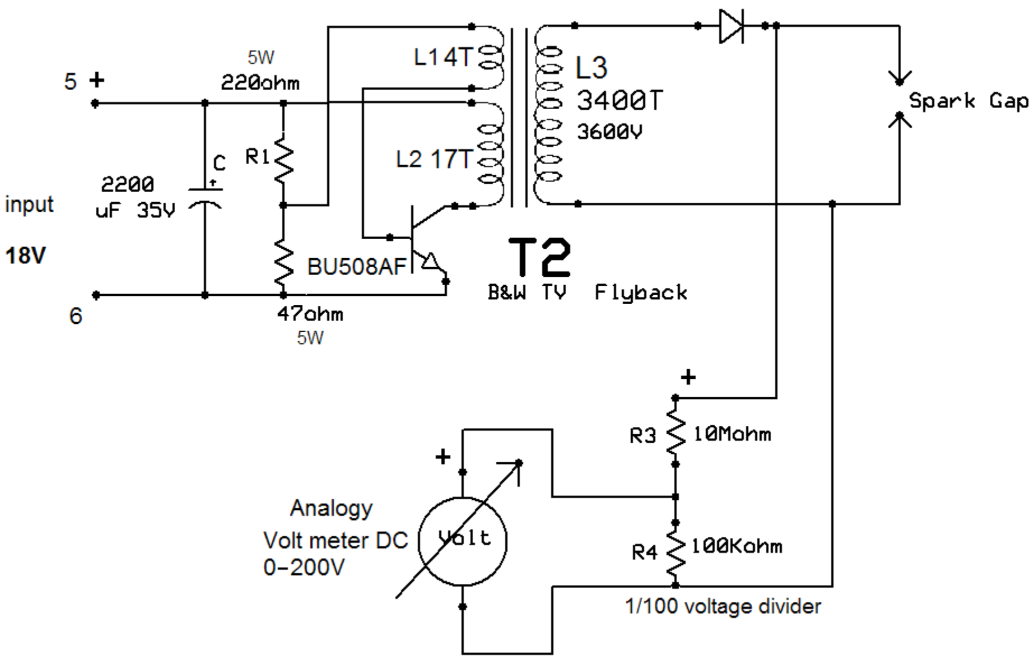
So far we have a stable DC from the main. The next step is to make a HV /high voltage/ and HF /high frequency/ stage. For that we use a driver circuit and a B&W TV flyback. For the driver circuit we can use either feedback circuit or a ZVS /zero voltage switch/ circuit.

The basics are for feedback circuit, from 10-20V DC through L2 and L3 windings produce approximately 4000V AC.
How to achieve that!
Take a B&W TV flyback and remove the primary windings. Make news. In my setup for primary L2 I use 0.6 mm diameter insulated wire, with 17 turns wound ccw /counter clockwise/. The feedback coil L1 is the same wire, wound 4 turns ccw. I fix the wires with glue gun. The secondary winding on flyback L3 remains the same. It is about 3400 turns.

Here is a schematic:

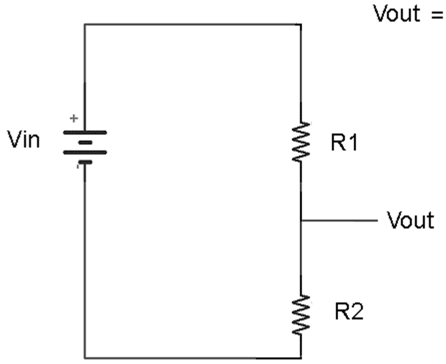


Stage 3
High voltage and frequency

So our DC source is 18V, and goes through smoothing capacitor to voltage divider. On the voltage divider the R1 resistor has a value of 220 Ohm and power rating of 5W, while the R2 resistor's value is, at my setup 47 Ohm with 5W.
Voltage divider
To determine the voltage between the two resistors, we use the voltage divider formula.

The voltage divider formula says **Vout = Vin* (R2/(R1+R2))**

$$Vout = Vin \times \frac{R2}{R1+R2}$$



So in our case Vout=18V*(47Ohm/(**220Ohm+47Ohm**))

Vout=18V*(**47Ohm/267Ohm**)

Vout=**18V*0.176Ohm**

Vout=3.168V

From this came out that the feedback coil is feed with 3.1V.
So as our input is 18V now we can calculate the **high voltage value output. Our L2 coil has 17 turns and the input is 18 volt so now from this we can calculate the voltage for 1 turn.** Well we divide the 18 V with 17 turns

1 turn = 18V/17trun

1 turn = 1.05V

From the secondary side **every turn will pick up 1.05V.** As the secondary L3 coil has 3400 turn then the outgoing voltage will be:

Vout = 3400 turns*1.05V

Vout = 3600V

From this point the output is HV so there is a problem to measure the right value. Because of that I use a voltage divider with a ratio of one to hundred and use analogy DC volt meter rated to 200V.
For that I use 10Mohm resistor and 100Kohm resistor. From the above formula we calculate

V measured = 3600V*(100 000Ohm/(10 000 000Ohm+100 000Ohm)

V measured = 3600V*(100 000Ohm/10 100 000Ohm)

V measured = 3600V*0.0099Ohm

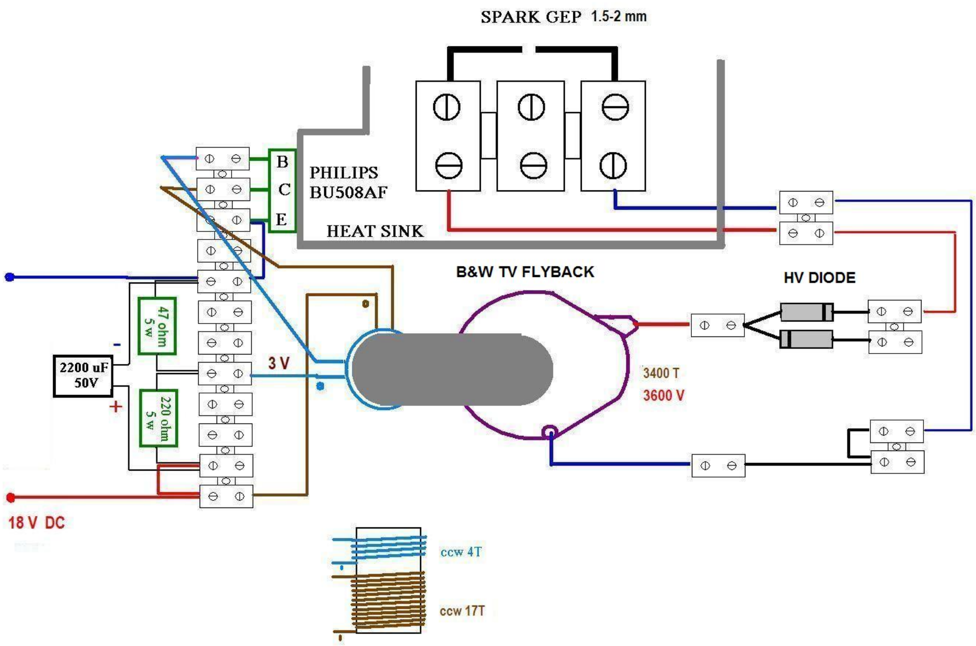
V measured = 35.64V ~ 36V

If we are not sure for the turns in L3 coil just use this setup to determinate the approximately value.

As you know the HV value and you don't know the turn on L3 coil, you can calculate.
If 1 turn equals to 1.05V then you can divide the 3600V output with 1.05V and you will get the turn on L3. L3=3600V/1.05V=3400 turns

The transistor needs a heat sink, to approximately 14V it won't go warm, but with 18V it goes worm and need better heating.

Here is how it is put on the board:



Stage 3
High voltage and frequency

Varying with the turns on L2 coil we can achieve higher or lower HV output.
If L2 is wound with 9 turns then the calculation in our case goes:

1 turn = 18V/9 turns
1 turn = 2V

HV out = 3400 turns*2V
HV out = 6800 V

Or varying with voltage in input also can decrease or increase the HV output.

1 turn = 12V/17 turns
1 turn = 0.70V

HV out = 3400 turns*0.70V
HV out =2380 V