The Resurrection of a Korg Mono/Poly

I bought a Korg Mono/Poly a few years ago as a non-working synth. It turned out that the previous owner had connected it to the mains supply here in the UK not realising that it was a US model. That didn't do it a lot of good I can tell you! The power supply in a MP is a potential weak link at the best of times and doesn't do the rest of the electronics any favours when faced with double the incoming mains voltage, but more on that later. The regulator transistors shorted and put sky-high levels of what should be +15, -15 and +5 into the boards.

I like to work backwards on a synth rebuild project so that the audio stages are available when it comes to getting the VCOs working and I can use the synth's own wiring harness too as I go along. First, I removed the KLM-353 board (out/headphone amp, MG1&2) and powered it up from my external supply - there was a dead short on the power rails. Every IC had blown; all five of them. I replaced them and powered up the board again. This time I was rewarded with a sound in my phones when I injected a signal into pin 3 of connector 2. The LEDs for the two LFOs seemed to blink correctly as the frequency pots were advanced so I left it at that.

With the board back in the synth and wired in, I turned my attention to the KLM-355 board (VCF, EGs, Noise Gen & VCA) and powered it up - again there was a dead short on the 15 volt rails and again, every IC had blown, including the SSM2044 VCF chip. That's 9 ICs in total for that board. With those ICs replaced, everything on that board seemed in order. With the VCF sweeping nicely and the EGs/VCA doing their bit when triggered from an external push button I'd wired up, I put that board back in the synth.

The next job was to check out the VCOs so it was out with the mighty KLM-354 board and, being prepared for the worst, powered it up and sure enough both power rails were shorted as on the previous boards. However, unlike the previous boards this could be bad news as the MP uses 4 SSM2033 VCO chips which are not easy to come by and if you do, four of them will make a big dent in your wallet. Even with 22 ICs on this board, I decided to replace them all except for the SSM2033s thinking that a guy needs a bit of luck at least once in his life. Anyway, 18 IC changes later and the moment of truth arrived.

Although at this stage there was no power to the VCO heaters, I connected my bench supply to the board and pressed my (so far) trusty trigger button and managed to get sounds from each of the VCOs. Applying various voltages to each of the CV - Ins (pins 1-4 on connector 12) produced different pitches albeit different for each oscillator. Also the pitch jumped up and down (but not by an octave) with the octave switches. I was pleased at this but not entirely convinced that the chips hadn't suffered some kind of damage, otherwise why would all the oscillators behave differently? But a noise is a noise and to hope for anything more was perhaps wishful thinking at this stage. There is plenty of room in an MP to build some discrete VCOs and do away with the originals, so all wouldn't be lost if the 2033s were bad - just a lot more work.

OK, it was time to take stock of the situation. I had replaced 32 ICs and got more square footage of printed circuit board operational than not. I was avoiding the big one - problem that is, not board. Earlier, when looking closely at the main 8049 mask coded CPU IC, I saw a fine crack running half way across its back. I knew this was bad news and perhaps thought that it might go away or heal itself if I ignored it and moved on to the power supply - the main murderer in this synth slaughterhouse epic.

Before I started on the KLM 356 processor board I did a bit of research, as I had already decided that an option was maybe to use Paul Maddox's excellent PolyDAC and go the MIDI route but that would preclude the use of some of the MPs key assign modes. It was then that I contacted Greg Montalbano of analogsynthservice.com in the US who sent me over a programmed 8749 replacement for around £25 (it was $30 plus overseas shipping). This is the same chip as the original 8049 except it has an integral EPROM which can be user programmed. I've since seen the binary code on the Zen Mono/Poly website so it's easy to do it yourself if your EPROM programmer supports that chip. So, with new CPU in hand it was time to check out the rest of the logic board.

Changing all the ICs on the KLM 356 board and a 2SA733 transistor that had shorted was the next task and with that done, it was time to test the synth to see if would work albeit still on life support with the bench power supply. With everything now wired back together as it ought, I applied power and tried the keyboard to see if anything, sound or triggering wise would happen. Nothing - it was a bit like Steve Race on 'Face the Music' with his dummy keyboard - a rendition of Bach's French Suite Courante in Cm sounding more like a 1960s typing pool. I also checked the key assign buttons on the front panel and they didn't change state so it looked like the processor wasn't scanning any switchgear, keyboard or otherwise. This assumption was only half right as the key assign switch scanning was cured by changing IC2 (74LS174) even though it had previously been changed. It may have been a faulty new part or it was out of spec. Why is IC2 and IC3 the only ICs that are socketed on that board? Anyway, that only left the inactive keyboard and it didn't take much to realise that the keyboard was on shared data and address lines that other switches worked OK on so could it be the keyboard itself? I've seen a lot of these membrane type key switches give problems but never one where every single note was out - but that is what the problem was - every single note was out. Removing all the rubber contact strips and then cleaning the gold plated contacts on the printed circuit board and the black conductive rubber 'pips' using isopropyl alcohol, cured the problem perfectly.

Although the keyboard now worked, there was something very much amiss. Scaling, tracking, calibrating? If the synth was working perfectly before the previous owner discharged the contents of the National Grid into it, then why was the calibration so far out now? I was still very suspicious of the SSM2033 ICs and convinced that they were faulty. However it always pays to completely ignore what previous owners say about a synth - *"honest guv', it was working fine before I ran over it in the car"* could really mean *"there was a fault with it and so I turned every trim pot I could find and it got worse - it was then that I decided to reverse over it in the SUV in a fit of frustration".* I was to discover later that my Mono/Poly had been a victim of trimpot butchery at some stage.

Before carrying out a full calibration as given in the service manual and still worrying about those SSM2033s, I thought it was about time to do something about the power supply as I was still operating from the bench supply. I replaced the 110 volt mains transformer with a 240 volt transformer of similar dimensions - this in itself was a bad move as I will reveal later. Moving on to the power supply board KLM-376, it was in a bad way with burned-out components as well as all the semis. trashed. The M5230 IC is difficult to source and I don't like the design of the supply insomuch as that there is no protection whatsoever in the event of overvoltage, short circuit or low flying hang gliders. The + and - series regulator transistors have to sink around 14 volts at about half an amp (more on the -15V) and run very hot indeed especially with the inadequate heatsinking. So, the plan was to just get the power supply up and running as quickly as possible and design a new one to be fitted at a later date.

I used the same original transistor arrangement for the + 15 and -15volt rails and used a fixed 78L15 regulator as a stabilised source for the +15v which gave an actual 15.3volts (calibration states + or - 0.5V) and a variable LM337L regulator with a 10 turn trimpot to set the -15v to within the required + or - 0.01v. These new components were easily accommodated on the existing board once the old components were removed. The existing arrangement to provide the +5v was used using all new components but with a ten turn trimpot used to make the adjustment to within 0.01v easier when setting up.

The power supply works fine although the power transistors on the 15 volt lines run hotter than I'd like and there's no real protection. It will suffice until the new improved PSU is built. It will be super accurate and have very fast built-in overvolts protection.

The final job was to look at the board (KLM-398) that controls the offset voltage to the VCOs and the board (KLM-357) that controls the heating current in the SSM2033s. The two TL072 ICs had blown on the offset board and the two 4558 ICs had bitten the dust but the four 2SD794 power transistors were OK on the heater control board. After changing the ICs I connected the plug to the board and checked that the SSM2033s were getting warm. They certainly were.

It was at this stage I thought that I'd better look into the architecture of the Solid State Micro SSM2033 - I wasn't familiar with the chip having cut my teeth on discrete VCOs and then Curtis chips. Looking at the datasheet showed that the negative supply on pin 2 had to be fed via a series resistor of 620R to reduce the current thus allowing the on board 8v zener to maintain a steady 8v. Was this one of the reasons that the ICs hadn't blown? Any series resistance and zener combination has to increase the odds of chip survival in a fry-up. OK so that explains the negative rail but the datasheet shows that pin1 goes straight to the positive rail which is +15v. So maybe the +15v rail didn't go into a massive overvolts situation and only the -15v and +5 volts rail did. All conjecture and maybe faster ICs took the brunt of the surge and shorted out more quickly than the 2033s could respond; either way it was still looking promising for the 2033s.

It was now time for the calibration as per Korg's service manual. Mmm. Getting the power rails correct was easy enough - they have to be within plus or minus 0.01v for the -15v and +5v rails and within 0.5v for the +15v rail. Next up, the key assigner adjustment. This needs an accurate DVM that can resolve to 3 decimal places. With the 'Tune Point' jumper in place on the KLM-356 board, set VR1 to give 10.583 volts at pin 1 on connector 27 (CV1 Out). This is done with the transpose switch set to 'Up'. Next, set VR2 to give 0.000 volts this time with the transpose switch in the 'Down' position. Finally, adjust VR3 to give 5.250 volts with the transpose switch set to 'Normal'. OK, this went smoothly but I noticed something whilst making the adjustments - all three trim pots were fully clockwise before I adjusted them - a pattern to be repeated later on.

Next the offset voltages for the four VCOs needed setting - this is done on the piggy back board to the VCO board. The manual doesn't make it clear where this is measured and gives 4 colours for each VCO which I presumed referred to the wires coming from the little board. This wasn't the case, or wasn't with mine anyway. Just measure the voltage on connector 39 on pins 1,3,5 and 7 accordingly and set the respective trimpot for the lowest to zero reading you can. OK, with that done it was time to calibrate the VCOs. There have been postings regarding this recently and there's little to add except that I didn't adopt stretch tuning. This is procedure I used: Set VR103 to give 55Hz on bottom A at 16', set VR102 to give 440Hz on top A at 16', set VR101 to give 440Hz on bottom A at 2' and set VR104 to give 3520Hz on top A at 2'. This is repeated with the respective trimpots for all 4 oscillators. Now here is where my earlier comments come into play again - every trimpot for the VCO pitch and tracking had been turned fully clockwise - which shows that you should never take anything on face value or trust the previous owner's story that "it worked perfectly OK until.... "

The fact that the trimpots had been set fully clockwise actually causes a headache when trying to calibrate because if you start from that point you can't bring in the top A at 2' - it is always sharp. The four trimpots are relative to each other to some degree and the only way to calibrate successfully is to start with each of the trimpots in the centre position to start with. I wish I'd discovered that earlier - it would have saved a lot of time and having to listen to those tones over and over again drives you crazy! Anyway the really good news is that everything calibrated perfectly and the VCO chips are fine. A testament to the Solid State Micro design of these ICs. A very clever and versatile chip indeed.

The very last problem only came to light upon reassembly of the Mono/Poly. I screwed everything back together and started to play it and there was significant mains hum present but only when the VCA was 'open' - no notes played everything was fine, play a note and you get a mains hum. It wasn't nasty hum, just an induced kind of hum. Cutting a long story short, it turned out to be the new 240v mains transformer inducing hum into the VCA/VCF board simply through proximity. I put the original 110V mains transformer back in its place and used an external stepdown transformer and everything is now fine. The 240v transformer although oriented the same way as the original and in the same place must have a stronger magnetic radiation than the original. As a final precaution I found an American mains lead which I wired in so it's impossible to plug it into a UK supply and only into the adaptor.

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