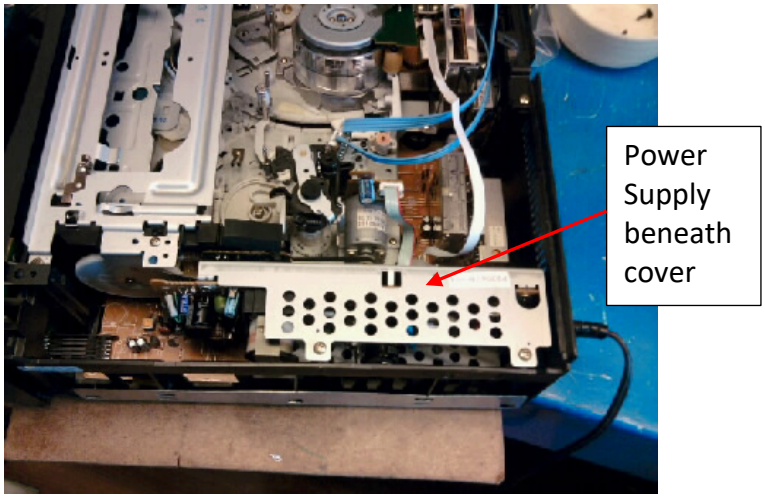
From The Workbench

Servicing a faulty Video Cassette Recorder with a Switch-mode Power-supply

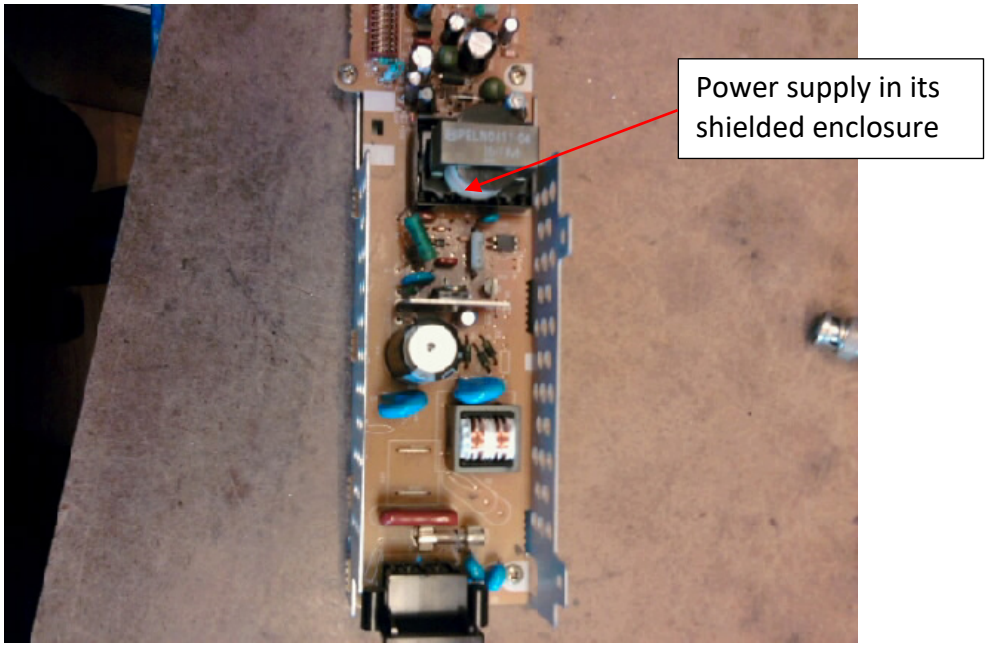
This V.C.R. Stopped working with no display and no proper sound except for a very faint whistle, coming from the power supply.

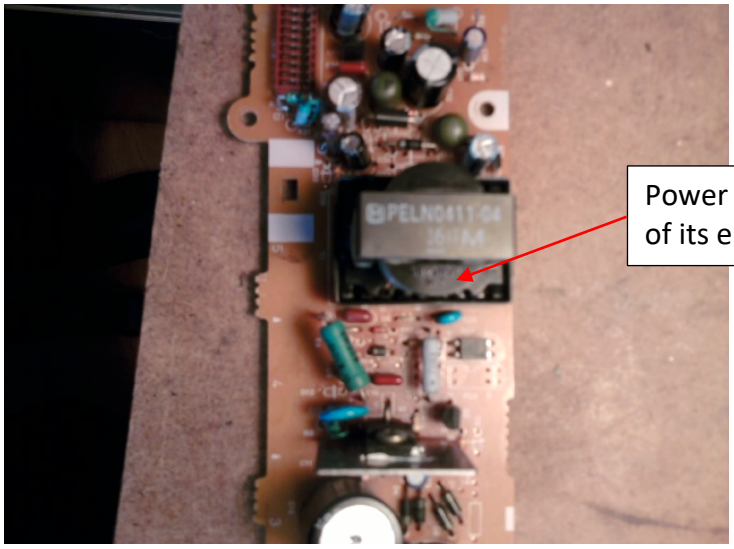


This VCR has a 2pin appliance plug for the mains and the Power-supply is housed in the shielded section closest to the observer. (See photograph above.)

Step 1: Remove the 5 retaining screws and lift this module from its socket assembly on the mother board.

Step 2: After the power-supply has been removed from the unit, the power-supply must be removed from its shielding.





Step 3: After its removal from the shielding, observation revealed a liquid on the VCR side of the power supply. This liquid appears to have come from one of the electrolytic capacitors.

Step 4: First, clean the board using a little Handy-Andy and a small brush and gently clean this area of the board, then gently rinse this area under a slow tap or use a spray bottle with clean water. Then carefully dry it with a hairdryer on low heat so as not to overheat semiconductors.

Step 5: After this leaky capacitor discovery, I replaced all the electrolytic capacitors.

Step 6: On my circuit-diagram, C3 is a 470uF x 16 V capacitor, and that was the one that had leaked! The general reason for such a leak is that when the AC is applied to this device, it causes it to overheat and so it just gorges the electrolyte out, shutting the power supply down. For AC to be applied to C3 then most likely, diodes 1 to 3 have become leaky. Why three diodes have been placed in parallel I do not know!! I used just one diode - a 1 Amp fast recovery diode.

Step 7: I checked the starting resistor and it was okay. This is a Switch mode power-supply hence they are efficient, but their radio interference can be bad, so most amateur radio operators dislike them.

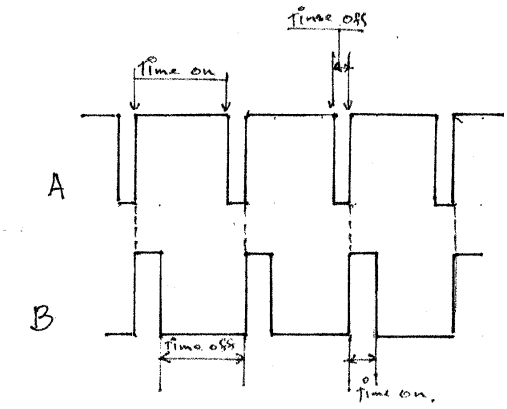
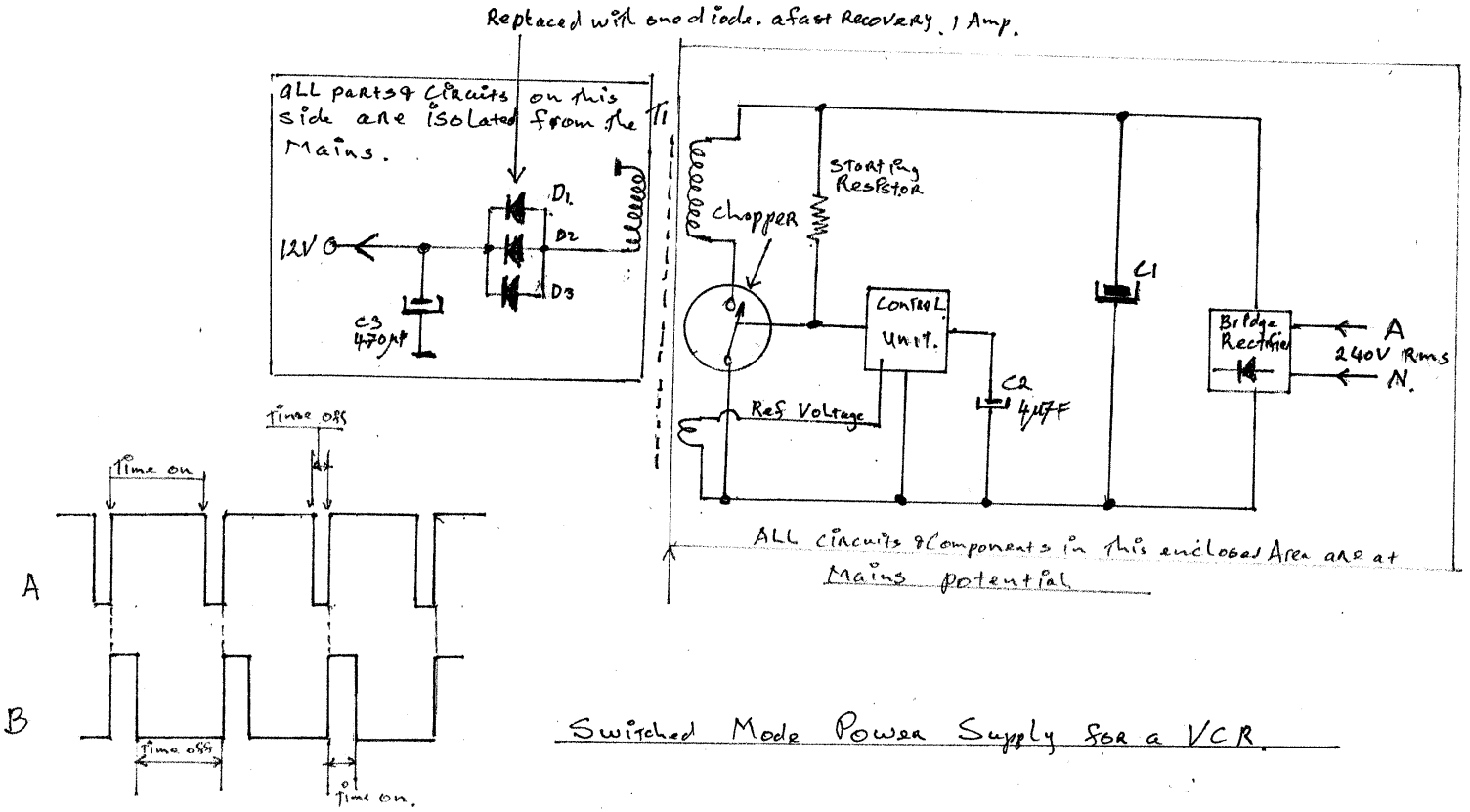


Diagram A

Step 8: When replacing electrolytic capacitors in a Switch-mode Power-Supply (S.M.P.S.) always choose proper switch-mode grade and those that operate at a maximum temperature of 105°C. These capacitors are especially constructed to be of low inductance hence they work at higher frequencies. Audiophiles love such devices in their power supplies, but how do SMP's work?



Switched Mode Power Supply for a VCR.

Diagram B

How does the Switch-mode Power-supply work?

From the block diagram above:

1. The mains comes in (fuses and mains filters are not included for simplicity) then to a bridge rectifier and into a reservoir capacitor (marked C1) this is between 100 to 470uF at 385v.
2. The positive rail goes to the primary winding of T1, through the winding to the "chopper" and then to the negative rail. ***I have drawn the chopper as a switch rather than transistor to get the idea across.***
3. The toggle goes to the starting resistor and the control unit.
4. On "switch on", the starting resistor starts the sequence. The toggle closes and energy is stored as a magnetic field in T1 primary from now on the control unit takes over and opens the toggle.
5. This collapsing magnetic field induces currents into the two secondary windings. One winding is rectified and filtered by the VCR. The other winding is used as a reference voltage to set the 12 V output.
6. If more voltage is required to hold the 12V, the control unit holds the toggle on for longer, and the time off is less (as in diagram A.)
7. The reverse is true for less voltage. The toggle is more off than on. (See diagram B.) This difference is called the "mark space ratio".
8. Because of the higher running frequencies 18kHz and beyond, T1 is a ferrite core, not a big heavy iron core.
9. For a given power, less copper is needed for the windings, keeping the unit small and compact.
10. T1 has separate primary and secondary windings, thus giving the unit mains isolation. But some SMPS are not isolated and fortunately, these are rare. For example, the AWA 4K TV. In the United Kingdom it was known as the 2000. It had a live chassis, but when it was built here, an isolation transformer was added so as to meet Australian regulations.
11. For further information refer to the circuit description for the Philips colour television chassis K9A - pages 32 to 38.