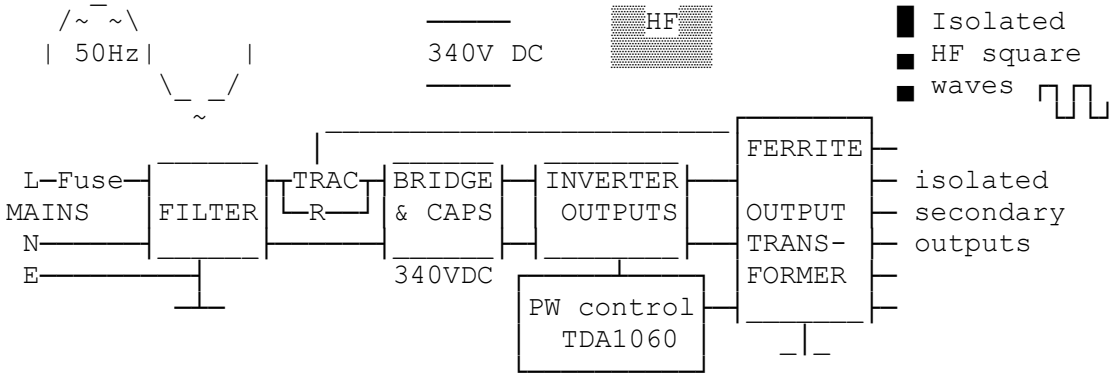
Reactance Controlled SM PSU

By G8MNY (Updated Dec 10)
(8 Bit ASCII graphics use code page 437 or 850, Terminal Font)

I came across a different type of SMPSU recently. I think it was from a mini mainframe computer. It looked quite conventional at first sight until I saw that it had isolated independent output regulation per rail! How did they do that?

THE MAINS BIT

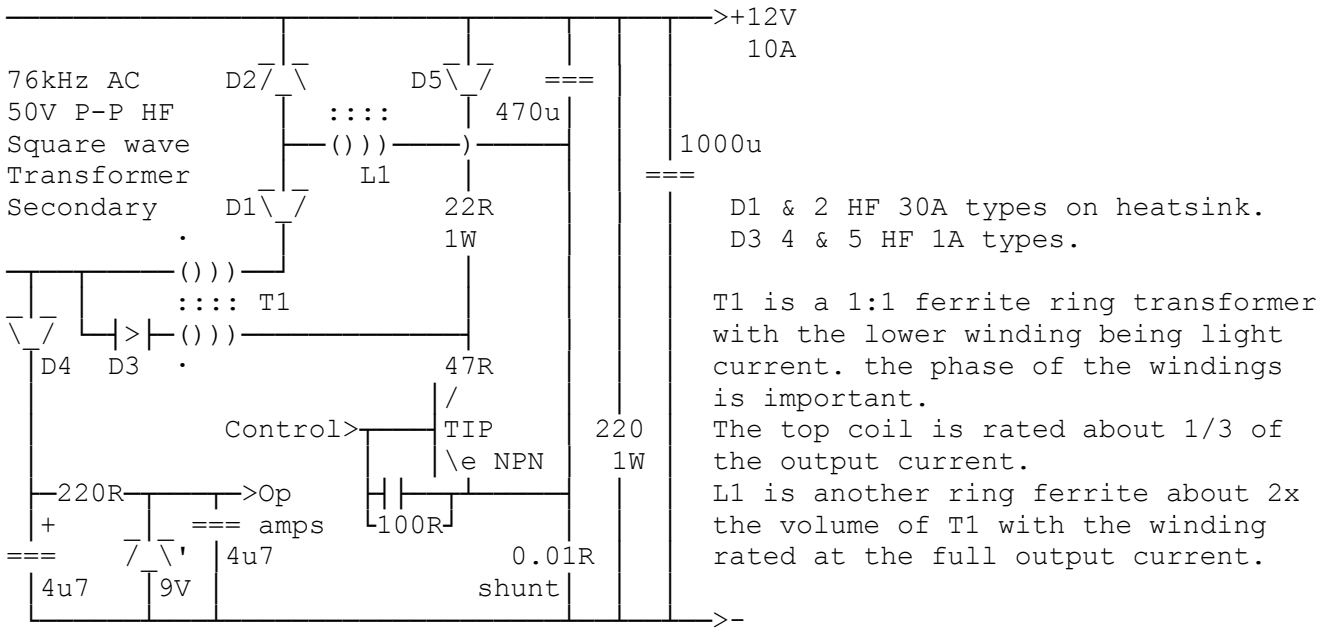
This was push pull @ 76kHz to a large ferrite transformer (600W), it had pulse width control that seemed to just control the maximum overall power available.



The main soothing caps (2x 1000uF & option for more off board!) are charged up via the series mains R, & when the output starts up an isolated winding is used to drive the mains live triac on, to short out the series mains R.

SECONDARY PCBs

There is one of these per output rail, a semi-linear 24V 1A PCB & 3 controlled reactance regulators for 5-7V @ 40A 2x 10-19V @ 10A, all isolated independent of each other, their circuits are very strange...

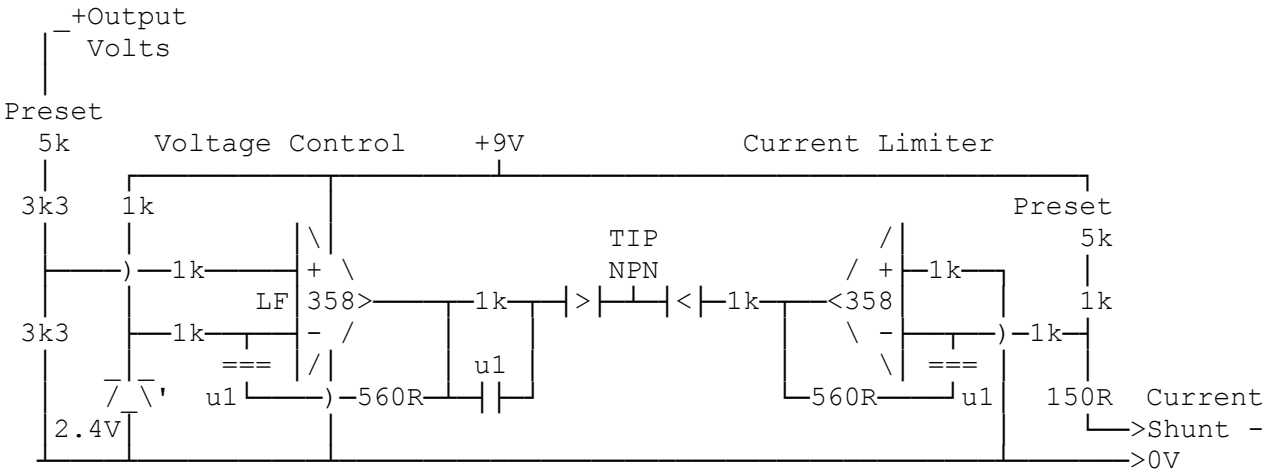


Ring transformers with no air gap are easily saturated with DC & then there inductance drops to almost zero!
The negative input swings go through T1 & D1 & Via L1 to the output. This tends to saturate T1 as current flows into L1. On reversal L1 discharges the stored energy via D2 to the output capacitors, increasing the output voltage. Applying load current increases the saturation of T1 & increases the drive into L1.

Positive input swings via D3 & T1s lower control winding & 56R are applied to the TIP transistor's collector. So turning on the NPN will produce some current in T1 in opposition to the saturation, e.g. de-saturating it. This allows far more voltage to appear across T1 & thus there is less output.

This means that 2W of control power controls 200W of DC output & all done with ferrite rings & diodes @ 76kHz.

OP AMP CONTROL
This is straight forward...



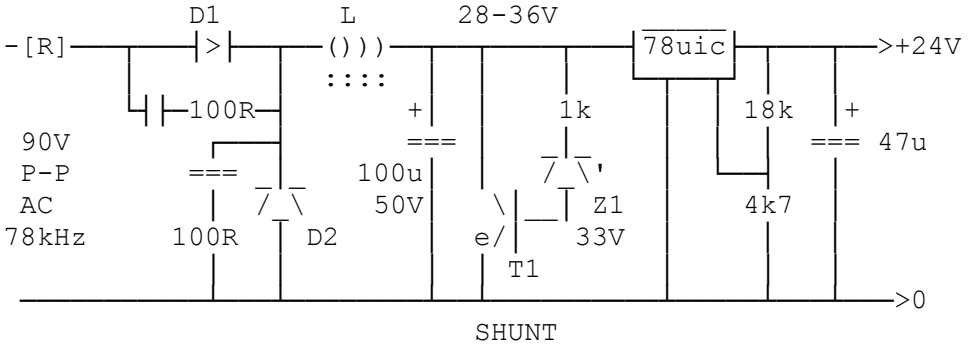
Voltage control is done with a sample of the output compared to a 5V reference zener. The op amp is slowed down with CR output to -ve input to avoid HF QRM & loop instability, but some speed up is applied to the output feed drive T1 base Note that op amp high, means output low!

Current limiting is almost a mirror image using the 0V input feature of the LF358 op amp. The more negative shunt input is taken to the negative op amp into to produce a positive output to stop the over current. The limit value is set up by applying current to the series 150R to give a small offset voltage, that equals shunts voltage drop at the limit current.

For diagram simplicity remote sense options are not shown, but they use 100R to extra terminals for remote sense leads, & these are connected to the relevant voltage reference points of the circuit not the shown local output terminals.

On the 5V PSU the current diode D2 is doubled up & on a larger heatsink. As 5V is used for logic chips, there is also an overvoltage SCR crowbar.

SEMI LINEAR REGULATOR
It used a swing choke L (ferrite pot core) & RF efficiency diode D2 in the input. This reduces the voltage & doubles the current available.



Due to the off load peak voltage of the choke input a shunt regulator Z1 & T1 adds a load when it is over 33V. The adjustable 78 regulator has inbuilt current limiting @1A.

EFFICIENCY
Although this SMPSU seem very complex, it all runs fairly cool, so I guess it is quite efficient really.

MY USE
As the PSU may be HF noisy, I do not intend to use it for ham radio work, but @ 27V for battery charging of 4 large 6V 200AH bus batteries. So I have uprated the two 10A 12V PSUs to 15A @ 13.8V & added a heavy relay to join them together powered from the 24V linear PSU (now has a supply [R] to reduce heat), so there is no battery load at all on no mains. I added LEDs & driver transistors driven from the curent IC to to indicate current limit.

The 40A 5V PSU has been set to 6.75V for boosting a 6V battery if needed.

Why don't U send an interesting bul?

73 de John G8MNY @ GB7CIP