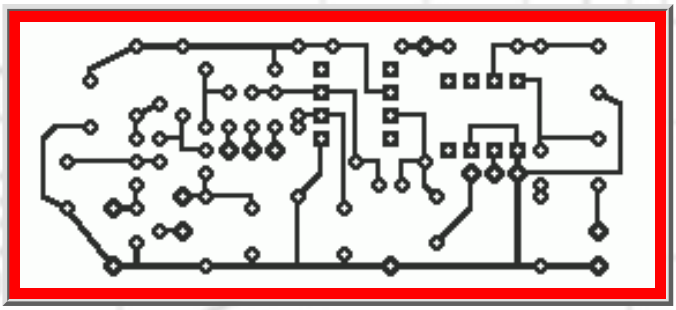
Using Super Mike

- Super Mike amplifier can be used anyway you want with or without the " Shotgun" . I used it with a dish type system and it performed very well . On its own the speaker can be used against a wall surface with excellent reception .

It is extremely sensitive and best results are obtained by setting the volume as low as possible to start with , set RV1 and RV2 to mid point , ambient noise will be present and cannot entirely be eliminated as it is present at all frequencies . Adjust RV2 for best clarity then slowly adjust RV1 for best frequency selection while adjusting RV3 for a comfortable listening level .

Layout





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Handy Dandy Little Circuits

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Mini-Electret Microphone

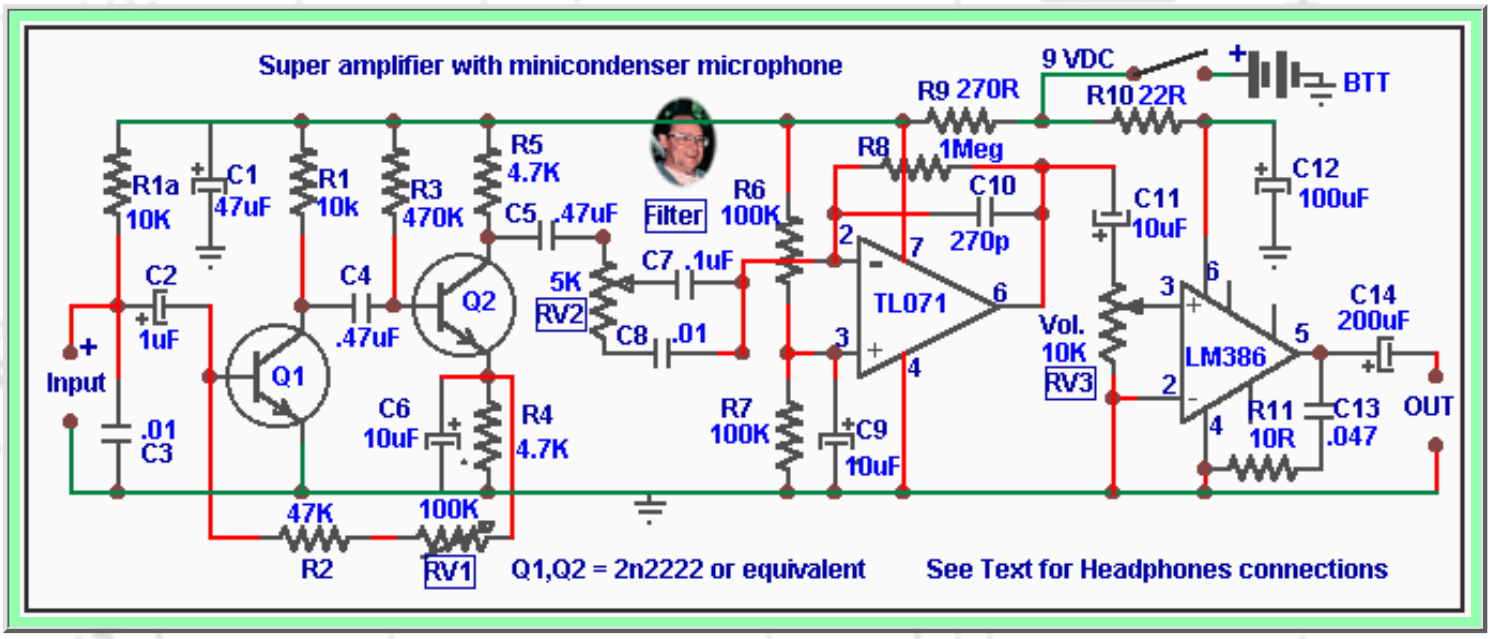
Circuit Description

Super Mike designed by L . Gendron (Aug , 2001)
As a reference you may wish to open up a new window to view the circuit while reading the description. **Resize as required** .

- The Super Mike Amlifier was redesigned to use an mini-condenser microphone element . The microphone element is very small about 1/4" dia . by 1/4 " long capsule with two coloured coded wires . This microphone is also known as an " Electret " as it contains an FET transistor in its capsule .

The microphone can be obtained from Radio Shack " Mini-electret microphone element " cat # 270-085 . With application instructions.
The microphone requires a positive voltage input of 4 to 10 volts and a coupling capacitor to the amplifier .

The microphone is now connected while observing its connection polarity between the base of Q1 and ground . As shown in the redesigned circuit , Q1circuit has been modified to accept the mini-mike input by adding R1a which supplies 4.5 volts operating voltage to the mike and C2 value now 1uF is used as the coupling capacitor to the base of Q1, the emitter is now connected to ground and R1 has been changed to 10K to allow more current for amplification .



Not mentionned before is the function of C3 , in both circuits , C3 is used to filter out any stray radio signal from being detected and amplified . You can check that my removing C3 and you should now have a local radio receiver . If C3 value of .01uF does not entirely prevent radio detection you can increase the value of C3 up to .047uF but any value greater than .047 will seriously filter out the microhpone higher frequencies .
Q1 is biased in the same manner as the previous circuit except that due the higher impedance input the feed back voltage from Q2 emitter needs to be greatly reduced and those changes are reflected by the new values of R2 , RV1 , and R4 .

By having to use C2 as the coupling capacitor to the base of Q1 , we are prevented to use the AGC circuit as in the previous amplifier as this would require to add a transistor stage for this function . RV1 now has the function

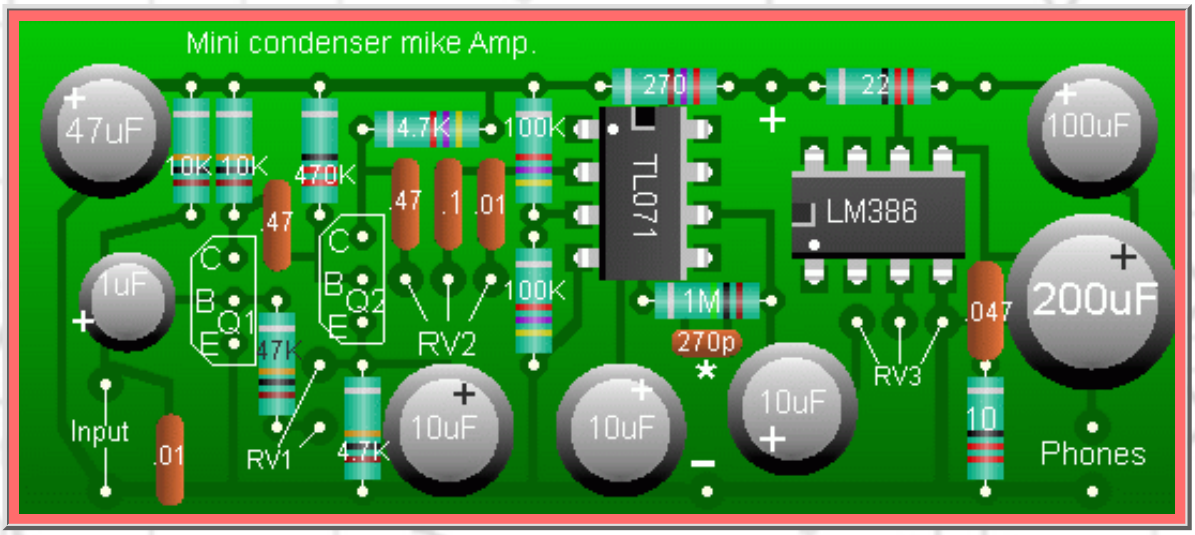
of setting the gain of Q1 at will for sensitivity as needed and allows Q1 to amplify all frequencies equally .

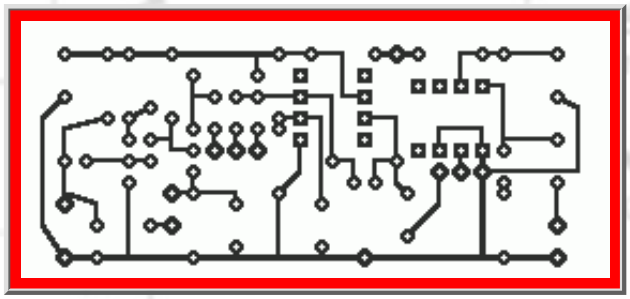
A further change which is optional was made to the RV2 filter where C8 value was changed to .01uF for slightly higher frequency response. Other than the changes mentionned the circuit is the same . Constructions and phones connections as detailed on the previous page apply .

Mini-Mike with Shotgun

- Using the mini-mike with the shotgun can easily be adapted by using a small plastic funnel to fit the diameter of the tube cap . The mike is inserted into the small end of the funnel and the larger end cemented to the tube cap after having previously cut out the hole in its face as described previously . The wire connection can be made in the same manner as the speaker . I used a short lenght of shrink tubing around the mike and part of the wiring to seal the capsule before inserting it into the small end of the funnel for a tight fit .

Layout





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Questions? Email me at roma60@home.com