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This bulletin will deal only with the basic construction, troubleshooting and adjustment of the blue box. If you would like to know the specific job of any part in the circuit just write me a msg and I will be glad to answer it.

We all know that the touch tones frequencies are composed of two tones (Two different freqs.) so that is the reason why we have 2 VCO'S (Voltage controlled oscillators). We will call these VCO#1 and VCO#2. If you have noticed VCO#1 and VCO#2 are exactly the same type of circuits. That is why only one was drawn. But remember that whatever goes for VCO#1 also goes for VCO#2. Both VCO'S are composed of a handful of parts. one chip two capacitors 2 resistors and five potentiometers. All of this will give you (when properly calibrated) one of the freqs. necessary (the other one will come from VCO#2) for the operation of the BB. Both of these freqs. will be mixed in the speaker thus forming the required tone.

This is one of the most sophisticated designs I have ever made. Why?. because other designs will drain the battery after 10 - calls! This design will make them last 10 months!!!!!. But never the less don't forget to put in a switch for on and off. Ok let's build the two VCO'S and calibrate the unit before we get to the keyboard construction.

VCO CONSTRUCTION

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TOOLS REQUIRED

1 oscilloscope (recommended but not required)
1 Freq. counter (REQUIRED)
1 Volt meter " "
Electronics tools (Pliers, drill, screwdrivers, etc)

PARTS

R1 1.5K RESISTOR 5%
R2 1K RESISTOR 5%
C1 .1uf ELECTROLYTIC CAPACITOR 16V DC
C2 .01uf ELECTROLYTIC CAPACITOR (MYLAR) 16VDC
IC1 2207 VCO CHIP BY EXAR ELECTRONICS
remember the above it is only for VCO#1 but the same goes for VCO#2.

R3-R4 150 OHM RESISTORS 5%
C3-C4 .1 uf ELECTROLITIC CAPACITOR 10VDC
P1-P10 200K TRIMMER POT - 20 TURNS

OBB.TXT

DIODES USED IN THE KEYBOARD ARE 1N914 TYPE (40 OF THEM)
AND 13 SWITCHES FOR THE KEYBOARD SPST. MOMENTARY.

SPKR= YOU CAN USE A TELEPHONE SPEAKER FOR THIS (IT WORKS BEST)
BUT REMEMBER TO TAKE OUT THE DIO DE THAT IS CONNECTED
ACROSS IT.

IMPORTANT NOTES

- 1 DO NOT USE ANYTHING ELSE THAN A MYLAR CAPACITOR FOR C2
- 2 PINS 10,9,8 SHOULD BE TIED TOGETHER AND BE LEFT FLOATING.
- 3 ALL RESISTOR SHOULD BE 5%! NOTHING ELSE
- 4 A TELEPHONE SPEAKER GIVES THE BEST RESULTS

TROUBLE SHOOTING

By now you should have constructed the two VCO'S on a bread board or anything that please s you.

Check for cold solder joints, broken wires, polarity of the battery, etc.....

Before we apply power to the VCO'S we have to adjust the pots for their half way travel point. This is done by turning them 21 turns to the right and then 10 turns to the left. Do the same for all ten of them.

Now apply power to the unit check to see that you have power in the chips by putting the positive lead of your volt meter on pin 7 and the negative lead on pin 12 . If you don't have anything there turn off the unit ant RECHECK THE WIRING.

When you get the right voltages on the chips, connect a diode to a piece of wire (look at fig. 2 for the orientation of the diode) from ground to any pot at point T (look carefully at the schematic for point T it is labeled T1-T10 for all pots) You should be able to hear a tone, if not disconnect the lead and place the speaker close to your ear and if you hear a chirp like sound, this means that the two VCO'S are working if you don't, it means that either one or both of the VCO'S is dead. So in this case it is always good to have an oscilloscope on hand.

Disconnect the speaker from the circuit and hookup the oscilloscope to one of the leads of the speaker and the ground from the scope to the ground of the battery. Connect again the ground lead with the diode connected to it from ground to any pot on the VCO that you are checking and you should see a triangle wave if not turn the pot in which you are applying the ground to until you see it. When you do see it do the same for the other VCO to

OBB.TXT

make sure it is working. (a mplitude is about 2VAC)

When you get the two VCO'S working you are set for the adjustment of the individuals pots...

ADJUSTMENT

Disconnect the speaker from the circuit and connect a freq. counter (the positive lead of the counter to one of the speakers leads that belongs to VCO#1 or connect it to pin 14).

Connect the negative lead to the battery negative and connect the jumper lead with the diode from ground to pot number 1 T1 .(The first pot number 1 point T1) If you got it working you should hear a tone and get a reading on the counter. Adjust the pot for a freq. of 1700hz and continue doing the same for pots 2-5 except that they get different freqs.

P1= 1700hz
P2= 1300hz
P3= 1100hz
P4= 900hz
P5= 1500hz

Now disconnect the freq. counter from the speaker lead of VCO#1 or from pin 14 (which ever you had it attached to at the beginning) and connect it to the speaker lead of VCO#2 or to pin 14 of VCO#2 and perform the same adjustments to P6-10.

P6= 1100hz
P7= 700hz
P8= 900hz
P9= 2600hz MAGIC NUMBER!!!!
P10= 1500hz

When you finish doing all of the pots go back and recheck them again.

KEYBOARD

If you look at fig-2 you will see that the keys are simple switches connected to ground and two diodes on the other end. These diodes are used to simplify the construction of the keyboard because otherwise the distribution of the ground signal for both VCO'S would have been done mechanically. One diode will go to VCO#1 and the other will go to VCO#2. Fig-3 shows the arrangement of the keys on the keyboard.

0BB.TXT

Below is a table that will help you connect the keys to required VCO'S pots.

KEY	TO POT ON VC01		TO POT ON VC02		FREQ OUT PIN 14 VC01		FREQ OUT PIN 14 VC0	
	C	1		6		1700		1100
0	2			10		1300		1500
E	1			10		1700		1500
1	4			7		900		700
2	3			7		1100		700
3	3			8		1100		900
4	2			7		1300		700
5	2			8		1300		900
6	2			6		1300		1100
7	5			7		1500		700
8	5			8		1500		900
9	5			6		1500		1100
X	-			9		----		2600

* REMEMBER THAT FIG-2 IT IS THE SAME FOR EACH KEY EXCEPT THE "X" WHICH*
* ONLY TAKES ONE DIODE. *

As a final word you can build this in any type of enclosure and should never be used to make free calls using the telephone lines. I hope this bulletin will clear any question you may had on the blue boxes.

If you have any question please
leave me a msg. and I will be very glad to
answer it.

TXS
MR. AMERICA

Ps. I would like to thank my keyboard, my fingers, and me for helping me write this bullettin. Without their help I would have never finish this project.

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