https://www.youtube.com/watch?v=ObQFTTJimuI
Method for finding the operating frequency of the push-pool.

0:00 Good time everyone, today I will tell you about method for determining the frequency of work
0:08 for push-pull, and for a given point that the wave processes took place in it,
0:14 show the heating of this coil without the presence of a load, that is, to
0:21 the current actually accelerated in the system, now we will test it and look at what
0:27 frequencies we always work, what frequencies we actually need for this
0:34 you will need such an auxiliary tool, a ferrite ring with mu one and a half or two
0:41 thousands are possible and higher, not important, dangling 8-10
0:46 turns, no resistor, we don't need phasing, we don't track exactly phase
0:51 you only need to know the amplitude of the current in
0:58 the system, how this thing works ? when it moves along the conductor,
1:05 electric current or charges are still but there is
1:12 spin rotation around the conductor a magnetic field is formed when this ring is put on
1:21 it captures magnetic field and on these turns it converts it into a voltage that we track
1:28 on an oscilloscope, to track this current movement in a given coil
1:34 we need to close the coil outputs physically, short and
1:44 already watch when this coil is working at half wave
1:49 where to start? we put a ring on, we close ends
2:00 we make a good contact and connect the oscilloscope, phasing does not matter
2:12 ground and probe itself, so of the appliances is also a must
2:19 signal generator, the output of the signal generator is hooked
2:26 to the coil directly, to the inductor itself, we will already see what we have, what
2:34 happens on the instruments, so now we see, it means we are supplying 5 kilohertz for
2:47 start, applying a sinusoidal signal
2:53 enabled, amplitude, amplitude is 10 volts and now we will
3:04 run through the frequencies and observe the waveforms that we have going like this
3:15 here is the usual frequency now we are going through work where
3:20 from 10 to about 45-50 kilohertz where
3:28 almost everyone work for us and we see that
3:34 there is no point in being in the 25 kilohertz zone because the amplitude of the current
3:42 minimum at this frequency, we go further
3:49 passed over 60 kilohertz and we already see that the amplitude begins to grow, we are looking further
4:00 that is, see what range
4:05 passed the amplitude now we have is here you can see 0.2 volts on
4:16 division, that is, not interesting so far
4:22 that nothing is visible, let's move on
4:33 that is, the amplitude does not change much, you can speed up the process more than one
4:40 kilohertz, for example, step by 10khz, look, we have already passed up to 500 kilohertz, this is the same
4:49 the amplitude did not change significantly and
4:58 that's just starting from 800 kilohertz we
5:04 see some jump in amplitude, growth
5:10 here the amplitude is growing, growing, we have reached
5:16 maximum around 910 kilohertz
5:21 accordingly, push pull can’t work at such a frequency, we have
5:28 one option to work in multiples of this frequency is acceptable, if this is 910 kilohertz
5:34 we can work at 91 kilohertz, now we will check what else can be
5:40 interesting at this frequency so
5:49 if we put our hand on the coil at this frequency, we can check how to

5:58 of this frequency, the surrounding objects influence on this coil
6:05 interesting moment such that the frequencies are stable, look now, I will
6:17 put my hand on the coil and we will observe the amplitude, I put hand
6:24 it can be seen that the amplitude increases, I put here hand on the
6:30 reverse turns - amplitude increases
6:35 now let's move on to the frequency of nine hundred and eighty kilohertz too
6:42 the amplitude grows by a thousand kilohertz, there is also a small increase
6:50 1100 gain minimum window of opportunity
6:56 we get somewhere from 850 to 1100
7:05 kilohertz works, we have determined the first range and now we can write it down
7:14 write down
7:20 let say 830 - 1100 kilohertz
7:28 this is our window of the multiplicity to which we will try to work on the push pull
7:36 further we will determine if any other high-frequency
7:41 component for the current in a given system at which an increase in current will be observed
7:50 we go even higher in frequency
8:00 we pass the ranges of a special increase in amplitude is not observed, we are looking for a moment
8:10 when there will be a clear jump, step of 10 kilohertz
8:19 quite acceptable, here we see at 3800 even we have a drop in amplitude, but
8:29 see, fixed moment, starting from
8:37 3910 kilohertz we have a sharp rise in amplitude
8:45 now looking for more smoothly ramping up
8:50 good growth, is growing, you can even see 0.5v/div
9:02 also a rise of 1 v/div
9:13 and now the decrease starts at about 4650
9:22 kilohertz maximum amplitude
9:29 4620-4630 kilohertz is our second
9:35 maximum, write it down
9:44 4624 4630 kilohertz see the effect on
9:56 hand at this frequency, usually at such high frequencies, hear and
10:05 that is, it is clear that these frequencies are not so stable, but the maximum amplitude is
10:12 normal process, let's see if we can find
10:17 anything further, further, decrease
10:24 amplitude
10:32 we break through a larger step of 100 kilohertz, here is some maximum that is still small
10:40 found at 7600 the frequencies are already high
10:45 we are no longer interested in this, and further 11
10:51 megahertz, such a high frequency of our systems is no longer achievable, it is not needed for
10:58 it will be very unstable results, let's say 8800 and the amplitude is not the same
11:05 large and the influence is very strong if we touch the coil in reality, we
11:12 determined two two operating frequencies where
11:18 the current we have is the maximum, one of them is the stable, course of our next steps
11:28 now we need to find such a frequency in a multiplicity in this range
11:34 which, according to the analysis of the spectrum, would fall into this strong frequency and at the same time
11:45 10th harmonic, it excites some of the frequencies in this range, the following is
11:54 we will need to do this to put the oscilloscope in spectrum analyzer mode
12:00 so called FFT mode, fast Fourier transform and check
12:07 spectrogram of this signal, that is, our window of opportunity is from 83
12:14 up to 110 kilohertz
12:19 work in multiplicity, we switch oscilloscope

12:27 to spectrum analyzer mode
12:33 FFT mode
12:40 and what you need to know about measurements in this way
12:48 measure the harmonics of the signal which will be shown in the spectrum as a graph in
12:57 decibels, using a sinusoidal signal
13:03 now I'll show you the time to enter
13:10 83 kilohertz is supplied, and now if we look at it in this
13:21 mode, the device shows only the central center frequency which
13:31 is fed on a sinusoid, in this case
13:36 and there will be 83 kilohertz
13:44 Now let's display the divisions on the sweep, we are interested in the sweep
13:51 divisions for a spectrum analyzer in the region of 50 kilohertz per division can
14:01 now disable our output 1, so that it
14:07 did not interfere with us, and now we can observe the spectral pattern now let me remind you
14:16 signal generator is in sine mode
14:24 what do we see here
14:32 here in the center of the intersection of the scales is
14:37 frequency and now if we appear we will place
14:44 central peak in decibels in central
14:50 area, we recognize its frequency, then in particular we place the center and see our 83
14:59 kilohertz now I will show where it is displayed on this device for me
15:04 displayed in the lower left corner, here they are 83 kilohertz is clearly in the center and
15:13 we see something that we feed into
15:19 sine mode device determines, in order for us to excite harmonics
15:28 you need to give a signal with a steep edge, which means switching the signal generator to
15:35 meander (square wave) move now we see that our picture
15:42 changed, we can observe in the multiplicity step
15:50 frequencies with any
15:56 spectrum range and now the search technique
16:02 we have determined that our largest current amplitude
16:10 is in the region of 4620 - 4630 kilohertz and
16:16 we are now in this range from 83 to 110 kilohertz will be interested in such
16:22 the frequency that will give the highest signal in
16:27 decibels at these frequencies we are looking for our frequency
16:43 4600
16:50 here at 4630
16:57 with a more precise set
17:13 here our 4630 kilohertz, that is, we understand what we need in the center now
17:23 selection of such frequencies in our
17:29 window of opportunity to place a peak
17:35 spectrogram center to the scale center, and start
17:44 search by frequency, going very smoothly
17:54 at 0.1 kilohertz and now we see we have the first hit
18:05 watch
18:15 84.2 kilohertz we write down 84.2
18:31 Next comes I want to pay attention
18:38 84.2 you can see that there are still harmonics coming out
18:45 we are interested in a cleaner spectrum when no side harmonics
18:57 this is how the picture should look like
19:04 here is another hit on 87.4
19:12 87.4 kilohertz, but we also see that there are side peaks, we write down
19:22 84.7 and four tenths of a kilohertz go

19:28 further
19:39 and here is a very good frequency that we found, an exact hit without strong
19:47 side harmonics, corresponds to 90.8
19:56 kilohertz, can go further
20:07 another hit 94.5 kilohertz
20:18 also good frequency, note them
20:26 writing down and marking those frequencies on
20:32 which do not have strong side harmonics
20:42 moving on
20:50 one more hit, but here we see already powerful side harmonics, skipping
21:03 we also see here at 103 kilohertz side
21:09 harmonics
21:21 also side harmonics at a frequency of 107.7 kilohertz are powerful and a window of opportunity
21:29 we have up to one hundred and ten kilohertz, we have followed him already further than us
21:36 interested now we can say that we have two most likely frequencies
21:42 for work it is 90.8 kilohertz and 94.5
21:51 kilohertz at which excitation occurs
21:57 coils at this frequency a powerful by current
22:03 so now let's see which of these frequencies will fall into our range of 830-1110
22:13 logged and collapse the spectrogram and
22:18 let's see what is going on with us in general and see that this is our first one that we
22:26 let's excite, let's say now it corresponds to 111 and set the kilohertz
22:34 our 90.8 kilohertz and we can also see
22:43 that the maximum excitement we have is in this zone
22:49 high-frequency and here is one of the peaks clear it and consider here it is ours
22:59 the frequency of the first 90.8 and went to watch
23:07 second peak 276, looking for high amplitude
23:15 and here we see one of the peaks that hit at a frequency of 90.8 kilohertz hits
23:27 we have exactly one megahertz and observe
23:34 that it is also very good in our window of opportunity, that is, exciting the coil at a given frequency
23:42 we give driving at first frequency component of the stable and second
23:51 and now let's see the frequency of ninety-four and a half kilohertz we translate
24:00 ninety-four and a half and look
24:17 the highest peak we have is the same
24:25 gets here but the greatest stability
24:31 if we remember we had around 910
24:38 kilohertz and the maximum gain, and when we put our hand on the coil and the maximum
24:47 increase in amplitude when amplitudes were noticeable, that is, we can now
24:53 to determine that this frequency of 90.8 kilohertz is the most suitable for us for
25:01 push-pull work and judging by the spectrogram and note that there is a search technique
25:16 before checking, we can transfer to our frequency
25:21 90.8 kilohertz collapse the spectrogram and also look at the highest
25:31 we set the peak decibels and we see that yes, indeed, one megahertz is exactly
25:40 we can transfer to another high peak
25:47 here he is the highest it is
25:53 our 4630
26:03 this is the peak
26:09 which means we found our frequency correctly, we can also do one more check
26:17 frequency data that we found out in practice by the similarity of beat pictures on
26:24 tt various frequencies, a rectangle is now being sent to us at a frequency of 91 kilohertz, we

also continue
26:34 observe current sensors
26:41 this is our signal that we give creates such fluctuations
26:47 if we consider them in a coil, we will look at the beating, we turn off
26:54 sweep
27:12 and interesting pictures
27:17 Now let's check the appearance similar to the data pictures of the waveform data on
27:25 another multiple of the frequency, we feed the frequency
27:33 our signal generators are 910 kilohertz
27:42 so now the oscilloscope shows the amplitude envelope and we see that
27:49 the amplitude has increased in fact the beats have been preserved has the same shape
28:01 under consideration now here is the sweep
28:07 is 5 microseconds per
28:14 cell and send to the our
28:22 fundamental strong frequency which
28:28 is 4630 kilohertz
28:42 smile
28:54 the amplitude goes off scale returned we see here already known familiar fish then
29:02 we got on the main strong feeling that for this coil it is possible
29:10 observe during buildup using a rectangular signal and you can
29:16 switch to sinusoidal signal
29:21 the amplitude will decrease as the beat will be kept from being seen at different
29:33 scan pattern is saved
29:44 two sines on the main carrier
30:08 also if the signal has sufficient strength, the oscilloscope will show the envelope
30:16 form, that is, a sinusoid on these fish, you can measure it and the frequency goes into the mode
30:32 cursor measurements, press pause, set 1 cursor
30:39 we set the cursor 2
30:56 we can see that the frequency of our beating, this coil is 32.47
31:11 hertz which is also
31:16 indicates that we do not have 50 hertz network pickups quite realistically occurring in
31:26 given coil process in practice I
31:33 also checked this result, a frequency of 91 kilohertz was applied here and this one
31:42 the coil began to heat up very well without the presence of a load at this frequency
31:50 which indicates that heating occurs in our area in practice
31:58 it feels like I didn’t measure it with a thermometer, well, about 45-50 degrees heating at
32:06 consumption of about 3 amperes, this coil is heated without
32:14 load, the obvious presence of current movement along the length of the conductor that we
32:22 in general, and we need to do it on the push pool
32:29 as such, the LC resonance I will show this in the future, that is, it is impossible
32:35 apply 91 kilohertz directly to inductor, what is happening, of course you can try it
32:42 but everyone was doing it, a very interesting moment happens if we apply
32:47 here a frequency equal to the frequency of push pull switches, that is
32:54 in fact, we get such a moment once... we draw
33:01 let's say we have this is our frequency to the push pool and we have a signal at work
33:09 transistors that we accelerate it in each half-cycle of work when here in
33:22 this point we will have a Tesla operation, here the blow will occur here
33:30 almost near the maximum we get what many have seen on
33:36 own experience damage of push-pull power switches and happen
33:44 our pool is driven into a different mode of operation as I drew earlier
33:50 and people had a lot of questions why I

33:57 drew this one which represented in
34:06 another video where I have a falling wave like me
34:12 drew there is a reflected wave and they are in phase, there were many
34:19 questions why it is so drawn, as it were, incorrectly, that is, we all know from the classics that the reflected wave
34:26 returns with a shift of 180 degrees, that's right
34:32 reflected wave by voltage flow, we do not consider this moment, that is
34:37 if we make the flow a reflected wave in the oscillatory circuit with a shift by
34:45 180 degrees it will be equivalent to the fact that my two magnets turn to each other
34:53 poles of the same name of the total growth of such a powerful magnetic field
34:59 will not be observed, which is why, in a push pool, are we achieving what we have in
35:06 the phase is the supplying reflected wave; physically, this can be seen if we hang
35:17 current sensor in the oscillatory circuit, inductor
35:23 circuit and on one beam we will observe such a picture that we have and
35:32 let's say that our wave has gone and the reverse one, which returns, it will also be
35:38 copy the phase and the same wave will be almost like this picture
35:43 they will phase only go with less
35:49 amplitude, like this, we achieves on
35:58 a push by selecting a container between a container that is on
36:04 the oscillatory circuit of the inductor between the capacitance that hangs at the output of the grenade
36:10 our gradient coil and what happens push-pull we have running on
36:18 low frequency but when we watch the oscilloscope
36:24 it will show us the purity higher than the frequency of the main signal
36:31 so in my case i found out that my frequency is 91 kilohertz this is
36:42 means that I need a push pool so that it actually works in 2
36:49 times lower, you can drive 3 times lower to get this picture in practice
36:54 received even in phase 3 waves like this is visible on the current sensors
37:05 in one phase when it happens with us
37:12 a powerful total addition of the magnetic field is obtained if we collapse
37:17 after that sweep time vesting then
37:22 we can see very interesting pictures of the so-called fishes,
37:30 why such a trick is needed, we have already discussed that if Tesla hits the main
37:37 as if the first harmonic out transistors get damaged, but if we have such a picture
37:42 then when Tesla works on free oscillation here at this point we have
37:50 there is a sharp rise in the amplitude of the current when we look only to you
37:59 transformer, we see such a picture that I
38:04 showed a video on the effect of the Tesla transformer on the current in
38:10 oscillatory circuit there, the amplitude of the current jumps up
38:17 our entire balance becomes much larger, while consumption
38:23 the total that we measure from the power source what we have
38:29 directed to power supply by sleepers consumption decreases current amplitude
38:34 increases system consumption decreases in numbers, in practice,
38:40 if in normal mode without Tesla, let say push pull
38:47 consumption is 3 amps at 24 volts
38:54 then when the tesla is working and increasing one of the special cases, it consumes 1 ampere
39:02 with the same 24 volts of power, such an interesting
39:10 feature in further videos we will consider this as it happens as
39:16 good luck to everyone