UV-K5 Chinese Radio Modification to operate at 27MHz

Hello, electronics and ham radio enthusiasts! My name is Wander Lúcio, and I'm sharing with you an interesting modification for a Chinese radio that originally operated in VHF/UHF and with some internal modifications, this radio can be adapted to work on the 27MHz frequency, expanding its possibilities of use.

Tutorial Objective

The purpose of this tutorial is to provide step-by-step instructions for performing radio modification. If you are curious, like to experiment and want to learn something new and even if you don't have a technical background, this guide is perfect for you as I will try to explain everything in an accessible and practical way. This guide is for you!

About me

As an electronics hobbyist and passionate about amateur radio, I am always looking for challenging projects. I made this modification to my radio, and I'm excited to share the knowledge I gained with you. I apologize in advance for any technical errors or lack of clarity in my explanations, as I'm just a self-taught hobbyist.

Now, let's dive into the modification details!

VHF/UHF Dual Band Radio Modification for 10, 11 and 12 Meters

In this tutorial, I will explain in detail all the necessary steps so that you can modify your HT Dual Band VHF/UHF to operate on the 10, 11 and 12 meter bands. With this change, you will be able to obtain transmission power between 3.5W and 5W, in addition to maintaining harmonics below regulatory recommendations. Reception will also be extremely selective.

Comments:

You will lose VHF/UHF transmission capability, but maintain reception in the 210MHz to 600MHz range.

The radio will transmit and receive on the 10, 11 and 12 meter bands.

Before we proceed, it is important that I share some truths about this modification. Although it may be a little disappointing in some aspects, I still consider it a great purchase due to the value for money.

Technical Modification Details

To be blunt, you**will not have a HT with (AM, USB, LSB)**. Instead, you will have an HT with complete FM perfection and an emulation of the other modulation modes. The reason is simple: the radio has an RF chip for FM, which is the heart of the device. Additionally, there is an STM32 (Clone) microcontroller chip that acts as the brain of the device and enables many innovative features.

What does that mean?

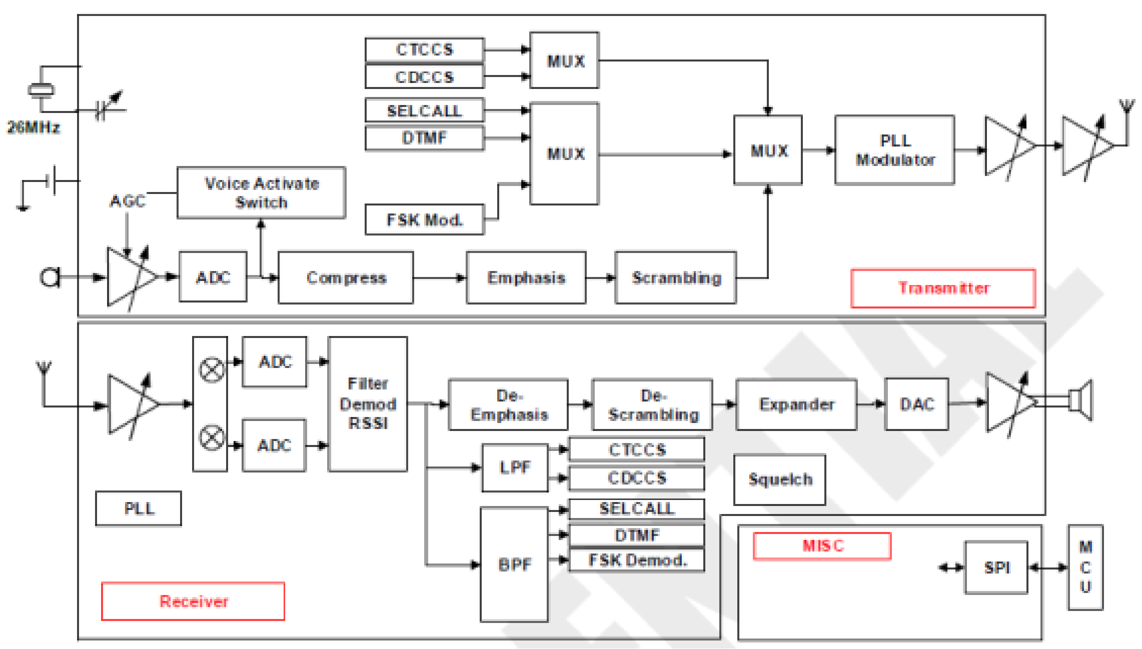
Perfection in FM: With the modification, the radio will continue to work perfectly on FM. This is the main advantage, especially if you prefer FM modulation.

Emulation of Other Modes:AM, USB and LSB modulation modes will be emulated. This means that the software will try to simulate these modes, but it will not be exactly the same as a radio dedicated to these modulations. Quality and efficiency may vary.

Final considerations

Despite the limitations, this modification can be a great option for those who want to explore new possibilities with their Chinese radio. Remember to adjust your expectations and make the most of what the device can offer.

RF CHIP**BK4819**



Now, let's delve into the specific modification for the citizen band (CB Radio in the USA or Radio PX in Brazil). As I already mentioned, the core chip is designed for FM, which means it spreads the modulated frequency both left and right in the RF spectrum. Regardless of whether we are in the supposed AM or USB/LSB sidebands, this characteristic remains constant.

RF Chip Technical Details

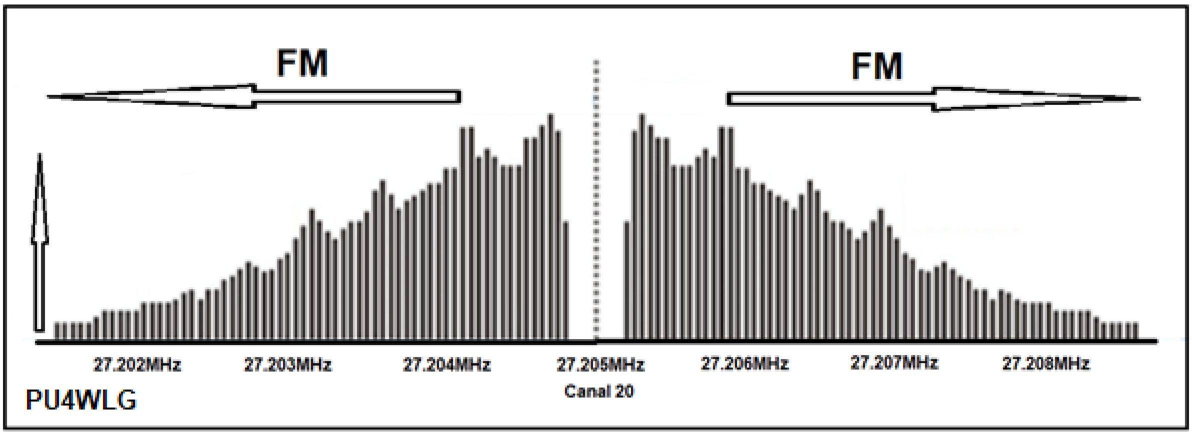
The RF chip used in this radio has the ability to transmit and receive FM modulations from 18MHz to 660MHz. It reaches up to 1.3GHz, but there is a jump between 660MHz and 840MHz. In fact, it can operate from 18MHz to 660MHz and from 840MHz to 1300MHz. This is something fantastic, as it is all complete, requiring only an audio amplifier, an RF amplifier and a microcontroller to have a complete radio (in addition to the RF filters for the desired band).

Limitations of Modification

However, the main objective here is to modify the radio to the citizen band. Your desire is to have a CB Radio in the USA or a Radio PX in Brazil. It is important to understand how the chip works. As I mentioned earlier, the chip is designed for FM, and its modulated frequency spreads left and right in the RF spectrum. This occurs regardless of whether we are on the supposed AM or USB/LSB sidebands.

If you are ready to continue, we can explore more details about the modification and how to adapt the radio to operate in the desired range.

Look at the image below.



DSB (Double Side Band) Modulation

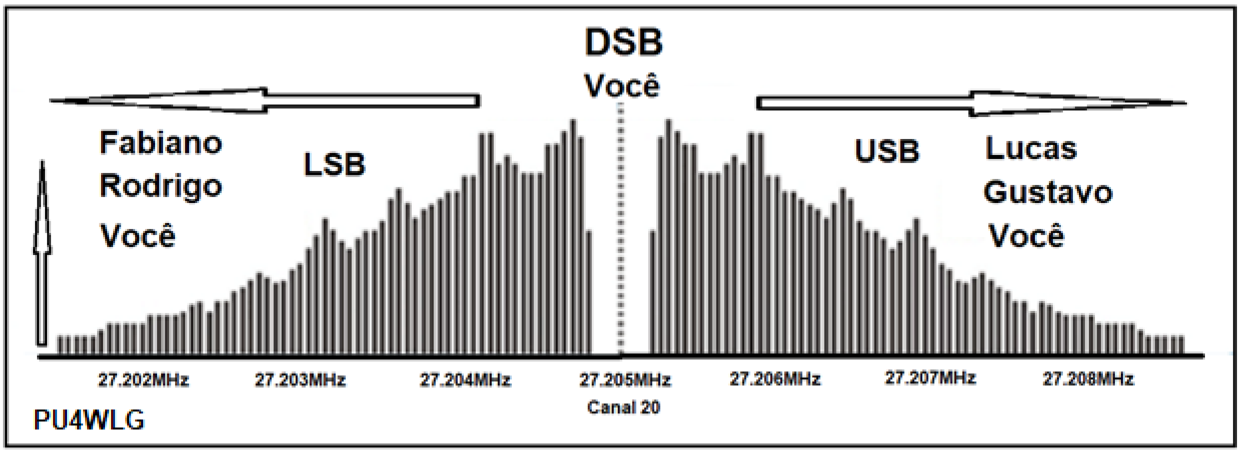
The Quansheng radio modulates both LSB (Lower Side Band) and USB (Upper Side Band) simultaneously, creating what we call DSB (Double Side Band). This technique allows the radio to emulate both modes at the same time, in the RF spectrum it is the same as operating in FM.

Audio Band Allowed for CB Radio

In the context of CB radio, the permitted audio band is 10KHz. For example, if we consider Channel 20, which is on a frequency of 27.205MHz, the band allowed for each channel is 10KHz. Therefore, channel 20 may be used in the range from 27.200MHz to 27.210MHz.

- **LSB (Lower Side Band):**A normal LSB radio uses only 3KHz to the left of the center frequency. This means that, in our example, it would be operating in the range of 27.202MHz to 27.205MHz.
- **USB (Upper Side Band):**USB uses the same 3KHz, but to the right of the center frequency. Therefore, it would be operating in the range from 27.205MHz to 27.208MHz.
- **Quansheng DSB or FM mode:**In this mode, the radio uses the entire 10KHz band, covering from 27,200MHz to 27,210MHz.

This illustration helps you better visualize how these modes work across the frequency spectrum.



AM Modulation and the Smart Gambiarra

Here's the crux: the AM. As mentioned, the BK4819 chip only does FM. However, there is a “smart workaround” that allows you to modulate FM and listen to AM. Test between two radios on your bench: one with real AM and the other with FM. Shift 4KHz between the frequencies of these radios. For example, Radio 1 on AM at 27.201MHz and Radio 2 on FM at 27.205MHz. Note that we are out of frequency between the two radios, around 4KHz. You can modulate on the FM radio and you will be able to hear it on the AM radio. Now, put both radios on the same frequency, 27.205MHz, but leave one on AM and the other on FM. Try modulating between them. It will not work. For this reason, you cannot achieve AM modulation between two HT Quansheng that are on the same frequency and are very close to each other, perhaps in DX you can. Programmers can emulate amplitude demodulation so perfectly that you won't get the characteristic FM hiss. This gives a false impression that the radio actually has AM mode. In short: in AM, the Quansheng display will show 27.205MHz, but the generated frequency will be 27.201MHz.

Transparency and Final Considerations

The Quansheng radio is really wonderful as a Dual Band VHF/UHF in FM, but for the cost and benefit, it is possible to modify it to 10, 11, 12 meters and have a “quick breaker” that can operate smoothly as a CB Radio.

I hope these explanations have clarified how they work and the differences between the modes.

If you agree, we will now make the changes.

Firmware update

The first step is to exchange the original firmware for the wonderful IJV firmware. You can find the firmware in the followinglink:
https://www.universirius.com/en_gb/preppers/quansheng-uv-k5-manuale-del-firmwareijv_v3/

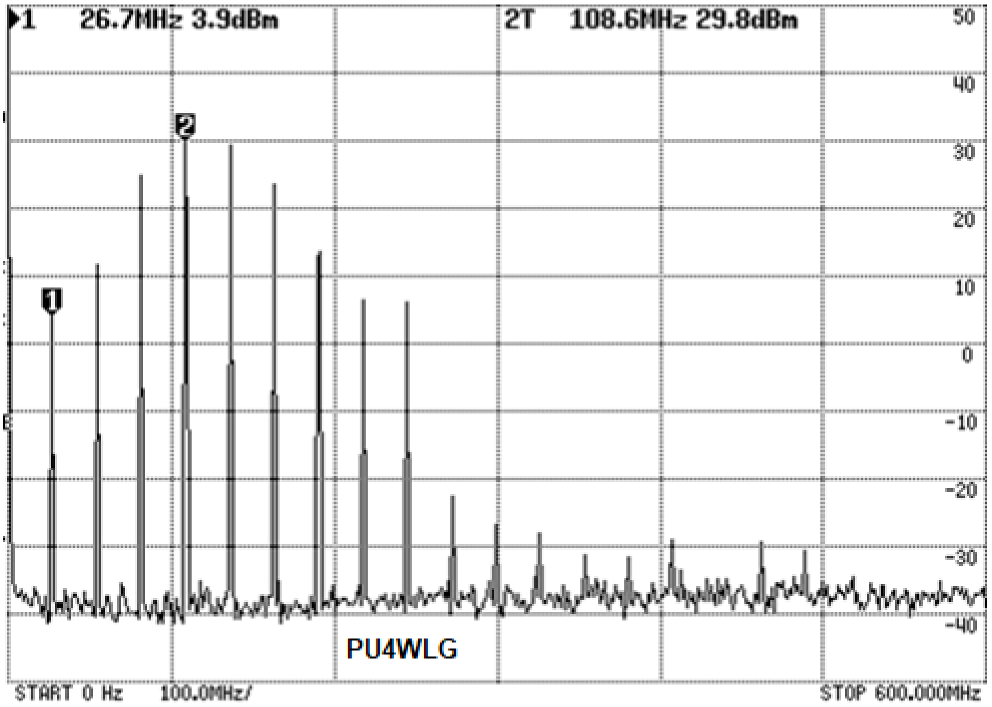
However, I will not describe this part in detail here in the tutorial. If you need help, watch some videos on YouTube or look for someone who has already provided this tutorial written by me, Wander Lúcio. Generally, whoever shares this tutorial also sends a ZIP file with all the material needed to update the firmware. This step is not complicated, but it does require a programming cable and a computer.

Transmission Power at 27MHz

After the upgrade, you might think that the radio is ready to operate on 11 meters, but it is not. The radio is a HT Dual Band VHF/UHF and will never be able to transmit enough power at 27MHz. You may even receive it in an absolutely precarious way, but you will not have any selectivity. The reception sensitivity will be present, but the problem is that any HF, VHF or UHF transmitter will silence the 10, 11 and 12 meters. If you only intend to listen to these tracks, you can check the possibility of using an external filter. However, in broadcasting, it is better to give up.

Spectrum Illustration

See in the image below what will happen when you press the PTT at 27MHz without having carried out the internal modification of the circuit:



Harmonic Correction and Power Increase

This is the most important thing about the modification: the initial transmit power at 27MHz is very low, only about 2mW (or 4dBm). However, the biggest challenge lies in the harmonics generated by this frequency. Let's analyze these multiplied harmonics:

1. **Fundamental Carrier (27MHz):**4dBm (2.5mW) **2nd**
two. **Harmonic (54MHz):**13dBm (20mW) **3rd Harmonic**
3. **(81MHz):**26dBm (400mW) **4th Harmonic (108MHz):**
4. 30dBm (1W) **5th Harmonic (135MHz):**30dBm (1W)
5. **6th Harmonic (162MHz):**25dBm (300mW) **7th**
6. **Harmonic (189MHz):**15dBm (31mW) **8th Harmonic**
7. **(216MHz):**8dBm (6mW) **9th Harmonic (243MHz):**
8. 8dBm (6mW)
9.

These harmonics interfere with many frequencies, which is undesirable. The good news is that we can fix this internally. Let's reduce all of these harmonics to well below 0dBm and increase the power of the fundamental frequency from 27MHz to about 36dBm, which will result in approximately 4.5W.

Internal Modification

The internal modification will involve adjustments to ensure harmonics are minimized and transmit power is optimized. With these fixes, your Quansheng radio will be able to operate more efficiently in the 10, 11 and 12 meter range.

Radio Opening:

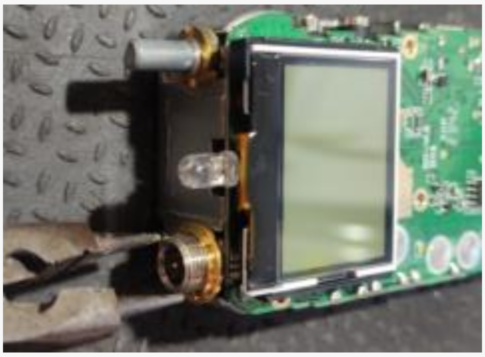
Remove the volume potentiometer knob.

Using a screwdriver, unlock the chassis from the plastic box.

Carefully lift the chassis until completely removed.

s play very carefully and remove the screw that was hidden and you can
The secure the display back in place (note: you can tighten this screw again
O to avoid moving the display and running the risk of
q

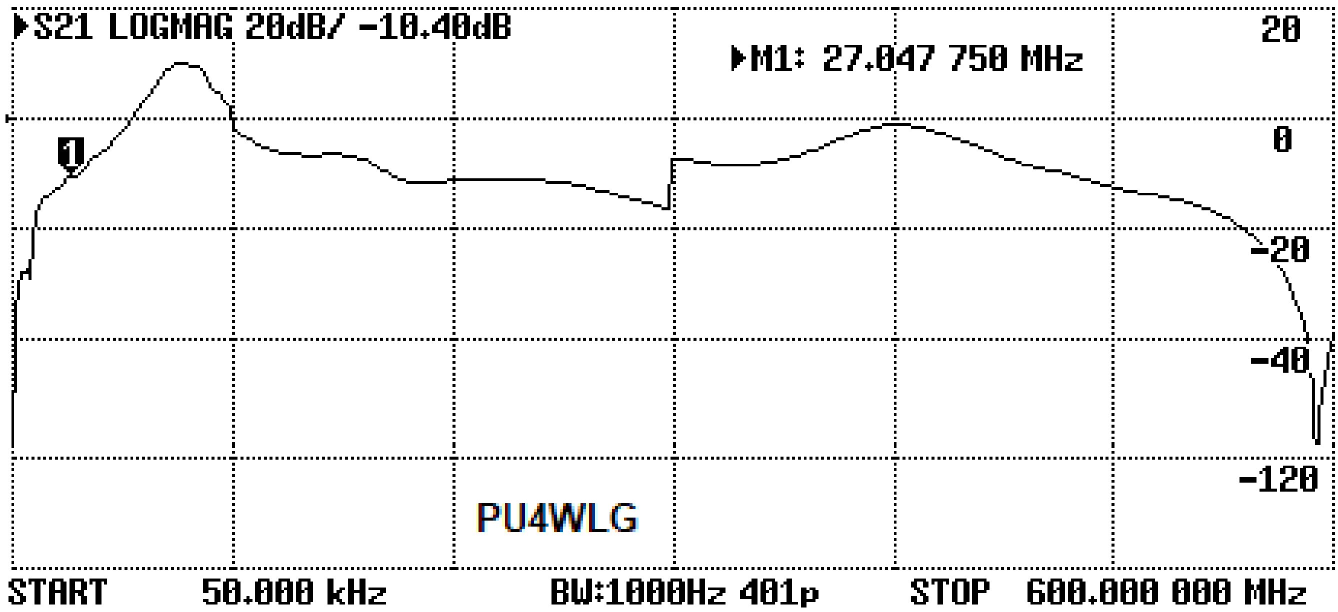
A the speaker wires using a soldering iron.



Using a special wrench or simple needle-nose pliers, loosen the two nuts that are holding the antenna connector and the volume potentiometer to the chassis.

Ready.

Let's start the modification with the reception circuit. The objective is to change the filters to make the selectivity from 26MHz to 29MHz.

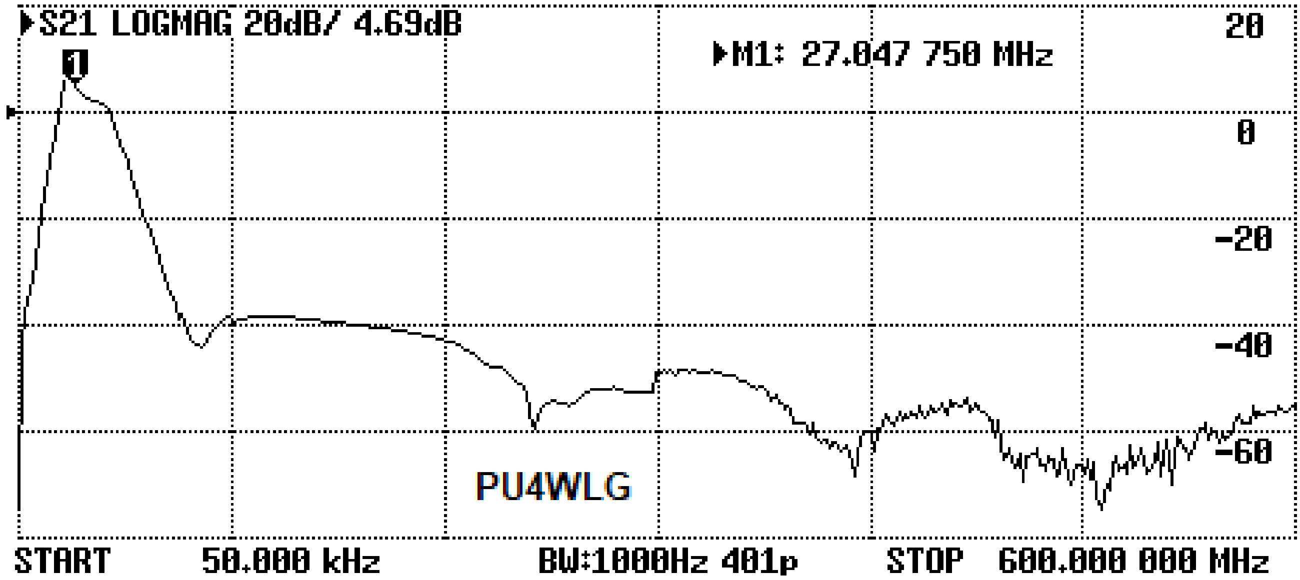


Original VHF Reception Filter

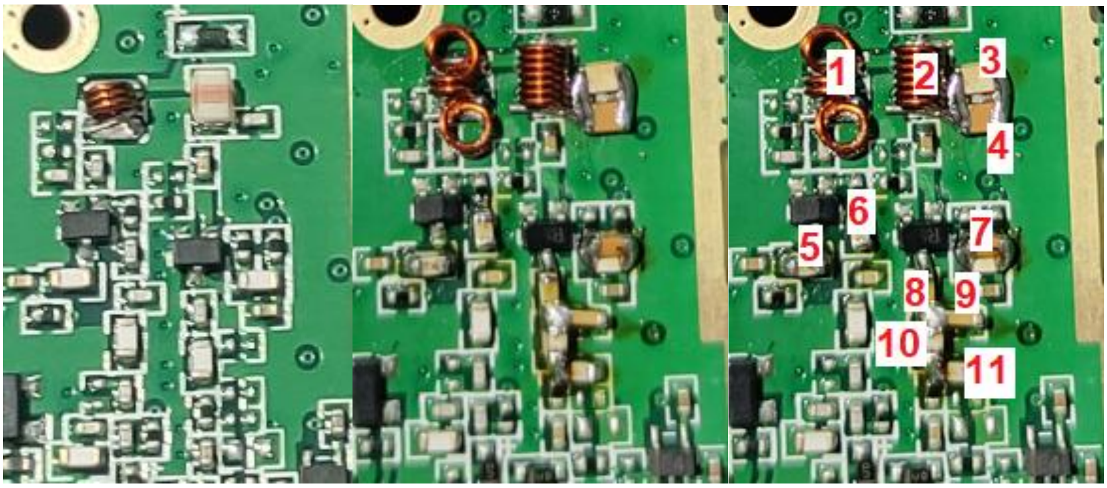
The graphic above shows the original VHF receive filter. Note marker 1 positioned over 27MHz. The amplitude is very low, and we have several bands ahead that are extremely higher than our 27MHz. This is the reason why the radio is not selective and is completely silenced by other stations when we want to hear 27MHz. The original filter has priority for VHF from 70MHz to about 170MHz. Let's lower this filter to operate at 27MHz.

Filter Circuit Modification

We will modify the filter circuit so that the graph looks like the image below:



Note that now, at 27MHz, we have a gain in amplitude. We made a good peak accentuated in the 26MHz to 29MHz band. To carry out this transformation, you will need just a few capacitors. I will first modify the UHF filter, which is simpler, but the Numbered photo below shows the modification of the VHF and UHF filter.



1 - 6 esp (UHF)
two - 7 esp (VHF)
3 - 300nH (VHF)
4 - 220pF (VHF)
5 - 10pF (UHF)
6 - 35pF (UHF)
7 - 220pF (VHF)
8 - 470pF (VHF)
9 - 220pF (VHF)
10 - 30pF (VHF)
11 - 68pF (VHF)

In the image on the left, we have the original circuit, and in the image on the right, we have the already modified circuit.

Note the two modified coils. These coils are from the radio itself and are used from the PA transmission filter circuit.

The coil on the left is a 6-turn coil. Two turns must be turned completely downwards, leaving two turns up and two more down. This is for the UHF receive circuit.

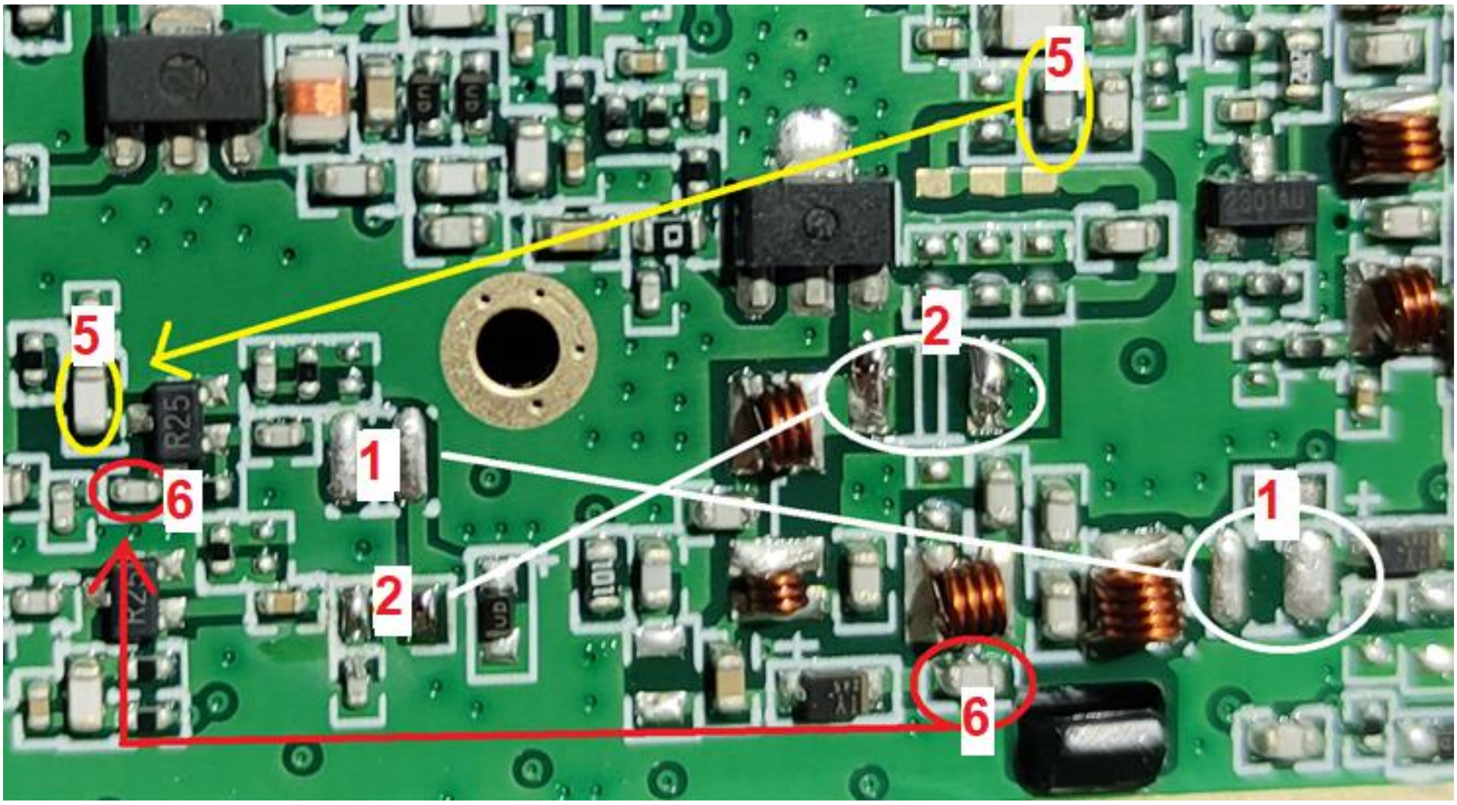
This modification allows you to take advantage of the UHF reception circuit together with the IJV firmware, which allows you to change the 210MHz reception (which was in the VHF filter) to the UHF filter. That is very useful as we will now have reception from 210MHz up to 600MHz using the UHF reception part.

UHF RX Filter Modification:

You will need two capacitors for this part.

The number 5 represents a 10pF capacitor.
The number 6 represents a 35pF capacitor.

These capacitors can be removed from the radio's TX filter circuit itself.



Let's continue with modifying the receive filter. Removing the coils and replacing the capacitors are important steps to improve selectivity and response over the 10, 11 and 12 meter range.

Modification of Coils and Capacitors

Coils:

In the original circuit image, notice the circles numbered 1 and 2.

The 6-turn coil and the 7-turn coil were removed.

This modification is essential to adjust the response of the receive filter.

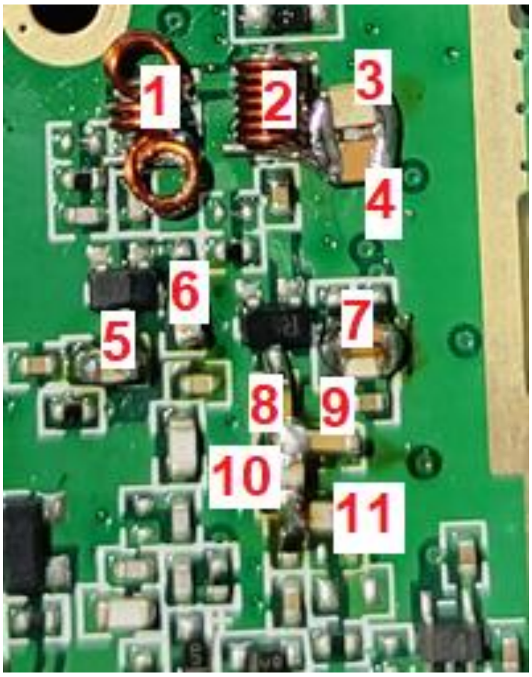
Now, let's solder the new coils in the correct location. For the 6-turn coil, you must move two turns completely downwards, leaving two turns up and two more down. This is for the UHF receive circuit.**Note: we are replacing coil 1 at once, but it refers to the VHF filter.**

Capacitors:

The capacitors were also removed from the PA circuit and soldered into place for our modification.

The capacitor circled on the right with the number 5 is a 10pF capacitor, which was soldered on top of the inductor on the left (also circled and numbered 5).

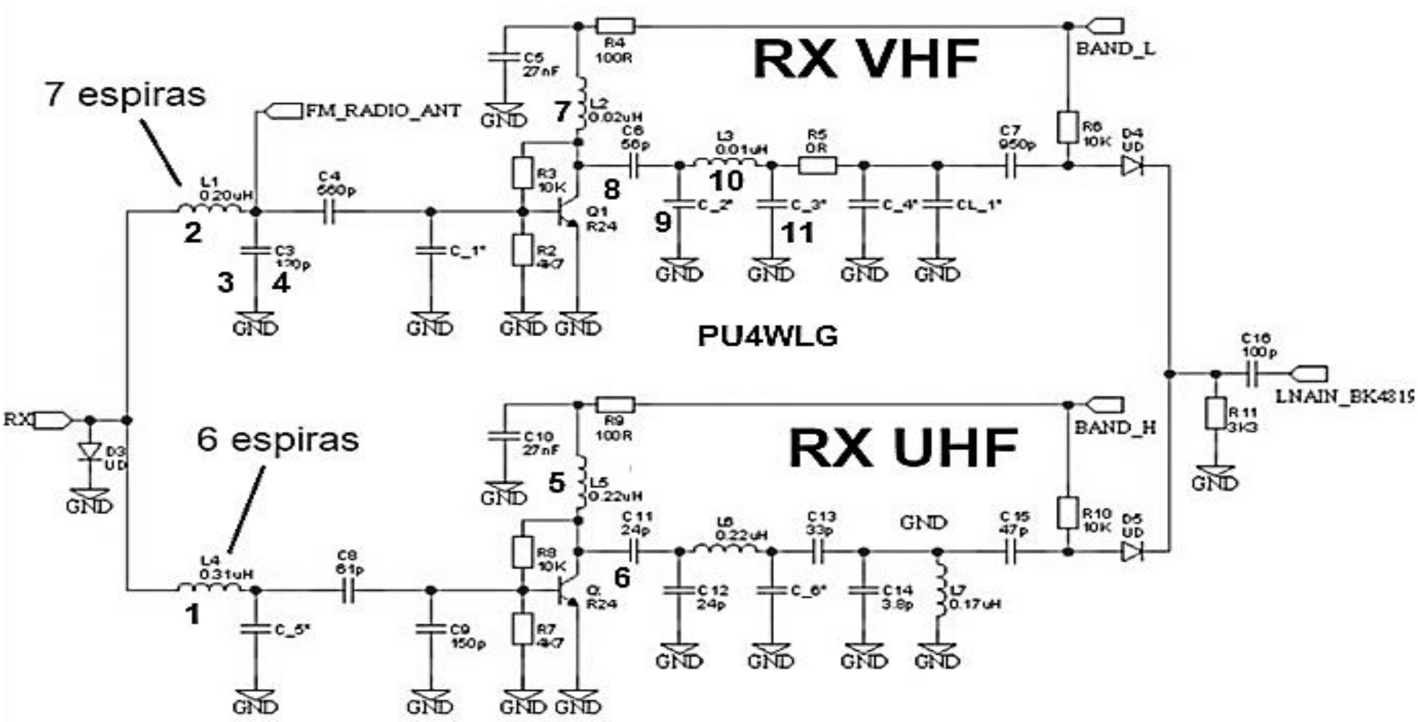
The capacitor on the right, circled with the number 6, is a 35pF capacitor, which was removed from the PA circuit and soldered on top of the capacitor on the left.



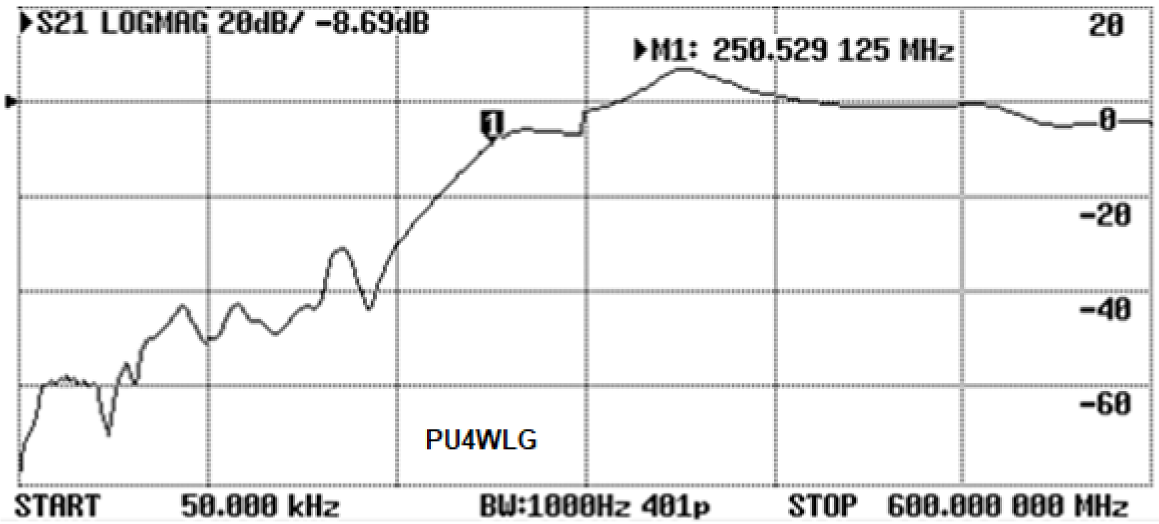
In the image above, we have the two modified circuits. If you have already made all the modifications,

Your board should look similar to the image above. However, I will still detail the VHF part.

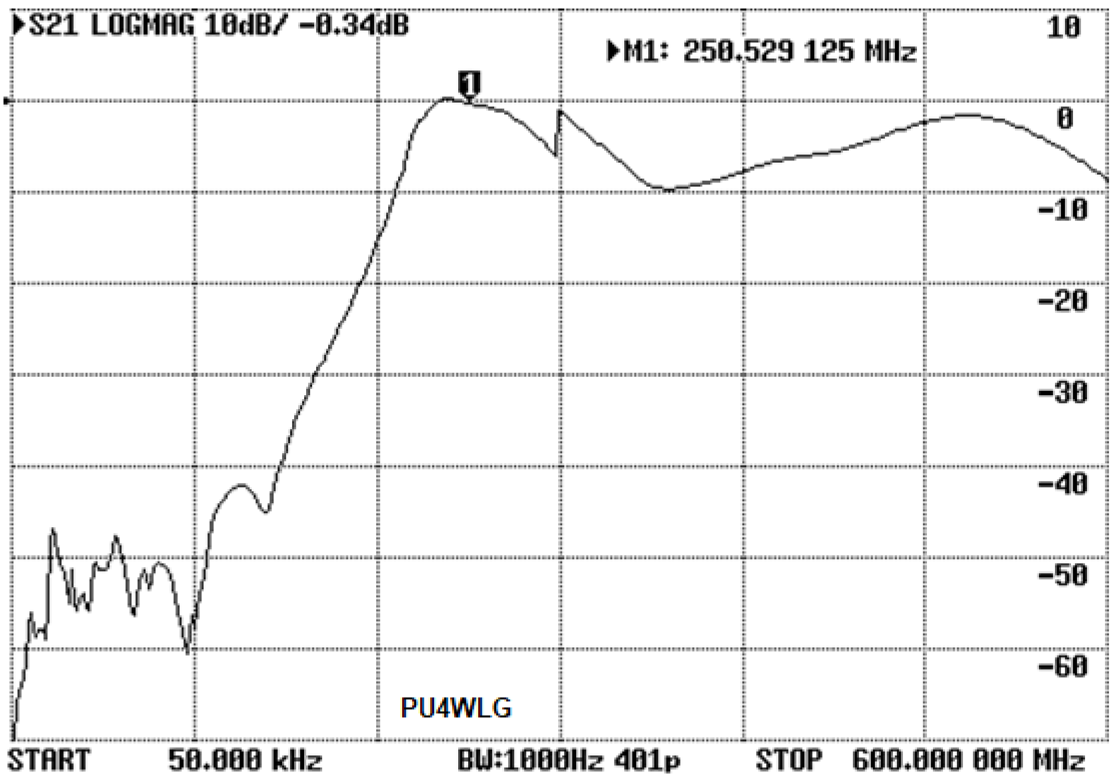
Note that in the diagram, the components that will be changed are numbered.



You have modified the UHF receiving circuit to a **better sensitivity in the range** 210MHz at 270MHz and 420MHz to 500MHz.



Before the modification, the UHF filter was **like this**.



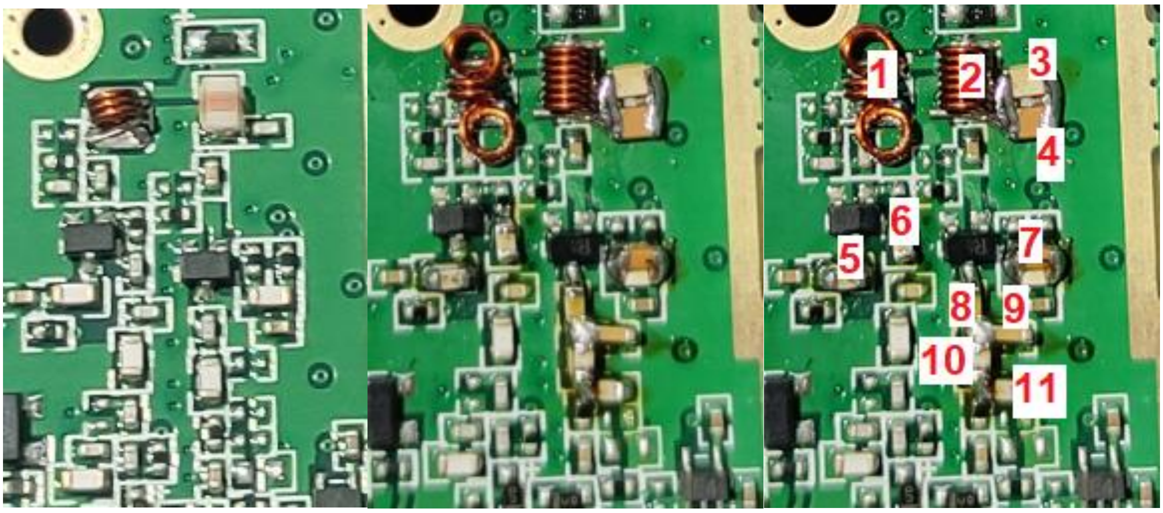
After the modification, the UHF filter was **like this**.

See the transformation of the UHF filter. The first image shows the spectrum graph on the filter original, **while** the second image shows the current transformation after modification. That was the modification of the UHF reception part, **aiming to take advantage of a feature of the IJV firmware** It is receive signals from 210MHz up to 600MHz. The change was made to improve reception of satcom that operates between 240MHz and 270MHz, **in addition to allowing better reception of 420MHz to 500MHz**.

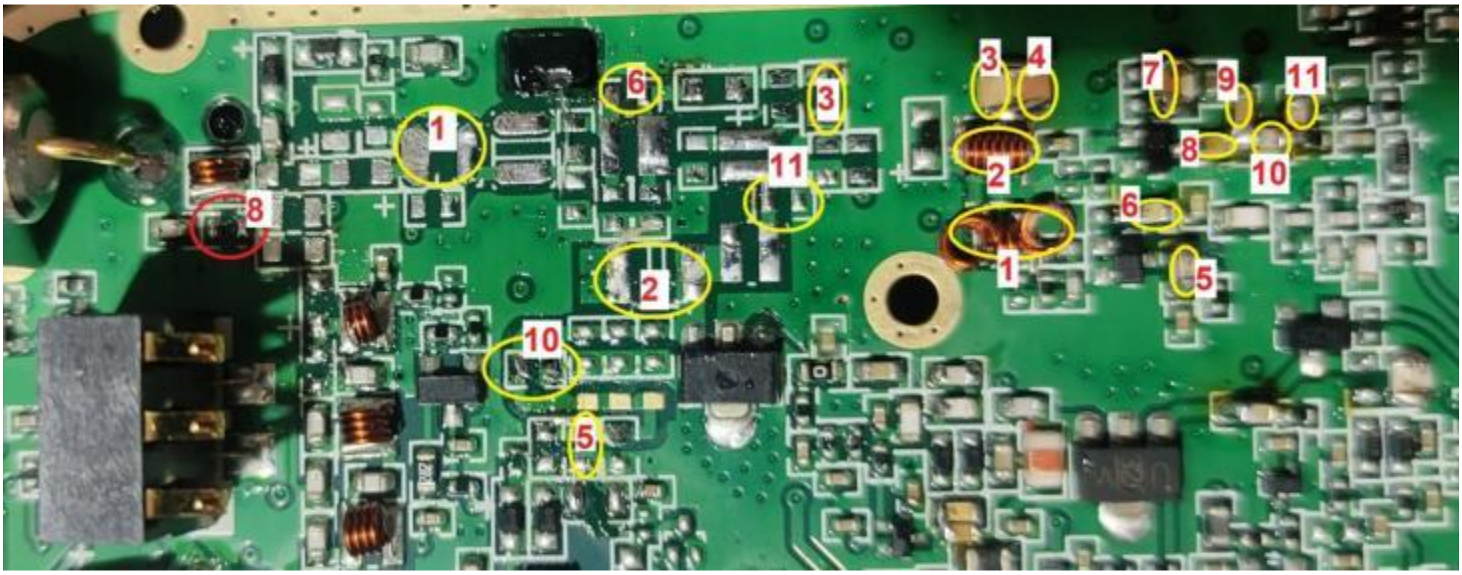
VHF RX Filter Modification:

Let's move on to modifying VHF reception to create a selective band on the 10, 11 and 12 meter bands. To do this, we will need to build a low-pass filter with a cutoff frequency of around 30MHz.

Modifying the VHF filter is crucial to achieving this goal. Although the numbered images below are for reference only, they will be helpful in understanding the process. Let's analyze these images and move forward with the transformation!



1 - **6 esp (UHF)**
two - **7 esp (VHF)**
3 - **300nH (VHF)**
4 - **220pF (VHF)**
5 - **10pF (UHF)**
6 - **35pF (UHF)**
7 - **220pF (VHF)**
8 - **470pF (VHF)**
9 - **220pF (VHF)**
10 - 30pF (VHF)
11 - 68pF (VHF)



This is the modification of the VHF filter from 144MHz to HF 27MHz.

Note: all components are just added to the RX filter, there is no need to remove it, as we are just changing the capacitance to convert 144MHz into 27MHz. Only the coils must be replaced.

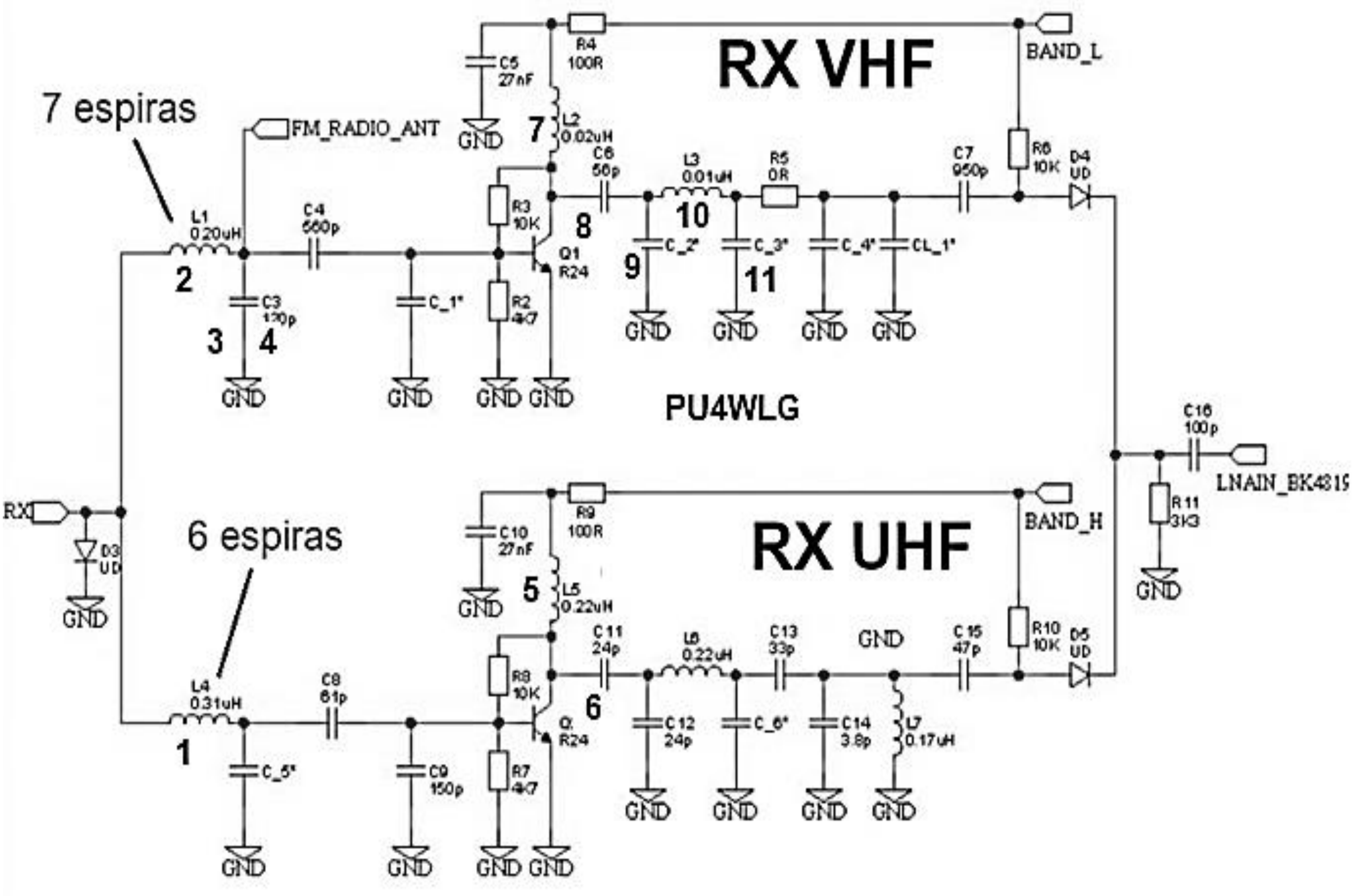
Let's analyze each component and the steps involved:

Component 2 (7-turn coil): Remove the 7-turn coil on the left side and replace it with the component numbered 2 on the right side.

Component 3 (300nH Inductor): Remove the 300nH inductor on the left side and add it in parallel to the capacitor on the right side (note number 3). **Component 4 (220pF Capacitor):** Unfortunately, this capacitor cannot be found on the radio board. Solder this capacitor in parallel to the 300nH inductor and the original capacitor on the right side (note number 4).

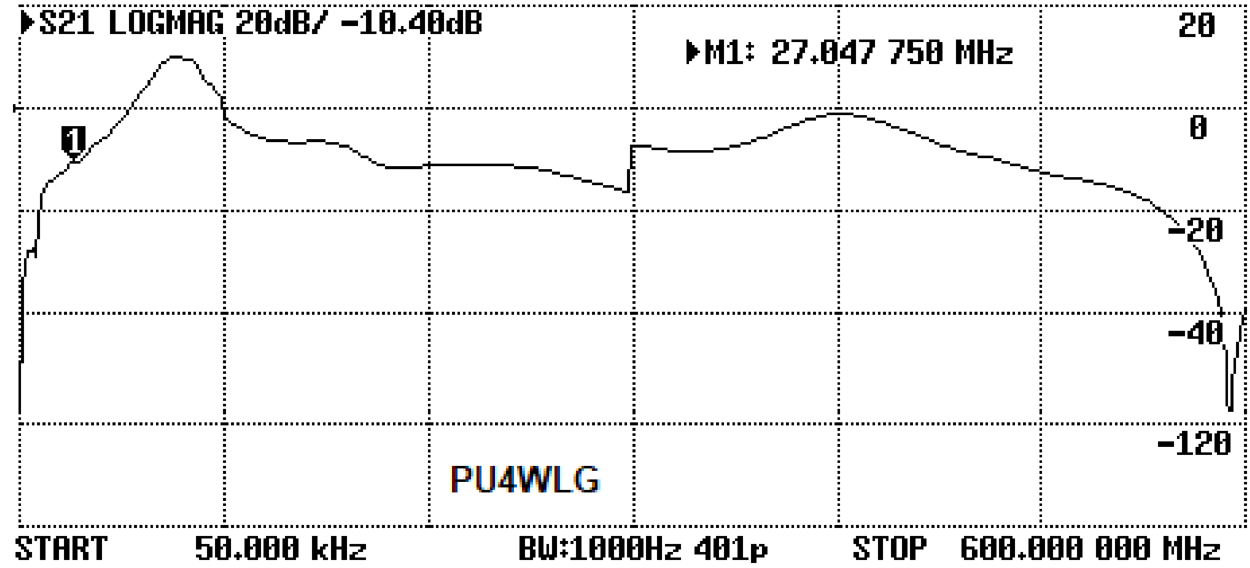
Component 7 (Another 220pF Capacitor): Again, this capacitor is not available on the radio board. Solder it in parallel to the inductor numbered 7 on the right side. **Component 8 (470pF Capacitor):**You can find this capacitor on the left side, also numbered 8. Solder it in parallel to the capacitor on the right side (note the numbering 8).

Component 9 (220pF Capacitor): Unfortunately, this capacitor is also not present on the radio board. Solder it between capacitor 8 and GND (note the number 9).
Component 10 (30pF Capacitor): You will find this capacitor on the radio board, numbered 10 on the left side. Solder it in parallel to the inductor located between capacitor 9 and capacitor 11 (note the number 10).
Component 11 (68pF Capacitor): This capacitor can be found on the radio board. Solder it between capacitor 10 and GND (note the number 11).

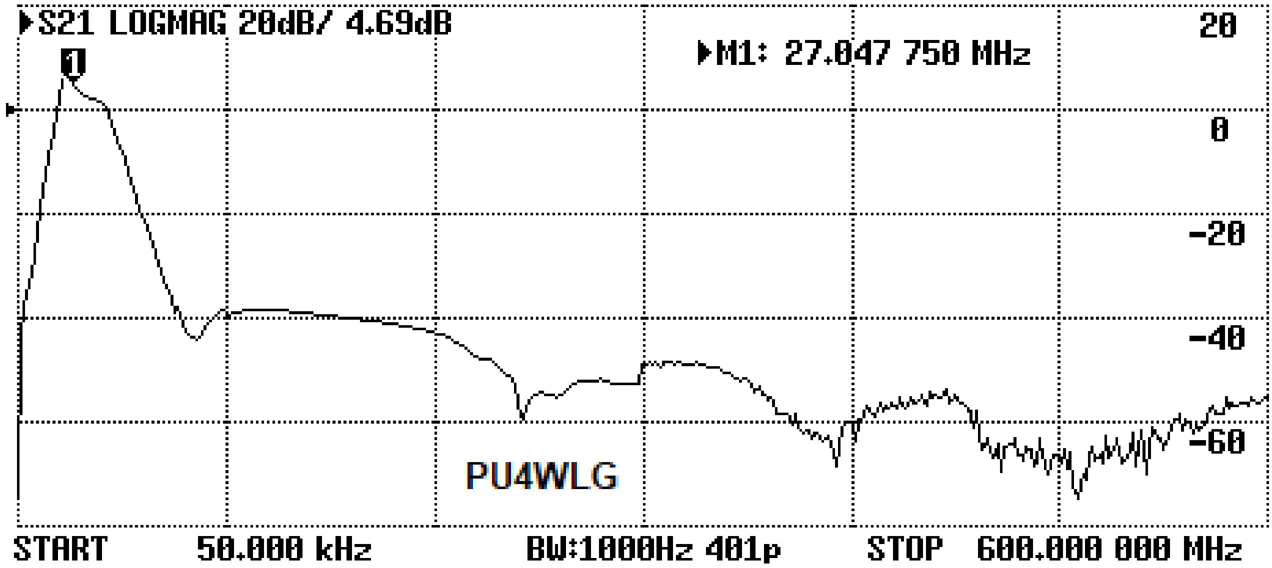


Congratulations! With the modifications made, your radio is now completely selective in the 10, 11 and 12 meter bands. This transformation will allow you to explore new frequencies and enjoy an enhanced experience.

To reinforce progress, compare the original radio spectrum with the result after the changes. The difference must be noticeable and demonstrate the success of your modification.



See below how you left your radio.



Congratulations!With the modifications made, you got a great 30MHz low pass filter. Furthermore, by eliminating frequencies from 0Hz up to about 5MHz, you have created a bandpass filter effective in the 5-30MHz range. Now your radio will no longer be affected by FM radio stations commercial (88MHz to 108MHz) and will not be silenced by nearby VHF or UHF transmissions.

My Experience with Filter Modification on Quansheng Radio

I work near a cemetery. As a ham radio operator, I like to do reception tests there. When I first received my Quansheng radio, I did a firmware update and using a portable CB antenna, I went for testing. However, to my surprise, I was unable to receive anything at all, not even hissing noises.

The problem was related to the proximity of an 800MHz repeater. This repeater was interfering with 27MHz reception, making it practically unusable. It was then that I decided to modify the radio filter.

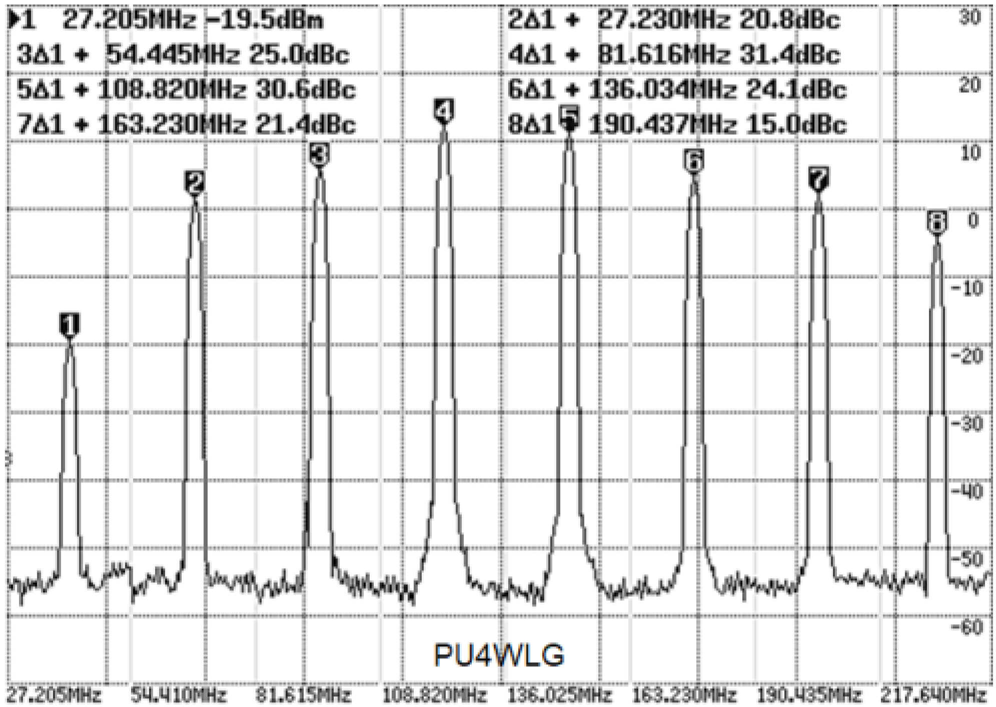
Later, my friend Junior (PY4ACJ) reproduced the same modification on his Quansheng. However, he faced another challenge. Junior works under the transmission tower of Rádio Itatiaia (at 610KHz). To his surprise, the radio was completely silenced in this situation.

To solve these problems, I used a 300nH inductor + 220pF capacitor at the beginning of the filter. This combination created a high-pass filter, allowing the radio to filter out unwanted frequencies. We now have a very selective filter on the 10, 11 and 12 meter bands.

Modifying the transmission filters from 144/440MHz to 27MHz

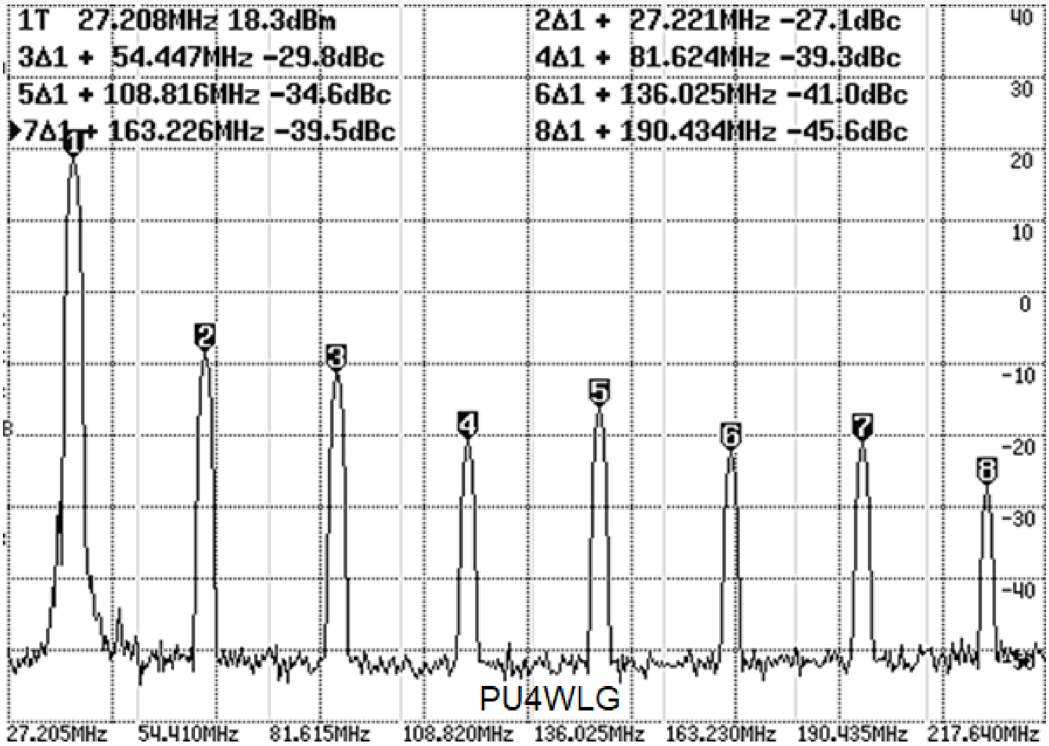
Now comes the hardest part of the modification. It consists of changing the driver to 27 MHz and the PA to 27 MHz, filtering the harmonics and obtaining a fundamental power of approximately 4.5 W.

To modify the transmission part, we will need**first modify the driver**.
Originally, the driver is unable to amplify 27 MHz. The image below shows a graph of the spectrum of the original driver trying to amplify 27 MHz. Note that the 27 MHz is very below 0dBm, and we need at least 18dBm at the driver output.



Driver modification is very simple. It is only necessary**three capacitors**: one of 330pF, one of 470pF and one of 1nF. The 470pF and 1nF capacitors can be found in the radio itself, but the 330pF capacitor will not be found in the radio. For the value of 330pF, you can use capacitors between 270pF and 330pF.

After modification, the spectrum will look like the image below.



Concerned about the presence of harmonics? Stay calm. All harmonics identified are below 0dBm and the main output MOSFET would ideally increase
+ 20dBm to these signals, which is conditional on battery voltage. The harmonic with the greatest magnitude is the second, presenting -5dBm. Adding +20dBm, we reach 15dBm at the MOSFET output at 54MHz.

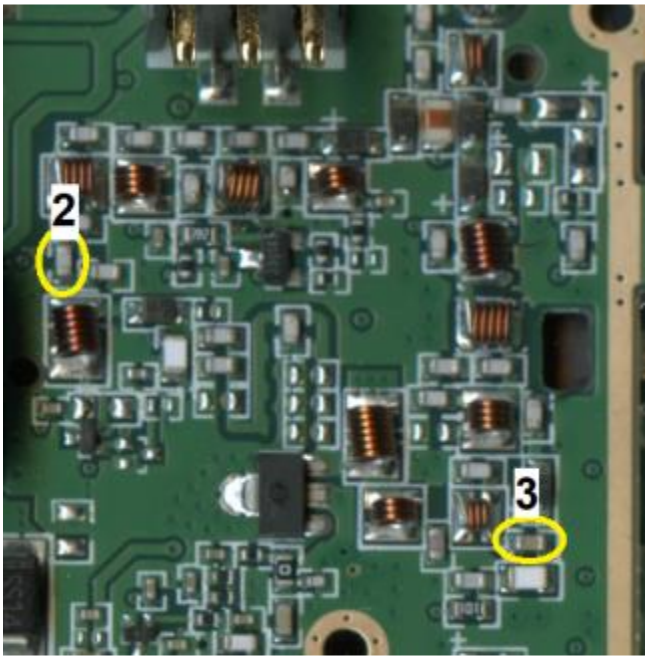
However, 15dBm can represent a spectral contamination of 31mW, which is prohibited by law. A crucial detail is that the RF output will be subjected to a 30MHz low-pass filter, attenuating the 54MHz signal from 15dBm to -30dBm post-filtering, equivalent to approximately 1μW of power.

Dispensing with theory, the current focus is to increase the driver amplitude from -19dBm at 27MHz to around +18dBm. The reduction of harmonics in the driver would require the replacement of inductors, an unnecessary step, since the harmonic correction will be applied in the final stage.

For driver modification, you will need the following components:

Capacitor number 1: Value between**270pF**It is**330pF**.
Capacitor number 2: Value of**470pF**. **Capacitor number 3**: Value of**1nF**.

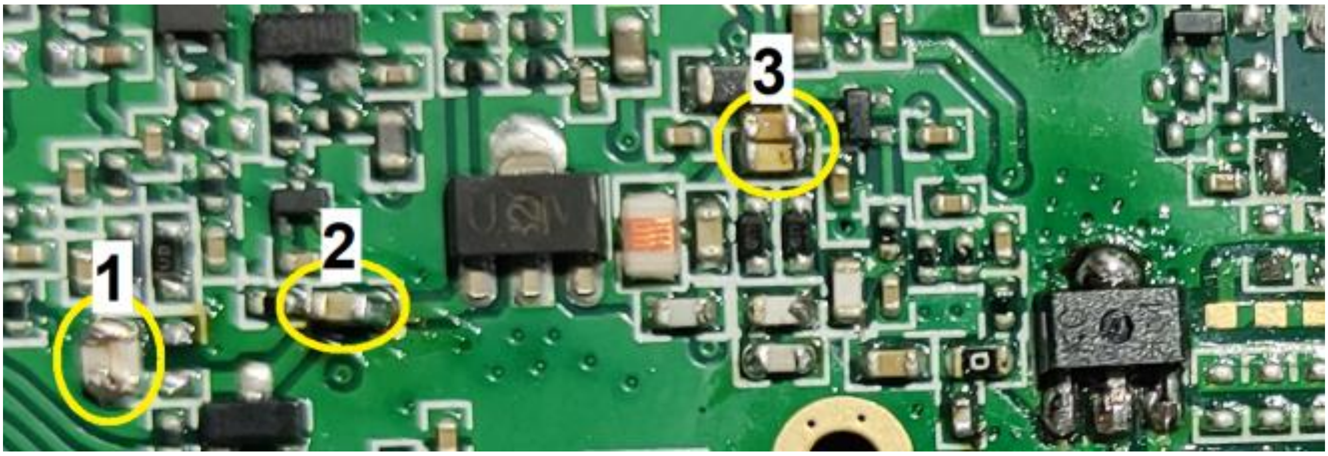
Make sure the capacitors meet the specifications required for the modification.



Proceed with removing the**capacitor number 2**, which is a capacitor**470pF**, It's from**capacitor number 3**, which is a capacitor**1nF**. It will be necessary to purchase another capacitor with a value between **270pF**It is**330pF**, which is not present on the radio.

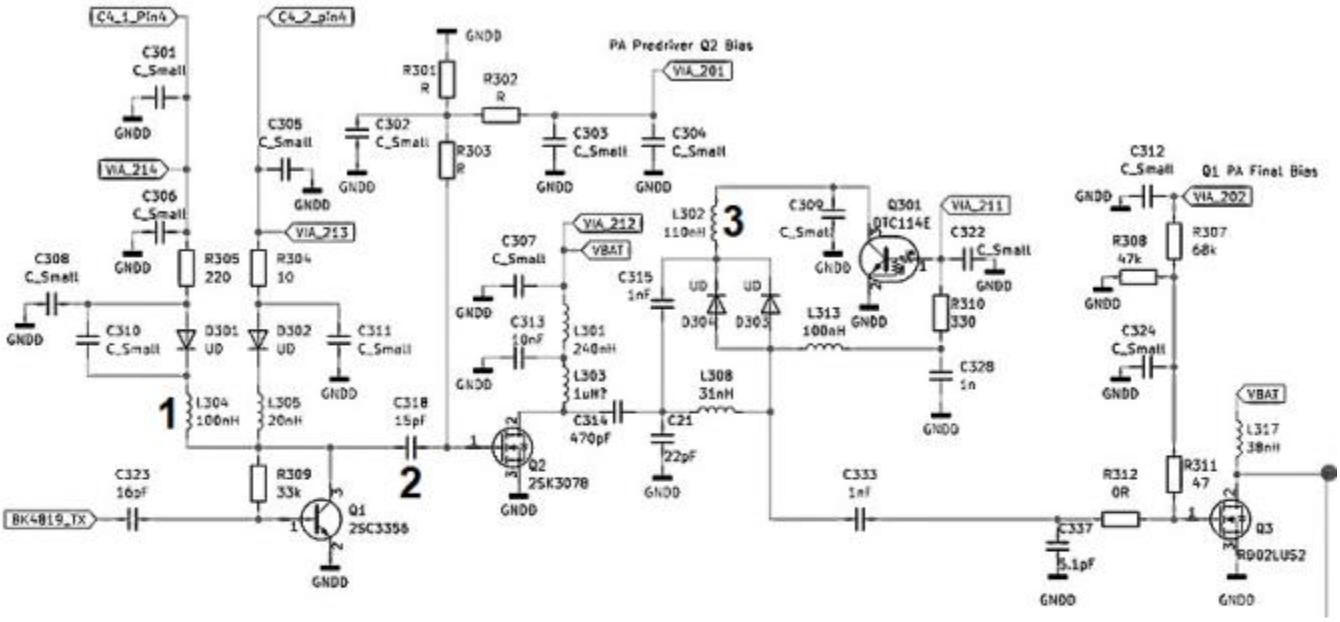
Modifying the driver is relatively simple: just add the three capacitors according to the number indicated.**Observation**: Capacitor values are added to the original components of the circuit.

An important detail: on the right side of circle number 1, there is a component that has been removed. This was an inductor responsible for changing the filter to UHF mode. However, as there will be no transmission in UHF, I chose to remove the inductor to prevent accidental activation of the PTT in UHF from inducing unwanted signals in the driver.

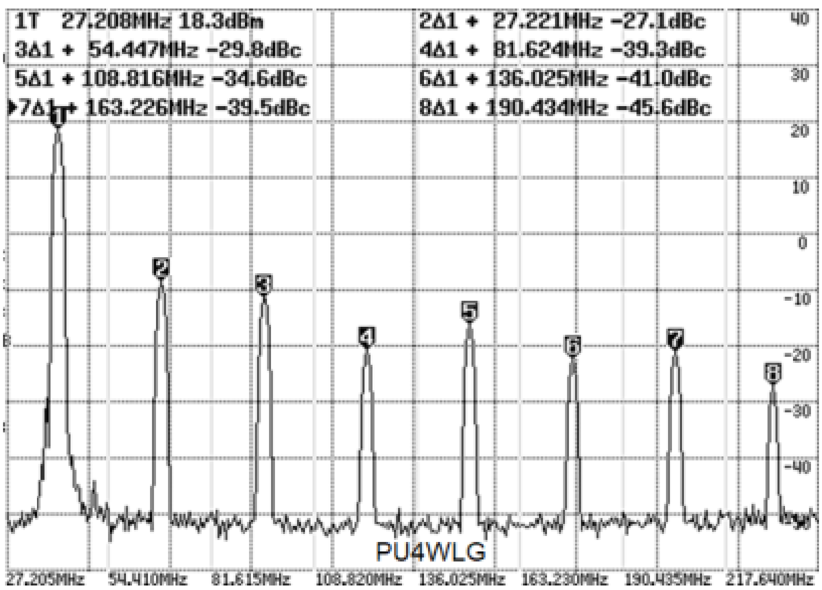


Capacitor 1: In between**270pF**It is
330pF. **Capacitor 2**:**470pF**. **Capacitor 3**:
1nF.

These values   are essential for driver modification. Now, with the right information, you can proceed with confidence.



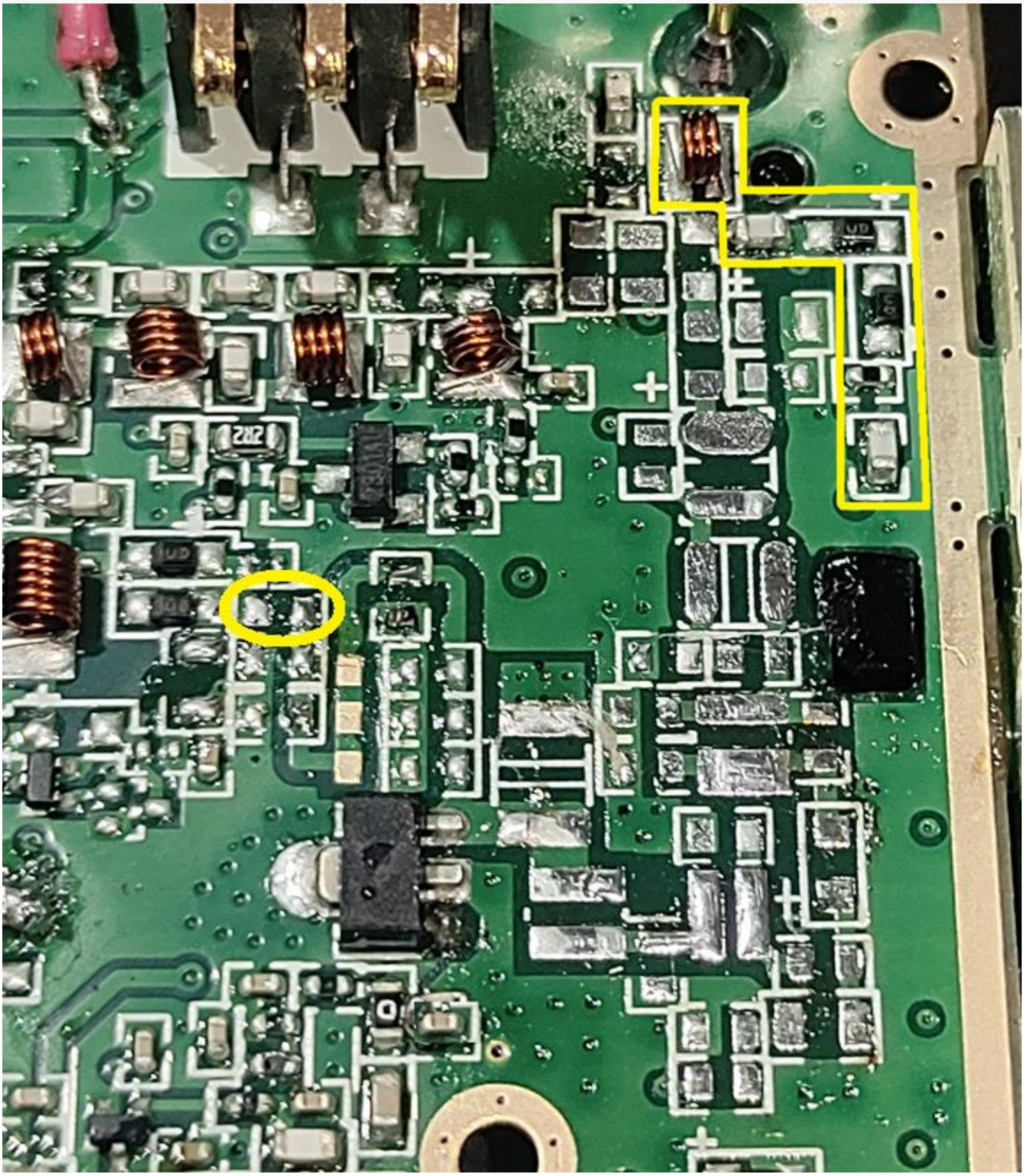
If you measure the signal at**GATE**main output MOSFET**Q3**, you will get the following graph:



To finish the modification process, follow the steps below:

Carefully remove all remaining components from the radio except those that are essential to the modification you are performing.
Space Preparation: Ensure the space is clear of obstructions and clean to avoid any interference during installation of the new harmonic filter.
Filter Installation: Proceed with the installation of the harmonic filter at the output of the main MOSFET, following the technical specifications necessary for correct signal filtering.

Make sure all connections are secure and there are no short circuits before testing the modified radio.



Visual inspection: Examine the board carefully, especially the area marked with a circle, to identify whether a capacitor is left. It is a capacitor**100pF**. (remove it)

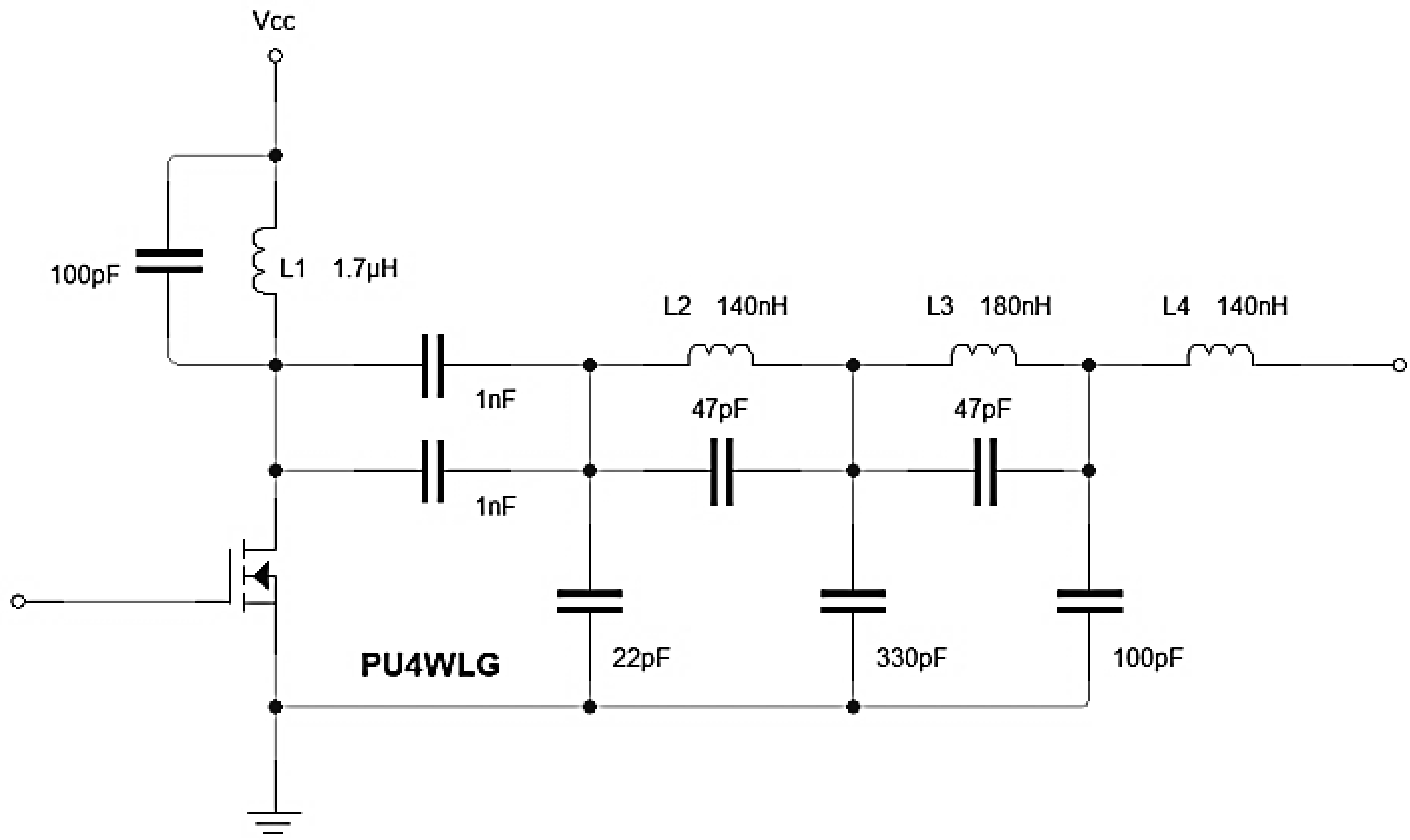
Selected Components: Do not remove selected components located on the top right of the board as indicated.

Coils and Capacitors on the Left: Check that the coils and capacitors on the left are inactive and do not interfere with modifying the filter to**27MHz**.

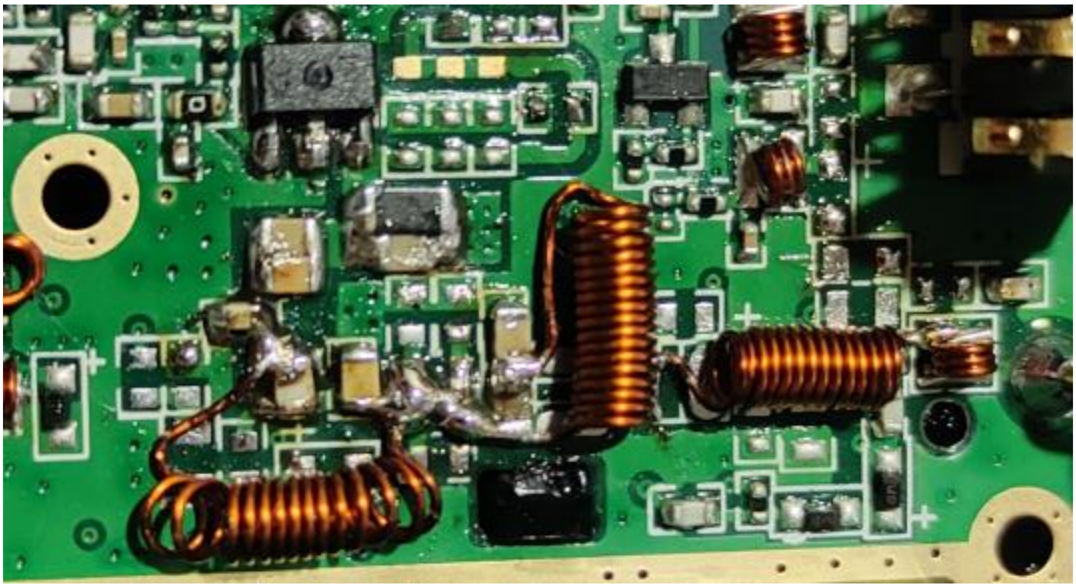
Capacitor Removal: Locate and remove the capacitor**100pF**which is above the MOSFET to avoid interference with the filter**27MHz**.

With the correct components on hand and the workspace properly prepared, We are ready to make the filter for 27MHz. This filter will be crucial to guarantee the purity of the transmitted signal, eliminating unwanted harmonics and ensuring compliance with transmission standards.

The diagram below shows the filter configuration**LPF**that we will make.



The image below shows the filter made on the board, but don't worry, because I will detail every step to ensure complete understanding.

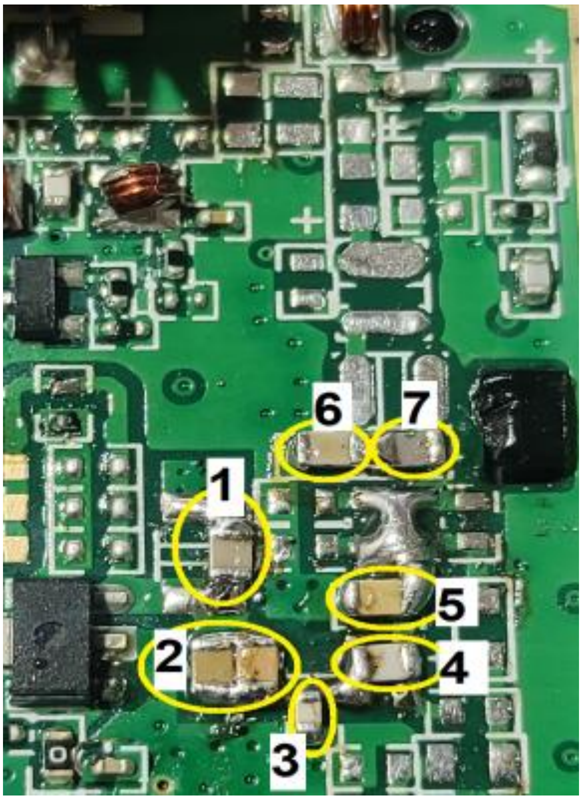


Start by adding the capacitors. Note: The position of the capacitors on the board is not a rule. You can find a better position, and if the setup looks exactly like the diagram, you can do it without any problems.

Here is the procedure for adding the capacitors:

Position Selection: Choose the most appropriate position for each capacitor on the board, considering ease of installation and circuit efficiency.
Installation: Insert the capacitors on the board, respecting the corresponding values and numbers.
Flexibility: If necessary, adjust the position of the capacitors to improve the circuit configuration. If the arrangement of components matches the diagram provided, proceed.

You need to add 7 capacitors.



Capacitor 1 has a value of 100pF
Capacitor 2 has a value of 2nF
Capacitor 3 has a value of 22pF
Capacitor 4 has a value of 47pF
Capacitor 5 has a value of 330pF
Capacitor 6 has a value of 100pF
Capacitor 7 has a value of 47pF

Let's proceed with making the coils:

Easy-to-make coils: For the three coils that are easy to make, you can use enameled copper wire and wrap it around an air core, according to the required inductance specifications.

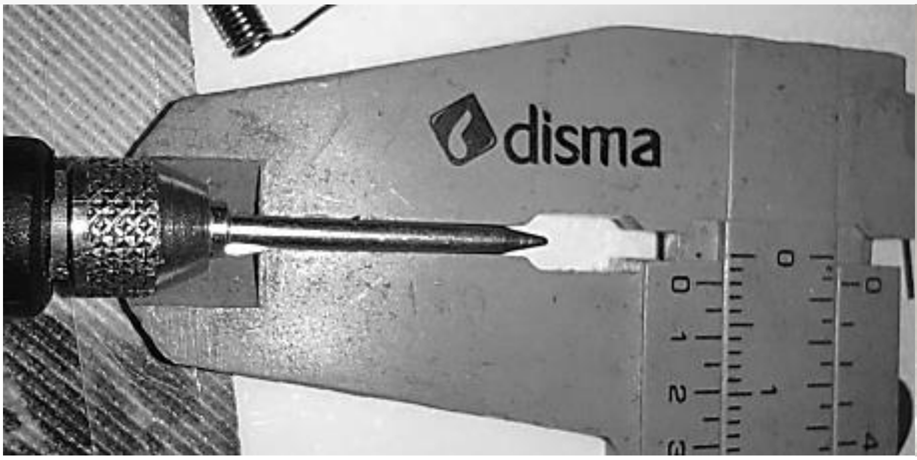
1.5uH coil: Due to the size of a coil**1.5uH**would have, it is recommended to opt for a commercial SMD 0805 inductor of**1.2uH**The**1.8uH**. This will ensure that the component fits properly into the available space on the board and maintains circuit efficiency.


To make the remaining three coils, follow these instructions:

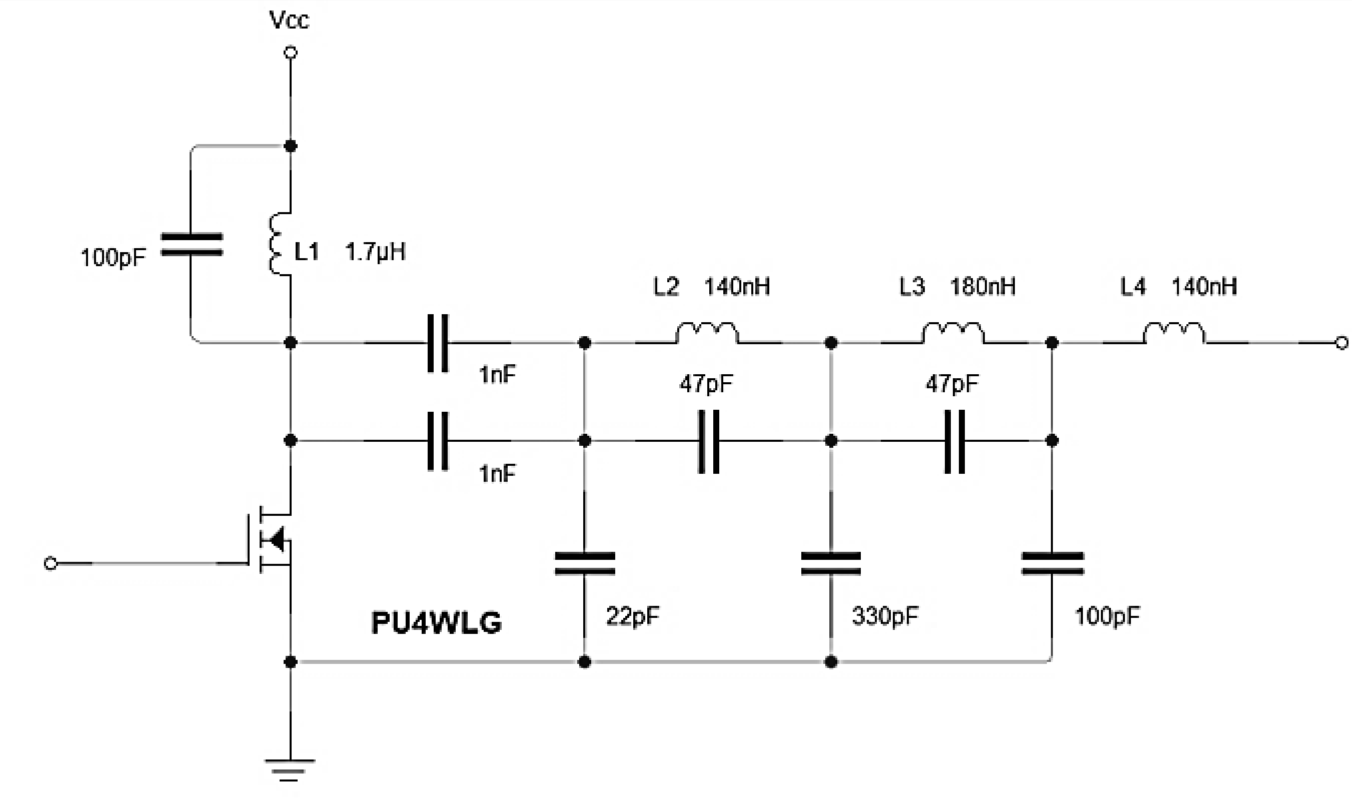
Material: Use an enameled wire**0.5mm**in diameter.

Winding Tool: To wind the coils, you can use the probe of a multimeter or any cylindrical object that has a diameter between**2mm**It is**2.5mm**.

Procedure:
Cut a suitable length of enamel wire.
Wrap the wire tightly around your chosen winding tool, keeping the turns as even as possible.
Remove the bobbin from the winding tool carefully to maintain its shape.




Let's follow the numbering of the coils according to the diagram for assembling the filter:



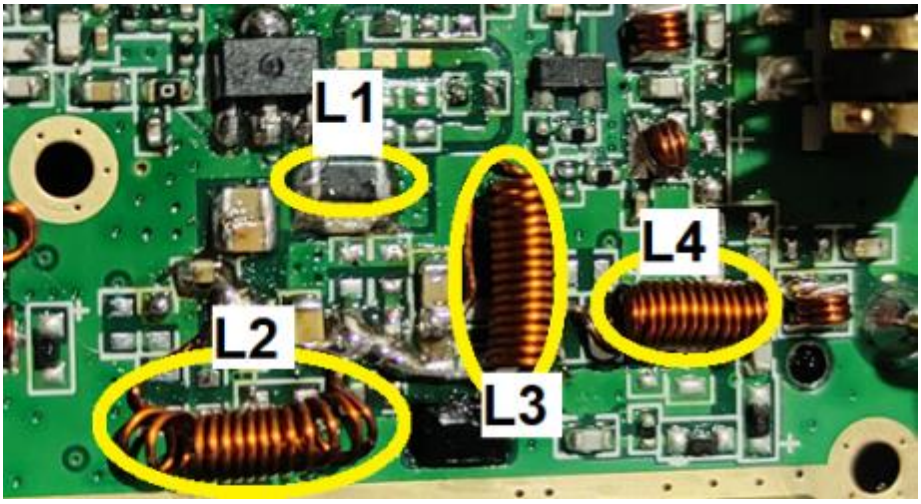
L1: Use a**SMD 0805 inductor**with inductance between**1.2uH**It is**1.8uH**.

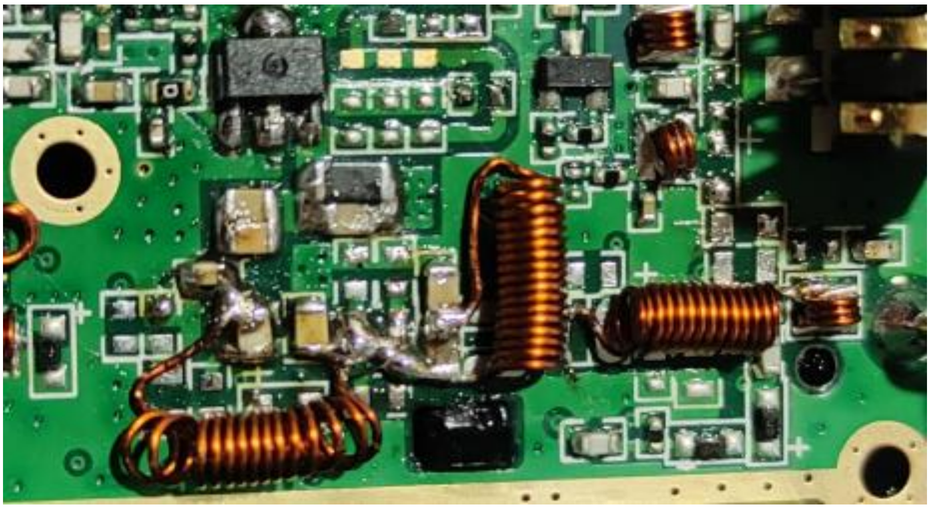
L2: Make a coil with**14 turns**of wire**0.5mm**in a core of**2mm**, resulting in an inductance of**140nH**The**150nH**.

L3: Make a coil with**17 turns**of wire**0.5mm**in a core of**2mm**, resulting in an inductance of**170nH**The**190nH**.

L4: Make a coil with**14 turns**of wire**0.5mm**in a core of**2mm**, similar to L2, with an inductance of**140nH**The**150nH**.

These specifications will ensure that the filter meets the performance requirements for the range of **27MHz**.





If you followed all the instructions correctly, it's time to test your work. Here is the detailed testing procedure:

Preparation: Make sure the radio battery is fully charged.

Assembly: Position the battery so that it makes contact, but do not mount the radio board to the chassis yet.

Radio Configuration: Set the radio to**27MHz**in mode**FM**.

Wattmeter Connection: Connect the wattmeter to the radio.

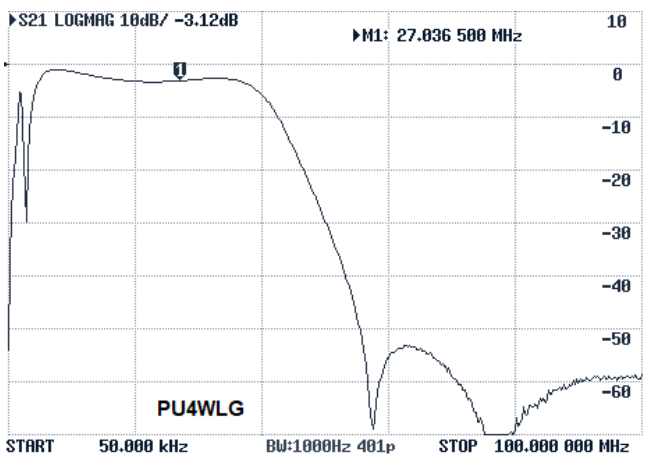
Test: Press PTT (Push-To-Talk) for short intervals, without exceeding**5 seconds**.

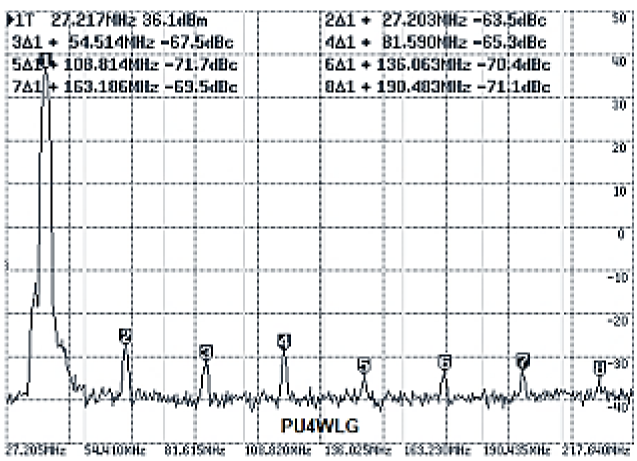
L2 Coil Adjustment: If the read power is less than**4W**, gradually adjust the coil turns **L2**and monitor the wattmeter.

Optimal Power: The objective is to achieve between**4.2W**It is**4.5W**, although the maximum possible is**4.8W**.

After carrying out these steps, if the power is within the desired range, congratulations! You have successfully modified a Chinese HT to operate on**27MHz**.

As for the filter graph on a spectrum analyzer, it should show adequate attenuation of harmonics outside the**27MHz**, ensuring that the transmitted signal is clean and within standards.





I hope this tutorial was helpful!

Thank you to everyone who followed this tutorial until the end. If the information shared was useful and you would like to make a donation as a way of encouraging my work, feel free to make a PIX or a donation via PayPal. The key to both options is my email: wanderlg@ gmail.com Your contribution is highly valued!

If you have any questions or want to share your experiences with radio modifications, don't hesitate to contact me. My email is wanderlg@gmail.com and on YouTube, you can find my channel as @WanderLucioGomes

If you liked this tutorial, please share it with your ham radio friends. Together, we can explore new possibilities and expand our horizons in the world of electronics and communications.

Until next time, and happy experimenting!

Wander Lúcio Gomes (PU4WLG)