Performance Improvements for the JVC 4DD-5 CD-4 Demodulator

Part 1

I became interested in CD-4 after acquiring a Denon UDA-100 UD-4 demodulator. The concept intrigued me, a high frequency carrier on an LP record giving four channels of (almost) discrete sound, maybe it was too good to be true. I set forth on my quest, with a JVC 4DD-5 demodulator, an Audio Technica AT440ML cartridge. and my Technics SL1200 with SME3009 arm. I thought I was set for CD-4 Nirvana.

Well as most have found out, the quest for high quality CD-4 playback is a difficult one, and the system did not quite seem to fulfil my high hopes, the arm was aligned and re aligned, stylus pressure checked and re checked, but still not perfection. I began to think all parts of my system were not good enough. Should I get a better demodulator, change the cartridge, what could I do?. Well I decided to change the cartridge as it was the simplest thing to do. Out came the AT440ML, a superb stereo performer by the way, and in went a genuine designed for CD-4 AT15Sa, complete with new stylus. Bliss!, no more odd sputtering or break up, everything working as it should, I was happy…. Or was I.

Everything was working, but I decided to look closely at the configuration of the JVC 4DD-5 just to see how it all worked, and to see what could be tweaked to improve performance. Out came the schematic, and a few hours was spent looking it over, from this initial perusal, and further study I have carried out modifications to enhance the performance of my demodulator. These are specifically for the JVC 4DD-5 and clones like the Marantz CD-400, but most of the modifications are applicable to other demodulators using similar circuitry.

Why the JVC 4DD-5?, well simply because it is cheap, abundant, and contrary to popular belief, quite a good demodulator. It may never beat a JVC CD4-50 or the like, but it will certainly perform well and as most of the mods are simple, they are cheap (in cost but not in performance).

Some of the modifications do not require any test equipment, others require some form of signal generator and audio millivoltmeter, but there are ways around this using a CD/DVD player and a PC with sound card as I will show.

DISCLAIMER

I shall not be responsible or liable, directly or indirectly, for any damage or loss caused or alleged to be caused by anyone attempting to carry out the following modifications. I shall not be responsible for any errors, omissions, or damages arising out of the direct or indirect use of this information.

Clean, Clean, and Clean Again….

Probably your newly purchased demodulator will be in poor cosmetic condition. Most of the time it is simply surface dirt and only in exceptional circumstances will the innards be in poor condition. First thing is to remove the top and side panels for cleaning, I find that baby wet wipes are ideal for the purpose, they do not contain solvents that can harm plastics or paint finishes. They are also ideal for brushed aluminium front panels as they do not (normally) harm the silk screen printing, but be careful, not too much pressure or your lettering will disappear.

Now the outer case is clean, next in line are the switches and phono sockets. I use a good quality switch cleaner called “Super 10” by Servisol, this is available in the UK and Europe, but I am unsure if can be bought elsewhere. Whatever you use please ensure it evaporates quickly and does not leave a sticky residue.

JVC used one of the world’s worst switches for the 2CH Direct Out function, these switches are silver plated, and oxidise badly. I would recommend bypassing this entirely and wiring the phono input directly to the sockets, but if you really MUST use it, give it a squirt of cleaner and “work” the switch a few times to clean up the contacts.

Next clean the separation pots and carrier level pots. Spray them with a little cleaner and rotate back and forth full travel to clean away any accumulated grime, you may have to do this several times to ensure they are ok. Do not forget the phono input and output sockets, most will be tarnished and need a clean, please do not use any abrasive compounds on them, it will cause damage to the plating, simply use switch cleaner on a cotton bud or swab and clean with that. Do not forget the inner part of the sockets, use a pipe cleaner or similar moistened with switch cleaner to do the job. Last but not least, clean the main selector switch, again “working” the switch to allow the cleaner to do its job, the ON/OFF switch would not normally require cleaning, so best leave it as is.

Now you should have a clean demodulator, ready for the next series of modifications.

Power Supply

As most of the demodulators are around 30 years old, they will be showing their age and some components will have started to deteriorate. This is especially true of the electrolytic capacitors in the power supply, they sit close to large resistors that run warm and will probably be dry or leaky. I would suggest as a matter of course they are changed immediately, the capacitor in the image below was removed from my own JVC 4DD-5, and shows some leakage from the rubber seal. (Not the marks on the side, that is glue used to keep the capacitor in place during manufacture)

For some reason JVC decided to omit C136, one of the power supply capacitors, I would recommend fitting this, and replacing the remaining capacitors as well. The original values seemed a little low, so after careful experimentation and evaluation, I increased their values to help regulation and reduce ripple and noise. This was successful, with no noticeable increase in output voltage, but a useful decrease in ripple and noise.

Component	Old Value	New Value
C133	100uF 50V	220uF 50V
C134	220uF 35V	470uF 35V
C135	100uF 50V	220uF 50V
C136	470uF 50V	1000uF 50v
C137	470uF 50V	1000uF 50v

I decided not to replace all other electrolytic capacitors, only the power supply ones as they are stressed the most, the remainder will be replaced as time permits.

NOTE

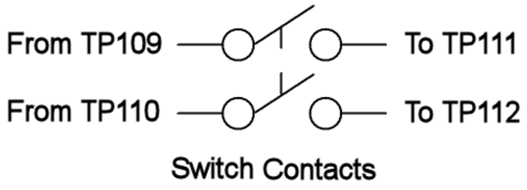
Most electrolytics are polarised, they have to be fitted correctly or they have a tendency to explode!. Be extra careful and note how the originals are positioned, mark the pcb as a guide and refer to the component layout and schematic diagram.

Extended Frequency Response

Filters are required in a CD-4 demodulator to remove the 30KHz subcarrier frequencies from the output audio signals, this means that the upper frequency response is limited to about 15KHz in CD-4 mode. The JVC 4DD-5 leaves this filter in circuit when in 2 channel mode, reducing the potential bandwidth that is available when normal stereo or matrix quad LP's are played. The frequency response can be extended by the addition of a simple switch or relay circuit. No adjustments are needed, and no alignment is disturbed by its addition.

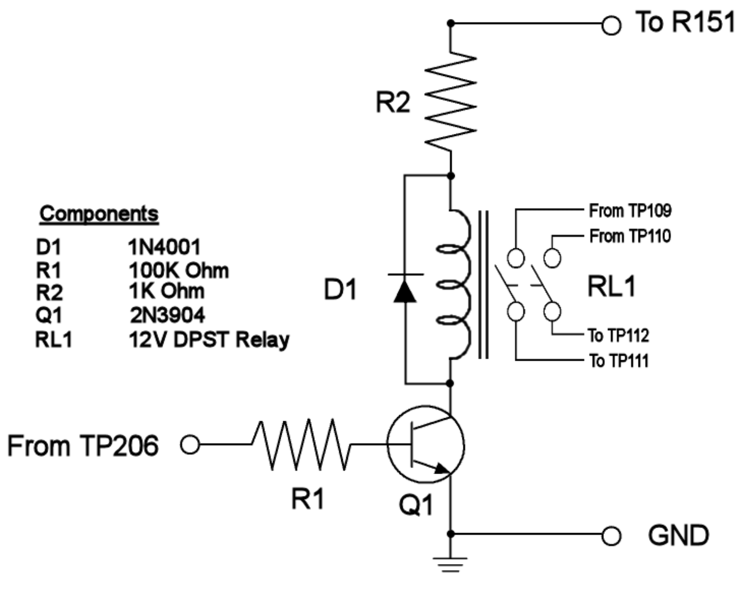
Simple Manual Switching

Using a small Double Pole Single Throw (DPST) toggle switch, the filter can be bypassed manually. Care must be taken when playing CD-4 LP's that the filters are switched back into circuit, and that shielded cables are used for the links to minimise stray noise pickup if the switch is fitted to the back panel.



Automatic Relay Switching

Using a small Double Pole Single Throw (DPST) low current relay and the following circuit, the filter can be bypassed automatically when in 2 channel mode, this is my preferred method.

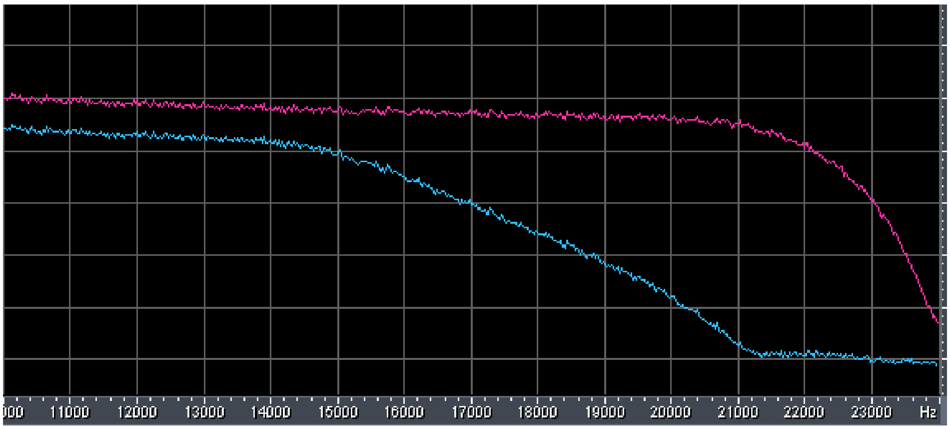


The circuit can be built on a small piece of perf board and mounted on top of the two red filter blocks using double sided sticky pads, layout is not critical. This is close to the test points, and minimises cable length. If mounted here, shielded cables are not required as noise pickup will be minimal. Power is taken from the power supply bridge rectifier end of R151, and ground from the adjacent earth tag.

Circuit Description

When playing CD-4 LP's TP206 goes low, turning on the CD-4 Radar lamp, and in the circuit above, turns off Q1 opening the relay contacts and allowing signals to pass through the filters. In 2 channel mode, TP206 goes high, turning on Q1 closing the relay contacts and bypassing the filters.

As the switching circuit simply links across the filters between two test points, I was concerned that there would be some interaction with the audio because the filters were not being switched entirely out of circuit. I ran tests to determine if this was the case, and fortunately as the results show, my fears were unfounded. The response above 15KHz is as flat as can be expected and a vast improvement on the unmodified circuit.



The blue trace shows the response of the original filtered circuit, the red trace is the result of the simple filter bypass. Frequency response now extends to over 20KHz before gently rolling off, with no obvious ringing or artefacts, the apparent roughness of the traces is simply due to the way I sampled the input. The level of one channel was reduced to make the image easier to display, in practice both traces would have been superimposed. Only frequencies above 10KHz are shown, lower frequencies are not affected.

The image below shows connections necessary at the power supply for the relay board and switching test point TP206. Also note the new replacement power supply capacitors as mentioned earlier.

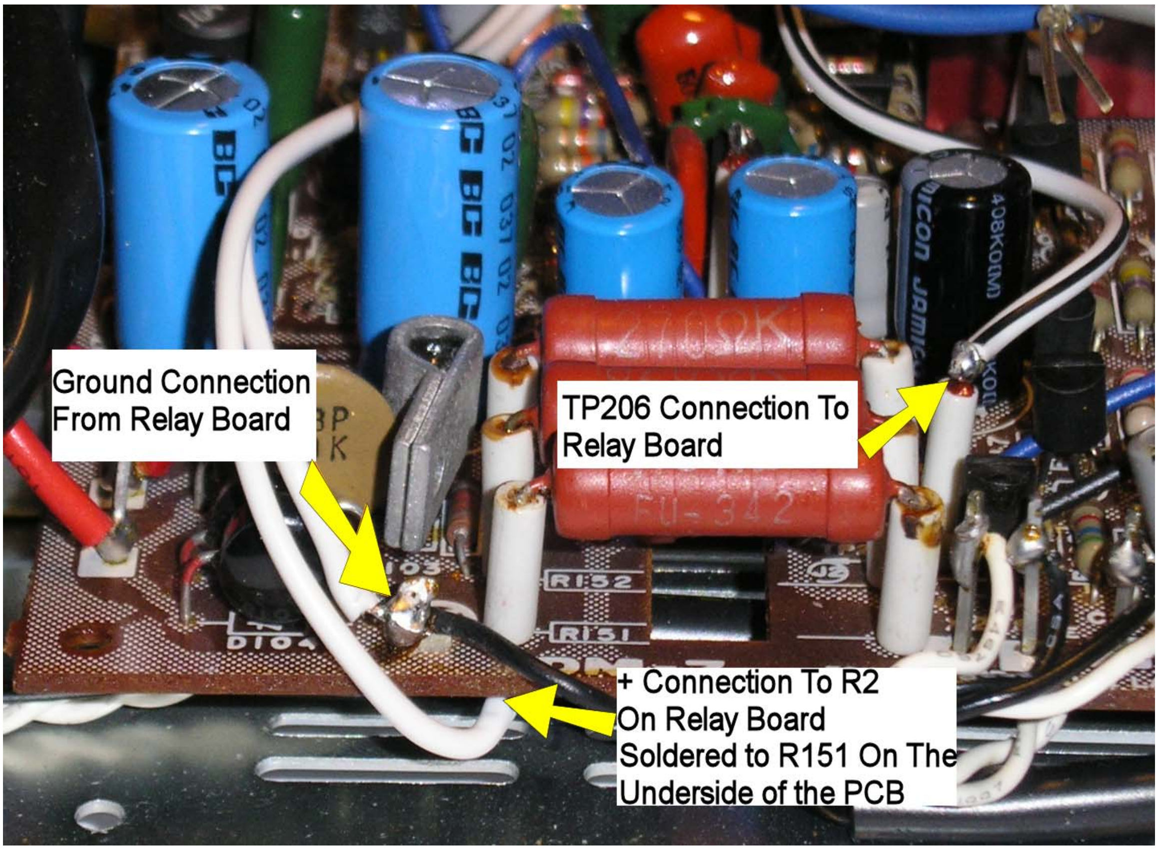
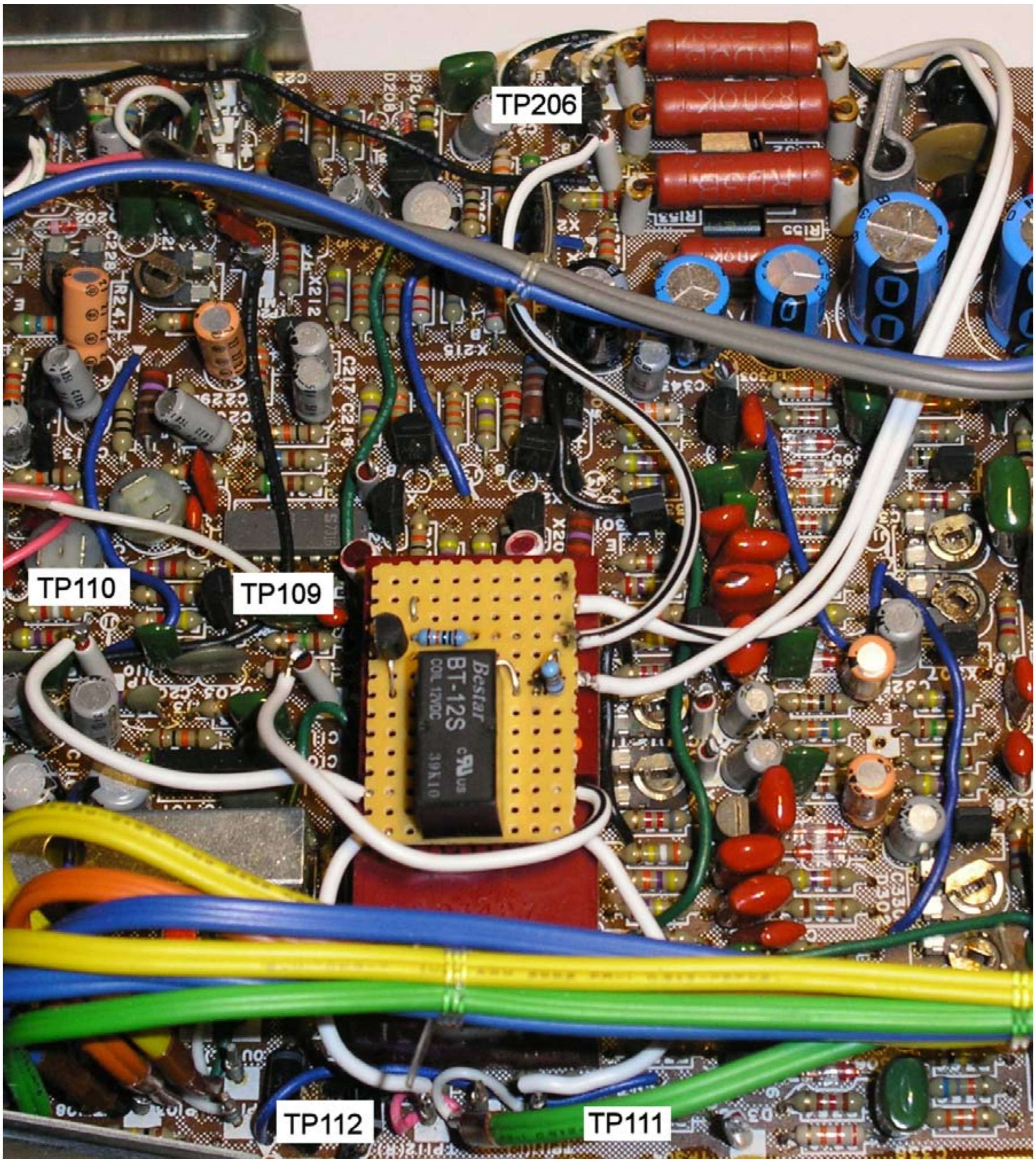


Image showing the completed relay board wired in circuit as described. This is a prototype board and looks untidy, but it worked very well. Normal hook up wire was used for all connections, hum and noise was not a problem.

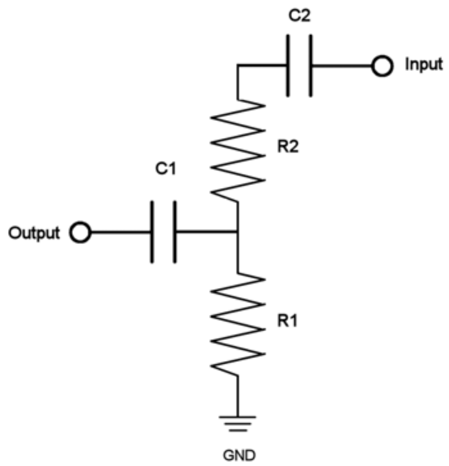


Test Equipment

The remaining modification requires some form of test equipment, an audio signal generator and audio millivoltmeter would be ideal, but simpler equipment can be used. Accuracy is not important, as it is relative, not absolute levels we are interested in. As long as minimum and maximum levels can be found, regardless of their absolute values, that will suffice.

My own tests were carried out using high quality test equipment, but not everyone has this available, so I experimented, and was able to set up sections of the demodulator using a standard PC with sound card as an audio level meter. The audio software used was N-Track Studio by Fasoft (www.fasoft.com). This is a free and excellent quality multi track recording package with good metering functions.

A signal generator is not required, a normal CD player can be used. I made a 2 track audio CD using a 1KHz stereo tone at –3dB, one track had both channels in phase, the other track had one channel 180 degrees out of phase, each track lasting about 5 minutes. The CD player's output was attenuated with a simple resistive attenuator to a suitable level for the demodulator as shown below.



	Attenuator
R1	1500 Ohm
R2	4700 Ohm
C1	1 uF Polyester
C2	1 uF Polyester

Two attenuators are required, and with the values shown they will have a voltage attenuation of approximately 12dB. It would also be possible to reduce the level recorded on to CD, but the attenuator gives added isolation and is to be recommended.

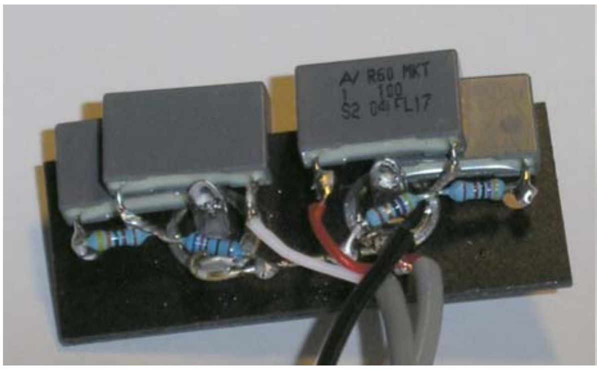
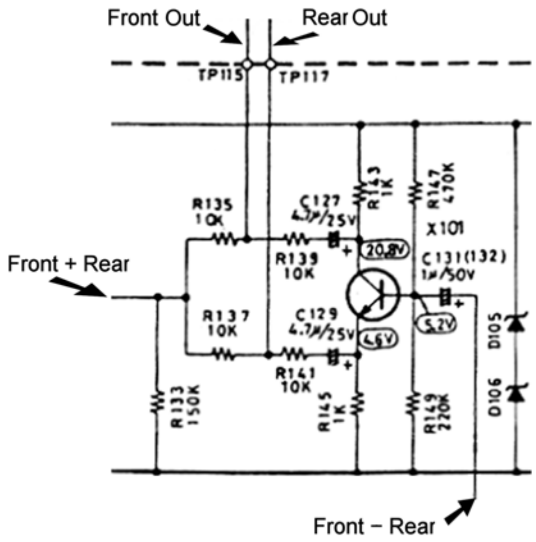



Image showing attenuator built on the back of a dual phono socket, this allows normal phono to phono leads to be used from the CD player. All connection references in the matrix balance set up will use RED or WHITE, these being the colours used in the attenuator shielded cable.

NOTE The ground connection to the demodulator is made via the black wire. The attenuator wires must have their shields connected ONLY at the phono socket end, the shield at the other end of the cable is cut back and insulated as shown.

Output Matrix Balance

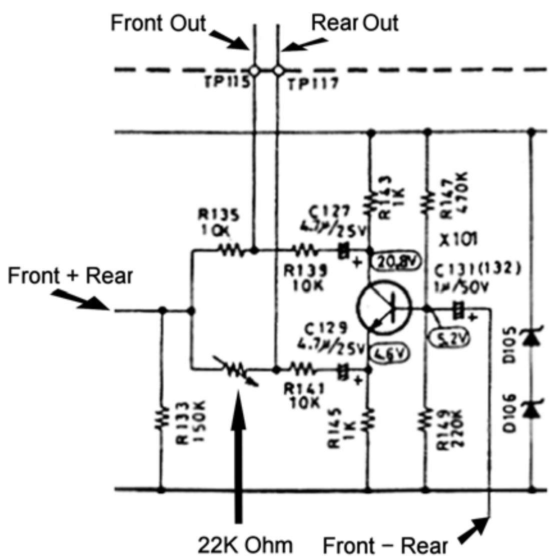
All common CD-4 demodulators have an output matrix circuit that, after demodulation, mixes front and rear signals in phase and in anti phase to produce separate front and rear outputs. The JVC 4DD-5 uses a simple single transistor phase splitter, as shown below, with a resistor matrix to do the job, others have the matrix built into the demodulator chip itself.



I found that when setting up my demodulator as normal, the best front to rear separation did not coincide with the best rear null point. Upon investigating this, I discovered an imbalance in the resistive mixer, showing itself as an increase in breakthrough from rear to front, and a loss of separation. This is probably caused by tolerances in the resistors making up the circuit, or simply drift with age.

In another demodulator, the JVC CD4-10 (also the CD4-10S Studio model), there is a trimpot that allows the matrix to be balanced. I decided to modify the 4DD-5 circuit in the same way and see if it could be made to work.

I replaced one 10K Ohm matrix resistor in each rear channel (R137 and R138) with 22K Ohm trimpots, as shown below..



Matrix Balance Setup

At this point I assume that the attenuators are built and the CD with test tones produced. It is advisable to terminate the phono input connectors to keep noise to a minimum, a 600 Ohm resistor in each channel will suffice. Set carrier level, separation pots and R137/R138 to mid position, selector switch to 4CH Auto. Front and rear outputs should go to your sound card, with your favourite software running to monitor input levels.

Right Channel

Connect WHITE attenuator cable to TP112, connect RED attenuator cable to TP304, black ground wire to ground terminal on back panel.

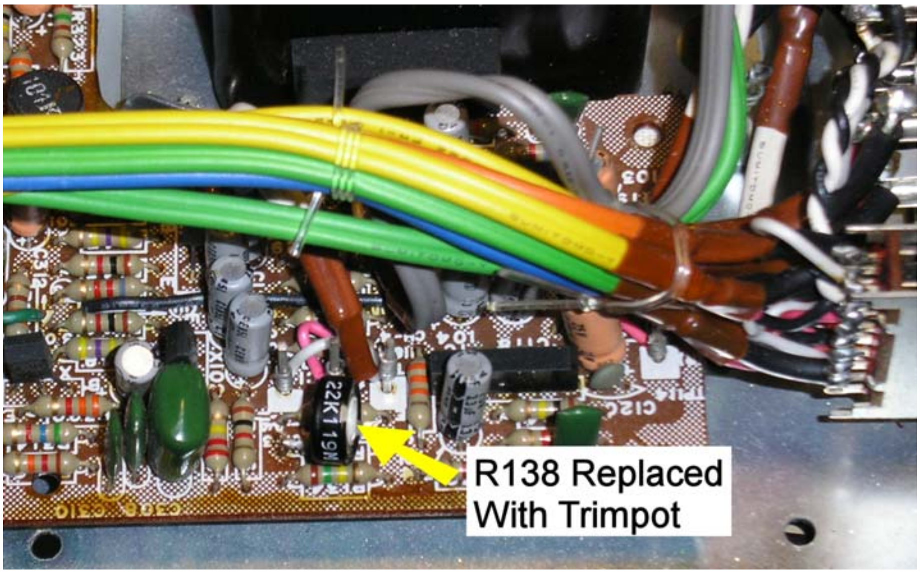
While playing the out of phase track from CD, adjust the RIGHT separation pot on the back panel for MINIMUM output on the RIGHT FRONT channel. This is quite a sharp null point and can be tricky to get right. When you are satisfied that you have the best null, play the in phase track and adjust R138 trimpot for minimum RIGHT REAR channel output. Again this can be quite a sharp null point.

Remove connections from TP112 and TP304. Leave black ground wire connected.

Left Channel

Connect WHITE attenuator cable to TP111, connect RED attenuator cable to TP303.

While playing the out of phase track from CD, adjust the LEFT separation pot on the back panel for MINIMUM output on the LEFT FRONT channel as above. When you are satisfied that you have the best null, play the in phase track and adjust R137 trimpot for minimum LEFT REAR channel output.



That concludes the balance adjustment. Remove attenuator cables and re assemble the demodulator.

All the modifications will make a good demodulator even better, and for a total cost of around $10, will not break the bank. The power supply capacitor replacement is not really a modification, it should be done as a matter of course. The improvement in frequency response and overall clarity with the filter bypass modification applied is superb. The output matrix balancing modification is also a useful improvement, however it is not as simple as the others and I would not recommend this for a novice. The results are very good however, with a 1KHz tone, separation increased, and there was a noticeable improvement when playing discs. Your results may vary, it depends entirely on how well the original demodulator was set up at the factory, and how much it has deteriorated since.

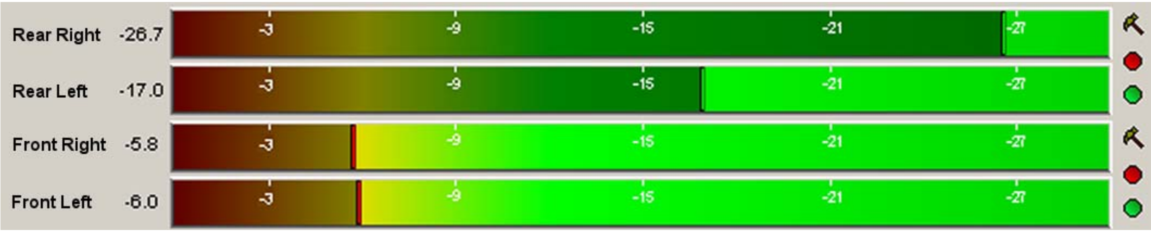


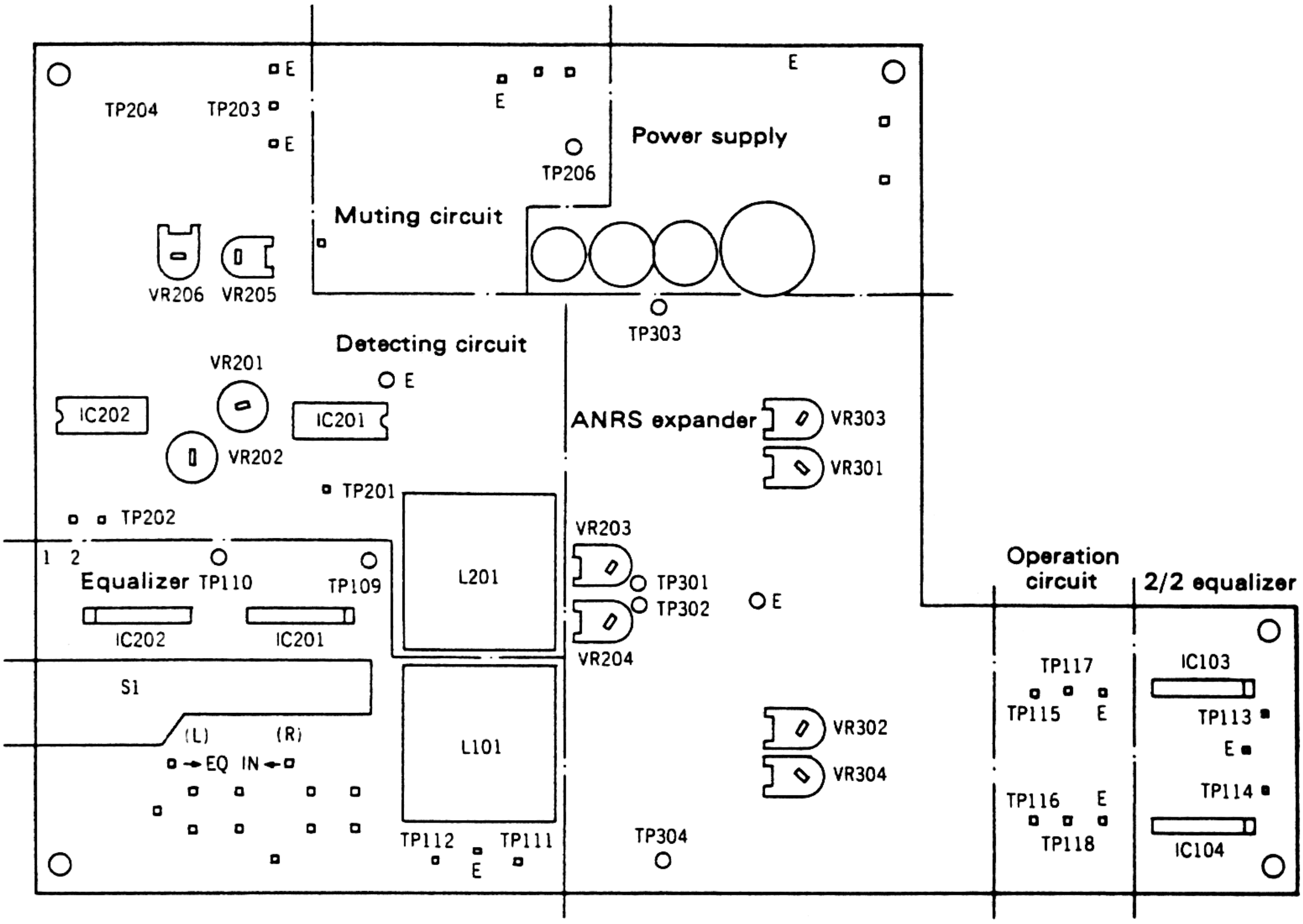
Image showing improvement in rear channel balance after modification, left channel unmodified, right channel modified as above.

I have files and information available at my web site, JVC 4DD-5 schematics, full service manual for the Marantz CD-400 (a 100% JVC 4DD-5 clone), and also the two test tones required to set up the matrix balance.

JVC 4DD-5 Schematic	http://www.grizwald.plus.com/quad/4DD5.pdf
Marantz Service Manual	http://www.grizwald.plus.com/quad/SManual.pdf
In phase tone	http://www.grizwald.plus.com/quad/Iphase.mp3
Out of phase tone	http://www.grizwald.plus.com/quad/Ophase.mp3

I hope that you find this information useful, it is given in good faith in the desire that we CD-4 enthusiasts can breathe new life into our old equipment, improving its performance beyond what the manufacturer was able to obtain when building down to a price.

Test Point Locations



This image shows all test points and adjustment points that are required for modifying and setting up the demodulator, please refer to the service manual for full schematic information.