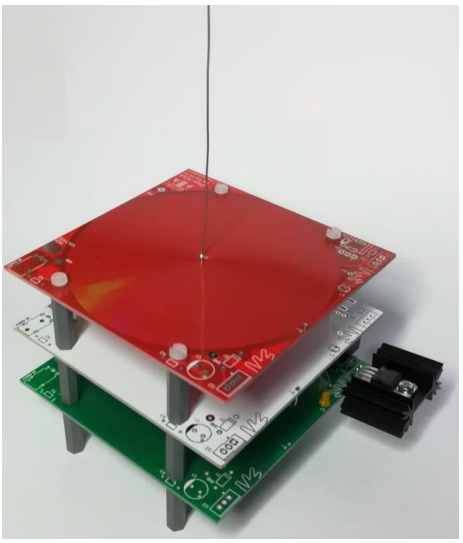
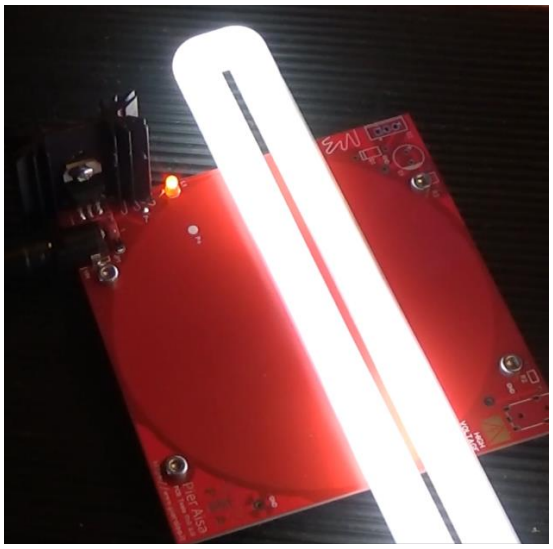
- Creates sparks up to 16mm (50KV)
- Able to light up tube lamps and LEDs
- Compact windings implemented on PCB
- Only 3 components to be mounted
- Multiple PCB can be connected in series



3 PCBTC boards connected in series



3 PCBTC single board in operation with gas tube lamp lighting up

DESCRIPTION

The idea of this *"Tesla Coil on a printed circuit board"* comes from the fact that the realization of the secondary winding of a Tesla coil is a very complex, tiring operation and also requires great precision, considering the high number of turns required for operation. Typically these windings are made up of several hundreds or thousands of turns, made with enameled wire, used for the construction of transformers and the slightest error during the construction of the winding can compromise regular operation with the creation of unwanted electric arcs between turn and turn. . This project makes use of a printed circuit that carries out the secondary winding in a controlled manner, so as to eliminate the manual winding phase, with the advantage of being able to keep the primary and parasitic electrical parameters under control, which affect the good functioning of the coil, since the operation is performed as the routing of a printed circuit through a CAE CAD software. Furthermore, since the winding of the secondary is the most difficult and critical element to make, with this printed circuit anyone will be able to put a Tesla coil into operation, with the addition of very few components. In fact, a very simple electrical scheme has been selected, which goes by the name of "Slayer exciter", and which uses only one transistor as an oscillator.

WARNINGS AND PRECAUTIONS

When the PCBTC coil is in operation it gives rise to the formation of the corona effect in the high voltage areas the electric arcs are able to ionize the air in order to produce a small quantity of negative ions and ozone (O3) and therefore it is necessary to ventilate the room frequently, to avoid the inhalation of Ozone, which is harmful to health. Furthermore, given the presence of a strong electric field, the use of this dominated is not recommended for all those who wear medical devices sensitive to electric and magnetic fields such as ***pacemakers***, because the coil could alter its regular operation. It is advisable to position the coil away from electronic devices, to avoid too strong stresses due to intense electromagnetic fields, due to the oscillation of the coil at a frequency of a few MHz, which is a radio frequency that propagates very well; in fact, you could notice some perturbations in nearby objects such as LCD screens and televisions.
This coil has been called "the Tesla coil for everyone", precisely because of its simplicity of construction and the low danger, in fact usually Tesla coils do not have these conditions, because they usually involve very high voltages and dangerous currents, but we must not underestimate anyway the electrical risk. Pay also attention to eyes and body not to go in contact with the PCBTC in operation.

TECHNICAL DATA

PARAMETER	DESCRIPTION	VALUE			UNIT
		MIN	TYP	MAX	
P	Power Consumption	20	25	40	W
f_{RES}	Resonant Frequency	0.835	1.033	1.100	MHz
L	Arc length	2	5	16	mm
V_{IN}	Power Supply Voltage	12	24	30	V
I_{IN}	Power Supply Current	1	1.1	2	mA

PCB in SERIES	TURNS	SECONDARY WINDING RESISTANCE (ohm)	INPUT CURRENT (A)	FREQUENCY (MHz)	ARC LENGTH (mm)
1	185	121	1,01	1.311	7
2	370	242	1,03	1.033	13
3	480	359	1.16	0.875	17

PCB TECHNICAL DATA

PARAMETER	VALUE	UNIT
Dimensions Lenght x Width	100x100	mm
Colors	RED, BLUE, WHITE, GREEN	
PCB thickness (RED, YELLOW)	1.6	mm
Layers	2	
Surface finish	HASL	
Copper Weight	1	oz
Material Details	FR4-Standard Tg 130-140C	

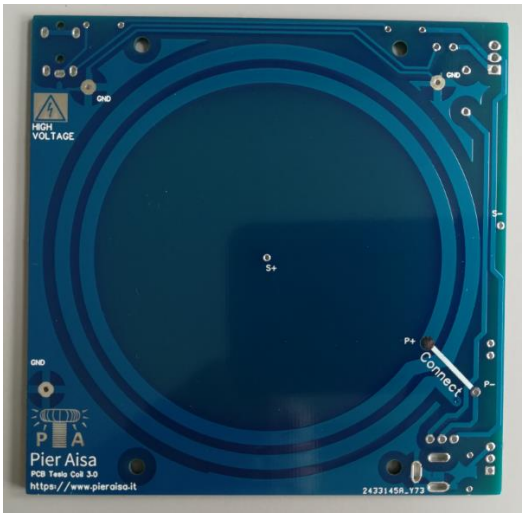
BILL OF MATERIALS

- DC1: Power IN jack
- CN1: Audio jack 3.5 mm 3 way
- C1: 2.2 uF electrolytic 16V
- D1: MUR120 diode
- KK1,KK2: Dissipator TO-220 ML35 for Q1 and Q2
- R1,R2: 82Kohm 1/4W
- R3: 10Kohm 1/4W
- Q1: Transistor NPN BD911
- Q2: Transistor MOSFET IRFP3205PBF
- L1: LED diode
- JP1: pin header male 3 way
- 4 insulators with diameter for M3 crews
- 4 plastic screws M3
-

ASSEMBLY INSTRUCTIONS

- PCBTC circuit assembly is very simple because there are few components to be soldered and assembled as shown in the "BILL OF MATERIALS". It is necessary to respect the polarity indications shown on the printed circuit for the diodes, the transistors and the capacitor. The printed circuit must be lifted from the support surface by means of turrets and screws in insulating material, to avoid closing discharges within the PCB itself.
- A connection joint must be made between the two PADs of the "Connect" silkscreen, using a metal conductor with a diameter of 0.5mm.
- The transistors Q1 and Q2 and the heatsinks KK1 and KK2 must be mounted horizontally, to allow the connection in series of several PCBTCs. In the case of a single PCB they can be mounted vertically
- To create a preferential point of emission of discharges, it is necessary to create a *Break-out point*, ie a point where the electric field is higher than the value present in other points and the discharge can be released into the air. The end of the secondary winding (PAD with *S +* screen printing) is then connected to a metal wire, which in its tip acts as a preferential emitter of discharges. To make the Break-out point use a rigid tinned copper wire, 8 cm long, welded to the central terminal of the coil, marked with the initials *S +* on the PAD. (Figure 9). Other lengths for this stiff wire can also be tried, but the important thing is that it is vertical and far enough from the PCB plane to avoid direct discharges on the coils.
- If more PCBs are to be connected in series, the final part of the Break-out point wire of the first PCB must be connected to the PAD marked S- (secondary winding start) of the second PCB as indicated in Figure 11. The additional PCBs they must be spaced with turrets and insulating screws.

PCB TOP side



PCB BOTTOM side

Connection of 2 PCB in series: a metallic joint shall be done between S+ reference of PCB 1 to S- reference of PCB2

POWER UP

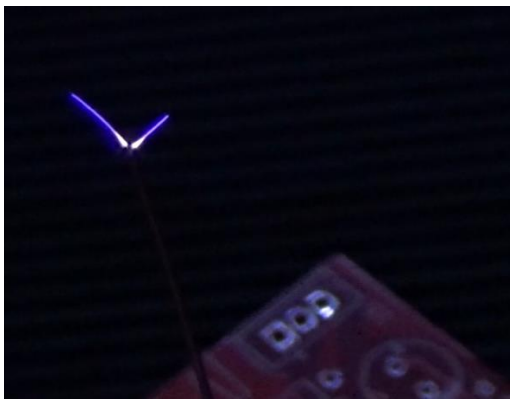
- Once the assembly has been completed, insert a small step in position 1-2 of the pin header with the code JP1, if you want only discharge operation or in position 2-3 for operation with audio modulation.
- It is necessary to power the circuit with a *+ 24VDC* power supply and at least *30W* of available power. If the coil is operating normally, the L1 LED must light up. Put close the PCBTC a gas tube lamp, without touching it (touching only the glass, which is an excellent insulator) and check that the lamp lights up. Approach the tip of a screwdriver, being careful not to touch the metal part of the screwdriver with your hands, to the break-out point and check that the electric arc is triggered.
- Because of the very high frequency energy managed by the Q1 and Q2 transistors, the maximum operation time shall be limited to 30 seconds, in order to keep the transistors not to hot and preserve them. Wait the necessary time to have the temperature on dissipators acceptable to re-operate the PCBTC again.

THE AUDIO MODULATION

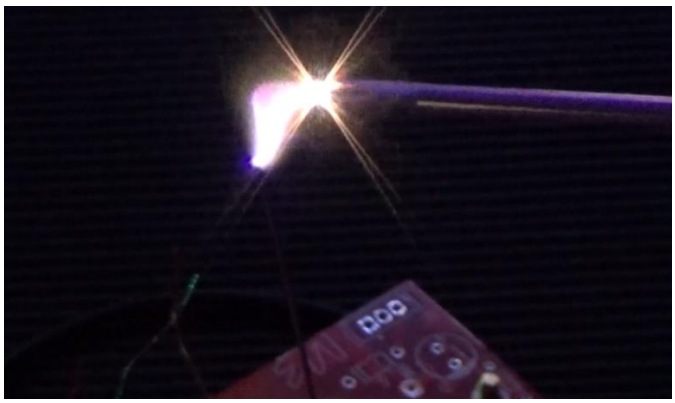
The coil can also "produce music and sounds", thanks to the air compression effect produced by the electrical discharges. To do this, it is necessary to supply an audio signal at the input of the printed circuit, which has a minimum amplitude of *10 volts peak-to-peak*, as a LINE level signal would not be sufficient for this purpose and thanks to the MOSFET Q1 the electric current that circulates in the coil will be modulated in amplitude. Obviously a lot of audio frequencies are cut, but you will still be able to hear the music produced by the discharges. This principle is at the basis of commercial “plasma-tweeters”, which are sound reproducers designed to spread music through the creation of plasma.

ADDITIONAL INFORMATION

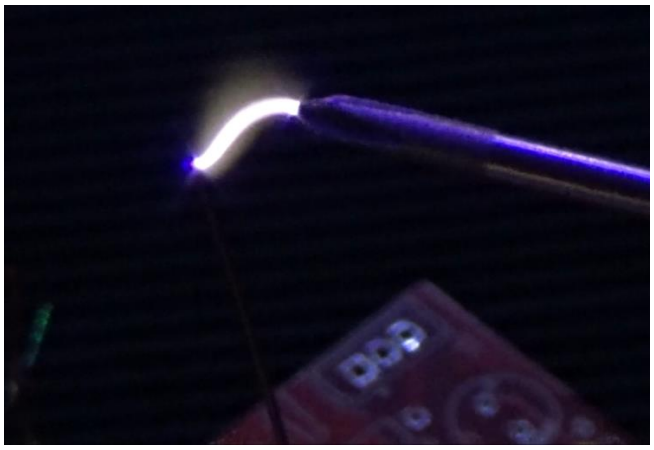
Following pictures show the PCBTC in operation producing corona effect clouds, stand-alone arcs and discharge arcs on metallic parts.



2 PCBTC in series create autonomous arcs



2 PCBTC in series create discharge arcs to the head of a screwdriver



2 PCBTC in series create discharge arcs to the head of a screwdriver

ORDERING INFORMATION

pieraisaforum@gmail.com