

Hypex NC252MP repair attempt (2024-5)

History

Around September 2023, one of the Hypex modules in my 8-channel Buckeye amp developed a serious fault (outputting about 46 V on the second channel speaker terminals, until the protection circuit shut it down about a second later). I suspect this occurred about the time we had a power blackout – when power returned but before my hi-fi system had fully powered-up and been initialised, the front-right speaker (or maybe both L and R; I have trouble telling because I'm almost deaf in my left ear) emitted a **very loud** 'woomp, woomp, ...' sound until I was able to switch off the Buckeye amp.

Dylan Launder (proprietor of Buckeye Amplifiers) sent me a replacement Hypex module free of cost (within warranty period), which, of course, fixed the problem. But I kept the faulty module, in case I ever had time to look at it (my suspicion from the start was a shorted output transistor).

Late-Nov-2024, we had a lightning storm and two consequential blackouts (not a direct hit near my house, but probably a hit to the distribution lines a few km away causing a breaker to trip) – both short (about 12-sec each) with about a minute between them. When my hi-fi system had rebooted after the **second** blackout, the same 'woomp, woomp, ...' sounded from the front R speaker, again (it didn't after the **first** of these two blackouts, maybe because the system hadn't finished booting by the time the second blackout occurred).

[I've never tried to locate the source of that 'woomp, woomp, ...' sound when powering-up after a blackout – difficult to do with my complicated hi-fi hook-up. It was easier to change the Touch-PC program (that controls most of the components in my complex hi-fi system) to not power-up the Buckeye amp until after the PC had booted and all other pre-main-amp equipment had been turned-on and stabilised.]

After those two short blackouts, I noticed that my two front woofers were not playing anything. Once again an NC252MP module (same location as the first – replaced – module) had failed with a DC output. I didn't need to open the buckeye to determine this: every time I powered-up the hi-fi, the front R woofer would hum loudly for about a second, before the protection shut-down the module's main power-supplies.

Sadly, being now out warranty, I couldn't get another warranty-replacement module from Buckeye, and exorbitant postage by USPS made buying one from them uneconomical. So I resolved to try to fix at least one of the two faulty modules I now have.

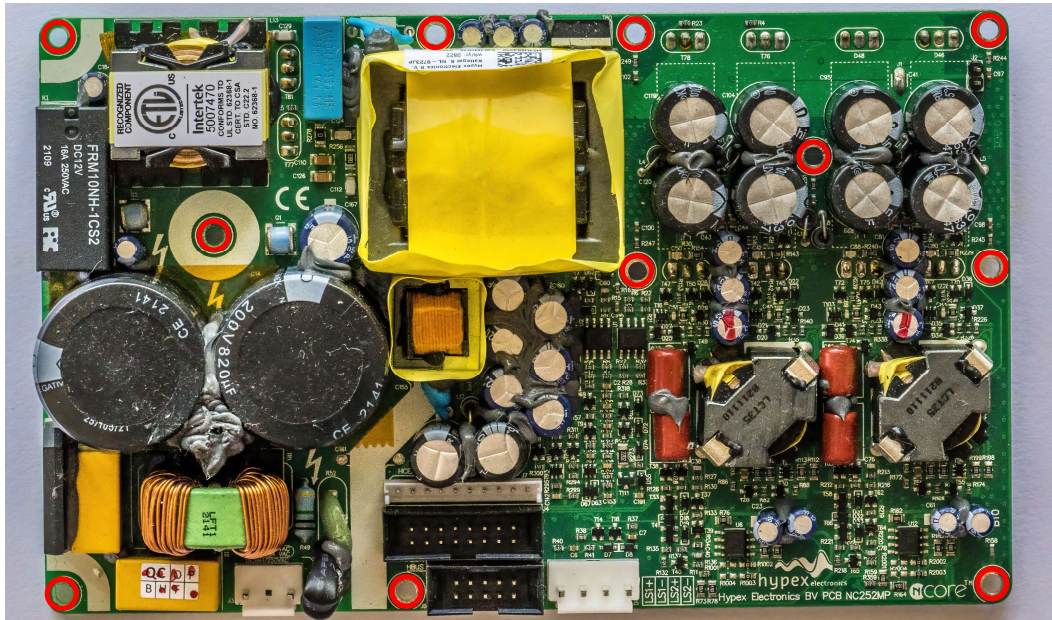
[Why only the front woofers? Each of my four speakers (quadraphonic set-up) is split into two circuits – woofer, and squawker/tweeter sections – each section driven by a separate amplifier channel. Hence the need for an 8-channel amp! Until now, the first Hypex module was driving the front L and R woofers. In hindsight that was a poor choice of configuration, as it places the heaviest thermal load on that one module. Once (if) I get the faulty module repaired/replaced, I plan to reconfigure the amp so that each Hypex module drives the woofer plus the squawker/tweeter section of one quad channel, so each of the four Hypex modules will share the load of the four woofers that, for most music, demand the highest power.]

Investigation (module #1)

To be able to test the output transistors, I first had to identify what types and where they are. As they are on the underside of the PCB¹, in contact with the heatsink plate, I needed to

¹ Printed Circuit Board

remove the heatsink. This requires undoing 11 screws (each with a spring-washer – don't lose them!), at the locations circled in red in the top photo of the board (don't miss the one in the middle of the 470µF capacitors!). [If you do happen to misplace a screw or spring-washer, the screws are pan-head M3×6mm.]



Hypex NC252MP top view

After removing the heat-sink plate, the board underside (see [bottom view](#) photo) shows eight TO-220 devices near one corner, and two TO-220F devices in the power-supply area. All of these are arranged to sit flat against some flexible heat-conducting pad material on the heat-sink plate, ensuring optimum heat conduction to the plate.

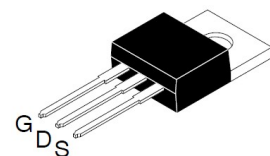
The component circuit reference numbers (Hypex use Tnn and Dnn for transistors and diodes, respectively) on the PCB for these ten devices are not all visible (the legends for the 'inner' row of transistors are obliterated by the 'goo' holding the row of small electros² together. So I have randomly assigned numbers (in red) for each of the TO-220 devices in the [bottom view](#) photo (I don't believe there's a problem with the PS section, so have not bothered to identify the two TO-220F devices).

The type numbers for those eight devices are as follows:

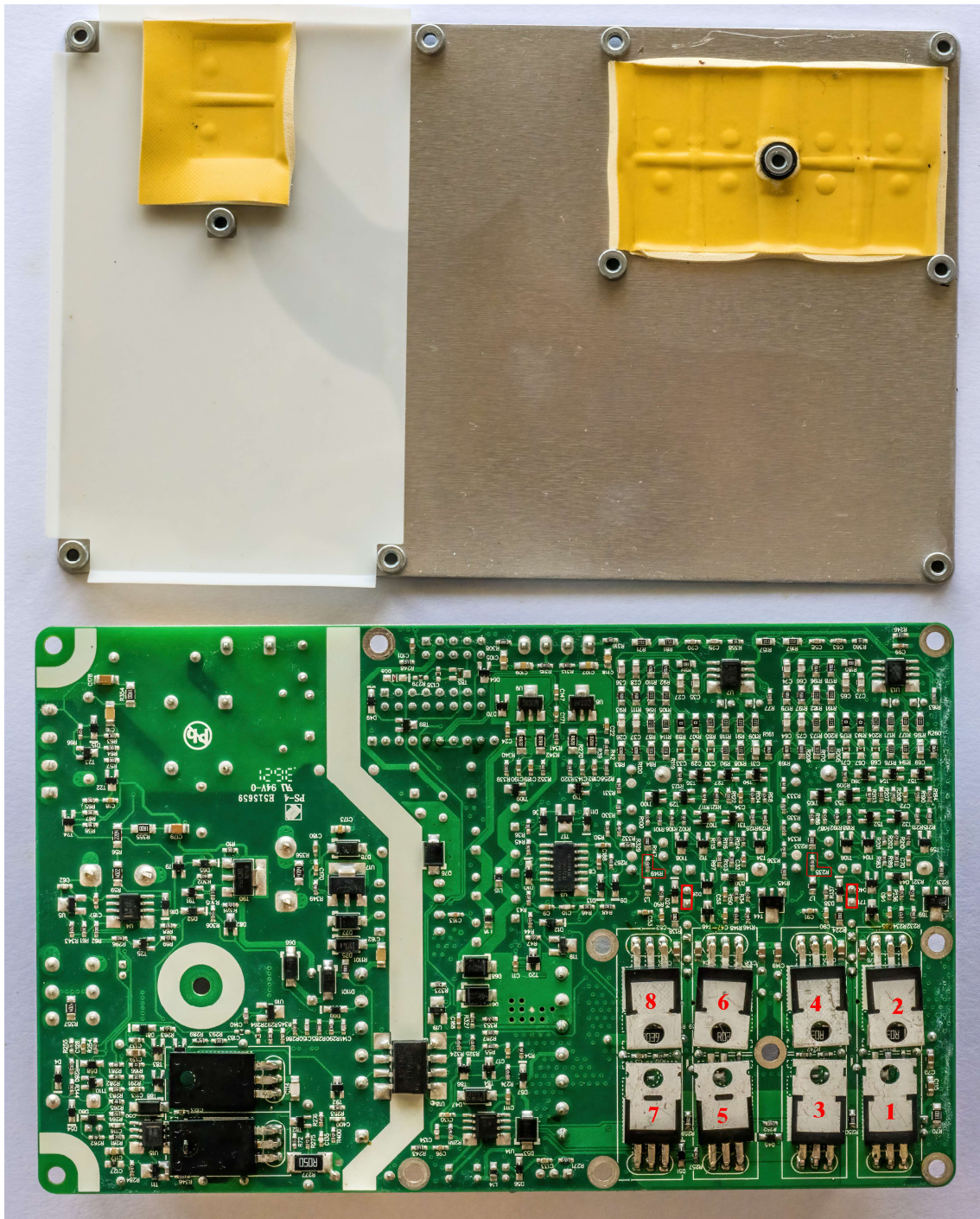
Reference	Type №	Description
1 (D46), 3 (D48)	BYQ28E-200 (Vishay)	Dual Common-Cathode Ultrafast Rectifier
2, 4, 6 (T43), 8	FDP2572 (onsemi)	N-channel Powertrench MOSFET
5 (T76), 7 (T78)	IRF640N (Infineon)	N-channel HexFET Power MOSFET

Datasheets for these devices are readily available from the respective manufacturer's website.

Having identified what each device is, I was able to do a quick DMM test to find that '6' (an FDP2572) was shorted D-to-S. The pin-out for all six MOSFETs is the same as the vast majority of TO-220 MOSFETs:..... ➔



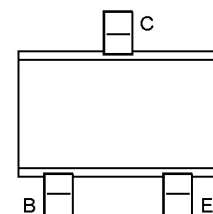
² Electrolytic capacitor



Hypex NC252MP bottom view, with inside of heatsink plate

Repairs

Before replacing T43, I checked (on the advice of Hypex) its driver BJTs (top side of PCB, near the MOSFET): T42 (BC817W, NPN) and T45 (BC807W, PNP), and also its 'shunt' resistor R139 (0R039, under T43). Both of those transistors have this pin-out (top-view):..... ➔



And I checked the 2R2 resistors R149 and R235 (underside of PCB, also outlined in red). I found all the above check results were OK. I ordered a handful of FDP2572 MOSFETs

(since I had more than one module to repair, and possibly more in future!), and after receipt, replaced the faulty MOSFET.

This was not easy, as one of the MOSFET pins is located close to some capacitors on the top side, so my desoldering iron's barrel won't fit in there without melting the cap sleeves. Furthermore, with lead-free solder and a multi-layer PCB, I needed to crank up my desoldering temperature to around 430 C (per the setting dial at the back of the desoldering iron – I don't know how accurate that is!). In the end it was easier to cut the MOSFET free of the board, then remove the pin remains by desoldering each from the board's underside, which at the same time sucks the holes free of solder.

Because access to the board's top side is limited, it would not be easy to trim the excess pin length after soldering the MOSFET in place, so I pre-cut them before soldering. And I decided the easiest way to solder the device in place was to place it in position without soldering, fit the heat-sink back-plate to hold it in place, then solder each pin from the top side (I used Sn/Pb solder, which is allowed for repairs).

The back-plate is desired for the next step – bench-testing. While it might be possible to perform measurements on the PCA³ without refitting the back-plate, given the considerable power dissipation of the output transistors, even with no audio output, I felt the risk of overheating them and causing more damage was more than I was prepared to take.

So the tests listed below that require access to the PCA's underside were not performed by me, but I retained them in this document in case you are bolder than me, and prepared to run quick tests without the back-plate fitted. ☺

Initial Testing

In the absence of plugs to fit J7, measuring voltages there, on adjacent pins, would be a little tricky, with the potential for a probe to slip and short adjacent pins. It would be possible to make these measurements safely using two crimp receptacles intended for standard 0.64 mm pin headers, soldering a wire loop to the wire end of each, then shrink-sleeving all but the wire loops with heat-shrink. By bending the wire loops at about 45° to the receptacle's axis, when measuring adjacent pins the test receptacles could be oriented with loops facing opposite directions, to minimise the risk of accidental shorts.

But since I had more than one module to repair (and potentially more in future), I chose to build a simple test jig. The first step was to obtain a set of plugs/receptacles to mate with the various sockets on the Hypex module. This proved to be a lot harder than I expected, as the housings to match J4 and J6 appear to be sold only in lots of 1,000+! FYI, here's a list of the required housings and receptacles:

J3 – VHR-3N (JST) + 2 x SVH-21T-P1.1 receptacles

J4 – [to suit: T821116A1S100CEU] (Amphenol)

J5 – VHR-4N (JST) + 4 x SVH-21T-P1.1 receptacles (RS)

J6 – [to suit: T821110A1S100CEU] (Amphenol)

J7 – EHR-10 (JST) + 6 x SEH-001T-P0.6 receptacles (RS)

The 16- and 10-pin Amphenol housings are seemingly not available in retail quantities, but the JST housings and receptacles are available in small quantities from major electronic component wholesalers (e.g. RadioSpares).

³ Printed Circuit Assembly

Thanks to a tip from Dylan, I managed to source the first four connectors in the above list from a Chinese company, Ghent Audio. They sell a harness kit, which has the four connectors with attached wires (<https://www.ghentaudio.com/products/harness-nc252mp>). I bought a set for my test-jig.

But the plug supplied for J6 had only two receptacles fitted, for pins 3 and 9 jumpered to *enable* the module. I wanted more pins accessible to monitor status signals and V_{aux} supplies. Like the plug housings for J6, the receptacles were not available in small quantities. I got ChatGPT to do a few searches for something that might work, and it eventually came up with some receptacles (from another manufacturer) which, with a little effort, just might do the job, though far from a perfect fit.

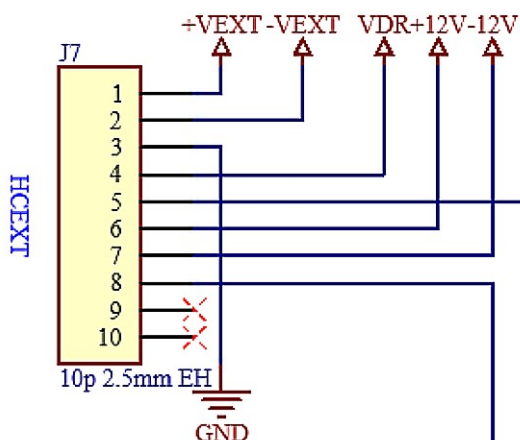
The second step was designing a PCB for the test-jig, and sending the design to China for manufacture. But being impatient to get my hi-fi rig back to normal, I decided to test the Hypex module with the cable set from Ghent and another connector from a local wholesaler.

Taking care to arrange all the wires so that none touched, and shorting each input to avoid any noise pick-up, I powered-up the module (on my test bench) in preparation for doing some voltage checks. After being on for maybe 20–30 seconds, there was a very loud ‘crack’ and I saw a spark somewhere on the board (?) from the corner of my eye. I quickly switched off the mains.

I carefully visually inspected the PCA (only the top accessible at this stage), looking for any signs of blackening or other damage, but could see none. At that time the two speaker cables were just hanging loose over the edge of the workbench, and I thought it might be remotely possible that a wire from each channel brushed against each other. But there was no sign of carbon or melted copper at those wire-ends, so I think that’s unlikely.

Needless to say, I tied the two speaker cables in a way that they could not touch, and gingerly switched on the mains again. No more sparks or ‘cracks’, so I proceeded to check a few voltages as suggested by Hypex, excluding the ones only accessible from the board underside and from J6:

Check all voltage rails (on J7). V_{DR} should be about $+14.5\text{ V}$ relative to $-V_{EXT}$. It should also be present across U3 (HEF4093, near centre of board underside: $7=V_{SS}$, $14=V_{DD}$).



J7 is the single-row 10-pin white connector on the top side of the PCB.

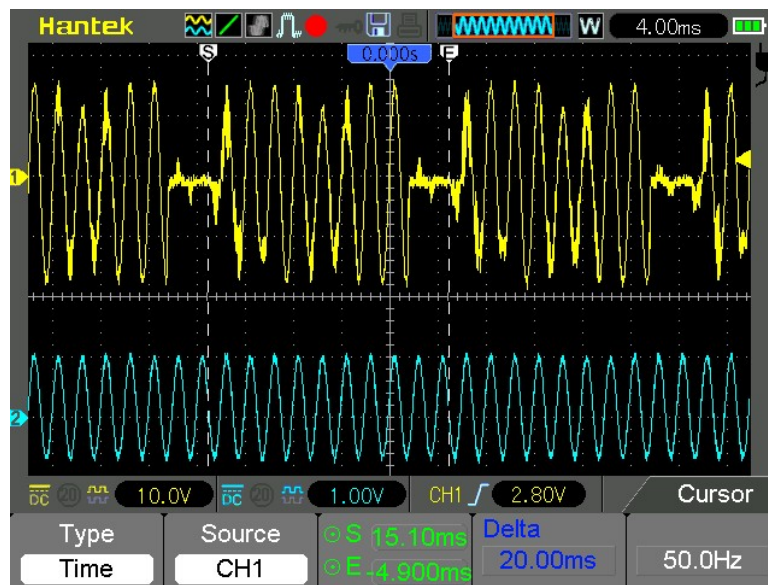
Pin 1 is next to the thick white line demarcating the power supply section.

$\pm V_{EXT}$ should be around $\pm 50\text{ V}$.

Measure (from the underside) the voltage across the caps ($220\ \mu\text{F}/25\ \text{V}$) directly above the two output inductors (with a red felt pen line drawn across their tops in my top view module photo [top view](#)). It should be $15\ \text{V}$. Of course I couldn't easily test the underside voltages due to the heatsink being in place, but all the others checked OK (with a DMM⁴).

Also check for $0\ \text{V}_{\text{DC}}$ on the buffer stage op-amp outputs (for the faulty output channel, U6 or U12; 2 outputs each, pins 1 & 7. Top side of PCB, in lower-right corner adjacent to pairs of $22\ \mu\text{F}$ electros.). Because these are signals rather than supplies, they are best checked with a DSO⁵ to ensure they are 'clean' $0\ \text{V}_{\text{DC}}$. But I was reluctant to do that. My DSO has slightly rounded probe tips, which can easily slip and short closely-spaced surface-mount IC pins.

With everything else checking-out OK, I then connected (with power off) a $4\ \Omega$ power resistor to the repaired channel's speaker terminals, a signal generator to the input, and a DSO (with isolated inputs) to both input and output. I then powered-up the module to check for the expected output waveform. This is what I saw (lower/blue trace = input, upper/yellow trace = output):



Channel 1 output and input, $8\ \Omega$ load

Clearly there's a problem! Looking at the output waveform, and noting that the interval between the start of one burst of sine waves and the next is $20\ \text{ms}$, my immediate thought was: "power supply (extreme $50\ \text{Hz}$ ripple)!"

Diagnosis (module #1)

After building the test jig (took a long time to get all the parts, including the PCBs from China, and for me to have time to spend on it!), I was finally able to connect the faulty module and do some more extensive measurements on it without the worry of shorting wires together. My jig includes load resistors that (via three toggle switches) allow me to load either channel (or both for some load values) with 2 , 4 or $8\ \Omega$ dummy loads. [See photos in [Appendix 1 – my Hypex module test jig.](#)]

⁴ Digital Multi-Meter

⁵ Digital Storage Oscilloscope

Initially I applied 8 Ω to both channels (even though I was supplying an input sinewave to only one channel). While driving the channel to produce the waveform shown above, I then checked with my DSO (from the test-points on my jig) all the accessible supply voltages available from J7 and J6. All were 'clean', with no sign of 50Hz ripple. I had previously checked the four diodes in the main bridge rectifier (D14, which presumably rectifies the mains input), but all the four diodes measured OK in each direction, so I had no good reason to think the DC supplies **would** have 50Hz ripple.

So in the absence of a circuit diagram for the Hypex modules, I am stumped, unable to do any systematic tests to determine why the audio output has severe 50Hz modulation.

So ends my work on the first failed Hypex module. I have set it aside until I have the time to remove the Buckeye amp from my hi-fi system and extract the second faulty module to see if I have more luck repairing that one!

Diagnosis (module #2)

The same MOSFET (#6) was found to be shorted in this module too. It was replaced, and the same pre-checks as for module #1 were performed (all OK) before re-fitting the heatsink for testing.

Sadly, the initial test showed the exact same faulty output as for the first module (see DSO screen pic on page 6). Thus the above diagnosis for module #1 applies here too.

I'm at a dead end. Of course, a circuit diagram from Hypex would solve my problem, but they are uncooperative despite me offering to sign a non-disclosure agreement. So time to search for a better-protected amplifier module, or a better-documented one!

Comments

I've read about some class-D amplifiers suffering from 'bus pumping', but have no idea if the 'woomp, woomp, ...' I've previously experienced could be that – I could find no audio samples on-line of how it sounds. There's a frequently-recommended design technique (reversing the phase of one channel) to minimise the possibility of bus pumping occurring, but Hypex claim to have implemented a different technique.

Although Hypex claims that these modules incorporate both over-current and over-temperature protections, clearly they are inadequate. But I can say the DC-output error-detection works, though whether it's fast enough (~900ms for a 50Vdc output) to protect both amplifier and speaker, I can't say.

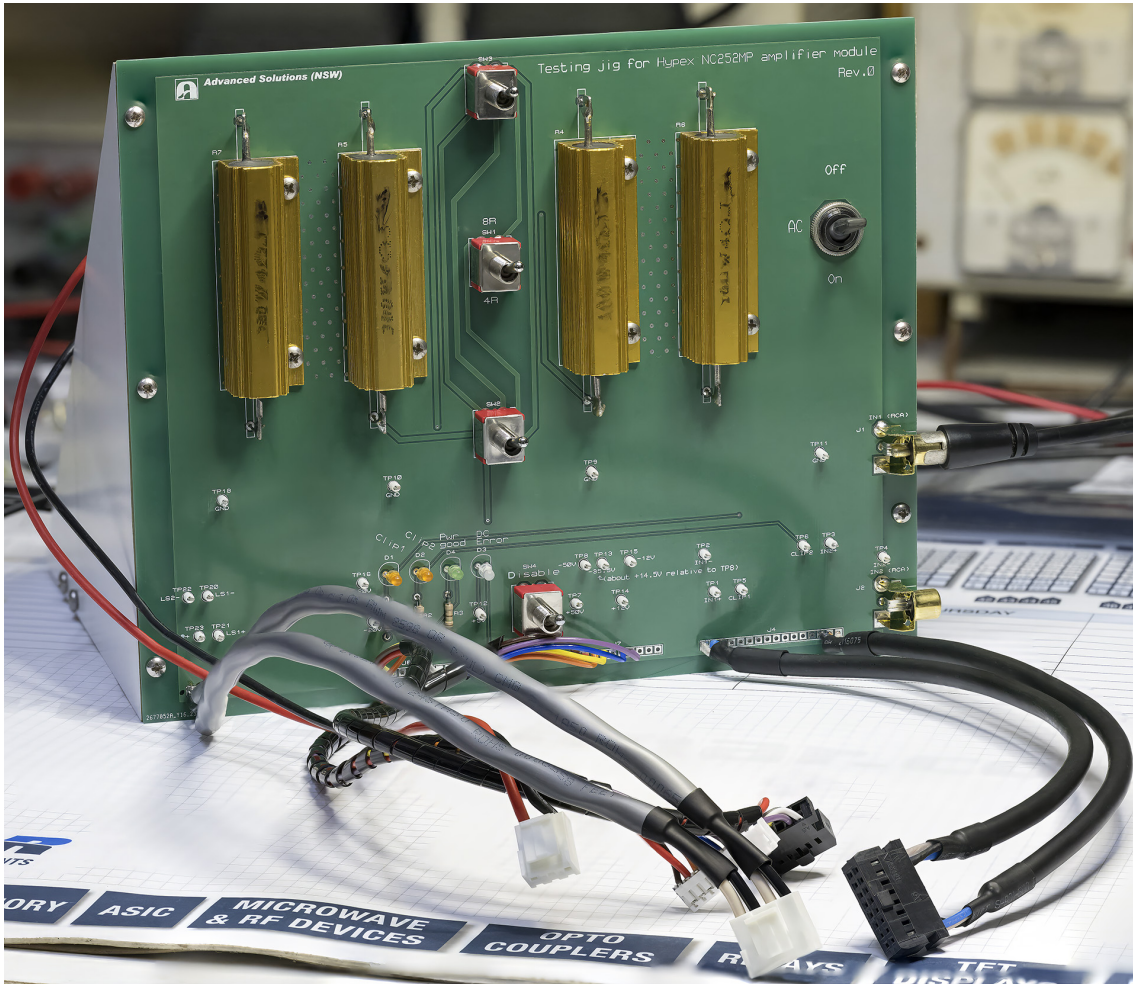
Conclusion

There's no doubt the sound quality from these modules is perfectly acceptable, but their fragility and 'unrepairability' makes them a poor choice for users without unlimited funds.

I will shortly be replacing my (now incomplete) Buckeye Hypex NC252MP 8-channel amplifier with something from a different manufacturer. Poorer, but a little wiser. ☹

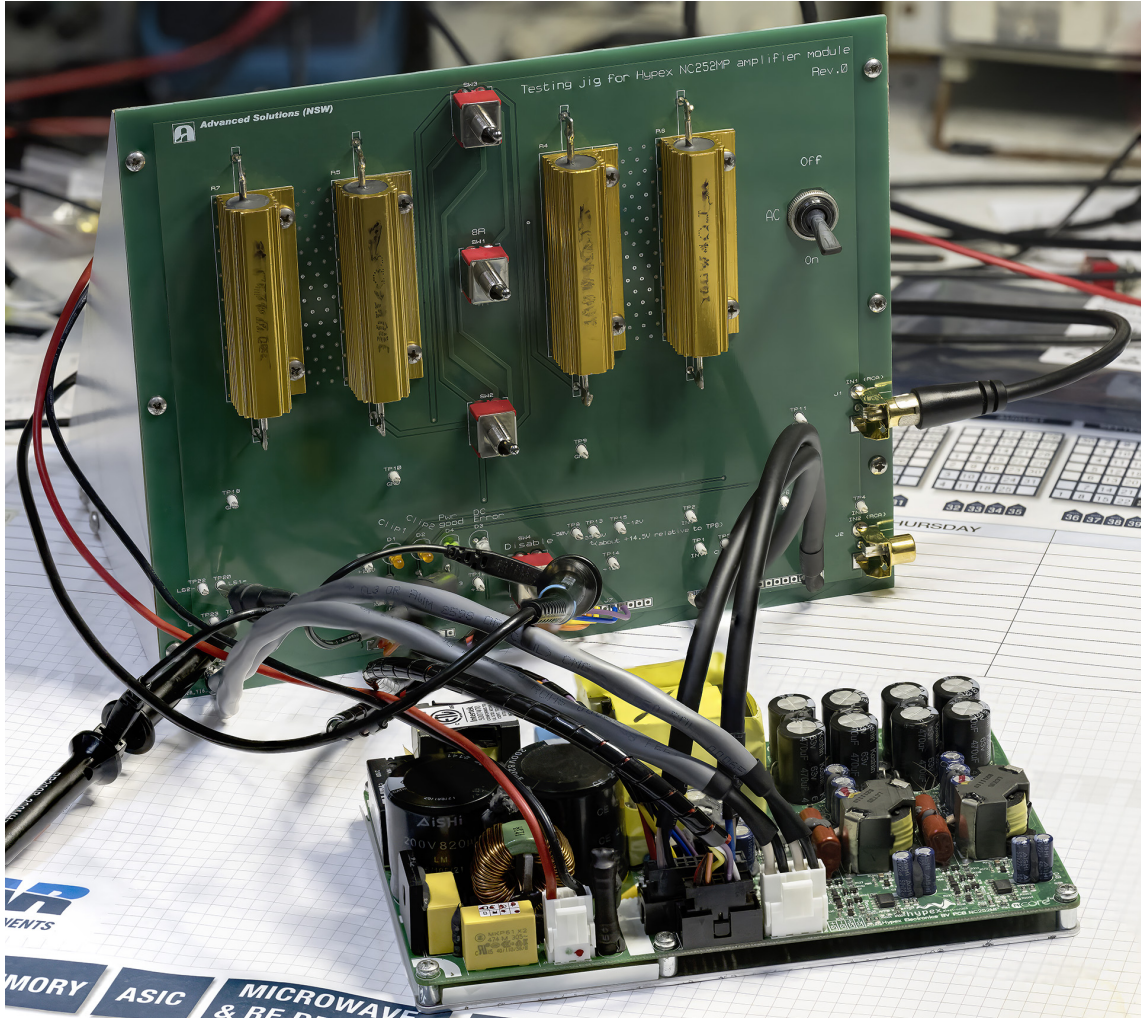
Appendix 1 – my Hypex module test jig

A view of my test jig (oops –forgot to disconnect the audio input before taking this photo! 😊)



Hypex module test jig – front view

And when in use (connected to a Hypex NC252MP module), with DSO probes attached:



Hypex module test jig – in use