

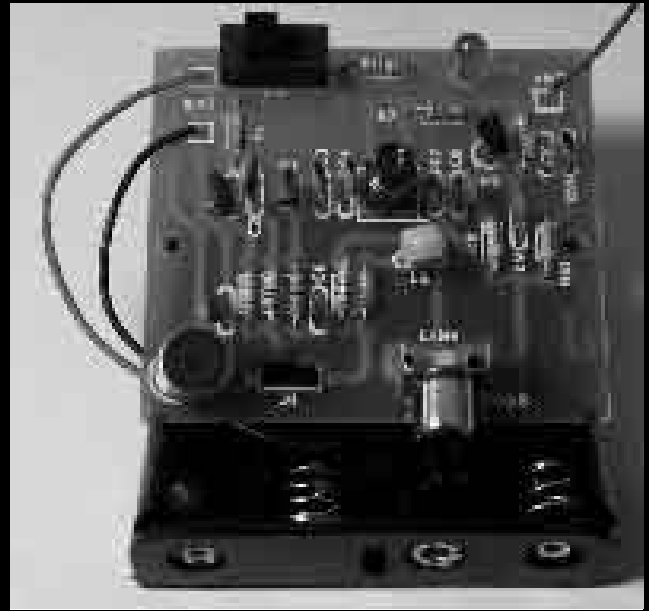
**Kit 99108**

**Gibson Tech Ed, Inc.**  
TECHNOLOGY YOU CAN BUILD ON

1216 South 1580 West Orem, UT 84058 800-422-1100

**GTE**<sup>TM</sup> #99108

**Powerful FM Mic KIT**



## Troubleshooting Instructions for Powerful FM Microphone #99108

### Step 1--Checking the PC Board for Breaks

If you are using a PC board other than the one supplied by GTE, make sure that there are no breaks in the copper traces. Examine each trace carefully, looking for tiny hairline cracks that indicate a break in continuity. These small breaks can often be easily repaired by bridging them with solder.

PC board checked for breaks.

### Step 2--Examining the Solder Connections

One of the most frequently occurring problems with any project is the existence of "cold", or poor, solder connections. Pay particular attention to the following five things:

1. Slightly tug on all components to make sure that all leads are securely soldered to the PC board.
2. Be sure that all solder connections are shiny; resolder any that are not.
3. Check to see that the solder has flowed into a smooth puddle and not formed a round ball. Resolder any connection that has formed into a round ball.
4. Look to see if any solder bridges (pieces of solder crossing copper traces) have formed. If they have, break or cut them with cutters or the soldering iron.

5. Check to see if there is any excess solder. If there is too much solder on the connection, remove some with the soldering iron.

### Step 3--Quick Checks

At this time it would be a good idea to check again and be sure that your project is functioning. If it is not, proceed with the Quick Checks below.

Problems with the 99108 Powerful FM Mic can be divided into three main categories:

#### **Problem No. 1: Proper placement of all components.**

1. Using the pictorial diagram, be sure that each component is in its correct place. Look at the numbers on each component to be sure the correspond to the pictorial.
2. Check switch S1. Place a clip-lead across S1 to bypass it. If the LED lights up after doing so, you know the source of the problem was switch S1.
3. Check the LED by connecting 6VDC across R11 and the LED. If it does not light up, it needs to be replaced.

#### **Problem No. 2: Proper orientation of transistors and LED.**

1. Check the transistors to be sure the flat side is matching the nomenclature on the circuit board.

Check the LED to be sure the flat side on the LED is on the side marked C on the circuit board. Check the Microphone is installed with the correct polarity.

#### **Problem No. 3: Check for protruding pins and leads that could be touching each other.**

1. Check to be sure you have trimmed all the excess leads of the soldered components.

#### **Important Notice to users of our kits:**

**We urge all kit builders and users to observe the regulations of their own national telecommunications authorities. Build and adjust this kit according to the instruction manual and do not modify it in any way. Check your intended operating frequency very carefully to be sure you will not cause interference to reception of licensed broadcasting stations.**

**If you receive any complaint about your transmissions interfering with broadcast reception, stop or change your operating frequency immediately. Please note that knowing and observing of lawful use of all kits is a first responsibility of all kit users and builders. We do not endorse any unlawful use of any of our kits and products.**

# The Audio Amplifying and Mixing Circuit

Transistor Q1 provides amplification for the audio signal coming from the electret microphone which would otherwise be an extremely weak signal. The audio signal also varies (frequency modulates) the oscillator frequency.

# The RF Amplifier Circuit

As was mentioned earlier, the function of the final radio frequency (RF) amplifier stage is to amplify the weak signal coming from the output of Q1 through capacitor C8. This function is accomplished by transistor Q2 and its associated components.

In order to produce amplification, the following are necessary:

-Transistor Q2 must receive positive voltage on its collector (C).

-Transistor Q2 must receive negative voltage on its emitter (E).

-Transistor Q2 must receive positive voltage on its base, but less than that received by the collector.

Q2's collector receives positive voltage from battery through resistor R8.

Q2's emitter is connected directly to the negative of the battery through R10. Q2's base receives a variable voltage through C8. Q2's base is bias correctly by resistors R7 and R9.

The signal voltage leaving Q2 is sent out over the antenna. The radio frequency signal carried by Q2 is a frequency-modulated signal. As a result of this frequency modulation (FM) process, the radio frequency signal varies its frequency following the variation of the audio signal.

When the FM signal reaches any FM receiver it is demodulated, amplified, and then sent to the speaker so that it can be heard.

## ASSEMBLY INSTRUCTIONS

### Mounting the Components

#### ( ) Step 1.

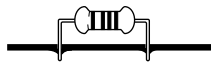
Important Information to help in successful kit assembly:

1. Check off each step as you go.
2. Use the best quality soldering iron you can, with a maximum of 60 watts.

3. Pick up the circuit board and look at both sides. Notice one side has metal traces while the other does not. All electronic parts in this kit will be mounted on the side that does not have metal traces unless you are told otherwise in the instructions.

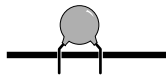
You are now ready to assemble the kit.

#### ( ) Step 2.



Using the pictorial diagram as a guide, insert each resistor, R1 through R11, from the component side of the circuit board and solder each one on the foil side. Cut off excess leads.

#### ( ) Step 3.



Using the pictorial diagram as a guide, insert all the ceramic disc capacitors C1 through C10,

from the component side of the circuit board and solder each one on the foil side. Cut off excess leads.

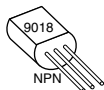
#### ( ) Step 4.

Install and solder in the 3-pin jumper header J1.

#### ( ) Step 5.

Install and solder in the inductor L2.

#### ( ) Step 6.



Identify Q1 and Q2, the CS9018 transistors. Mount them to the PC board with their flat sides in the correct direction, as shown in the pictorial diagram.

Leave about 1/8 to 1/4 of an inch between the body of each transistor and the surface of the PC board. Solder and cut off excess leads.

#### ( ) Step 7.



Install the Electret Microphone MIC, with the correct polarity. Mount it to the PC board as shown in the pictorial diagram. Solder and cut off excess leads.

#### ( ) Step 8.



Install the 5-pin transformer L1. The center lead on one side is not used. Just bend it upwards. Be sure to put the transformer in the correct way as shown on the pictorial. It will not work if you orient it wrong. Pay attention to the center lead you bent. Make sure it is on the correct side as shown.

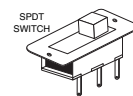
#### ( ) Step 9.



Install and solder the LED as shown. Be

sure to pay attention to which side is the Anode and Cathode. Cut off excess leads after you solder it.

#### ( ) Step 10.



Install the SPDT slide switch. Solder its leads as shown in the pictorial diagram.

#### ( ) Step 11.



Install the RCA Jack at the location marked 'Line'. Solder its 4 leads as shown in the pictorial diagram.

#### ( ) Step 12.

Install the antenna wire to the circuit board in the hole marked 'ANT'. The optimum length for the antenna is 1/4 wave length.  $(l) \text{ Wavelength in cm} = (v) \text{ speed of light} / (f) \text{ frequency} = 3 \times 10^{10} \text{ (cm/s)} / 90 \times 10^6 \text{ Hz} = 333 \text{ cm}$

Therefore the length of the antenna should be about

333 cm divided by 4 = approx. **83 cm**.

#### ( ) Step 13.

Install the Battery Holder wires to the points marked + and -. Please connect the red wire to the point marked +.

## Operating Procedures

Once you have assembled the kit,

(1) Insert four 1.5V 'AA' Batteries in the battery holder.

(2) Be sure that the on-board jumper J1 is set to the 'M' mode so the microphone will be in the circuit.

(3) Place a radio receiver close to the transmitter and turn in on to the FM band. With your transmitter on, adjust the tuning dial on the radio until you hear a feedback squeal or whistle sound. You should be able to talk into the microphone and hear yourself in the radio.

If there is a station operating on this frequency, adjust the frequency of your transmitter with the ferrite slug in the middle of L1 transformer with a non-conductive tuning tool, for example, a piece of plastic, so that you are not broadcasting at the same frequency as the station. (You do not want to interfere with any broadcast station. It is illegal and has strict penalties.)

(4) To use the transmitter to broadcast your 'Walkman' or similar signal, set the jumper of J1 to the 'Line' mode.

Please be sure the antenna is fully extended and not in contact with any metal surface.

## Circuit Operation

Congratulations on building the 99108 FM Transmitter/Microphone kit. Before you assemble it, let's take a look at how it works.

## A Miniature Radio Transmitter

You have here nothing less than a miniature radio transmitter. This project transmits a modulated carrier frequency of between 88 MHz to 98 MHz a distance of approximately 40 feet. Your FM radio at home is designed to receive signals in this frequency range. While this project puts out a weak signal in comparison with a FM broadcast station, at close range (10 to 40 feet), its signal is strong enough to override the standard broadcast message.

## Reading Comprehension

1. This project is nothing less than a miniature \_\_\_\_\_.

2. This transmitter sends out to a radio signal in a frequency range of between \_\_\_\_\_ MHz to \_\_\_\_\_ MHz.

## Stages of the FM Transmitter

As you can see from the schematic diagram, this project has two stages: a mixer/oscillator stage and a final rf amplifier stage. The mixer/oscillator stage is built around transistor Q1 and its function is to amplify the signal produced by the microphone and 'mix it' with an oscillator frequency. The amplified audio signal is then sent through capacitor C8 to the final amplifier stage. This circuit produces an alternating current in the radio frequency range. That current is then run up and down an antenna wire and converted into electromagnetic radiation, or radio waves. First, we will discuss in detail the oscillator stage, which is the heart of the transmitter, before turning our attention to the audio amplifier stage.

## The Oscillator Stage

An oscillator consists of three basic parts:

1. A **tuned circuit**, consisting of C4, and the primary of L1- The tuned circuit (LC circuit) determines the frequency of transmission. That frequency can easily be varied, a

fact that we will explore in a moment.

2. An **amplifier circuit** that will take the LC circuit voltage and boost it- It consists of transistor Q1 along with biasing resistors R1, and R4.

3. A **feedback method** to send a portion of the tuned signal back to the amplifier in order to maintain oscillation- Capacitor C3 performs this feedback function.

## Reading Comprehension

1. This FM Transmitter with Microphone has two stages, one being its \_\_\_\_\_, and the other an \_\_\_\_\_.

2. The final amplifier stage \_\_\_\_\_ the signal produced by the \_\_\_\_\_ stage.

3. The mixer/oscillator stage produces an alternating current in the \_\_\_\_\_ frequency range.

4. The three basic parts of an oscillator are: A \_\_\_\_\_, an \_\_\_\_\_ and a \_\_\_\_\_ method.

## The Tuned Circuit

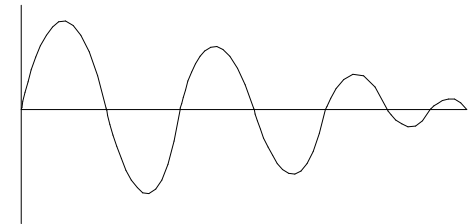
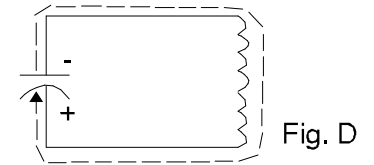
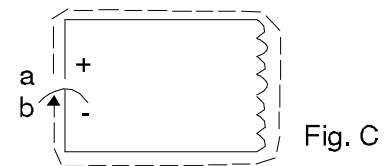
An LC tuned circuit consists of a coil and a capacitor in parallel (see schematic). Our circuit uses the primary of L1 and capacitor C4. Voltage is placed across the LC circuit, C4 will charge in one direction. The capacitor then discharges through the primary coil with electrons flowing from one plate to the other plate. (Fig. C) The capacitor is now charged. The capacitor then discharges back again with the opposite plate becoming negative. (Fig. D) This process will repeat itself until all the electrical energy is dampened out. The wave form for such a signal is shown in Figure E. It is necessary to find a way to reinforce these oscillations, to keep the signal from being lost. Before we see how this is accomplished, a few points need to be made concerning the LC tuned circuit.

## Reading Comprehension

1. An LC circuit consists of a \_\_\_\_\_ and \_\_\_\_\_ in parallel.
2. Current moves back and forth from one plate of the \_\_\_\_\_ to the other plate.
3. If the oscillations of an LC circuit are not reinforced a \_\_\_\_\_ wave results.

The function of the LC circuit is to

determine the frequency of the oscillation, or, the amount of time it takes current to travel back and forth between plates of



Dampened Wave Fig. E

capacitor C4 through the primary coil of L1. It is the size of the capacitor and coil that determines this frequency.

-If either C4 or the primary of coil L1 is increased in size, the frequency of oscillation will decrease.

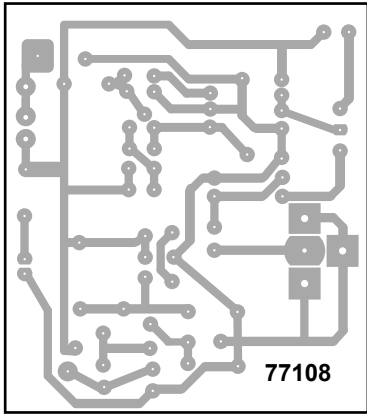
-If either C4 or the primary coil of L1 is decreased, the frequency of oscillation will increase.

In our circuit, C4 is a fixed value of 6pF. It is quite small electrically and the frequency of the LC circuit's oscillation is high, its maximum being around 98 MHz (Figure F). By adjusting the ferrite slug in transformer L1, you can adjust the frequency from its highest point, approximately 98 MHz to its lowest point of 88 MHz.(Figure G).

## Reading Comprehension

1. An LC circuit determines the \_\_\_\_\_ of oscillation.
2. If either the size of the capacitor or coil in an LC circuit is increased, the frequency of the circuit will \_\_\_\_\_.
3. If either the size of the capacitor or coil in an LC circuit is decreased, the frequency of the circuit will \_\_\_\_\_.

FOIL SIDE



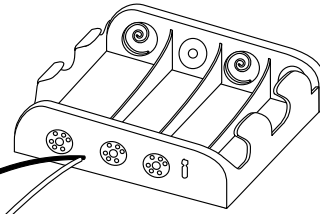
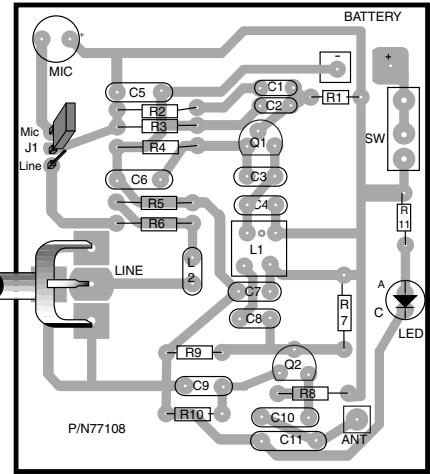
**Parts List**

- Q1, Q2: CS9018 Transistor
- R1- 15 k ohm Resistor (brown, green, orange)
- R2- 5.6 k ohm Resistor (green, blue, red)
- R3- 10k ohm Resistor (brown, red, red)
- R4- 1k ohm Resistor (brown, black, red)
- R5- 560 ohm Resistor (green, blue, brown)
- R6- 100k ohm Resistor (brown, black, yellow)
- R7- 27k ohm Resistor (red, violet, orange)
- R8- 470 ohm Resistor (yellow, violet, brown)
- R9- 43k ohm Resistor (yellow, orange, orange)
- R10- 4.7 ohm Resistor (yellow, violet, gold)
- R11- 470 ohm Resistor (yellow, violet, brown)

- C1- .1  $\mu$ F Capacitor (104) 0.1 $\mu$ f/100nf
- C2- 330pf Capacitor (33) 331/330pf
- C3- 8 pF Capacitor (8)
- C4- 6pF Capacitor (6)
- C5, C7- 0.047 $\mu$ F Capacitor (473) 0.047 $\mu$ F/47n
- C6- 47pF Capacitor (47)
- C8, C9- 0.001mF Capacitor (102) 0.001 $\mu$ F/1nF
- C10- 100pF Capacitor (101) 100pF

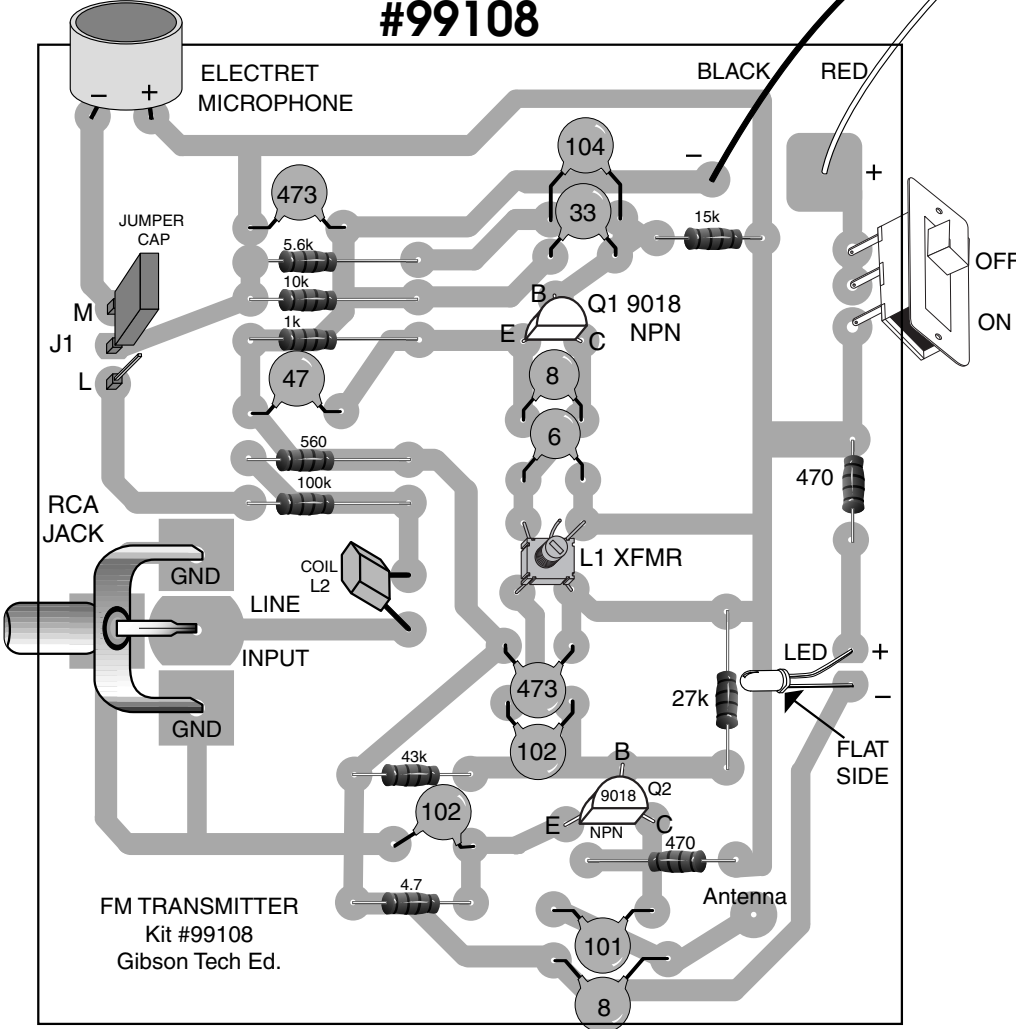
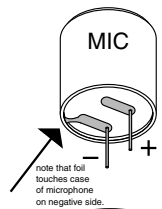
- MIC- Condenser or Electret Microphone
- L1- 5-Pin Transformer Coil
- L2- Inductor
- LED- Jumbo red LED
- S1- SPDT Slide Switch
- Jack- RCA type for Line Input
- Antenna- wire 83mm in length
- Battery Holder for 4 'AA' type batteries

**77108 CB COMPONENT LAYOUT**

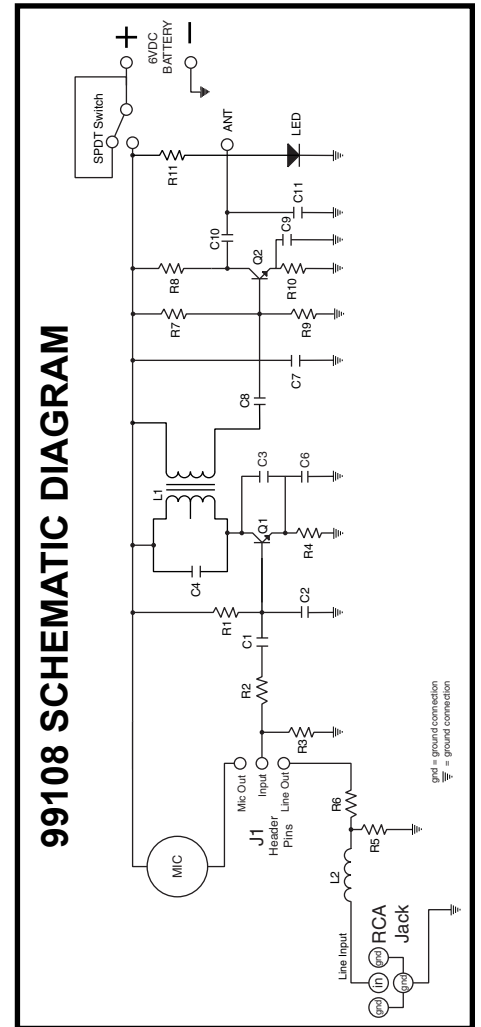


BATTERY HOLDER

**Powerful FM Mic KIT #99108**



**99108 PICTORIAL DIAGRAM**



**99108 SCHEMATIC DIAGRAM**