YAMAHA CS-15

Don Solaris Mods

WARNINGS:

1. After drilling the unit, always use vacuum cleaner afterwards, and remove any metallic dust, as it might fall on the printed circuit board and cause a short circuit!
2. Modify the unit at your own risk. The author does not provide any kind of guarantee for your device, nor will cover any cost caused by eventual damage.
3. Always disconnect the unit from mains supply before performing any operations described in this manual!
4. This manual assumes some basic knowledge in electronics.
5. Software synths suck.

Description of mods

The original CS-15 is a great monophonic synth from the late 70's. It has a specific dual 12 dB multimode filter structure (Image 1) and a dual signal path. However these two filters are permanently set into parallel connection. This can be sometimes limiting, specially when more filter power is required (i.e. 24 dB response). One of the mods here will provide your CS-15 with serial filter connection - the 24dB mode. Of course, switch is included so that you can always bring back the original unmodified parallel filter routing the 12dB + 12 dB mode.

One of the features that make CS-15 specific (next to parallel filters) is the ultra fast LFO that will go all the way up to 100 Hz. There are no many analog synths with LFOs that can go that fast (most end at 10-15 Hz). The potentiometer is used to tune from 0.1 Hz to 100 Hz. If you look at the numbers, this is quite a big range, and we said majority of LFO modulations are performed in up to 10 Hz range. The same is applied on CS-15's LFO potentiometer. That means, you can precisely tune from 0.1 Hz to 10 Hz (over 80% of potentiometer's turn).

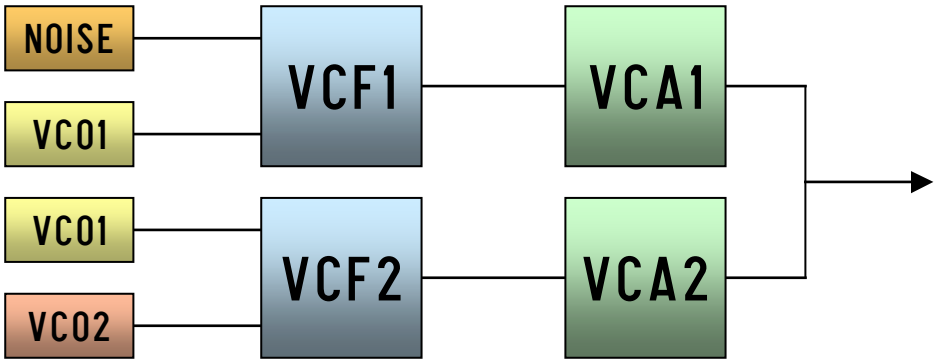


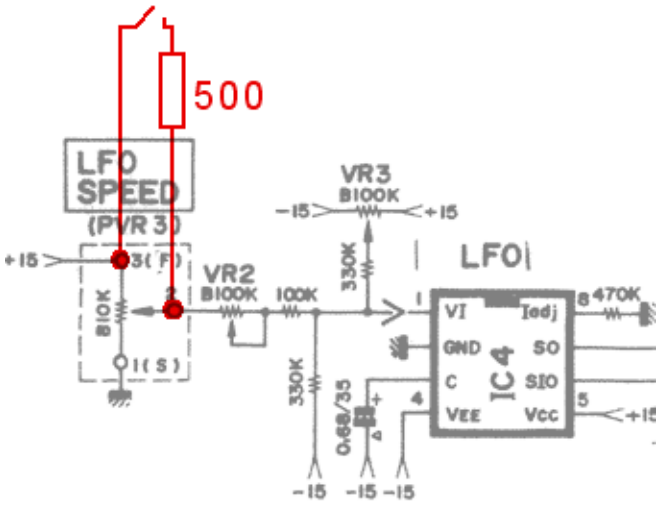
Image1: CS-15 original signal routing

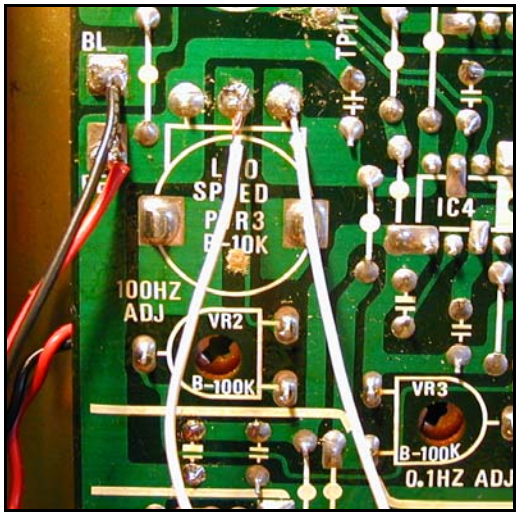
However, going from 30 Hz to 100 Hz occupies only 10% of the potentiometer's turn. So if you were to perform some kind FM or Ring Mod effects, this might become a tricky job, as it requires precise tuning, but instead potentiometer jumps from i.e. 20 Hz into 40, then 70 then 100 Hz. Please note, this doesn't have anything to do with potentiometer's condition (cleaning). No matter how good you clean it, the same problem will exist, simply because this is the physical precision limit of the potentiometer. The only solution is to expand the precision in the high frequency range. In other words, we will expand 10% of potentiometer's turn into some 80% or more. Switch is included to provide the original unmodified version.

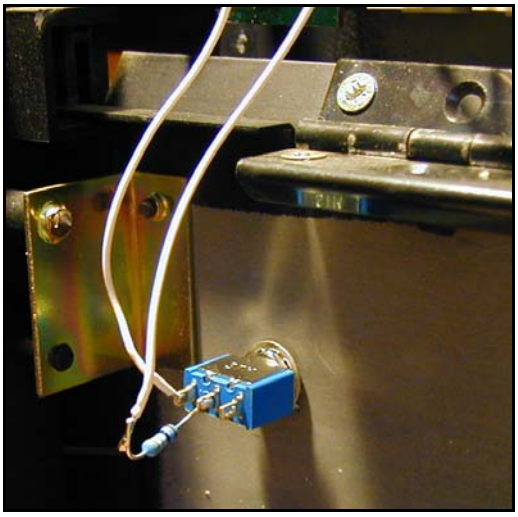
Third thing we will do has to do with signal routing. It will let you have a White Noise generator outputted into VCF2. Why is this important? Well, after you put filters in series, White Noise would end up in VCF1. This is not what we want, since in serial connection the VCF1 is located behind the VCF2, therefore White Noise would not be processed by both filters, only one. Now you might ask "why VCF1 is placed behind VCF2 and not vice versa?". To cut the long story short, the first version VCF2->VCF1 is much easier to be performed and requires much less work.

Mod 1 - Extended LFO precision

This is really a simple mod. Requires a switch, a 500 ohm resistor and two wires. As already described, what we will do here is to increase the precision in the high frequency range 20-100Hz of the LFO. First, drill a hole on the back side. Put the switch in. Solder a 500 ohm resistor on it as shown in picture below and connect wires to locations specified on schematic - shown in red color. Note: drill the hole with the top cover full open and leaned back into its lowest position. This way you will see where top panel ends, so it won't turn out that you put a switch, but can no longer fully open the cover.



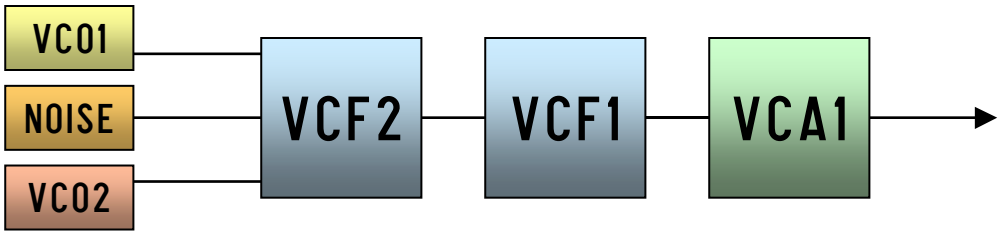




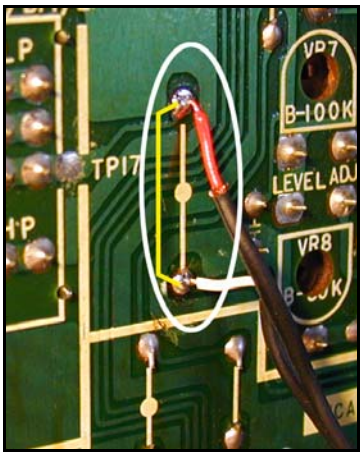
Images above show exact locations where to solder the wires. This potentiometer (PVR3) is located on the left side of synth board. Try to cut resistor prior to soldering to make it as sort as possible (shown above).

Mod 2 - Filters in series

This will not actually give a true 24 dB response, but will come close and the difference is quite big between original 12 dB, and two stacked in series. As previously described, putting VCF 2 in front of VCF 1 is much simpler solution than doing it vice versa. This is because oscillators 1 and 2 are output into VCF 2, so we can think of it as the "main filter", while VCF 1 takes only one oscillator and white noise. Please keep in mind that if you do this mod, you must also do the next one, else the noise will not be processed by both filters once you engage filter series switch. It is also a better idea not to insert any sound between VCF2 and VCF1 when they are connected in series, for better overall response. Image below shows signal routing once you complete this and the next mod.



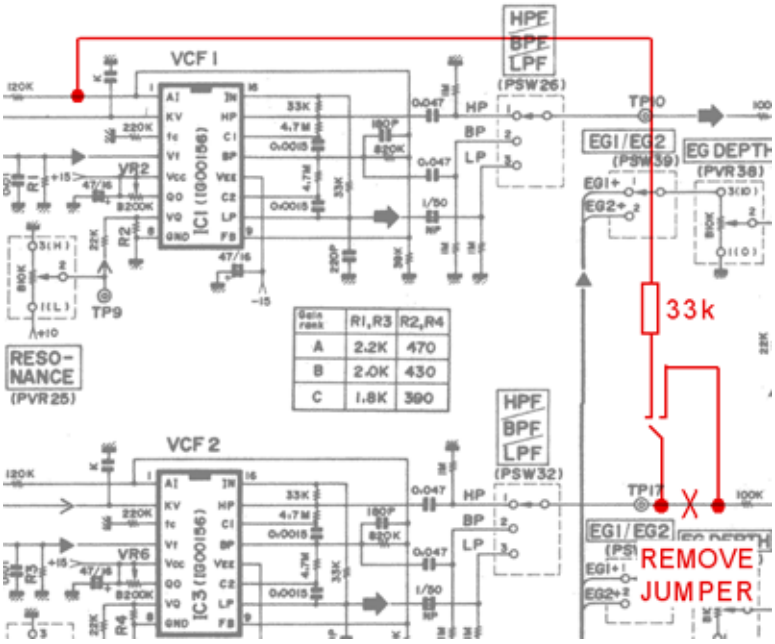
For this mod you need 3 shielded audio cables, a 33k ohm resistor and a switch. You start this mod by removing a jumper located right of TP 17 - as shown on image below. To reach this jumper you need to remove the right board panel. Start by removing four screws that are holding the ADSR envelope. Now gently remove potentiometer knobs by pulling them up. Use some tool to reach below the knob, because if your CS-15 hasn't been regularly maintained and cleaned, you might find it difficult to take knobs up. You can use a screwdriver to reach below the knob. The trick is to create a lever, then knobs will easily go out one by one. Next remove bolts and take the board out. Now unsolder the jumper on location shown in picture below. **Note:** you can not actually see the jumper on this picture below as it was located on the other side (and it was already removed), but it is drawn on the image with 3 yellow lines.



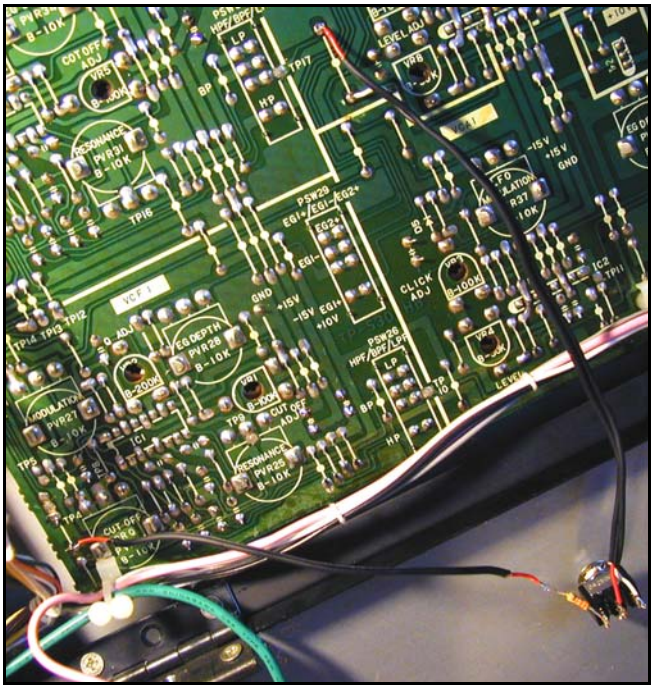
Think of it as x-ray image of the PCB with jumper shown. The wires you can see will come later, ignore them for now! After you remove the jumper, put back the PCB. A small advice: you can remove the solder on jumper connection prior to board removal as it is much easier to operate when the board is held tight by the synth itself. Then just remove the board and pull up the jumper.

Now it is time to drill the hole in the back. By location of the jumper you can estimate the best location for the switch. Please note, you can't put the switch wherever you desire. It is important that wires from the jumper to the switch are as short as possible. Therefore make the hole for the switch vertically from position of the jumper. Put the switch into the hole on the back side and tighten it. Now fully extend the top cover of CS-15 so it leans back to its lower possible position. At this point cut two wires so that their length matches exactly a distance from the jumper to the switch.

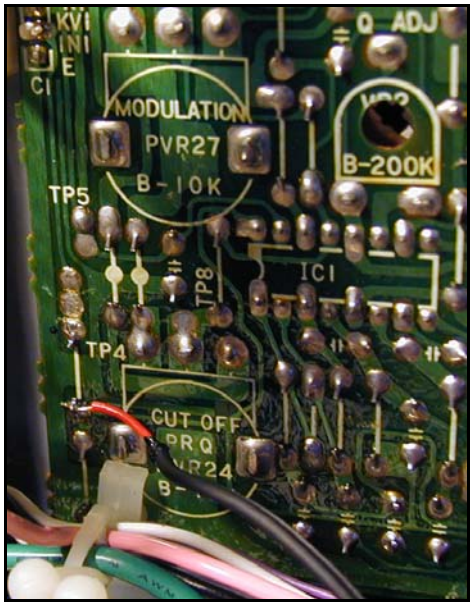
Wires must be shielded (thin audio cable) and as short as possible! Don't worry, you don't need to ground the shield, just leave it on the cable and isolate it using varnish or a tape. Exact location of where the wires should go is shown in the schematic below.



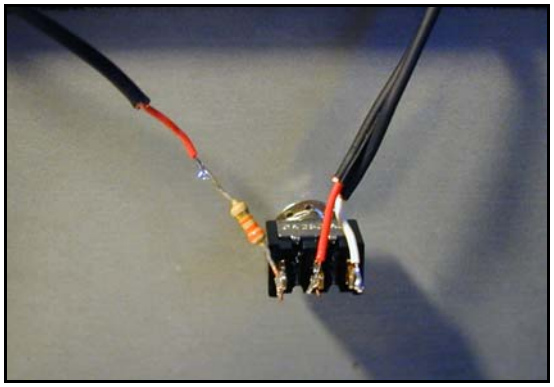
When you look at the board, on VCF 2 section right after PSW 32 there is a TP 17. Jumper is marked with red X (image above) and is located right after the TP 17. Now solder a 33k ohm resistor directly on the switch, but prior to that cut it to shortest possible length. Next thing is to solder two cables into the holes where the original jumper was located. In other words, we are putting back the jumper, just this time it will go via the switch. On the image below you can see all three locations, plus the switch.



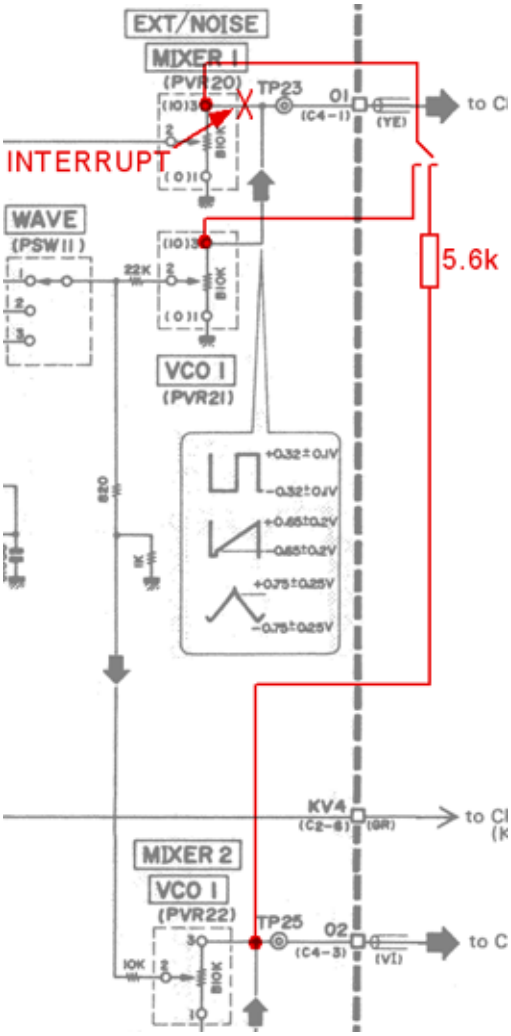
The third wire goes from resistor to the location shown on image below. It is right after the resistor shown on schematic above prior to VCF1 filter input. As in previous case, use shielded audio cable, cut to shortest possible length. This is all because a keyboard produces high frequency interferences that might enter the audio path if the cable is loose and reaches the other side where keyboard is.



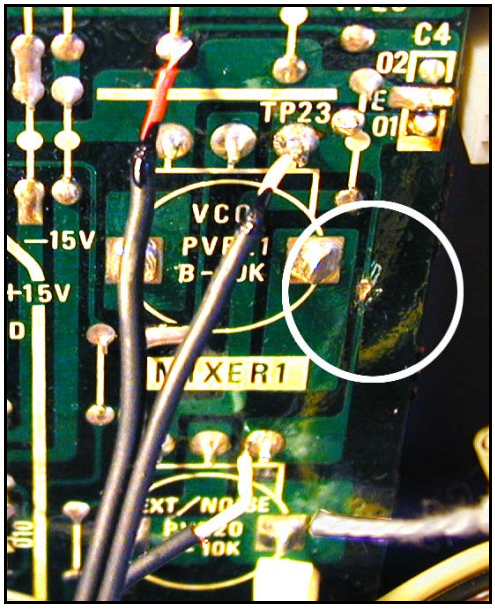
VCF1 connection


Detail of the switch

Mod 3 - White Noise routed into VCF2

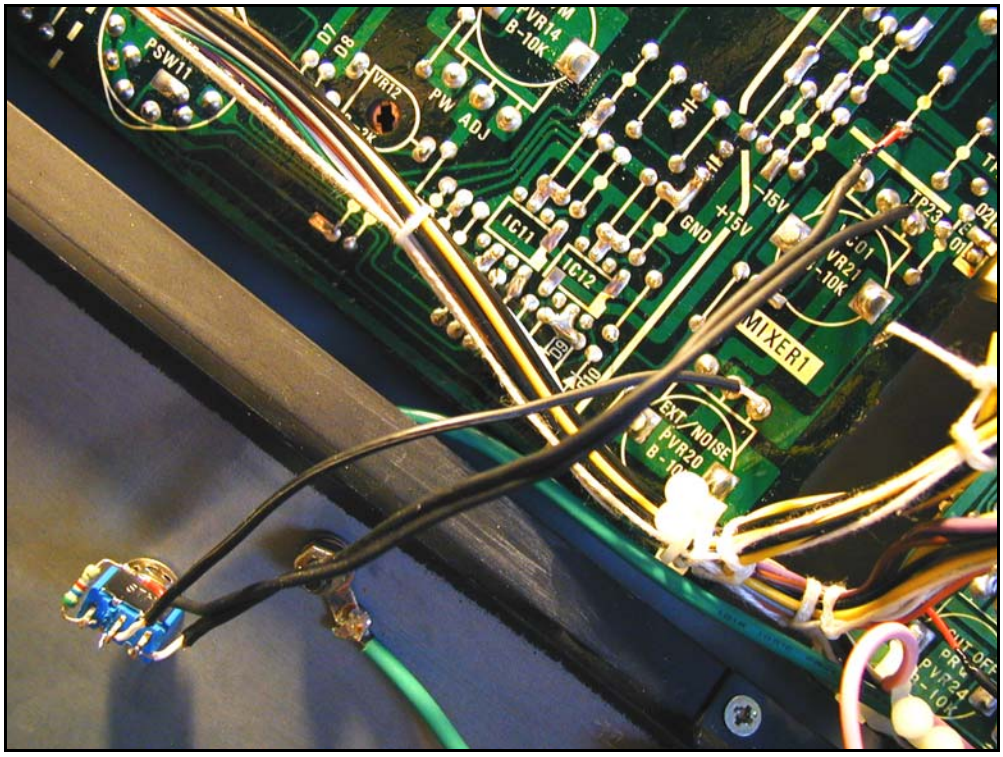


For the previous mod to fully work, another modification is required. White Noise should be routed into VCF2 so that it can be routed through both filters and doesn't enter the audio path in between two filters. This mod requires removal / interrupt of one PCB copper line. In the image below a white circle shows a place from where you should interrupt the signal line. Use a scalpel to scratch the surface, then break the contact, pull it up and cut it with sharp cutters. Test with multimeter that there is no more connection in this line!



This mod requires 3 shielded audio cables, a 5.7k resistor and a switch. Schematic above shows exact locations where to solder wires. As in previous example start by making a hole and keep in mind you can't put the switch wherever you desire. It is important that wires from the PCB connection to the switch are as short as possible. Therefore make the hole for the switch vertically below position of the PVR 20.

Now take the resistor and cut its leads to the shortest possible length. Solder the resistor to the switch and connect audio cables. Once you complete this task, result should look as on the image on the next page.



With this mod, all our modifications are done. Your CS-15 is now expanded - with its sonical palette at least doubled. Form the back side, your CS-15 should look something like this:

To fully enjoy the benefits of your modified CS-15 please fully recap the unit (replace all electrolytic capacitors) and then calibrate it using the service manual. The service manual is available online from **deepsynthesis.net** website.

Don Solaris
Jun 2007

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