Replication of Roman Karnoukhov’s (Akula) device by Sergei Stalker (translation rev.2)

introduction text source: https://lenr.su/forum/index.php?threads/replikacija-konstrukcii-romana-karnouxova-akula.3/

Every novice experimenter in the field of construction of fuel-less generators will inevitably encounter the problem of constructing control circuits for a device, the so-called controllers. And here there are two main directions:
1. circuitry based on logic elements.
2. circuitry on programmable chips.
At the same time, the power modules that will be controlled by these controllers are identical. Which way to go is a personal choice of everyone, there are advantages and disadvantages in both directions. But practice has shown that programmable controllers are prone to errors due to the influence of electromagnetic radiation on them during the operation of Tesla coils and resonators, and the system of full shielding with a metal case with its grounding did not save them from "hanging". Therefore, I personally settled on logic with a low degree of integration, direction 1. The video "FEG Controller" shows a schematic diagram of such FEG device controller. The circuit was designed by me and tested in practice.

https://www.youtube.com/watch?v=jeEaKI1TZ3s

Controller for FE generator

video transcript:

0:00
Hi everyone
Stalker with you
today we will talk about FEG controller
quite difficult topic for discussion
many of those who made FEG don’t like talking about it
nevertheless I think that I have to show and explain what here and why
here a schematic of the controller
made by me
0:32
here is how it looks like in device
it divided in two parts
here we have push pull controller
also two trimmers to control Tesla coil pulses
width of the pulse burst and it’s phase relative to push pull
and here a module for Tesla coil control
0:55
in this video we will look in details in module controlling push pull
and all this surrounding
and in next video we will into Tesla coil controller
ok, so let’s start
1:14
what’s first ?
Here a pulse generator
I didn’t want to invent anything, you can use other chips if you like
here I am using TL494

here you see we have power supply coming in
7812 regulator, capacitor on the input
1:34
capacitor on the output, choke and one more capacitor after it
you can see it here on the board
here 7812
choke, capacitors
next, this was power for all chips
in this controller main chip used is TC4093
2:00
here are logical elements inside it
Russian analog is K561TL1
what is this elements are ?
Element is Shcmitt trigger with inverse output
and two AND inputs
2:35
here you can see pin numbering and power supply pins
ok, let’s move forward
we make generator with TL494
you can use any other chip you like
3:00
I would like to bring to your attention
capacitor here 6800pf
I was tuning system approximately to 15khz
this controller will work +/-10khz from this
if you need other frequency
some components in this schematic will change
3:30
please note capacitor and here two resistors
they define frequency
here 5k and 500 ohm in series
here these two resistors on the board
why?
3:53
we need this to be able fine tune the frequency
otherwise you will not see all interesting “things”
so I can tune frequency with 0.001hz precision
nothing we can do, it’s a way how system works
tuning should be very precise
4:15
do you remember that once Ruslan Kalabuhov mentioned
that he has frequency adjusting resistor
and you can attach a small motor to turn it
and it is very difficult to de-tune system
next
we could send generator outputs directly to MOSFET drivers
but this doesn’t work for us
4:40
we need to add one more chip and made delay with it
delay implemented with R and C at the 4093 inputs
how this work
signal from TL494 go thru resistors 10ohm

come to 4093 input
5:11
it come thru 4093 and feed to resistor
resistor limiting current
and so it allow to adjust charging time of this capacitor
so the higher resistance the longer capacitor will be charging
and so we have here interesting effect
here I will explain it
5:50
we have slow rising edge
and trigger has a point where it is switching from 0 to 1
so the longer this rising edge the longer delay
6:12
so changing resistor we can control the delay
we do this because it will help us control Tesla coil
so that we could move along all current sine
6:45
if we do not make this delay
our Tesla will late and we will be making pulses at a wrong time
there is no reason beat into falling sine slope
and even more strange would be pulse during dead time
7:07
there is such disinformation in the web
in dead time current is zero, so can't accelerate nothing at that moment
ok, next
so we made a delay for both channel
after that we send our signals to drivers
7:30
here are drivers, I have here UCC37322
how I showed earlier there no need for such powerful drivers
this is my test and prototype board so I use it for different purposes
7:55
Ok, so common power
it marked here +15v
then drivers also powered with 15v
and push pull output stage powered with 24v
how it made on the board
here a use DC-DC step down 24→15v
24v comes from these power supplies
8:37
here you see wire going directly to driver powerful without 7812
it is presented here
we have pol cap here and ceramic 4.7uf on each drive power pins
and here resistors and push pull output stage
you can watch it in a separate video about push pull
9:12
we will not look into it
there were no changes at that part
ok, we made delayed signals for push pull
now original signal go to this socket
here it is on the board
you can see a piece of wire here

here you can see it well
9:46
we need this so that we can chose on what halph of sine we will work
on positive or on negative half
we can connect one or another output of TL494
10:37
here we have a part of schematic which controls Tesla coil
i.e. it controls phase and length of Tesla coil pulse burst
how it works
selected signal from TL494 go to input of another TC4093
similar time delay circuit here
here 4700pf capacitor for delay
and then signal go to similar TC4093 which performs
function of subtracting signal from itself
how it works?
11:46
I will explain it with this picture
for example
let’s assume we have such signal
here we have Schmitt trigger with inverse output
we get this signal, wide
12:03
then this signal go to resistors
here it is 10k
then we do interesting thing
we feed signal and inverse and delayed signal to another element
and so what happen
let’s check input 5
we have here original signal
but on 6 input we have delayed signal
and so what 2AND logic doing, it subtract signals
then we just need to invert it one more time
14:13
I will show how it works when we look how Tesla coil works
14:52
now it is clear why we need delay for push pull
we use not delayed signal to control Tesla coil
co we can move along all sine wave
15:11
now I will show how this works
let’s see how delay working
yellow is on the TL494 output
here it is
blue on the MOSFET gate
now I will turn delay adjusting trimmer and we will see how delay circuit working
15:51
now you can see that because of capacitor there already small delay
now I will start turning
you see
yellow is TL494 output
and blue is driver output
you see signal delayed

16:18
on the circuit this is one of these two resistors
when tuning you will need to adjust both channels
so that phase between them 180 degree
how usually push pull work
17:00
also this delay circuit does not affect duty cycle
I will change now duty cycle let’s see
17:11
see what happen
I change dyty cycle on TL494
and so it changing on the driver output
so it works, we can control duty cycle also
17:37
ok, so our delay works
so our system can work with Tesla coil leading push pull pulses
now I will reconnect blue channel
to output where we control Tesla coil
18:06
here this output on the schematic
18:17
two TC4093 chips controlling phase and length
and outpout socket with 3 wires output, ground and power
18:36
here these 3 wires
black is ground, red is power
and white is signal
here it is on the Tesla coil control board
now I will connect scope probe and we will see how pulse burst controlled
19:10
let’s see
yellow probe still on TL494 output
now first I will turn this trimmer which controls phase
and then next this one which controls length
19:35
now changing length
difficult with left hand but I will try
19:58
we see that pulse burst length is decreasing
so this circuit working fine
we can tune even one pulse on the Tesla coil
20:27
now turning back, it get wider
this was one resistor
here another which controls phase
here it moving
we can see why delay needed
we can’t move output outside the original pulse
21:19
so if we would not have delay, we will be late
but now in this position our signal is leading the current sine
so we can work in the region where current sine crossing zero

and start rising
22:00
so here we are working in the rising part of sine wave
22:22
and here we can work on falling part of sine wave
for that we need such delayed setup
now it synchronized with one channel
we can reconnect to the second channel using this socket
22:48
here it is on the board
ok, next let's see what is happening inside the pulse burst
here it in bigger scale
23:06
here blue channel scope probe
I reconnect it to the driver output which controls Tesla coil
here you can see pulse inside the pulse burst
very nice so that we can control Tesla from the push pull board
23:51
for example I changing length
24:11
also can make it shorter
see we can make almost nanosecond generator with this setup
"struck" with just one pulse
here you see just one pulse
so we can make 2, 3,4,5 pulses
we actually don't need more for this Tesla coil
4-6 pulses, no more, more are useless
25:01
when we look how this board works
here we have frequency and duty cycle controls for these pulses
but this will be in the next video
25:31
here the pulse burst
we can also change it's position (phase)
you can see it is moving
circuit allow adjustment in wide range so very nice for tuning
now driver working on MOSFET gate
26:23
currently frequency about 1.6mhz here
this nice pulse edges give UCC37322 driver
on the gate
quite nice looking signal for such frequency
26:58
So here it is
such controller
build it, no pity
I spent long time to design it working
but it is fine
people doing a secret out of it
but I say you honestly, this is just 10% of the working device :)
absolutely no reason to make secret out of it
ok, what I would like to show

here on TL494 we have a input pin 3 marked with a star
my circuit is multi functional
I didn’t show here I have one more chip
so it is possible to make push pull also producing pulse bursts
e.g. for controlling Tesla coils
so if somebody interested you apply high level to pin 3
and TL494 stops and so you get modulated push pull
one more time schematic
everything is easy obtainable, I didn’t want use 5v logic
because we will be starting our system from 12v battery
28:28
so we will have 12v right away
and this DC-DC converter will make 15v from 24v when system running
so we power drivers with 15v
and logic thru 7812 regulator
all RC now shown for 12v power
if you wan use other voltage all timing will change
because Schmitt trigger levels will change
now this 1000pf and 6800pf carefully selected for 12v operation
if you can find TC4093 you can use Russian K561TL1
now this values are for 15khz central frequency
but you can change it if you need, just change these RCs
everything will work
circuit tested, feel free to replicate :)

In the video "Controller TT" the high-voltage module for the Tesla transformer (TT), which is compatible with the synchronization system of the FEG controller, has been discussed in detail.

https://www.youtube.com/watch?v=Bhc1xFNgrVA

video transcript

0:00
hello everyone, stalker with you, we continue
today we will talk about control circuit for our Tesla coil
about the board for it, first, look here my control schematic
0:16
now we have reached this place
there is an output from this control board
of push-pull synchronization and where is
one chip for controlling phase and another for controlling length of pulse burst
here three wires go to Tesla control board
0:41
Tesla coil control board
we place scope probe now
we will observe the scope traces on the yellow channel of the oscilloscope
1:00
it is connected directly to what comes from the push pull board
we should get these sync pulses
now we will make them bigger on the scope
here the width of these sync pulse is changed by 4093 chip
1:20
if I turn trimmer resistor on the board
here you can see
now I am decreasing width of this pulse and this pulse length
will define number of pulses in the pulse burst
1:42
everything in order,
but if somebody interested here total consumption of the entire controller with all drivers
1:57
so and here is the schematic of the Tesla coil control board itself
what are we seeing here
so here have arrived the power supply 15volts
also came pulse itself and common wire
2:18
here it is, red is power supply, black is common, white thin wire is synchronization signal
ok, what we see also
power supply comes to 7812 regulator
with standard components around, choke needed for noise filtering
and one more capacitor
2:40
same power arrangement as on previous board
and very important
driver powered directly, not thru 7812 regulator
this is mandatory
3:00

ok, let’s look further
what we have
first our signal comes to ir2113 driver
it’s first channel, this is pin 10
and comes out at pin 7 thru resistor to diode kd522
or any other fast pulse diode (translator note: e.g. 1N4148)
3:23
and come to this jumper
this jumper is presented on the board here
it is also visible here metal jumper set
what is it it gives us
if this jumper is removed from Tesla will work in a similar way as Kacher in continuous mode
the generator will not be interrupted and will go in continuous generation
3:56
who needs this function, removes the connection and that's it
Tesla turns into kacher
further from it the signal goes to our chip TC4093
then what happens here on this chip
we will take a closer look at picture
make it clear here the logic
4:25
our signal that comes from the push pool is here
this one on the oscilloscope, so it gets to the driver
to the first channel amplified and hits the diode
after what is the logical element of this chip here
on this logical element implemented oscillator
this is marked here frequency in the pulse burst
this is resistance 200ohm 260 ohm from output to the input is sent to the capacitor as well
5:00
how this schematic works
we have, when the input is a low signal level
here let's say in the Schmitt trigger inverts our high level signal
high signal level sent through resistors to the input capacitor,
the capacitor is charged to high potential to the point of trigger
and output signal resets to low after this capacitor is discharged again
there is a high signal level and that's it
5:39
repeats, that is, we have here on this the circuit
assembled an auto-generator
its frequency changed by this resistor,
i.e. we change the number of charges that go on the plate of this capacitor,
this time setting circuit
5:54
creates for us a generation, what makes diode here
then through diode it a high level comes through the driver
this diode switches on sharply saturates capacitor and since
here the high level is kept here at the output low
all schematic stops and there is no generation
what we need this signal for ?
6:20
this signal is actually this one large rectangle
this is the time for which this capacitor is locked

and this time which is given for that the schematic make continued generation
in this way implemented frequency oscillator for Tesla coil
6:44
further, why is the driver used here
you won't be able do anything without it
you can try, without driver it will always have the first pulse width different
in relationship to other pulses
7:00
and stability will be lost, in addition
here you can see that and output from this logical element
goes also to the second driver input and through
it goes further to the next RC, that is, the driver we have
completely separates this logical element from all influences from the outside,
from power supply noise
7:30
and from the subsequent circuit the decoupling occurs
and this circuit is very stably keeps frequency
in this way we achieve and thermal stability and remove frequency drift
7:50
further according to the schematic
output of this one frequency goes to the next chain
that also sets the time, it is responsible for the duty cycle
duty cycle varies from 30 and practically up to 50 percent
depending on frequency, but there might be 48 percent somewhere maximum
8:10
thru damping resistor and trimmer resistor
310ohm and capacitance 470 pf and also come to same
chip TC4093 to the second logical element
circuit work the same way
we adjust the number of charges passing in a unit of time
charging the capacitor and therefore we work
same way also at the hysteresis point of this trigger of this element and we change duty cycle
here mandatory element this little resistor is 1k
without it this will work at all
9:00
next, we still need one element for inversion and we we get our pulse bursts,
that is, the schematic is simple and reliable as a Kalashnikov rifle
I it recommend for use
we have analyzed the logic and so here how it looks on the schematic
9:27
driver, components around it, diode, jumper
signal comes to logical element
here is our resistors presented
this is frequency adjusting trimmer and capacitance
well and here from the output we take the amplified
9:57
signal, we get an output at pin 4
so it go again to second driver channel
20 ohm resistance and that's the duty cycle adjustment
here is the resistor 1k
further happens one more inversion here input
10:14

logic element inputs 9 and 8
output 10, from it go to another element
inputs 13 and 12, inverted and go through resistance 10 ohm to the driver,
we have here ucc37322
10:42
from the driver signal go thru 1.5 ohm to gate, transistor k2611
the transistor works through fast diode in this case mur860
and then I picked it up here resistance 2 ohm
it is needed for the operation of this transistor
without overload, further, to the Tesla inductor (translator note: inductor = primary coil)
11:07
so how it looks on the board, well, here's our
dumping resistance 1.5 ohm here is the discharge resistance
at the gate 1k
by the way, guys, I haven't finished drawing, it
have to be done, without it will not work
for this case now we will correct
how it looks right in front of you
11:41
we draw resistance and here
it is to the common wire, and like this
we pass and sign 1k
key powered through the DC-DC converter
in my case made a converter 12 to 200 volts
12:19
here this board, also push pool type
in this converter I made voltage feedback
so we have ability to adjust nominal supply voltage,
ok, we see plus go directly to the inductor here
for the Tesla coil
and our minus goes to transistor source pin
12:50
voltage adjustment is an important factor for
the tuning of the entire this system
so not only duty cycle here, but also Tesla coil power supply voltage
it needs to be adjusted, the system will
not work if you feed too much voltage or too little, that is,
this parameter is needed to be tuned individually
in further videos I will show how it works,
Tesla coil, although I already have on my
channel video recorded about Tesla coil and preliminary tuning
now I will show scope traces
here is quite acceptable in in my case, 130 volts are now set
13:36
only 4 pulses and the system works very well
I'll show the schematic once again and go to scope traces
13:50
so the second channel is blue
now directly on the transistor’s gate
is turned on, and we see we have pulse bursts
making bigger scale
here in in this case, we now have two and a half pulses

14:15
from system goes
now I will find my screwdriver and we will adjust
on the board here frequency control trimmer resistor
and duty cycle of the pulses control
I will turn now the trimmer resistor on this board
it is pulse burst width control
14:46
let's see how the circuit works
see what I'm doing, now I'm decreasing
we'll see decreasing sync pulse and here on the blue trace
15:00
we see that with this system it is possible to generate even one pulse
so you can do even a nanosecond pulse generator with this setup
you can make width so small
that there will be only one pulse
for example, I add 2 pulse, 3
it is generally adjustable up to 10 pulses
all I will not show it all
here 4, try it yourself when you build it
5 and so on, let's go back
at I'm interested in work with 4-5 impulses
no more needed, so now let's follow
15:39
I will now be working on the duty cycle in the pulse burst
the resistance that responds for duty cycle
duty cycle regulated anywhere from 30 to 50 percent
the same I said, here let’s look
16:00
by the way frequency adjustment of the system itself, it will also influence
the higher the frequency, the more we have pulses in the burst,
but now I will turn the trimmer resistor for duty cycle
is the minimum duty cycle and we begin to increase
it is clearly visible that the duty cycle in the bursts increases
the pulse burst itself does not move anywhere from sync pulse
everything works fine
16:31
duty cycle will be clearly regulated even on one pulse
now I will decrease pulse burst up to one pulse
for example, select the number of pulses
here our picture
17:00
set the sync pulse down, so that it was clearly visible
now we see that we have on each sync pulse single
the pulse in the system now
duty cycle at the maximum, that is
full-fledged nanosecond generator here
maximum duty cycle and now I will reduce duty cycle
17:35
you can see that it is regulated like this in wide range
if you need reduce even more the duty cycle,
for example, for a nanosecond generator

you just add the frequency on the master oscillator
and the duty cycle will be much less
18:00
so, why we need adjustment for for duty cycle for Tesla coil ?
this is an important parameter, this is also
needed for system synchronization
it works in pair with adjustment of supply voltage
important parameter, when you do tuning
do not forget to about this
because with no adjustment of duty cycle in
the pulse burst you will fail
this is how compact it looks
everyone will make board for themselves
18:37
yes, I want you to pay attention, see resistor here
these are 2 ohms how they are made, on heatsink
I placed 3 in paralleled by 2 watts because through
them we have a high current which goes to Tesla’s coil inductor
is mandatory for cooling, here is the diode, in this enclosure mur860
it directly goes to the drain of this transistor k2611
19:00
good luck to everyone in the design,
wait further videos
support my channel with your “thumb up” button
let’s work together

Another version of the high-voltage module is presented in the video "Controlled kacher", which can also be connected to the FEG controller instead of the TT controller module. This high-voltage unit is assembled according to the schematic of a controlled auto-generator.

https://www.youtube.com/watch?v=NGiBxuLgjrw

video transcript

0:00
good time today to everyone
I will tell today how to make a circuit of controlled kacher
for our systems the schematic turned out to be working ok
modulation can produced by an impulse of a given duty cycle with frequencies
from tenths of hertz up to 50 khtz when system works
0:23
on the kacher's circuit, that is high voltage
Tesla coil commutation with “cold” end connected
to the base of the transistor or up to 100 khz
if this circuit is to be used as a switch when working
on a resistive load such as a incandescent lamp
0:52
here you can see that the values are indicated,
divider resistors, here are the values
in brackets, these ones resistors selected
for those who will make the system as a
switch to work on an active load
so that here on the base of the transistor
1:18
with these values of 350ohms and 740ohms
the system create a bias of 4.7volts in this point
if we look measure voltage here with the disconnected base of transistor 2sc5200
1:40
this divider creates 4.7volts with supply voltage which is 15 volts in
this system value in brackets
our main value which will be used on the kacher's circuit
and also by analogy with the previous schematic which
gave 3.3k and 2.7k (showing schematic of non-modulated kacher)
2:10
the circuit through which the
kacher is powered similar, and in this system here it is presented
except that it is drawn here DC-DC converter
step-up DC-DC converter
2:34
I also gave it in my videos from 12v,
there is output voltage from 50 to 200 volts
this circuit of controlled kacher start working
in the region of 10 volts supply voltage (at this point)
2:55
I tested it up to 100 volts,
in particular our transistor operational up to 200 volts
main power switch

circuit is fully compatible
with in this schematic which I also gave
3:19
you can watch my video “controller for FEG”
except for one moment
this is how it connected
the same connector and we continue here (on another schematic)
one important thing,
such that for controlled Tesla coil
3:45
control pulses we needed
like this, a long signal with a small
pause between them, this pause is for
controlled Tesla and
4:03
formed these pulse bursts according to its logic
in previous videos we also sorted out this moment
for this board it is not right
to be compatible we need to remove one inversion
in this case, we do not connect to the pin 10
of TC4093 that goes to the output
but to the pin 11, that is, we remove one inversion
and then we have a signal at the input here is such a form,
we can we set its duty cycle controlling
4:50
running time of the controlled kacher circuit
and to implement this schematic of controlled kacher
and we need two chips, one of them is
famous driver for my previous video ir2113
this is a two-channel driver that does not forms
dead time between signals and second
chip TC4093 is 4 Schmitt trigger
with 2 AND inputs and inversion on the output
5:39
several resistors, pay special attention to resistors
that bias the gate of the transistor of p conduction
because transistor of p conduction needs to control of negative
voltage, and n channel transistor we control with
positive potential, with them all easier,
for p channel it is necessary make a system that
controls with negative voltage
and this one our divider, we will be interested in which in ultimately
determines consumption and stability of this circuit
6:33
the divider on the gate of the transistor
irf4905 is selected in such a way that
here the negative voltage was about 14.7volts
it is the same as n channel transistors can be controlled by voltage up to 20 volts
but most importantly, this divider is chosen
so so that this transistor during its operation lengthened the time of signal
7:06
in relation to that time which

comes from the drain of the n channel
control transistor
this is one of the features of this
schematic is also need a fast schotky diode in
this case sr510 but actually a 2sc5200
transistor and two n channel transistors
7:37
now let's analyze the logic of this schematic
I prepared a drawing which will make it easier to understand how this works
according to the schematic, driver
our chip TC4093 and schematically
indicated the switches that work in the schematic,
that is, first transistor, second, third, but our main 4 we do not denote it here
it does not participate in the logic, it is a power switch
8:16
look, control signal with
some the duty cycle that we set with using
an external generator it goes directly to the
first channel the driver has an output from the pin 1
and go to transistor 2
transistor 2 in our case, this is this transistor, which controls
p channel transistor,
now the logic of the action,
the control transistor one that shorting base of the power transistor
to ground, we control it through logical
9:11
elements of the TC4093
why it is done ? to add some time delay by several inversions
logic elements create small delay in order to to shift signals in time
9:33
now let's figure out what's going on the outputs of the driver
here after we submitted this signal to driver, we have at pin 7 a signal
with a lag relative to signal on pin 1
here it is shown on a time diagram
that signal on pin 1 is slightly ahead of signal on pin 7
10:11
then the signal goes to the transistors
they are marked here
and what happens here
you need to understand that transistors, they have properties as well as logic gate invert signal
we are considering this process,
that is, it was here is the signal on the second transistor it inverted
but he turned here is our signal shaded at the time
as the signal on the first transistor also invert
to this signal but the time lag between them remained
10:51
since these transistors have the same marking,
the time the delays on them are the same
transistors are same series
so far we have time delays only due to elements of TC 4093
11:12
then the signal from transistor 2 through the resistor divider falls on transistor 3

and resistor divider selected so that on transistor 3
we have signed here duty cycle increases
so that it increased the duty cycle of this signal
11:34
it inverts our signal, shaded, but together
with the fact that he it inverts, it it also increases
it in time, while transistor 1 leaves the signal
inverted but time with respect to the input signal
but and does not change in time and if you check
these points with a dual channel oscilloscope
12:00
it will be clearly seen that the signal is on the
drain transistor 3 increased its duration in relation
to the input signal and it will also be noticeable
time shift, this is done so that the transistors worked
with overlapping signal, artificially we create
in this system the pass thru current between two transistors
12:34
in this case it is not dangerous
because transistors operates in such mode to a resistor through a diode,
that is, this resistance converts the thru current to thermal energy
resistor this by the way, it doesn't get very hot
I recommend to put here here in these circuits here are 2watt resistors
13:04
but 1watt also fit well, and these like 1watt
can be used
and so now, if we go to the next point here I
drew signals here
13:20
if we disconnect transistor 1 from the divider by resistor,
we will see such a signal its form here
will be exactly this
this will be the control signal which comes out of the drain of the transistor
three that is p channel transistor it has such a rising edge and some falling edge
13:48
but longer in time
and if now let's see the signal that comes out from
the drain of the transistor 1 it has a delay since
we formed it here this delay, and its leading
edge falls here at this point
14:10
the moment occurs when this transistor opens
some time where transistors work with overlapping
and actually, our signal takes this shape
this we need, some smoothing of rise edge
given transistor take this very well and works in switching mode fine
that is, do not worry about this leading edge
especially when the system works in
14:45
kacher mode and it doesn't matter
how leading edge looks like because kacher for a while
like any coil Tesla accelerates to its maximum

just this insignificant time is enough to accelerate it
and so more this smooth edge observed somewhere from 40khz
and above at lower frequencies it is practically appears as a rectangular
15:21
and so, for what did we do this moment with overlapping ?
in the first place, this moment with overlapping allows
you to cut off from the circuit here this resistor
and sharply set the base of our power switch to ground
since the switch is n-channel conductivity
negative potential voltage on its base it is abruptly close it
the same time this key still plays a very
important role it does not allow the kacher to start
in the sense that it is marked with a dotted line that
we have a common ground conductor is also a grounded wire
16:17
that this transistor excludes not only this resistor
also sets the base on ground and also connects
the cold end of Tesla coil directly to the ground
further any osculations that could excite
generation of this power switch, they can no
longer get to base, because base and emitter junction the power switch has
some resistance which is more than resistance of the open MOSFET transistor
switch and therefore, the ground
is connected with cold end of
17:02
high-voltage coil and no longer any oscilations
can force the given transistor to operate in generator mode
the only thing that can be seen when work
at high frequencies about 20 to 50 kHz
if your kacher’s high voltage coil has a good quality factor
you can watch the moment of rise that we are
17:37
we will further consider this on scope traces
rise to the maximum and then the tail of decay
if modulation is enough close in time at frequencies above 20 khz
then you can see such a moment that fading tail intersects with the moment increase
that is, at the moment kacher no longer works but because
of his Q factors still exist in it damped oscillations
but at the same time such a switching circuit
damped oscillation is only free the kacher does
not work at this moment and consumes nothing
18:13
let’s consider circuit solutions
in this case we can observe that the chain through
which the power supply connected remains the same
from the previous schematic of an regular (translator note: continuous mode) kacher and here
it is presented in this diagram
this circuit has input terminals, connect positive and negative
poles of power supply, capacitance here
further, filter with opposite winding,
further, again the main filter capacitor
and high frequency film capacitor

we analyzed this moment and for this board
19:02
I just made an additional board which
controls our power switch
the switches are on the heatsink
here its clearly visible
by the way the heatsink is too big for it
it doesn’t get too hot, ok put on a smaller one
and so we we can observe
our chip here as on which implements delay TC4093, dual channel driver
other components, input with filters and now we have
the main divider to the base of our power switch
3.3k, 2.7k, schottky diode sr510
19:56
and here are three transistors that are on a common radiator
transistors a little warm
therefore put them on the radiator, you
can use individual smaller heatsinks
I use heatsink to mechanically reinforce prototype board
I tried use minimum components, system workable
the power supply is connected to the inductor
instead of inductor as I said earlier, you can connect resistive load
and use circuit to operate switch
20:44
now we will connect the circuit to the
driver and let's see its capabilities in action this
is how the breadboard is assembled and connected
to the ground because the grounding for this system
plays an important role
connected power supply
I use two laboratory power supplies
the separate one has a rating of 15 volts a consumption
is visible now logical part without applied signal
21:19
we will change the voltage at the input
here PSU voltage adjusted with this trimmer and we will observe
the power consumption, signal will be feed directly from the
laboratory signal generator it is now
in pulse mode pulse amplitude we will have 10 volts
21:45
in a positive half-cycle with a duty cycle
starting 10 percent
will use scope to see what it hapening
main power supply for the power switch connected to this point
and then goes to other parts according to the diagram
ok, switched on the circuit
it starts working from the control signal with a duty cycle of
17 percent is now in
22:17
this case, the frequency is 10 kilohertz
for the convenience of observing the signals,
we see that the system does not consume much

the logical part, here we have a voltage supply
and current consumption at which this system
has entered a stable generation
22:43
now we can observe that the field is
not too large around the system i.e. if I touch with neon bulb
it lights up and here the
oscilloscope probe is near
we can observe scope traces
23:00
how does it work now kacher
at this supply voltage we see that the quality factor
of the system is very high
we can also see additional wave which carries out some
amplitude modulation in the system
and you canl experiment an interesting moment
now, if you bring your hand to the
high-voltage coil you can see how the system reacts
23:40
for a proper test, we will now increase
supply voltage of our system example works
well confidently here we apply 55v
see consumption slightly increased
signal naturally goes off scale and you can
already hear that appeared at the end “phitonka” (translator note: HV HF discharge)
we now hear the sound from frequency 10 khz
let's try to increase the duty cycle
24:23
increasing the duty cycle, we observe
changing the scope trace
already visible increases from duty cycle consumption of the
system, clear that “phitonka” has become powerful
stretches up to 1.2-1.5 centimeter
we see scope trace that the working time
of our system increases, raise the control
duty cycle impulse then now set 40 percent
duty cycle of the control pulse
25:15
the scope trace has this shape,
but we already have such a mode on the system
which is not interesting
because the duty cycle is very large
visually you see that “phitonka” became a very powerful
neon bulb glows at a long distance
and it burns very well with this frequency
24:45
by the way, with this schematic you can do
singing Tesla coil which will play midi file
now I will show you by an example frequency
you can listen to the sound right now
26:00
now we have 3 khz and now we hear a sound

that our “phitonka” produce we'll see that
at 3 kilohertz happens you can move to
26:27
1 khz, the tone sound, now I change
the frequency here it goes already there in
inaudible range now 25 khz
see that also modulation of kacher
works ok, I will reduce duty cycle
26:57
to 30 percent that is the system works
stable, “phitonka” powerful enough
at 30 percent at frequency of 25 kilohertz
we have this voltage and current consumption

27:18
here I set 20 percent duty cycle
consumption immediately dropped noticeably
in general, the system will work somewhere
here with this consumption 23-25 percent
of the control impulse, the total consumption
now let's see the frequency capabilities 25 khz 35 khz 45 khz
28:04
it can be seen that the modulation system
carried out 55khz here
the work of the system stops at 55 percent because you need
to add the duty cycle I added a control
pulse, up to 35 percent and
the system started working again
28:39
the adjustment range is very wide
let's play again in the musical mode
28:57
very interesting thing now we can
move to 100hz, can make 50 hz
for modulation here is 50 hertz now I will
show scope traces here they are, we see that
29:35
I have this shape and I reduce
now 15 percent is clearly audible the transformer sound
is the same as it works, starts sparking on metal
object with a frequency of 50 hertz
30:00
that is, a circuit even for experiments
very good for those who want study
and build something like that
interesting even just for demonstration
30:19
this sound is now from “phitonka”
31:00
played enough, build your own and play with it
the thing is cool,
I turn it off, pulsing all channel off, only the consumption

of the logical parts and now we see that
consumption of power stage is zero
31:26
let's move on specifically to our tasks
the circuit remains working even when connecting
a large enough antenna we can also observe that
it produce “phitonika” with the same modulation frequency
on the antenna itself that is, the antenna itself is
produce “phitonka” on metal object when connected antenna
we have a large the diameter of the electric field
that is neon bulb reacts from big enough distance
consumption with antenna here
32:08
now I would like to note such an important feature
of the kacher setup
now I will scale up the scope trace
to carrier signal, see clear sine
32:25
observe: I put my hand closer, I can see that the frequency
float, that is, you can see here now on the
oscilloscope that kacher this circuit which is
auto generator with feedback to the base transistor
and in our system it useful so that when this is here
the antenna is with us directly over the inductor of the system
32:46
the magnetic field of the inductor creates a
interference to the antenna and this potential voltage
sent through high-voltage coil to the base of our
power transistor, in this way, kacher has one
irreplaceable plus in relation to controlled Tesla coil
just for the for those who will work on
the so-called glitch chips TL494
33:21
this is the effect that now feedback
is provided when the hand approaches,
it also works and from interference from the
inductor and it turns out such a moment that
kacher makes it easier phase-adjust frequencies
among themselves on the low part of our what
is happening in the circuit push pull inductor and
our high voltage high frequency system precisely because it
33:56
auto-generator
controlled by Tesla coil unfortunately, this does not allow there either
this moment has to be corrected manually
therefore other things being equal conditions
when working on a kacher, tuning of the system is easier
34:12
there is also a moment, that kacher is
very clear seen that it ringing, now it is
observed that signal has reached its maximum
even if we will now change the duty cycle control

signal to 20 percent we also see that
when the system has a good Q-factor, tail
ringing is big enough
34:44
how to get rid of it the system, that is, we
we see that we have some moment acceleration
to the maximum and then decline
you can get rid of this tail just apply the usual
schematic solution, here at the tip of the antenna
where we have “phitonka” on metal object
we make an spark gap to the ground and
by spacing tune it
35:16
here see scope trace, see I bring a metal
object and the ringing disappears now the
ringing goes away in our the system
now I will try to tune more precisely
35:40
so that we see this moment
35:50
it is clearly seen that the ringing is cut
with with the help of a spark gap, this is the
whole tail can be cut very well
by the way the spark gap
will regulate the final amplitude
on our high-voltage terminal
I wish you all successful experiments
and all the best

The video "General diagram of the device" shows a block diagram of the connection of all electronic modules and considers the implementation of the "self-looped" power system.

https://www.youtube.com/watch?v=YkyeKCnzU3Y

video transcript

0:00
good time to everyone
I have been questioned for a long time on my channel
about the general block diagram, how modules are connected
to each other, its main components
I did not give this schematic for some time for certain reasons
because it was necessary to check out many options
and evaluate their mutual work in a common system
on this picture is presented block diagram
0:38
of the device that we are now will analyze
I want to say that it is the option on which I am now
settled I don't want to impose it on anyone because there is
some confusion between those who talks about how it works
1:00
this does not mean that people are cheating
it can mean one thing that there are many versions of this device
that's why one person can speak one and the
other radically the opposite
I want to give a little advice, best when you build device like this
to rely on your own opinion, do your own experiments and draw conclusions
from them and above all believe the testimony specifically
of your devices
1:53
so my main component of this device is our coil,
it will be the reactor in which process takes place
and if people do devices and the same processes
in occur in the inductor, then the statement is true
that, this coil they already have simply a pick-up coil
can be wound as you want, e.g. as one layer coil
2:27
if the main process is running in the inductor
I work with other design principle, therefore, to the
manufacturing of this coil we have certain requirements
how to make it I already made a video which is called “a resonator“
2:53
further, the second main component is low-frequency
master oscillator it is made on the basis of the push-pull
which works on a ferrite core with a gap
and from the ferrite core, there are two secondary windings
3:20
3-4 turns one winding and about 20 turns second
winding, here this winding 25 turns is connected to the main
coil to the cold end and it all forms a “loop”

3:44
this loop on low frequency is not resonant,
here you can see that I marked the decoding in the
figure, characters means П right winding direction,
Л left winding direction, and asterisk means to adjust during tuning
these components such as capacitors or windings, the number of turns must be
selected in practice for particular device
4:12
about direction
so here the symbols are indicated where the right ones and
the left in this case is a certain rule that I try stick
it right-handed winding for magnetic field and left winding
for electric field
4:40
so there is a moment that introduces some misunderstandings
how to wind right and left winding
I like define and in particular, if we wind the coil,
let's say here we have a wire, frame, we take
5:00
left hand and clamp the beginning of the wire
now if we do winding with the right hand
and then look along direction how we wind
and what is seen is winding goes clockwise
5:26
defines that it is a winding is right-handed
if we take wire with his left hand and we clamp it
and wind it on the other side and now we want to determine
the direction of winding
then we also need to look at direction from left to right and look from
5:55
the side to which the wire rises on the frame
and here we clearly see that our winding is made against
clockwise means this will be left side winding
6:12
this module of converter in practice looks like this
ferrite from deflector system of old TV
usually these are there the low-frequency ferrites
you can use a ferrite ring
also without gap, just when no gap the tuning gets a little
more complicated

6:45
tuning of push-pull
but since this one goes split into 2 halves
from the factory there is no difficulties with it
7:00
the fact that these are here 3turns pickup coil
we have it on the opposite halve of the core in
relation to turns controlled by transistors
here are 8-10 turns primary windings of push pull
gaps, we have gaps in these points
so 3 turns coil should be on the opposite side

it is form a decoupling transformer
we have this white wire, these 25 turns, here is their output,
which then follow the schematic to the cold end of our coil
and to capacitance that connects afterwards
8:00
with the hot end of the coil
these are the leads which go directly to the drains of transistors
here in the center you can see the middle point of these
windings here it is goes with us to plus of power supply converters
and also see that on on the back we have the main storage
capacity for push pull
8:32
and the plus connects to the center point
this is our wire going to minus which goes to the sources
of transistors
but this is generally a power supply wire, this one
8:53
the question arises for what purpose we connected this coil
in series with twenty five turns
this is done so that in the system forming a
serial oscillator circuit of inductor with these 3 turns
not just have a sinusoidal oscillations of a certain frequency
but these sinusoidal oscillations
should be amplitude modulated
if we look here, at this point, with correct tuning, we will see that our
carrier signal is modulated then
9:35
we can see either “fish” like signal with modulation
to a zero or a partial modulation but modulation
in the inductor circuit must be at least 50 percent
of amplitude for the same purpose we have power
supply to the converter not 12 volts but 24 this
increase in power supply voltage allows us reduce number of
of turns
10:07
which we wind here
number of these turns decreases
therefore 25 turns of left winding are also marked with an asterisk
and on the number of these turns need to be tuned
to that moment so active voltage which is supplied
into this circuit when you see what a in inductor
you have amplitude modulations
10:38
carrier signal
without such modulation in inductor
you will not be able get the system working at all
might have noticed that I am using for inverter power
supply not one unit with rated output voltage 24 volts
but two power supplies connected in series with a rating of 12 volts
11:04
using power supplies from the company Navigator
rated 5 amp at 12.5v volts

power supplies designed to keep running the system in
offline mode when it goes to rated power
11:26
this connection of power supplies allows
start the system from battery at 12 volt
start is done like this
first this toggle switch closes
power supplied to the converter, also goes to all control
chips in all modules, we already looked schematics
of the of these modules
12:00
and also power, after this button is closed,
goes to the converter that supplies power for
Tesla coil or kacher, with such connection at
this point, there is no need to put a diode that blocks
the voltage that comes from the power supply when
the system running on itself
this battery can remain in the system,
no need to disconnect it, and while this toggle
switch is closed it battery is charging
12:38
for clarity we will test the system with two power supplies
connected in series, we have
two power supplies 12 volts each
we have a starting battery, this is the output we have this point
which connects plus battery, the second
output is our 24 volt output which subsequently
go to power of push pull converter
13:20
connected now common of multimeter with minus
of battery
and measure the voltage on battery
see it is 12.9 volts
now i am connecting to pin which in future will be 24 volts
from the power supply, here in this one here
13:52
and the middle point, the connection of two
power supply, connected to the battery
we see that the voltage of battery minus
drop on diodes in power supplies appeared
on output second of the power supply while the battery can
be freely turned on
this voltage we have at the output
and now you can see that one of the LEDs on the power
supply module lit up
14:30
on the power supplies to which we apply
battery potential, now I will connect the power
supplies to the mains, they will begin to generate
voltage and we we will already see the voltage
of the common output two modules on the multimeter
15:00

connecting the PSUs, we see that the voltage
we have changed, 24.99 volts almost 25 and
we see what is in this including we have a rechargeable
battery under potential from the first power supply and
will constantly be in charge mode
15:25
disconnect it and see that some voltage drop
occurs because the voltage now of fully charged battery
slightly higher than the voltage can give a power supply
15:47
on these power supply adjustment of
output voltage within certain limits can be done
it is produced with the help of these here trimmer resistors here
you can set for example 13.5 volts and this
battery will always charged
turn off power supply
we see that the voltage drops, gradual discharge occurs and
see again battery voltage
16:19
the use of two PSU
16:29
of 12 volts and we are solved
by one a problem namely a startup problem converter
for power supply of the kacher or Tesla coil
it needs power supply voltage 12 volts therefore
the voltage from battery directly fed to this converter
if closed this button to start the device
17:08
to stop device it is enough to break this circuit
when device not in use
this switch should be open to avoid battery discharge
17:28
the next block of the system which is
extremely important for it correct work is this one
here low frequency choke
it was in the first variations of the schematics of some authors,
we then saw it disappeared as unnecessary
the choke has two main functions
the first it does not pass high-frequency component
to the diode bridge and further through it to the load
and subsequently to the input path of the power supplies
in the main path we have electrolytic capacitors
therefore when getting here high frequency capacitors
can fail, in practice they just explode
and the second main
18:14
moment is also blocking high frequency
but why ?
the high frequency should work exclusively
here in this circuit, if it goes further then the length
of its path will increase and the system unbalance,
it will just unrealistic to tune such system

this is one of the most important parts which by
no means you can not refuse to install
you can make it with any low frequency ferrite core
on a ring or take the same core
18:49
from deflecting system from the old TVs
in practice, this can look like this
you see immediately that the winding made
with two wires, 8-15 turns, but the average value is 10 turns
19:05
quite enough for reliable blocking high-frequency
component
further, after choke we have a diode bridge
diode i use fast or ultra fast
you can also use Schotky diodes with
voltage from 400 to 600 volts this is
quite enough for me personally I use diodes in this
packages, this case contains two diodes with one common
wire
19:42
connected by cathodes together
central the output is the cathode
since in this case two diodes,
i use them respectively, in parallel that increases
the total current rating which can pass through
such a pair of diodes
20:00
placing diodes on the heatsink for good cooling
this heatsink of course too big
I just have such heatsink, it is possible use smaller
and diodes are bolted to the radiator through I use the
insulating plate with mica
after which the rectified voltage go on
this is the main storage capacitor
capacity 25 uf 400 volts
20:30
that already rectified voltage go on the load
and power supply input
input polarity applied to PSU
does no matter, in the input path they contain on the diode bridge
and this means that the polarity reversal for them
does not have any issue
can be connected in any polarity
20:52
as a load, you can use incandescent lamps,
all kinds of heating devices, it’s not important
if only it could work from DC voltage also
many modern devices in which it is used
power converters of this kind
21:25
old devices must not be connected,
which input path instead of such converters

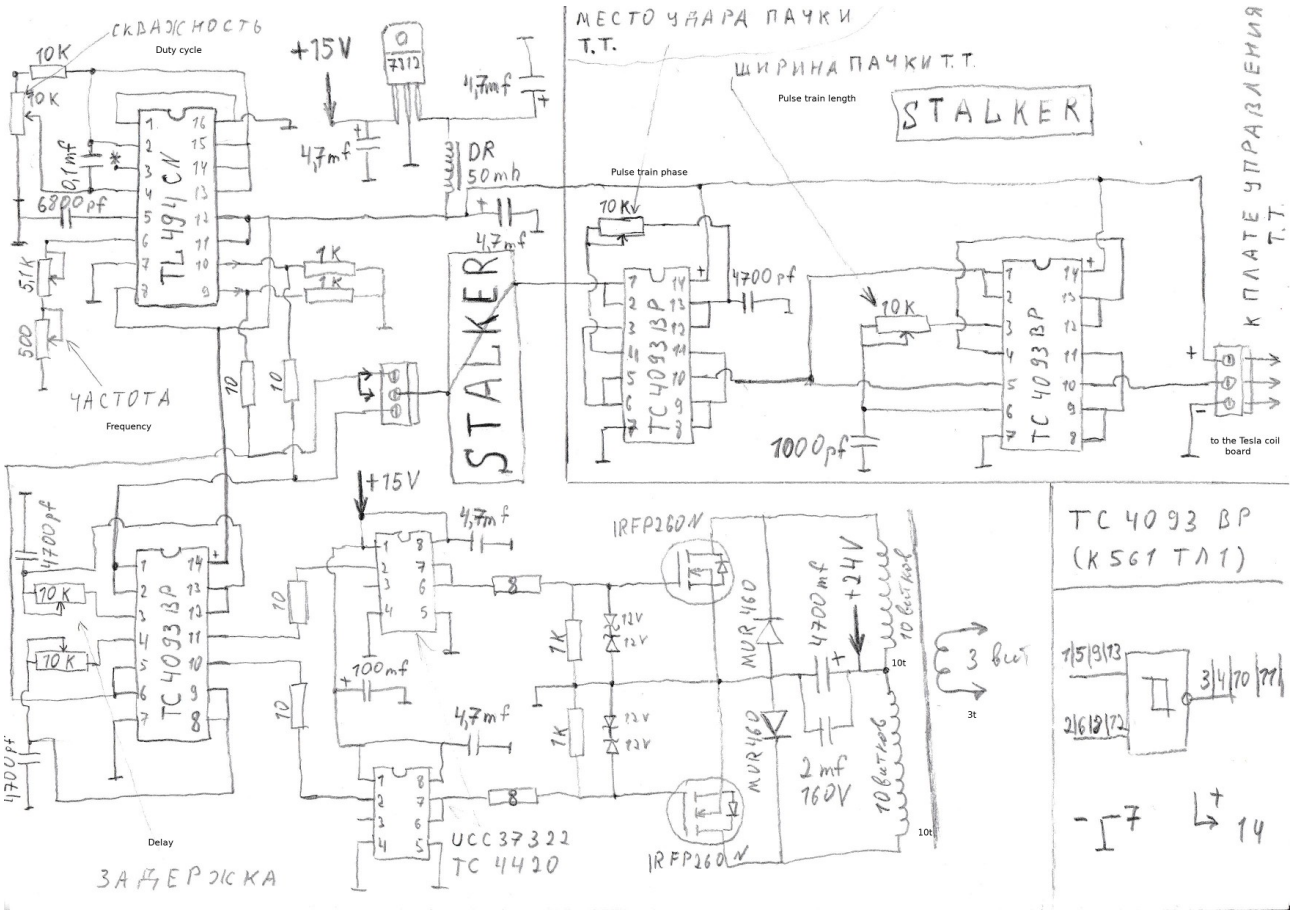
has a transformer, its primary will burn out from
DC voltage and cannot be connected here
devices that have at their input asynchronous and
synchronous motors
the engines will just stand in idle windings will overheat
22:00
and they will also be damaged
DC high voltage motors works fine here
the whole unit consisting of a diode choke bridge
and main storage tank fits in one common box
see top cover and housings a wiring
connections are carried out on the outer side
this mounting option is very convenient in
our work on the plane board
22:35
now for some design features
the antenna is the device that we have irradiates our
coil together with the inductor with electric field is
performed exclusively made of aluminum as
ferrite sticks we only use low-frequency ferrite
by the way you can
23:03
use not only this view ferrite sticks
can be used rings half rings the main requirement that
ferrite is for low frequencies
and especially if we we work as a system with kacher,
here I am not just drew it like this
I drew that this one the ferrite filter is located
in the zone of reverse turns of our coil near it thick part
interesting things happen the phenomenon of a
magnetic field from coil
23:43
creates interference on this ferrite and modulates kacher
its output also with us acquires amplitude
modulation at all in a given construction for
its correct work extremely important are these
amplitude modulation, their phase alignments
24:05
about what is better to work on controlled Tesla coil
or controlled kacher
from practice I will say that much simpler tune this
system when as high-voltage part we have kacher
which is auto generator
its feature magnetic field from inductor
induces an electric potential on this antenna
24:36
and it goes through the coil to the base of
control transistor which drives the primary
coil Tesla transformer this way here we have this
magnetic field some phase adjustment and
synchronization of two generators
25:00

also we can see what is here and schematically
I marked generators, in this extremely
important when setting up this its duty cycle
is required set up and see also synchronization
I will schematically mark them with the letter S
synchronization is carried out between primary
generator and secondary generator, it is carried
out using trimmer resistor but generally
in these settings are a little insufficient
25:33
this is a pretty rough setting with by means of
trimmer resistors therefore, some fine tuning may
be executed by the power transistor itself in this circuit
that controls the primary winding is why the
system start problematic enough if
26:00
you are using controlled Tesla
there you need to tune very clearly so that the system
started
you can also notice what is the ground
wire on my diagram connects exclusively to
this module if used controlled Tesla coil
the ground wire is connected directly to its cold end
26:28
if controlled kacher then to the emitter of power transistor
also the ground is not connected to common wire
at any point and not it is connected to our coil or to its inductor
if you connect grounding at any of these points directly
then all interaction between Tesla coil and this system
will stop
27:04
Tesla coil will interact exclusively with itself, that is,
actually equivalent the circuit will be if you feed the wire
grounding directly to the antenna
in no way Tesla coil will affect this system
and so you can never tune the system
maximum if you connect ground through fast diode
it can help if connect the diode towards ground from coil inductor
27:44
you can do the operation on half-cycle and the diode must be
connected to this polarity that he did not cut that
half-period by which Tesla works
this is extremely important
28:00
given lack of ground connection to the coil
works well in this case, in my design
because as if people use in other ways of tuning
the ground wire as a mean which can move the coil
to the half wave mode, it turns out that a quarter
of a wave in them in this coil and a quarter of a wave
fits the length of the grounding
28:32

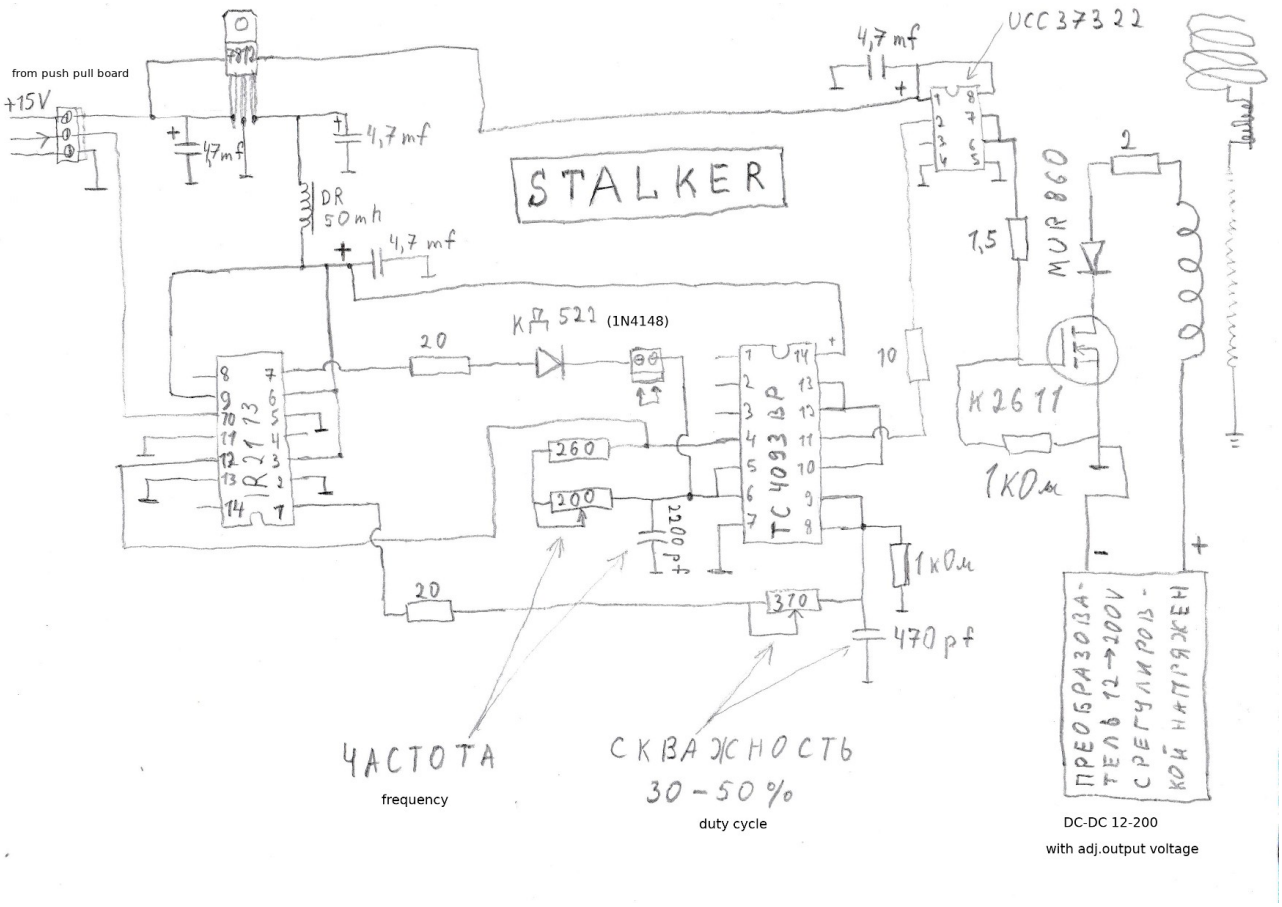
then grounding is mandatory connects to
coil to change system mode to half a wave
but in this case I'm not using it is
therefore I do not recommend connecting
grounding to this or this point
28:51
this schematic this is just a my design, one of the
possible options, you can also use instead push pull
generator single transistor, instead of serial resonance circuit
use parallel resonance circuit, instead of seting the amplitude modulation
using the supply voltage and push pull implement
forced low-frequency modulation
there are plenty of possible variants
29:24
therefore, I advise you to choose for yourself some
decisions and develop it
instead of doing blindly copy
29:34
I also take this opportunity to convey thanks
to everyone who helped me with understanding of
this system and a special thanks to the person from
the forum realstrannik, to my good friend
it doesn’t matter Slava who and what think about you
I know who you are, really big respect and thank you for your help!

This folder on the Yandex disk contains the schematics that are presented in the video. This is the required schematic platform for starting experiments:
https://yadi.sk/d/8rY1WiX6vZSnw

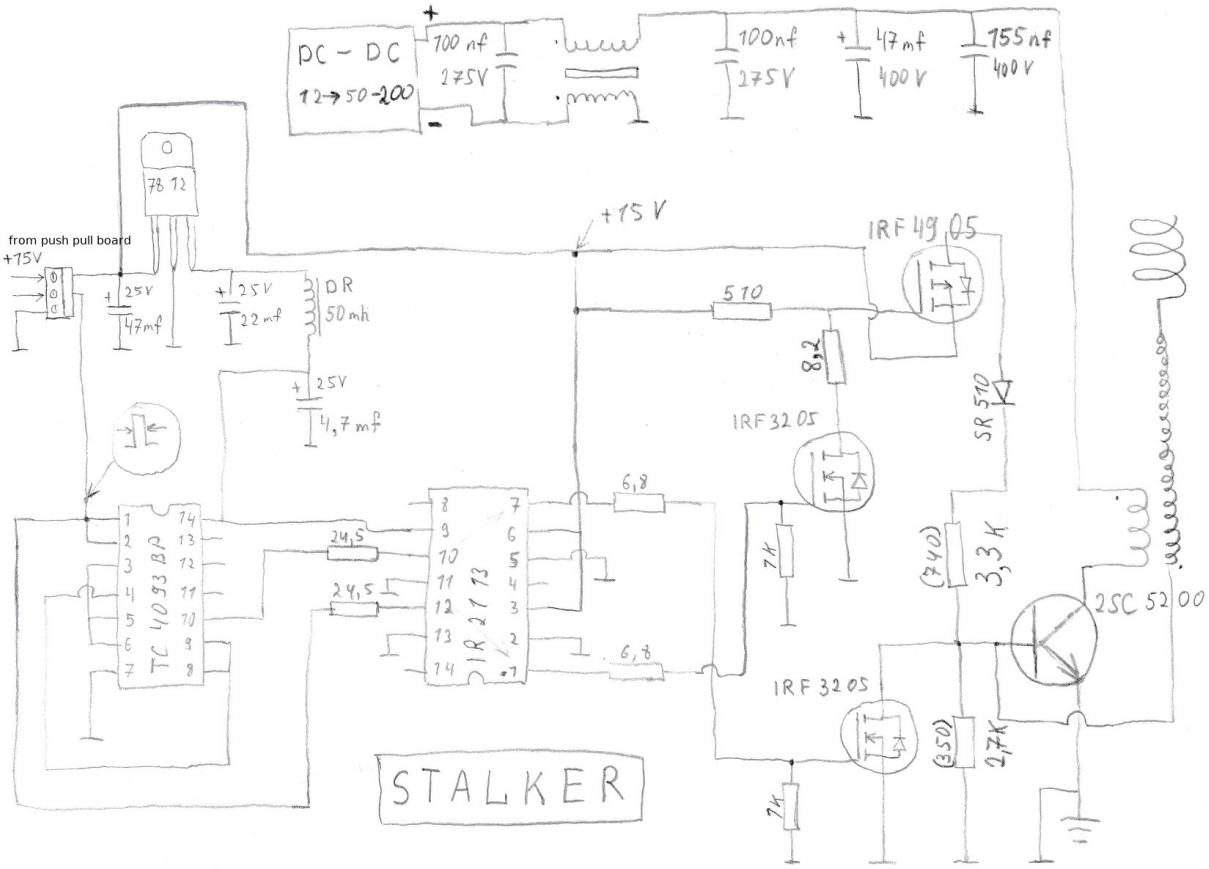
Here schematics with translated text



push pull board with synchronization output for Tesla coil

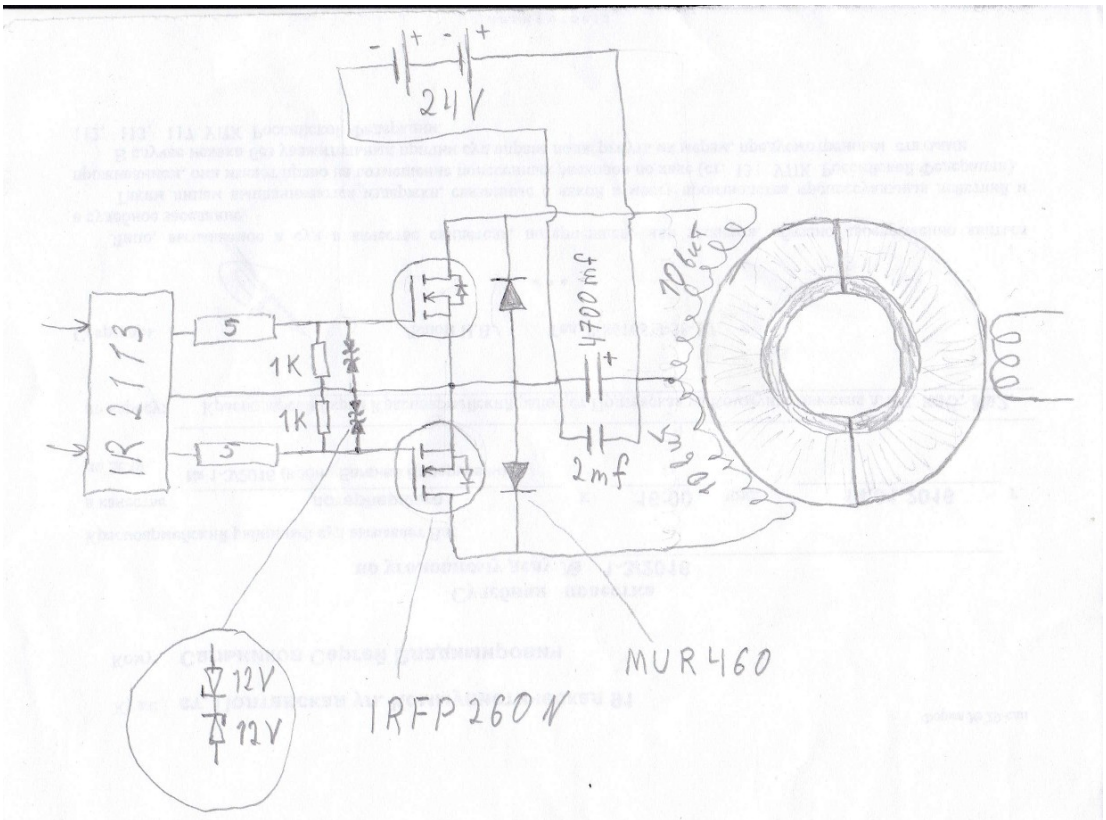


Tesla coil control board

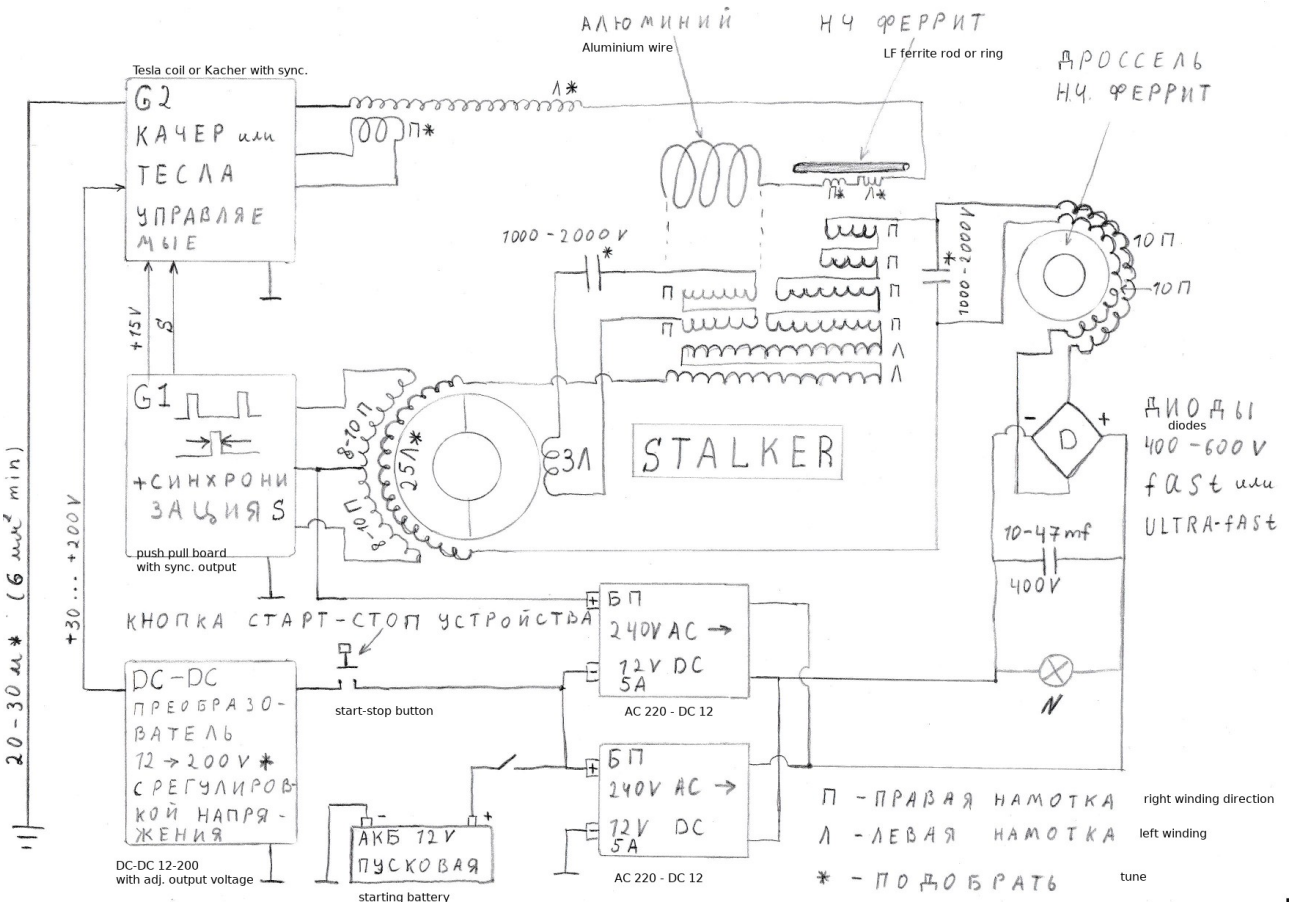


Kacher (*) control board

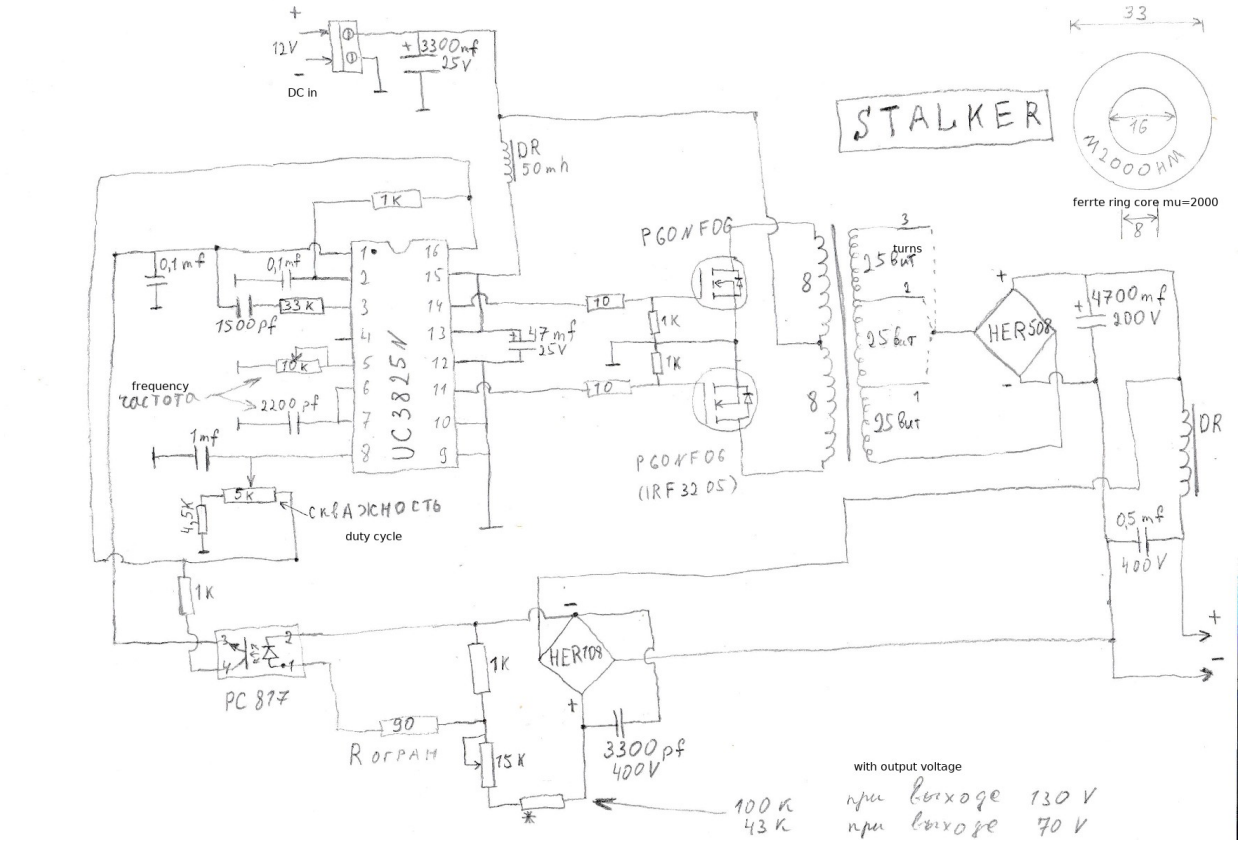
*) kacher – Tesla coil with one transistor auto-generator driver



push pull (output part)



modules connection



DC DC 12 – 200 for Tesla coil or Kacher

https://www.youtube.com/watch?v=XDXTxPRPxSU

Push-pull schematic and tuning

video transcript

0:00
hello everyone today we will talk about push pull
push-pull is a converter on two transistors
highly efficient on low-voltage power supply
means the main parts of this power converter are two transistor
0:23
they work on winding with the middle point and
after which the result we we get at the output at the
load, but for this system, the usual push pull does not suitable
we have a number of differences our system works
on natural energy therefore push-pull too will
be slightly adapted for this case
0:53
here is the prototype board that we we will test
control board driver used TL494 can
be used sg3525 uc3825 and any others will suit
absolutely with duty cycle adjustment function
1:20
driver specially taken with 2amp outputs ir2113 to show
that usually the driver works ok in this system
here we have two transistors on heatsinks
well and everyone's beloved famous TV core
1:45
then let's go through the schematic
this is how it should be push-pull and you don't need
invent nothing to cheat the main thing is transistor
ifp260n and similar high voltage transistors
why high voltage ?
2:15
this system has static discharge during operation
and if transistor will be low-voltage,
then the diode located in it, in reverse, it is also installed by manufacturer
for low-voltage and it will cut static discharge and to
transform it into heat, we do not need that
2:37
it is why in our system high voltage transistors
work, you don’t need to buy too high voltage transistors
and for too large current because the
currents in our system is small
task of this inverter do not power the bulbs
not do so that they burn
but just to run wave processes in the resonator
3:03
then we go along the components around
we have necessarily in the gate circuit
a 1k discharge resistor to common wire

and there is definitely a counter connected Zener diodes
12 volt this to protect gate from bursts of statics
3:30
further, reverse diode between source-drain
symmetrical whole system, diode, fast switching
in this case used mur460
you can use any other high speed schottky diodes
each transistor is loaded by 10 turns winding
and there is 3-4 turns at the output winding
4:01
so our power is 24 volts, the capacior, in this
case of 4700 microfarads and in the working circuit
you will need to install 2 microfarads surge
damping capacitor and it is needed for quick discharge
because that the switches open abruptly and these
electrolytes capacitors are generally work like dampers
4:39
polar capacitor does not like high current pulses
therefore a ceramic capacitors is installed
which work out much faster than electrolyte capacitors
allows you to make steeper leading edge on the driver
so the gate capacitance is charged through 5 ohms resistor
5:07
so this is how it looks
here on power installed 7812 regulator
filter choke, capacitors, this provides power for TL494
let’s see further
5:21
surely, why everyone can’t see all the interesting
effects that are on push pull, because we
have duty cycle adjustment resistor, this resistor is frequency
adjustment and so you need to do so that let's say
ten revolutions of this trimmer resistor
which is our push pull frequency control
maximum change by 8-10 khz
and it is even better to do the range when the coil is known
yet pick up less resistance here
and plug in to limit range to 5 khz
6:12
because if you scroll quickly frequency
you can’t notice anything interesting
further, there is a capacitor
capacitor tube-like, Soviet production
now analogs of such capacitors, capacitors for smd mounting
6:32
the advantage of these capacitors is that
even if they are heated with a soldering iron, their
capacity does not change, they are high temperature stable
that's why here you need to use such capacitors so
that your frequency do not drift because as soon
as you tune in to the effect and step away from
the adjustment temperature changes in the place

where this device is located

7:01
the frequency will drift away and you will loose
the effect, the signal goes on the driver
amplifies it and goes to our transistor
now let's start schematically
we will have power 15 volts for TL494
push pull power 24 volts from these batteries
what else ? the important thing on power
7812 regulator provide power only for TL494
you should never put driver’s power thru 7812
even so 7812 can handle 3amp current, is is very slow
circuit and the driver needs form a steep edge for
charging gate capacitances that is why even if you purchase
expensive drivers 6-8-12 amps, they not able
8:10
to drive transistors and transistor explode even
at low power consumption, because these regulators
are inserted in driver’s power circuit
and you need to set for each driver a ceramic capacitor about five
microfarads to form a steep edge, especially
for powerful drivers
this is how the schematic looks on board
8:38
we see diodes here
here are zener diodes
this 1k resistance
let’s start, I connect the power supply
8:55
we see the consumption of the circuit
is 15 volt, 0.04 amp is quite enough for
control and look now we have a yellow
channel on the gate of the transistor, blue channel of
the oscilloscope is connected to the drain
9:25
look what happens
and here we see, here is such an interesting picture
yellow channel is control
but blue, what we see here, the amplitude
9:40
the spike is almost 250 volts
it jumps 238 – 250, why it happen ?
this is done by adjustment of the core gap
here this part of the gap in the core,
we need adjust its width, and also adjust number of turns
and duty cycle
10:12
the gap in the core shouldn't be big
your core losses will grow
it will heat and nothing good will come of it,
but gap is required, we need in this system generate a static

surge with a steep front for further work
gap width here maximum = A4 print paper thickness
10:40
but in this case, here on the core gap
I have even less – a masking tape
it is made here and here
the core is pulled together with electrical tape or other materials
but not metal, to not make shorting turns
11:03
notice how the system is wound
that is, push-pull primary windings we have is on one half
and secondary is necessarily on the other half
why this made like this ? Output coil creates a small
magnetic field around itself,
and it does not apply to the entire volume of ferrite
11:28
but the primary windings forms a
circular the magnetic field, is thereby achieved
decoupling, when on this side of the system there
will be further static bursts during work
this gives protection to transistors and not gives the opposite
effect, this is the so-called isolation transformers
they have a reduced COP due to what windings are wound on
different core parts
12:05
but in on in this case, in this system, this is needed
it is impossible wind the windings on one core side
you can also use such are the ferrites
be sure to take big ones for this systems
must have great throughput
in particular brand 2000 (translator note: mu=2000)
all static effects can be obtained and on such rings
but it is easier to use on cut ferrites
and now let's take a closer look at what we have going on
with statics
12:43
ok, power is 24 volts, these are peaks
these “needles” are just the environment's answer to the work of our system
we send there pulse with a steep edge
and it respond with a “click” (sharp pulse)
further peaks not interesting for us
13:09
the are fading
we are interested in the amplitude of this the leading
edge of the emission
this emission ultimately raises the overall amplitude
now duty cycle is 11 percent
13:31
now i will change duty cycle
let's see what happens
the consumption of the system is now about 0,
I increase the duty cycle

here now a duty cycle of 20 percent, 25, 27
here you can see at 27 percent of the duty cycle
a beautiful signal has been generated for us
14:20
look at consumption, it has increased to
400 milliamps and now we look at blue channel
I will remove yellow channel
we are interested in the blue channel
it is the signal on the drain
14:43
on the blue channel we have 50 volts per division
50 volts per division
we look at the amplitude
actually rectangle when working
this is the static emissions of the environment
and falling peaks
our amplitude rises from 24 volts up to 70 volts
that is what we do we get a static spike
and this a static spike gives us an increase straight
in a rectangle up to 70 volts
15:20
in fact, we get an increase already by push pull itself
that is, here is such an interesting effect
for us what is the gain in this system here
on the primary windings we sent 24 volts power supply
using statics i increase it up to 70 volts and we have a transformer
working in a step-down mode after that
15:45
after that we don't actually work on 24 volts but on 70 volts
stepping down this increase we send it to accelerate the
circuit, with such minimum consumption
it is clear why the adjustment for duty cycle in this
system needed
and also now
16:06
I will switch the yellow channel of the
oscilloscope to second drain of another transistor
also set 50 volts
switching channel, setting trigger
now let's set up
everything yes yes signal
16:48
adding the duty cycle now and that we
see an interesting picture see that statics not only
increased the amplitude of our signal but also
increased its duration, that is, in fact, duration
regardless of the length of the control pulse it is
now 50 percent
17:14
50 percent on one channel
50 on other channel
this trick is very important make on push pull

it turns out like this picture if we match see what
almost everything is filled with a signal
17:35
this is how static works if we expand we'll see
we are interested here, the width interested in this
next subsequent peaks are fading
18:00
the same will happen on the yellow channel
here the leading edge is smaller, it is also will grow
later when push-pull will be connected to the coil
because during operation with static natural electricity
the coil on which these occur effects are always divided
by zone of suction in this case is the zone suction is on the
blue channel and energy discharge zone
18:46
in the suction zone the amplitude is always higher
but if we give an energy sink that in future
here will go to the coil, on both channels
will have the same signal in future
now let's see, we are see that the neon bulb glows very well
on static, but in the zone of energy discharge is actually a cold end of the coil
now these 10+10 turns the glow is smaller,
which is why the width of pulse is smaller
static present I must see some everywhere
the glow on the radiator,
also visible on the power supply
19:31
glow visible on control, wherever we connect
everywhere there is static in this system,
let's touch it on the pins of the chip, anywhere,
that is everywhere present this static potential
is what we are
19:47
in the future should be transfer to coil for
activating high-frequency processes
this is the initial setting without anything
what what you need to get from this core
so that it gives a static potential
with which we will be in the future work with
one more time scope traces, how it looks
20:18
and now I will decrease the duty cycle
now duty cycle 46 percent
reducing, we can see what processes are
we see that system consumption decreases
we see the arrow goes down smoothly
a statics works for us, therefore duty cycle adjustment
in this system important we don’t need to light lamps
21:01
the main thing for us is to get this static
potential and we see what's on every steep edge
there is a clicks

we also reduce the duty cycle and now we went down
to almost zero now duty cycle
somewhere in the region of 3 percent
adding a little and see that static burst maximal
one more time schematic
circuit checked, works fine, build and use it

Resonator coil (grenade)
https://www.youtube.com/watch?v=pNFXlo5jv4g

video transcript

0:00
hello everyone, good time to you
with you stalker and today we will analyze an interesting the topics
here are these questions that are often ask me subscribers or
people with with whom I communicate as well
the way of winding of gradient coils, popularly referred as “grenade”
why is it made like this, for what we need a reverse turns,
why its length is 37.5 meters, is only a grenade coil
0:28
suitable for our systems
but let’s go in order
let's start with an interesting point about which
only a few people know
the efficiency of the second type for the resonant circuit
0:41
what it is ? by the way, there is practically no information about this
here I have prepared an interesting the picture
let’s start with it, let's say this our push-pull works
yes, one transistor triggered, the second transistor triggered, and along the
length of this wire wave went wave with LC resonance frequency
let's say we set it up, it reached the end and
so let it reflect like this two sine wave drawn by black pen
1:18
and that's what is interesting, if we will look
the process by voltage, then we have everything standard
here, that is, if we have waves from the incident wave
converge in phase and the reflected wave, we get here standing wave along the length of this wire
we are not interested in this, we need, so to speak,
let's call this moment, create resonance in this system
by magnetic fluxes, in magnetic fields, that for this you
need to do, for this we also create our falling wave, but
2:01
look this moment of its poles at, we have
a reflected wave and now they must match not only in
phase, but also in magnetic flux and how only this one
the moment happens, we are formed interesting picture
2:18
we have aligned by the magnetic field the
incident, reflected wave and also us must be aligned
in the magnetic field standing wave, and if this moment
occurs in the circuit are abruptly form powerful
oscillations with current rise, amplitude of current and
amplitude of voltage this is this moment of efficiency
of the second kind for the resonant circuit
2:48
what is the essence of the phenomenon, that is,

we will analyze it using an example let's say two coils
that create magnetic fields, one magnetic field we have
pulsates, increases, decreases, this is will be a magnetic field for a standing wave
the second magnetic field we also pulsates but also revolves
if we we combine these two moments when us combined
and angular rotation and direction magnetic poles we will
have this here interesting phenomenon
3:25
its hard to achieve, but possible
I will show now an interesting program
how you can calculate our future coil
3:40
open the search engine in this case it is will be Yandex
and we type in the search engine line gorchilin calculator
here we have to the answer from the search engine,
choose a combining
3:59
LC resonance and standing wave mode, we open
(translator note: http://gorchilin.com/calculator/reactor?lang=en)
opened,
we get just into this calculator
we see graphs here and see the drawn coil here
4:17
the calculator calculates the length of the coil and wire step
for what it needs to be done
how are we going
to work with it to begin with
4:33
what are we doing to do
opened this and we take our assistant caliper
and starting to measure, I've already done it measurements
that is, you have a wire, everyone will have it different bought
for example in this case I calculate a coil for wires on
5:00
insulation with a diameter of 4.2 mm
then it is important we measure it does not crush the wire with
a vernier caliper, for example, like this, they came to measure and recorded
that is, we will be interested
parameters: wire diameter with insulation, wire core diameter
your wire will be twisted, twist it into a flagellum
and we measure the diameter of this bundle
5:34
here in my case it turned out 2.5 a millimeter
now we need also measure the diameter
of the coil, i.e. coil diameter is the diameter of the
bobbin on which we will wind
let's say we have a coil
yes we take a caliper and measure its diameter
6:01
measured, the result and recorded it in the
table, in my case is 50 millimeters
now we will also be interested in parameter insulation thickness

the insulation of my wire is half a millimeter
and what will be the length of the wire length the wires are still unknown to us,
but in calculator I figured out what I will have 45 meters
now I'll tell you how I do it did it
go to our calculator
6:42
after we have made all measurements and we look
now I will expand this
we see wire length
wire length until we we know we do not
know here we are enter wire core diameter millimeters
what we measured 2.5
diameter coils in millimeters
7:05
we measured 50 millimeters, but you
need to take into account such interesting moment
here I am in this case entered 51 millimeters here
7:23
the diameter of the coil does not add up only from the diameter of the frame itself
but diameter is added wall thickness insulation
that is actually our wire does not go along the
frame itself, but it dangles along the frame on top of the insulation, we add to coil diameter 2
insulation thickness then there is in my case I have a thickness
7:43
of insulation 0.5 millimeter I added one millimeter
that is, we understood why fold the wire on both sides
so we add 1 millimeter
it turns out 51 now we come
8:10
but here there is a moment additional data
open and fill in
here the dielectric constant 3.5
this coefficient is deduced from the experiences not only by me
but also of others people
be sure to install an electric permeability 3.5
for which this parameter affects this is our wire
8:38
available in insulation we have dielectric
constant also at the frame on which we wind
these pipes and ultimately this parameter affects
the speed of wave propagation in this conductor
further, multiplicity
9:02
standing wave in the coil, we enter ¼
LC resonance harmonic 1
additional capacity picofarads 0
coil bobbin thickness here we also measure with a
caliper pipe wall on which we wind
we write down and then we enter here
9:22
any value, let's say we're interested in value
but there from 30 to 50 meters, let's say we

entered 40 meters
click here, it will do calculations
and see what will be in the calculations
9:43
we change the length of the wire
why?
here we are interested in this step of the wire
see now here 4.24 millimeters and our
9:57
wire as we remember, I wrote down 4.2 then in
this case we need to play here in this column the length
of the wire pick up such a length that the step
of the wire is here turned out to be equal to its
insulation diameter
10:25
in my case, this is 4.2 millimeters
but since the wire when we we put it in a coil
with go with tension and it turns
out such a moment that the wire goes down slightly
in oval shape and its width is actually increases just for this
we select the moment we have 4.24 -4.26
there is a little more
it will be match the reality
of styling the wires for which it is important to combine here
11:00
just this moment a step of a wire
step of wire in our case determines turn-to-turn capacity and also
it determines our inductance, that is, in ultimately it
defines our LC resonance and here is the length of the
wire determines exactly what we will have standing
wave along the length of this conductor
11:30
and here is the given calculator works very well
shows the graph of intersection with another graph
we see it displays
here on the bottom frequency
it shows the frequency for a single layer coil with this pitch
11:50
not for our coil, that is, we will be interest
here in this case in in this case we will be interested
in here this moment inductance in micro henry and
12:01
the number of turns
inductance we have 171
number of turns 268
we write out this parameters which we selected
for this step wires that match 4.2 millimeter that is to us the
program showed 4.24
we satisfied with this
we do next
we take our
12:36

frame that we measured and we wind this
here is the length of the wire 45 meters is what you
need put into coil add your add to
this length let's say I add 35 centimeters to start
and 70 centimeters to the length of the wire for
the end that we will finish winding which
13:02
will be hot end under 70cm why
because it then goes through the pipe and returns in reverse
that is, two lengths from the beginning, but these 45 meters should be
wound,
then we took our frame we wind our wire
we check our calculations
13:25
that is, we wound the wire and we have
this wire must converge the number of turns and
should converge inductance
if we converge here these two parameters means
we are further we can wind this wire already in real coil
if we have these parameters differ by inductance or
by the number of turns, especially the number
turns, we pay attention
13:50
it means that somewhere in the program we entered imprecise values
that is, we did not took this moment into account
maybe incorrectly measured insulation
or pipe’s wall thickness
let's say we have a pipe and and has different diameters
with regard to the number of turns that influence
inductance
it could be that turns coincide but inductance will be different
14:19
let's say it will be higher
if the inductance is higher then it’s ok
if let's say you get 175 – 180 micro henry
this is not an issue if it did not agree exactly
but if you get there much more
this means a wire that you took it is not pure copper,
copper has impurities
14:42
of other metals that increase it inductance,
that is, this wire is already not suitable for further work
here why everyone says take the wire from oxygen-free copper
that is from oxygen-free copper, this is copper which
annealed in an oxygen-free environment, in inert gas
and so if our parameters coincided
the next thing, we wound the coil
15:09
coil winding rule
take this coil as an example
let's analyze
here are our coil what the rules of winding ?

in the first layer we must lay exactly
a quarter of the total length wires that the
program is calculated
15:43
you take a wire and label it
let's put marks every 5 meters and then eventually divide by
calculator in our case it turned out 45 meters
divide by 4, 1/4 part put on the first layer
another ¼ put on the second layer
16:03
then the third layer of wires are laid geometrically
till to the middle of the first layer
further 4, 5, 6 layers will be a inductance matching
the inductance of this the coil should be the same
as in calculations in this case 171 micro henry
16:32
that is, we will need this coil wind up with
exactly the same inductance
it is a must, it will not work without this
inductance affects LC resonance
as well as our step of wire is the turn-to-turn capacitance
which affects the LC resonance
otherwise if we make the coil with different inductance
LC resonance is gone
17:06
here is this calculation in the program
thiese intersection points
we won't have a matching LC resonance
with a standing wave and the coil will not work properly
this is one of the important rules
17:22
what needs to be done
now how we wind the coil
we know several ways, saw them showed us by
Ruslan, also others in particular Alekseev
how we do it
17:35
we wind the wire to the end of the coil
we go back
put the wire, here it goes
and wind in reverse,
that is, in reverse
why these coils wound with reverse turns
18:01
yes, see if you wind the whole coil one way
then its inductance will be much higher calculated
we understand that we have a multi layer coil inductance
increases that is why the coil winds in reverse to keep
the original inductance
18:22
usually third layer, when we wound, decrease the inductance
below calculated, the fourth layer raises it smoothly

5th layer rise a little faster,
and 6th layer is also smooth raises the inductance
and playing already on the fourth, fifth and sixth layer with number
of turns, moving them from one layer to another we must
fit exactly these according to the calculated 45 meters
of wire per coil, and achieve here same inductance
19:00
when we did it we achieved this inductance,
we can go ahead and wound inductor
we measure inductance and then we can go
already to the winding of the inductor well,
let's spend another interesting moment with
this coil we have analyzed one way winding now there
there is another way of winding
19:21
the wire runs through the entire the coil inside
that is, we started winding in the first way from here (right)
in the second way it is the same but we wind the first layer
from here (left) we return and wound more and already also
we wind the third layer to the middle it is important the
same the thing to observe the inductance
19:51
you can wind these coils in different ways they all work
as you do I wonder the main thing is that you
observe here this moment of calculation
it is important
20:08
what can i recommend how i do
let's say you can wind like we already looked
in one direction and then in reverse the other
way but i do it differently
I wind it in one direction, then I pull the wire to the
start and wind again in this direction
20:34
what it gives this moment this
the moment gives us when it works
here is the inductor physically at length conductor
so that if it is wound in different sides when we hit
part of the wave moves in one direction
and part of the wave went other direction
20:55
with this winding what happens
if we wind the wire with transition
of wire back thru coil
then we already have these pushes from inductor
they directed this wave into one side at the end of the guide
and we have coil working better
21:18
about the foil which you put in a coil,
let's say I am experimented, you can see I even
made a output there, foil underneath the coil
this is one of the options

as other options could
this is the foil that located
21:41
is in reverse layers, let's say here on the
example of this coil, here we see the wire is from
it a connection from the foil with me from one
edge, that is, that I made different experiments
and from another side
i checked the winding of the foil under the coil and
foil winding in this area reverse turns until the middle
it was time when I have not used the calculations
there is what the foil does foil in this case if it can help
and can seriously ruin the picture
22:25
that is, the foil is a reflector for magnetic field
and there are times when the coil without foil does not work
and the foil, put it under the bottom of the coil
i'm more interested in the region of reverse turns
of separation multidirectional magnetic fluxes
that LC is just shifting to the desired side
changes the inductance and match LC with
standing wave occurs and then the coil it starts to work
that regards the foil
23:10
now in these last coils,
I do not I use foil, it just isn't necessary if you
calculated it correctly and the coil turns out to
be a working foil there it is not required
take away fold this coil
and so here's an example of one coil as you can clearly
see here that I was playing the number of turns in layers, that is,
I picked up the inductance by moving here
23:47
here we have 3 layer, 4, in those windings
which we know it wound also up at the end
I missed the turns here that is to match inductance
to calculations of the program
a matter of practice
a little practice and you learn how to do it
24:11
further with regard to inductor
quarter wave length, or inductor length halh-wave ?
from practice I will say you'd better do the length 1/4
it is easier to catch on it standing wave
combine these processes to work with hereafter this
coil then see what rule of winding
24:41
for inductor, inductor winded in multiplicity
of inductance for the coil with here I will turn on
multimetr, so that it can be seen for measurement
25:00
of inductance

and look, now I measure
green connections are the coil itself,
that's the inductance matches 134 micro henry
25:22
now I will measure the inductor inductance
inductor we measure and here it corresponds 68
micro henry
and that is half of inductance of this coil itself
how this is done ?
we see the inductor wound a little outside the box
25:56
to make it fit it needs to be played length of winding physical
on a coil, can be played with the step of the wire
under inductor can be placed cardboard to increase the diameter
then there is this is selected in practice already under
this coil if you wind the coil in multiplicity in inductance
and the inductor and the “grenade” itself you get high
and low harmonics already working in phase
it turns out increases of efficiency of this system,
the inductor will have less heat on it
26:32
in practice and the coils work in concert
because here the whole system is
built on magnetic fields of their rotations these are
the elements inductance is mandatory to consider
27:00
so about inductor I talked
now what to do before inductor
before inductor we need to checked this coil
the concept of wave resonance
what is it and how does it arise in these coils
with a calculator i already expained
by the way, these frequencies here which will be
signed under the coil on do not pay attention to
them here this here resonant frequency and natural
capacity we do not need a calculator eork for a
single-layer coil it is important for us to keep the
winding step which we got and it's important
27:43
keep the final inductance
we made this
further, on my channel there is a very interesting video
called “a quarter-wave resonator” the video
is specially made in order to test the coils on it
did you make coil ok or not
in this video look and I use this one here
an interesting thing is we have a special addition module
28:23
for the signal generator
well, or anyone else that you can do yourself,
but of course it’s better what you have there a
laboratory generator signals

what it represents itself, the inductor, transistor
in this case irf840, tried many but this transistor
has minimum gate
capacity is therefore can work efficiently at high
frequencies
that there is still, driver here through resistance
here the resistance is about 5om per between
the source and the gate we have a discharge
resistance 1.2k
29:15
well, or 1k any will fit here
further chip is a Schmitt trigger, double inversion
here connected here the output of the generator
with signal generator to it directly, that is, to reduce
the effect of any static emissions directly to the
generator itself here at we have a power source
I use wall power, can be done with the battery
it doesn't matter the main thing is that it is stabilized,
that is, here at the output
I get 15 volts goes to power the driver,
that is, here there is an electrolyte capacitor here 15 volts
and capacity which is for fast increases the performance
of the drivers here are 2 microfarads that is it affects
the leading edge
30:17
which unlocks the transistor
see the video
there i change the duty cycle this is the
inductor coil itself connects directly plus
power goes and goes to it
30:45
connects to a power source that directly
works for this
I do not recommend using the coil
more than 12 volts all these effects are visible
that is, we wound the coil and put it on it our inductor
for tests is somewhere in this area
and the test the coil, looking what is happening
31:07
in th video quarter-wave resonator this case is
presented
so back to picture
31:30
what should be here
i am schematically painted fluorescent lamp
if you have a coil, you will see a very interesting
moment that herself the lamp on it will have an
alternation more brightly luminous stripes with
more dark if it lies parallel here of this coil
what does it mean?
you catch a moment like this you can see
32:00

that these stripes are running fast
you with selection of frequency you are trying so
that these stripes stopped they stop running then
there is what we have this lamp will show us
longitudinal standing wave
here I am schematic painted rotation
it rotation corresponds to longitudinal
standing wave around this coil when
32:33
this moment efficiency of the second type
for a resonant circuit
if this is not already, longitudinal wave is
just interaction of this coil with the medium it
is so that the lamp reacts on it
32:50
and I want to warn everyone
you will experiment with this one coil with minimum voltage
yes, supply there but no more than 12 volts
because this system you are not with it yet familiar,
it has a very strong effect on health is extremely strong,
that is, it is possible get very strong effect in just a few minutes of work
as you can feel ?
here and high frequency vibrations and low-frequency
that is, low-frequency vibrations can to knock down the rhythm
of the heart you will feel a lack of air
33:30
will feel unwell
higher frequency vibrations
acts on the brain through a few minutes of work is
observed headache it gets worse with the course of time
so you saw this moment, when the fluorescent light
came on with these stripes, turn off the system work as
little as possible, use minimal power
34:00
if coil does not produces such effects as here in this video is a
quarter-wave resonator it means that something is done
wrong, something has been done you are not suitable
for this system
yet an interesting point about the coil
as per indirect parameters determine what you got a
working coil working
34:36
with this addition module you can notice an interesting
moment
about the influence on health I have already said
but there will be one more moment the coil is not connected to anything
but in the zone of reverse turns it will be heat up
feel heating about 40 maybe even higher degrees
on the hand will be tangibly that is, in the coil you will
observe this movement is already and the wire will itself physically
warm up and interesting point about heat balance
35:14

energy can even be seen approximately
for example, you supply 12 watts here for but this inductor
the coil will warm up for the same 12 watt or more,
imagine that heat up coil like this, you can say
piece of copper multi-meter plus in insulation
so that this business goes there is clearly visible
abnormal movement in this coils
35:55
this is such an interesting moment that you
can determine
further the coil and when will be connected in the future
to push-pull from the inductor if even with no load
if you get properly frequencies often
push-pull will modulate you high-frequency process
it will also warm up without a connected load and
more, you will immediately notice, if the coil is
wound correctly, that no need to pump into it
lots of energy is absolutely unnecessary
it already starting to work enough independently
and by high frequency and by low you will see their
efficiency gain
36:40
with push pull work on both low and high frequencies
now question about 37.5 meters
why
36:55
Ruslan recommended it,
I checked it in this the program
that showed it to you coil it really goes to 37.5 meters
but with one condition what's the
thickness coil frame here this one parameter must
match 4 millimeters why 4 millimeters
because standard for european pipes is different
and most likely thickness the frame they have there
is more we have
in the best if we would be here in Russia find the thickness
of the frame 2 millimeters
and then for happiness that's why in our case when
we wind the coils
37:54
equal 37.5 meters frequency natural
oscillations LC resonance will be high that is, I checked
with me somewhere in the area 2.2 – 2.4 mhz
that is, work at a frequency like this high
with Tesla coil in the future will be very hard
it turns out too small
38:18
if we watch the video from Ruslan
what does he say there what is there frequency 1.5 mhz
1.6 can be 1.8 this the maximum
is clearly visible the problem is that for these
frames we you need to increase the length

of the wire in this nothing terrible, let's say here
I have the coil has 47 meters of wire length and
and LC resonance corresponds to 1.54 mhz
38:58
that is, quite comfortable
frequency can be operated at 47 meters wires
everything happens everything works like this
next question we have next is what the is
the wave resonance very interesting question
guys wave resonance occurs just here
39:17
in these conditions, plus another additional point
if these are all moments coincided in magnetic fields
the magnetic field of the LC converged with resonance with magnetic field
from the standing waves,
these conditions is not yet a wave resonance here is
the video quarter wave resonator on my channel I show
how get this
you need to pulse with a frequency of LC resonance
40:00
how determine the frequency LC resonance
now I'll tell you this moment
let's say you made coil and you don't know anything yet
what you are doing here
you have two ends of the wire, they are marked
that is,I have a wire from which we started to wind this
cold end, the wire we ended up with is hot end
40:40
here I am marking it with red tape
this the wire comes out
what we do, take the oscilloscope probe
attached with the common for the cold end
wire often has thick insulation
we attach additional alligator tip
an alligator hooked on the insulation this is enough for us
and here we attach there oscilloscope ground to cold
done this thing, connected
41:27
after this point is done we wind here in this
area one and a half or three turns small wire and
connect to laboratory signal generator
we give sine, not meander, of because with meander
you can catch it is not known what is on in
this case, we are interested in the frequency LC
resonances of this coil we supply sinusoidal signal
set the amplitude around 10 volts and
we follow the oscilloscope until that moment
40:06
when we tune the frequency
until we will have the maximum amplitude of the sine
in of this coil,
that is, this moment we caught here, let's say

as I said on 47 meters I have a frequency of LC
resonance for a given coil corresponds to 1.54 mhz
comfortable frequency
that is we I know that I will already work with Tesla coil at this frequency
for a given coil now
that we have defined this moment we put this inductor
here it is, with this additional module that presented in the video on
which and gave an explanation and what we do we
set the frequency
42:56
of pulse repetition from this transistor is equal
to the resonance frequency LC of the given coil
width, we set such that we have the width of this pulse was equal
to a quarter of the length standing wave
this is a must do
and now as soon as
43:28
I drew schematically with an arrow
as just the beat of this pulse on the video
it will be seen well, a quarter of the length of this
already powerful wave
which was formed, powerful wave at efficiency of the second
type for the resonant circuit we have
a wave resonance then there is no wave resonance exist
as an independent phenomenon
44:01
it simply does not exist, you will not see it anywhere
wave resonance occurs when you at the same time
for this coil accelerate LC resonance
and standing wave and in the future
our system and will work so
that push pull accelerates our resonance in of this coil at harmonic of high
frequency and LC resonance
Tesla coil will work on a standing wave high-frequency and when
accelerates simultaneously both a standing wave around the system
appear, a longitudinal standing wave on which it will respond the fluorescent
lamp, this is shown
45:03
in this video of mine which is called quarter wave
resonator
there is only one last question left,
is the “grenade” coil mandatory
we can do such a grenade coil
in this case, this is the moment of it winding what
it does in reverse winding
45:29
and precisely to maintain inductance
observe inductance we get a working coil
that is our inductance is consistent with LC resonance
the grenade is not necessary to wind
you can, for example, wind the coil in two layers
you can generally work on a coil in one layer

all processes there will also go and it will also work,
we get efficiency second type, accelerating LC
resonance, we accelerate in a quarter of the period length
46:03
standing wave
two waves collide in a magnetic field and a powerful longitudinal wave
around the system
that is, we work on transverse waves
but when they collide already in magnetic field two transverse waves,
longitudinal wave formed
longitudial wave does not belongs to our system directly
46:27
this is just the vibration of the environment around this coils
longitudinal wave already
capable of just interact with the environment and
it and is able to give an increase in our system
we have such a tricky system why its no one can do repeat
it is imperative to observe these moments
that is, remember all the work done on magnetic field
do not track the voltage
it is imperative to track the currents system,
the current is responsible for in the system for the formation of the
magnetic field
monitoring it accordingly we track the magnetic field in the system
47:21
good luck to all
use the calculator
a separate thanks from me to the person who
provided this calculator
it helps a lot
Thank you very much Vyacheslav Gorchin
you will also find other points of interest on
his website I recommend, a person knows what
he doing
good luck to all

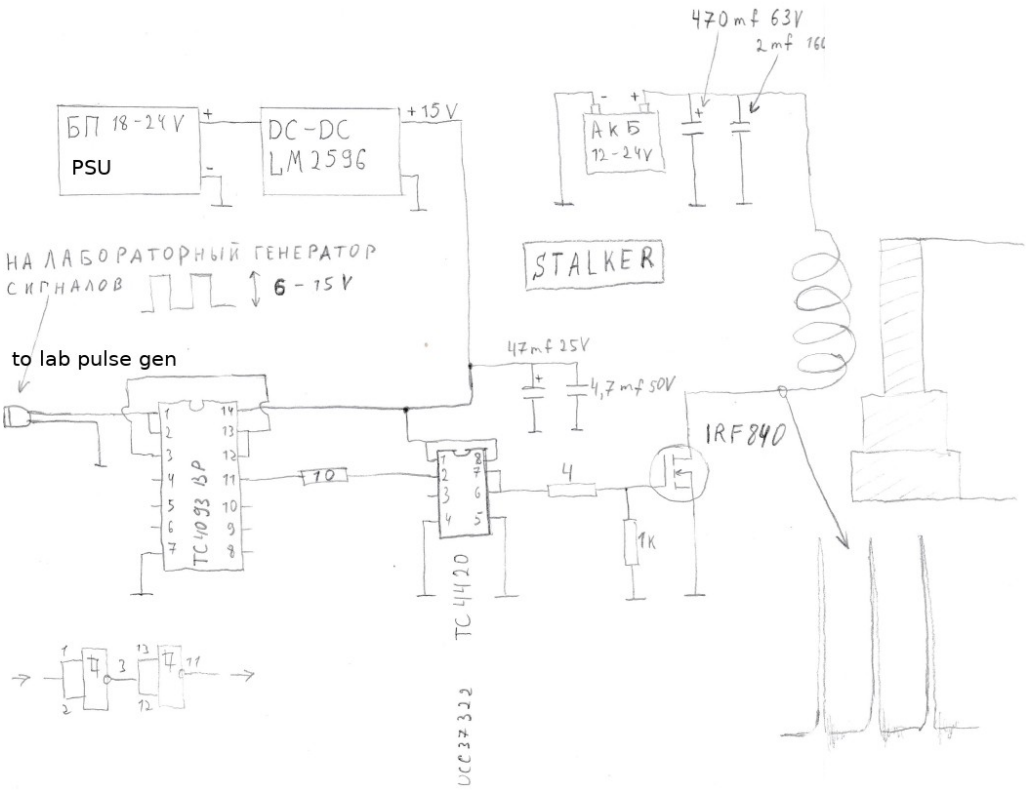
https://www.youtube.com/watch?v=wh23XTOE5jU

¼ wave resonance

video transcript

0:00
some windings work the same way as Tesla coil
here the coil, inductor (primary), this is pulse amplifier
for signal generator
driver, logic for generator protection
0:23
here switch, battery for power
here we will monitor the signal at the drain of the transistor

this is frequency
frequency of LC resonance for this coil
but duty cycle will be such so that pulse length will correspond to the length of signal
which would be at the frequency of wave resonance process in this coil
ok, let’s start
0:58
here we have power consumption
12 volts 1.5 amp, little less
this amplitude of the signal on the drain 276v
duty cycle 3.7 % in continuous mode
so we “strike” with such pulse
1:24
what about coil ?
coil’s cold end connected to the ground
hot end not connected
let’s check with neon bulb
starts glowing, in the area of reverse turns
glow very brightly
1:49
let’s take a hot end and ignite the lamp
the lamp lit up, that it, now the coil forms a standing wave in the space around itself
longitude wave
camera can’t pick it up
2:21
but on the lamp
now the glow is alternating between there are bright stripes there are dimmer ones
this glow reflects the geometry of the longitudinal standing waves around this coil
2:45
it can be seen that touching with the hand affects
when connecting the hot end the glow becomes much stronger
if we carry fluorescent lamp away it still glow
even if you disconnect the grounding
coil will work at a quarter wave
3:32
and as we see there is glow
will also increase when touched
which means that when the coil is grounded, the glow will be brighter
4:00
attaching grounding
glows brightly
this says about matching of this resonator with a length of grounding cable



pulse amplifier schematic

Work of controlled Tesla coil, preliminary tuning
https://www.youtube.com/watch?v=GMcglx5I-O4

video transcript

0:00
so now we will watch this here is the generator
controlling the power switch of Tesla transformer
here this is that the oscilloscope probe
at the gate of the transistor here
0:26
see there are bursts of pulses
now we will scale up
use in a pack 4 pulses
duty cycle 40 percent
is enough 4 pulses to accelerate the system
the ammeter will record the current consumption
0:55
move probe towards antenna
adjust the voltage
and set power on
power comes here from this inverter what under the gasket
so that we not short anything accidentally
ampermeter, power supply12 volts
here we have invertor feeding Tesla coil
now here 130 volts
1:30
for this power switch, the circuit
power switch, schotky diode, limiting resistance
well, this exit is going to inductor, power supply there
now we switch it on
see that we have consumption almost 1 ampere, that is, 12 watts
2:04
look what is going on here
and here this kind of signals
like this the packets of pulses
are coming now we can scale up this signal
we see here such spindle-shaped signal
can stop this, this is how it accelerates only with 4 pulses
2:43
the system turned out good balanced
the lamp is on
good discharge e.g. on screwdriver
3:07
ok, neon lights are on, but in in principle, as
a standard, we see that here is a sinusoidal signal
only 4 pulses but this is here we saw
in the case and at Ruslan
he showed this signal
3:34
it is assumed that this is not an operating mode
just currently balanced tuning system

that is, here
we see transformer on ferrite
by most likely, this ferrite is not coped with system requirements
to give use some pulse signal here on antenna
4:10
we will change it, select it, let's see what what
will happen
next here the system adjusts the frequency,
duty cycle signal from those four pulses
and here already the adjustment of burst pulse
duration and location (phase), it's all standard

DC-DC converter for Tesla coil or kacher
https://www.youtube.com/watch?v=rlXcRHgyfnY

video transcript

0:00
good time of today for everyone
we will look in the power supply
for our Tesla coil in the system
here the schematic diagram of our converter
what are the requirements
0:18
the converter is powered from 12 volts so we could run
system from one battery and it should
keep the voltage stably on output
for this to happen we need feedback
now on it let's take a closer look at how it works
0:39
the converter looks like this, such a thing
as seen from to detail side
I will explain what is where
the layout is not too complicated
in principle you can use it not only for powering
Tesla coil, also as normal converter for other purposes
can make 220 volts, how much you need
everything will depend on this transformer
how many turns you wound on the secondary
1:15
so let's go
according to the schematic
power in came 12 volt
power is applied to the capacitor
capacity is 3300 micro farads 25 volts
then this power is sent to the midpoint of the transformer
we have push pull converter
for low voltage it is the most efficient
1:44
on the primary we have 8+8 turns
secondary winding secondary winding wound with
75 turns after every 25 turns an output
here these ends 1,2,3,4
2:05
as the core we use is this ferrite ring
mark 2000 (translator note: mu=2000)
it has overall dimensions as presented
a hole 16 millimeters, 8 millimeters wide
and 33 millimeters on outer diameter
2:30
quite enough also here used a choke
in this diagram, it is made on this little ring core
on any which ring you have
there is a brand there from a thousand to two (translator note: mu=1000...2000)

any suitable for what you need
2:47
this is our output goes to Tesla coil power switch
here will be sharp differences of voltage during operation
of the switch and also static potential
appears and this one under the choke we
have these drops smoothed and it does not go back to our schematic
3:13
before output we have capacitance non-polar type
set of capacitors 400 volt 1 microfarad to extinguish
these bursts
here on the board 5 capacitors 1uf
here is this choke on the way out
we look now how does it work
3:41
I use converter circuit uc3825,
and it is in dip8 (translator note: dip16) package
means the advantage of circuitry a driver is built inside
so it is not necessary additional driver
4:00
quite his enough to work with these transistors
in such a small package TO-220
they work fine here we also have a
discharge resistance, 1k, in principle,
everything is standard in previous videos seen
components around, here is possible not to put
the diodes all work fine without them
here is not such a scheme with high requirements
4:38
so the components around visible
it is simple
that here's another interesting thing, I think we look on feedback
loop
feedback implemented using optocoupler PC817
very common, now we a little enlarged this
5:06
and we will analyze
so here is the connection of optocoupler
and consider how it work
we take the supply voltage not from here with this
capacitor which we have at the output
take it before choke
without all sorts of bursts that will be when power switch is working
5:41
and means minus we have a common output
it gets on the diode bridge
diode bridge especially from diodes 4 pieces her108
in this scheme why i decided to apply here diode
bridge again we need stability
6:10
so that feedback is not shocked with moments of statics
here all these moments left this is very important

when working with this converter
in conventional converters here it was possible put one diode
or two well i decided to apply here also small diode bridge
6:29
so this looks like they are 4 diodes
capacitor for which of them the potential leaves 3300 picofarads
at 400 volts this converter when winding 75 turns
gives a voltage of 130 volts at the output
6:55
so what needs to be done here
to tune feedback so that it work well, so we have it built on
divider and divider assembled with resistance 1k
further trimmer resistance 15 k
it is will set our voltage on the output which
holds the converter and another resistance which will
need to be picked up in depending on the voltage
with which Tesla coil will work
7:35
it is marked with an asterisk but in particular
for my setup I have and I work with
an output voltage of 130 volts then the given resistance
is 100 k if at the output and I work
with voltage 70 volts then I get it resistance 43k
8:00
on the optocoupler set limiting resistance
the principle of operation is when the potential is on
output reaches a certain value this potential and we
also pass charges the capacitor through the diode
bridge and this moment of potential is devided with
using this resistor divider
8:24
further through the limiting resistance hits the
LED in the opto pair the LED is activated that is
physically sends a light signal to the base opto
transistor opto transistor turns on and thus we have
a signal from the emitter of this transistor which
comes on our first pin
8:51
for the first pin in this chip with us
feedback is obtained specifically about voltage
and this chip that it makes it reduce the
duty cycle of the signal reduces it until the potential
at the output will not fall
9:12
that is, the system is in balance why we select
here is the resistance if it will wrong and under
this voltage your the inverter may not work
with high frequency
which will be inconspicuous on the load
but will be acceptable if the load on the lamp can be
seen such a moment that the lamp will be noticeable
flicker that is, incorrectly selected this is resistance

9:41
tune up to as long as the feedback is be
carried out and no flicker will be
all these moments are very good seen
by the oscilloscope, consider how it is works
further, so surely, this one diode bridge its common
minus does not connect with the common on the
minus for the power supply of this chip
10:07
this is a separate part that works specially for the
LED in this optocoupler and here is the output from the converter
here schematically marked what to the input diode bridge
is made on diodes her508 they can be connected first you
can wind the second third output more than 4 you will have
for a raise voltage
10:41
here also minus output it does not connect with
the common we get it circuit with inductive decoupling
and we have Tesla coil is separated from the general schematic
it is not affects it with its potential all that there we
have all sorts of static voltage surges during setup
and others affairs
11:06
so the following, examined, now let's see the
board as presented, what we see here here is the
input capacitance further power supply itself the
chip is carried out through a choke here it
is presented in the diagram
11:30
through the choke also to remove what ripple
effect will there be the chip worked well for
us here here is the resistance which we change this
just this resistance marked with an asterisk
11:48
push pull, 2x 10 ohm we have here goes
to the gate and transistors
transistors picked up from the old PSU for computers
here from other P60NF06 as well can
be used irf3205
12:11
on the primary here is a wire in lacquer
insulation shrink-fit
the transformer is wound with wires in pvc insulation
wire is 1 millimeter, in insulation it is 1.5
12:33
then here is still interesting here with transformer
output to diode bridge
diode bridge hits the capacitance
this capacity we have here it is 4700 microfarad 200 volts
200 volts enough because my converter at
130 volts if think of a higher converter here pick up the
capacitor here

13:00
well, since the volt is at least 50 with a margin
but from what our this pulse converter
so so so what else can cause difficulties
here understandable by the way, the surrounding components
are simple but this chip if
you look you can also make overcurrent protection
13:31
it is carried out in my opinion on the 9th pin a
practical chip turns out to be good powerful
converters can even make the welding inverter
very good variant of execution only of course if welding
inverters will do accordingly, it is already necessary
to put here normal drivers but for these transistors it
is quite enough, that is, everything turns out compact
nicely big radiator is not needed
14:02
the highlights are now let's let's see how it works
for us like this with what do we start setting up this converter
14:16
check accordingly connection
further do not supply power on push pull,
we check the work itself
see with an oscilloscope
relative to common to the gate and check that
on us there were square-wave signals from a pause in between
14:44
here the given resistance of 5 k here
sets the final the duty cycle of the the pulses
themselves transistors here is the resistance
for 5 pin 10 k capacitor 2200 picofarad
15:04
this is our frequency defining circuit that we do
with it we put it for a start trimmer resistance
10 k we power after checking on our
push-pull and find such a moment for a given your core
15:24
turn the frequency on chip and see that
your converter has at idle for a given frequency which
you find was the smallest consumption at this frequency
and remain that is, the given frequency but for my
ferrite the frequency somewhere around 65kilohertz
15:52
you may have another, but you need to go to such
a frequency where we need a ferrite on the core the
lowest losses, that is most of the material in this core
will reverse magnetization with minimal resistance in
the magnetic field then the efficiency of your converter
will be much higher
16:17
plus will be less heat up the transistors itself

transformer well given the converter will have good
characteristics
after you find given trimmer resistance frequency
you are with see see how he was connected
by connected contacts measure resistance
16:46
after it is soldered here already to converter usual resistance
with such a nominal matched but or close to him any
and all and it remains on this diagram more adjustment for
further work we do not need frequency
17:10
and he's a duty cycle this process setting its
resistance can also be will replace the usual resistance
it is much cheaper after setup so let's see how this case
works for us
17:29
by the way, the converters are powerful
enough now I connected it to the output of it we start a
300 watt lamp, we see it on we have 47 volts to the lamp,
I now have the first output are used according to the
schematic, that is, on the first the output I get about 70 volts
18:00
now trimmer resistance set to the limit is about
50v so I'm twisting the lamp we see that our converter
holds 50.5 volts stable at the output when connected,
heat the glasses small draw down, that is, our load serious,
I even connected two 300 watt lamps and if I
wonder what consumption we have now 3 amperes 12.5 volts
18:41
and this moment so there is an scope trace now
it is very clear how the feedback works
press pause and consider the moment it can be seen
that the signals does not intersect but the duty cycle decreases
constantly at the influence of feedback
19:09
we see that and then the voltage on our
duty dropped voltage increases and then the
chip again limits duty cycle on channels
this process it is clearly visible in this mode,
the balance we are constantly working that is
like this you should get an interesting signal
bouncing this is how the feedback works now
I'm remove the load see removed the load
19:45
the converter went into pure maintenance
mode on voltage amplitude 50 volts at the output
that is, we get the duty cycle minimum for these
costs we can consider how it works then there is
a feedback for that and is needed to keep a stable
voltage and consumption in this mode of operation
of chip minimum
20:14

that is three hundredths ampere to keep
idling these 50 volt for this converter is quite
we have enough
Tesla coil naturally should not consume so much
check this converter this
is already a test case for him 300 watts make
sure we have it all works well can i tested it
and 130 volts on this lamp occurs power drawdown
is about one 125 volts per lamp
20:55
25 watts keeps everything stable,
that is you can do at will for this we remove any voltage
from the converter 300w now let's
see how it works feedback
21:16
oscilloscope our signal peak duty cycle I screw
in 25 watts now consumption it begins once we have
a lamp the chip also lit up a little went into
such a pulsating mode by duty cycle
21:43
here is the cutting duty cycle in pulse bursts occurs
that is, the chip itself works in pulse bursts and
the duty cycle in the pulse burst is regulated automatically
22:08
very good working mode and one more moment is
needed so that this the frequency of the pulse bursts was as high
as possible is also selected here by this here the tuning
resistance that we considered in the work feedback
22:29
this resistance is very important for quality work so
that your lamp does not the flicker
there were no sharp changes and so now you can still notice
let's consider how it resistor
22:57
trimmers according to the schematic we have this is
type 15 k in feedback as they will influence regulation
voltage voltage drops smoothly with turns of given resistance
23:29
and you can set on the chip and on
the final as a result, the supply voltage is what you
need to voltage dropped from 50 to 33 volts can
be set to any point operation in this mode
here such an scope traces
23:55
well, accordingly, the lamp is not visible so that
it lit for her already low voltage the moment of
work is clearly visible it is worth removing the load
and the microcircuit goes into limited mode
use of the minimum duty cycle
24:36
I put back 300 watt and see that
the duty cycle increased by the moment consumption

has also increased, that is the converter is fully
operational
24:56
and so now the moment for what such complexity
for powering Tesla coil
why is this converter needed?
with such characteristics
25:14
on diagram of what happens when Tesla coil
works on this system it needs the power point,
that is, the system must be in balance if we submit
too much supply voltage there will be such
a moment that Tesla coil will start push the process in
the resonator itself
25:45
that is, on the grenade we have instead of
increase amplitude of the current will be observed
lowering, on the contrary, if the voltage will be too
small then it will not have quality interaction
in the system, the will be no gain
26:06
this is done exactly by powering Tesla coil properly, plus
power by the way can when you have already run out
of all potential that can be adjusted here at this resistance
power can be adjusted with this resistance also smoothly the
very final duty cycle
26:35
this is resistance on this chip
restores the final duty cycle
can be set any in your own desire
if you don't need too powerful converter can limit the duty cycle in the
area is 35-40 percent with this resistance
all good luck in designing

bonus video for those who read until this point
https://www.youtube.com/watch?v=bVlQ2zH8i3E