

Converting Computer PSUs

for amateur use

by

Pat McGuinness G4FDN



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Synopsis

- **How and why I became interested**
- **A brief introduction & history of SMPS**
- **Safety precautions**
- **Identifying the different types of PSU**
- **Testing computer PSU's**
- **Overview of PSU architecture**
- **Identifying key components**
- **Stopping interference & noise**
- **Getting different voltages**
- **Common component failures**



Disclaimers & Acknowledgements

- No originality claimed
- Most of the “pioneering” work on converting computer PSU’s for amateur radio use done by Udo Theinert DL2YEO
- Earliest article in RadComm in July 1992
- Also covered again by Ian White G3SEK Nov & Dec 2004

How and why I became interested?

- **Being given a really heavy (> 40lbs) PSU for 4m linear using a 4CX150 valve**
- **Started thinking about possible alternatives more suitable for use in a shared domestic environment**
- **Started experimenting with computer PSU's to see what they could be made to do**

SMPS versus linear PS

■ Advantages

- Lower cost
- Lower weight
- Smaller size
- Higher efficiency

Disadvantages

- More complex
- Not straightforward to fault find
- More RF noise unless precautions taken

A brief history of SMPS

- 1952 first transistor “ringing choke” PSU
- By late 1950’s self oscillating, push-pull, & drive push pull SMPS had been developed with feedback & regulation
- 1960’s intro of PWM control
- 1970’s SMPS in consumer products, TV’s, VCR’s
- Late 70’s first home computers with SMPS



CAUTION
Risk of
electric
shock



**DANGER
OF
DEATH**

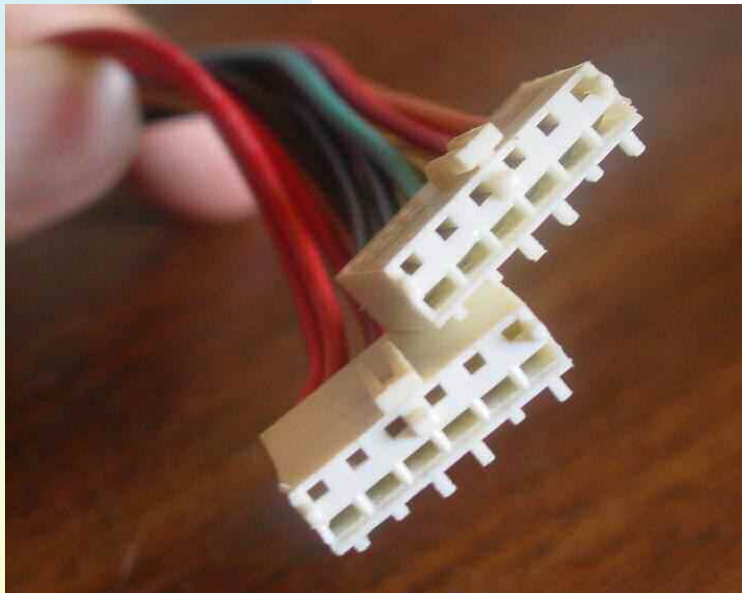
Safety Precautions



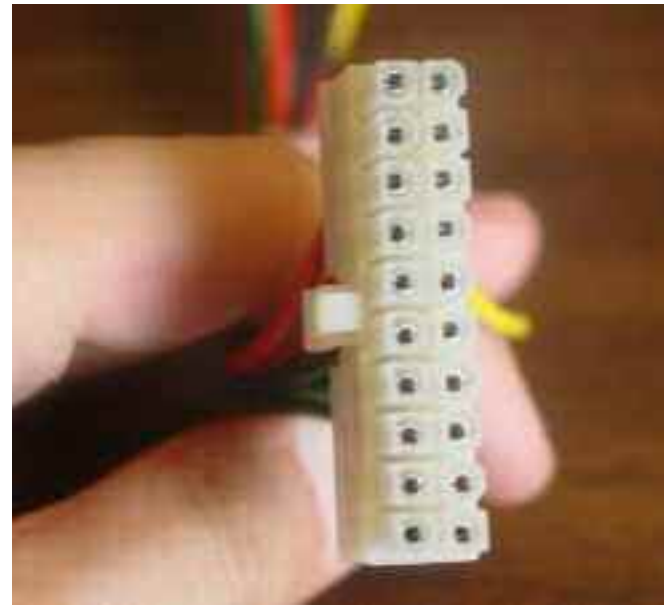
- Danger of **FATAL** electric shock - 240V AC, 340V DC
- Danger present when power lead disconnected due to charge storage in electrolytic capacitors
- Only connect or move test leads with power disconnected
- Don't work on PSU's when tired or distracted

Identifying different types of PSU

- By motherboard connectors
- By case outline and label details

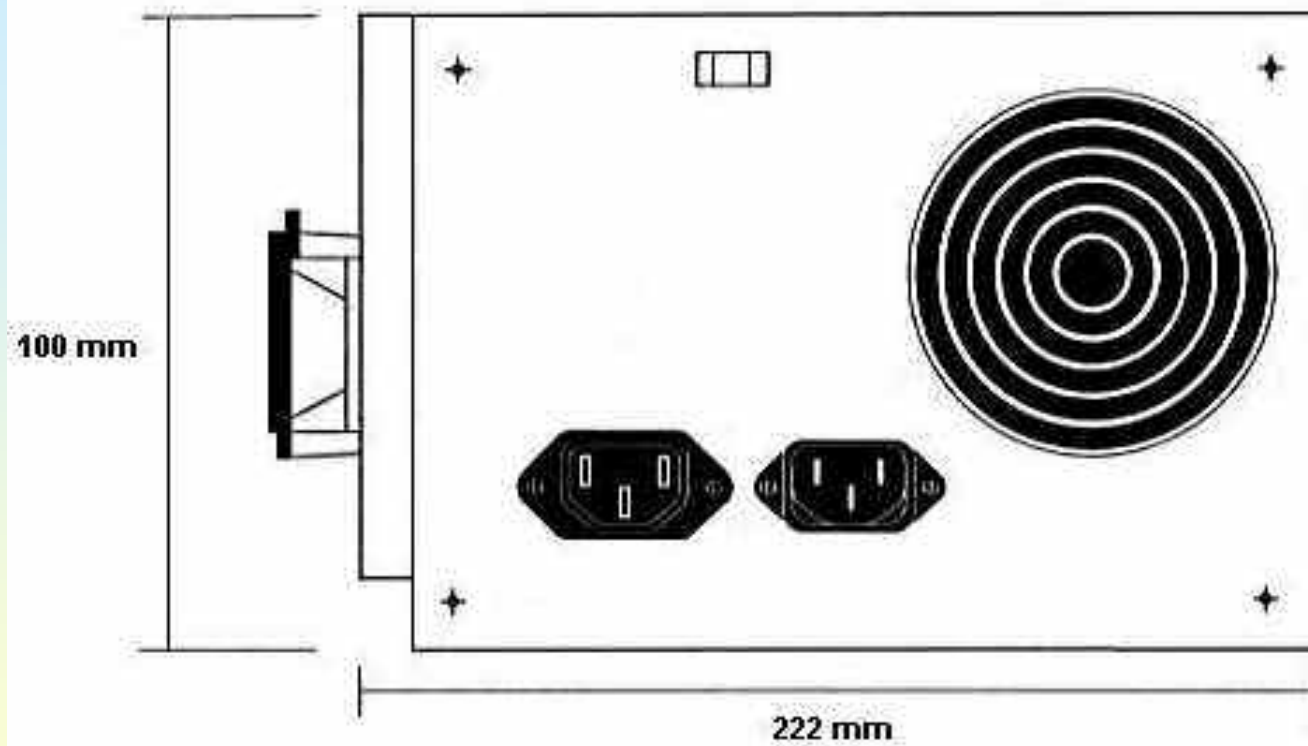


PC, XT & AT

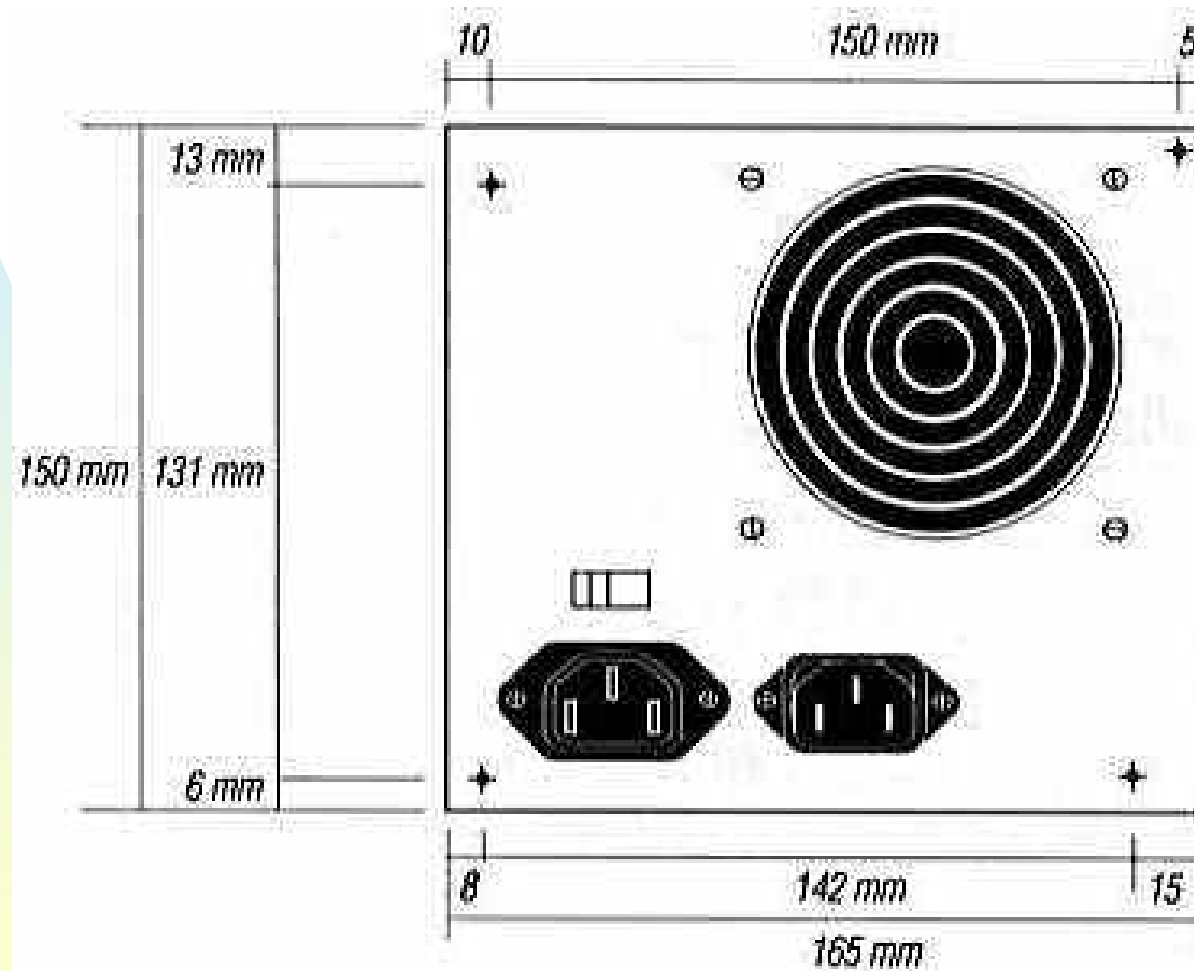


ATX & Later

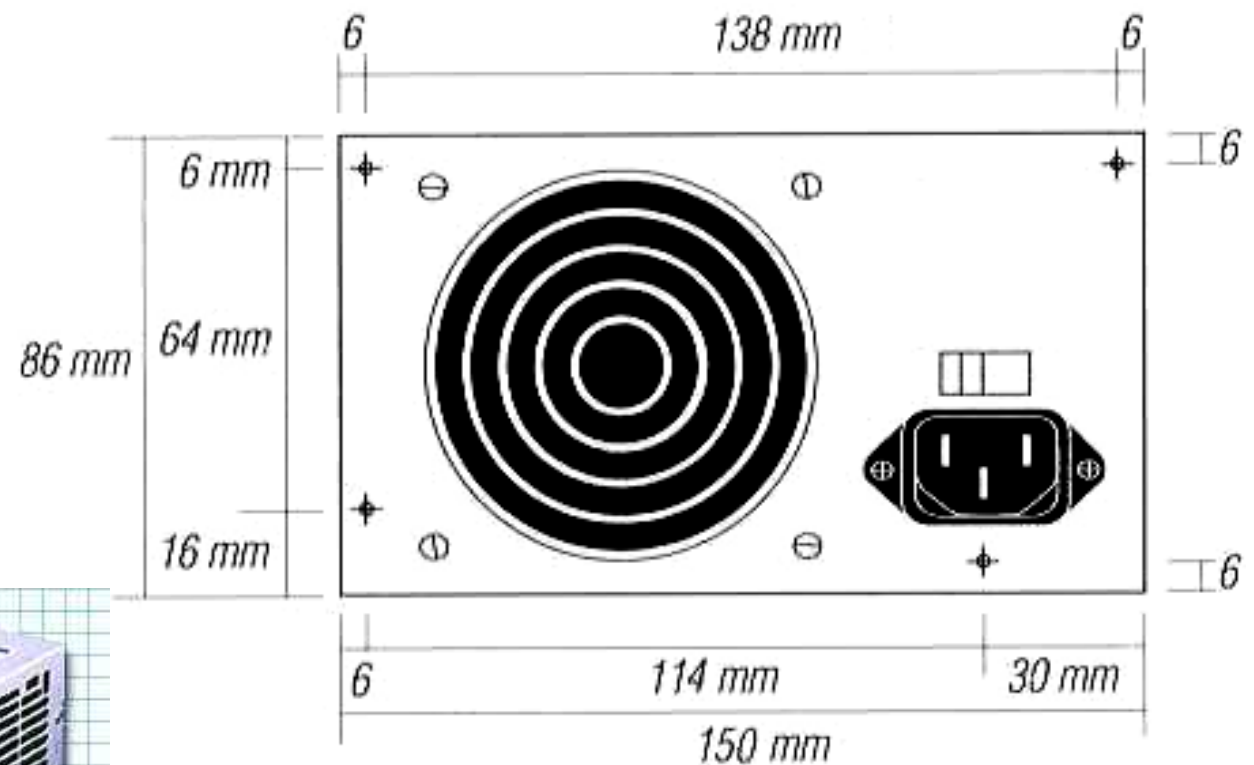
PCXT PSU case outline



'Baby' AT PSU case outline



ATX PSU case outline

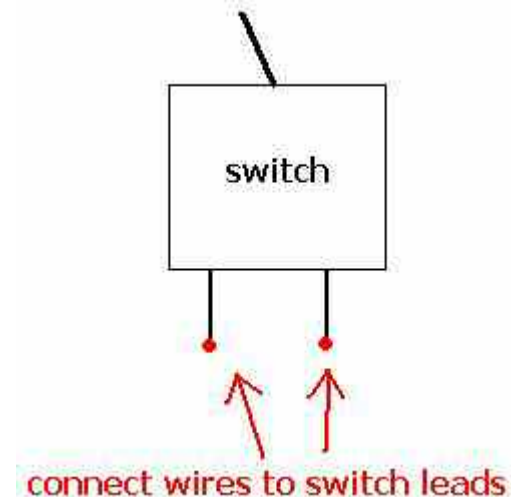
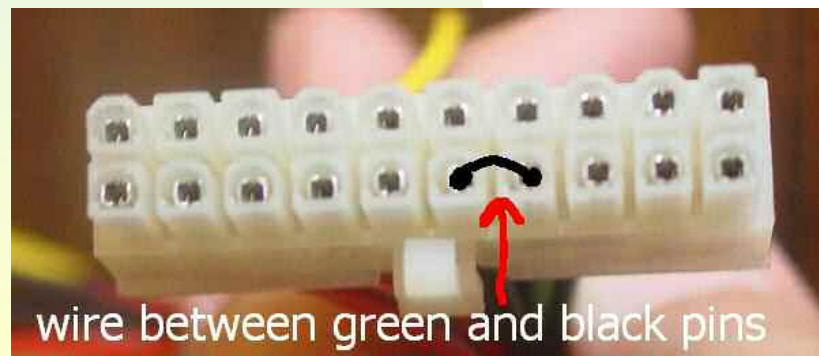


SFX-Micro ATX PSU case outline

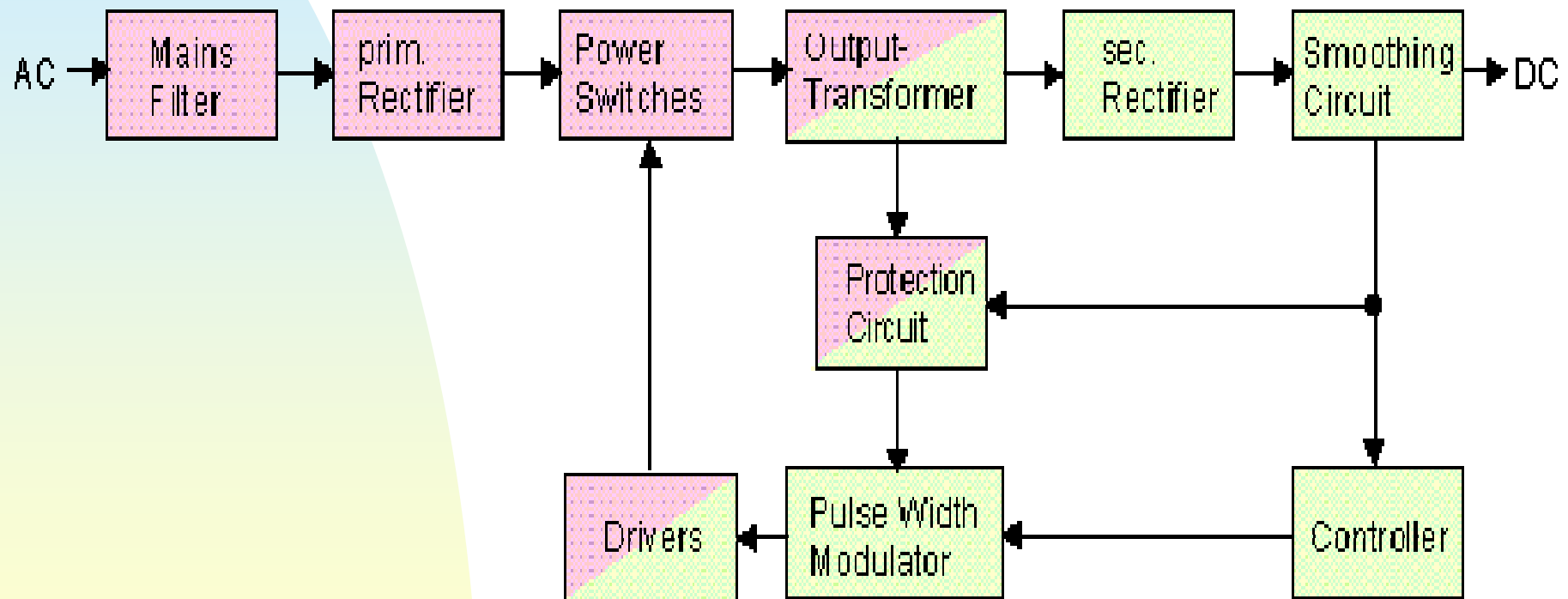


Testing computer PSU's

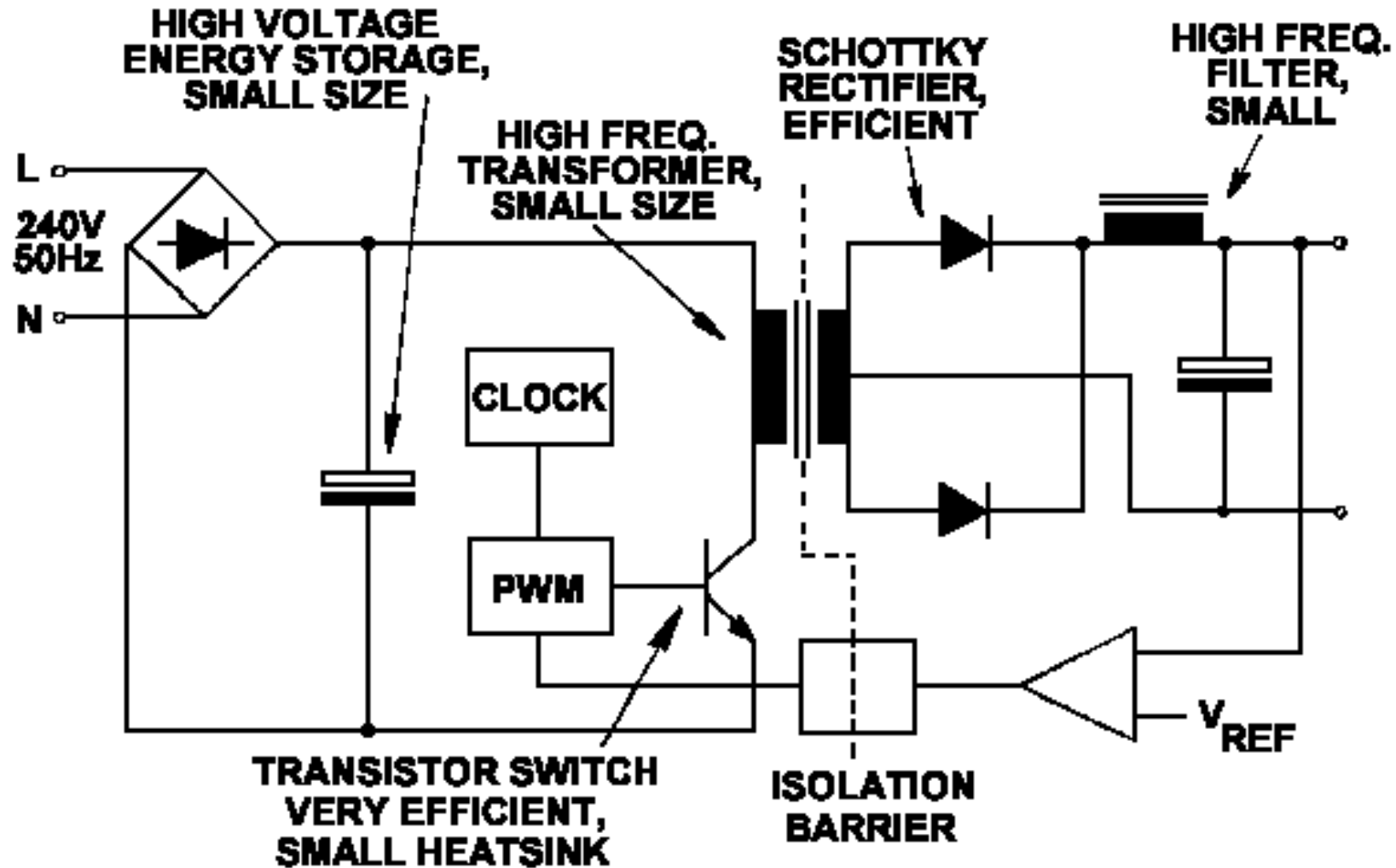
- Connect a small load to +5V and +12V outputs ~ 0.5A to 2A, typically. Car stop or indicator bulbs are useful as they give visual response
- ATX and later PSU's need a switch or link on the motherboard connector to switch on



Computer PSU architecture



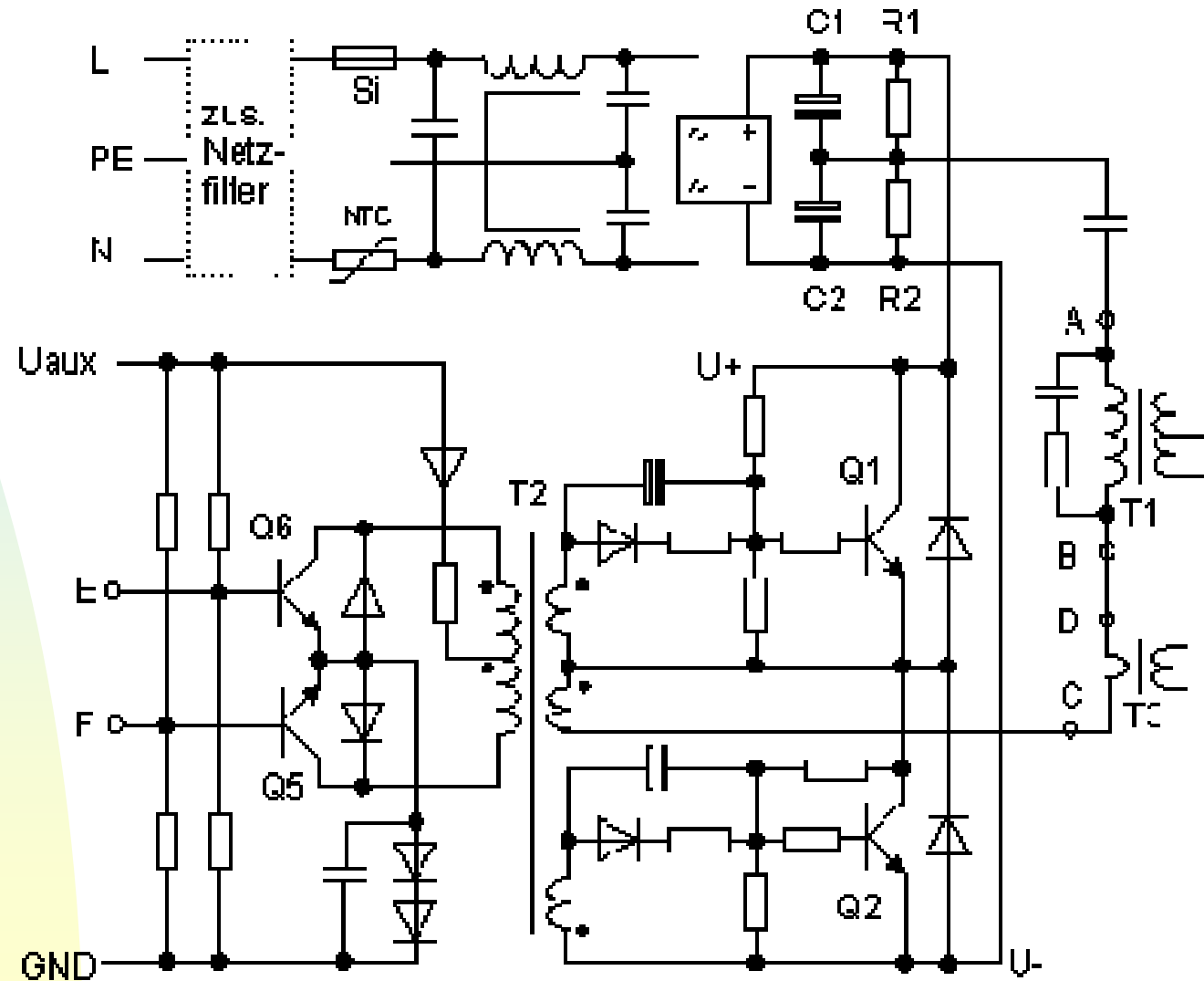
Basic circuit



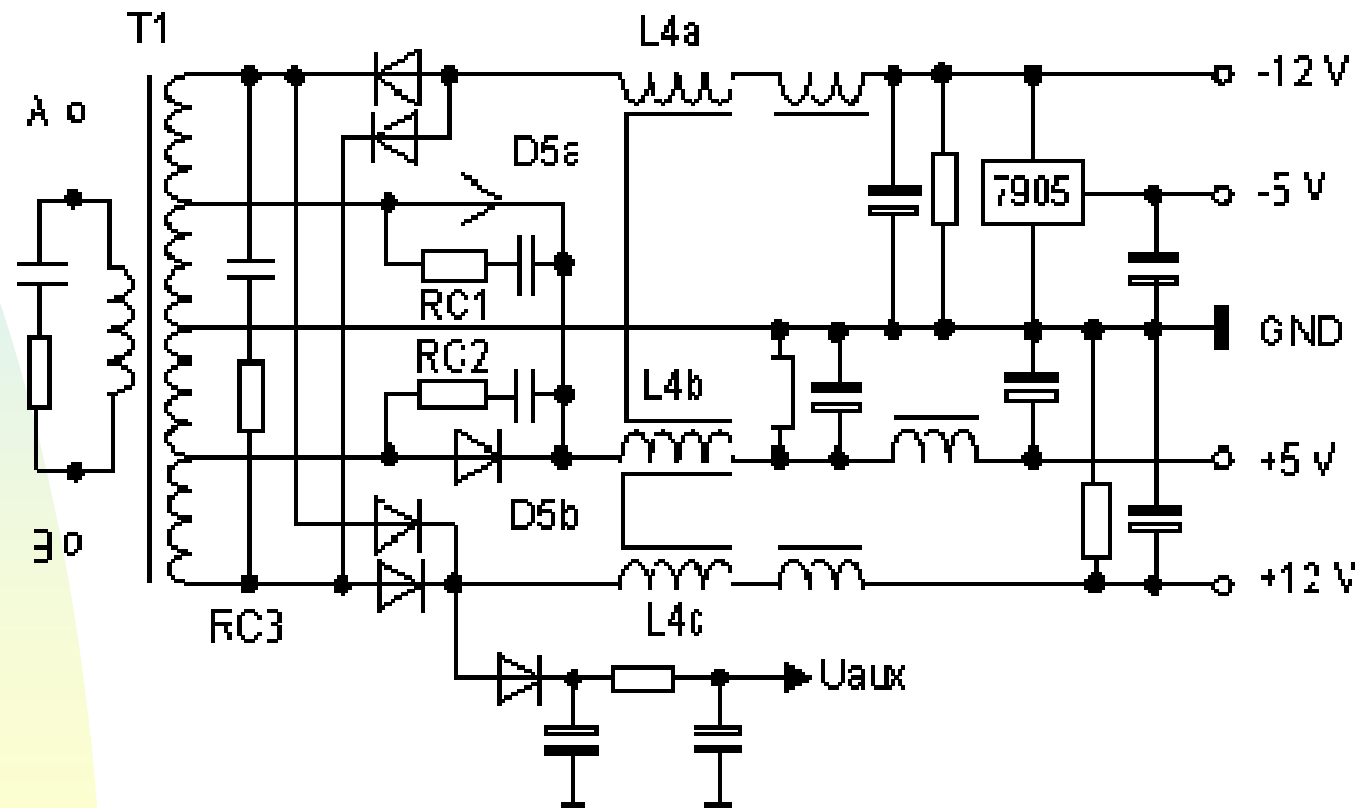
Basic circuit operation

- After switch on, circuit operates momentarily as free running oscillator
- The PWM IC then takes over and syncs the oscillator.
- An error amp compares the voltage at 5V/12V output and adjusts the width of the pulse.
- Increased loading makes pulses wider, less loading pulses narrower.

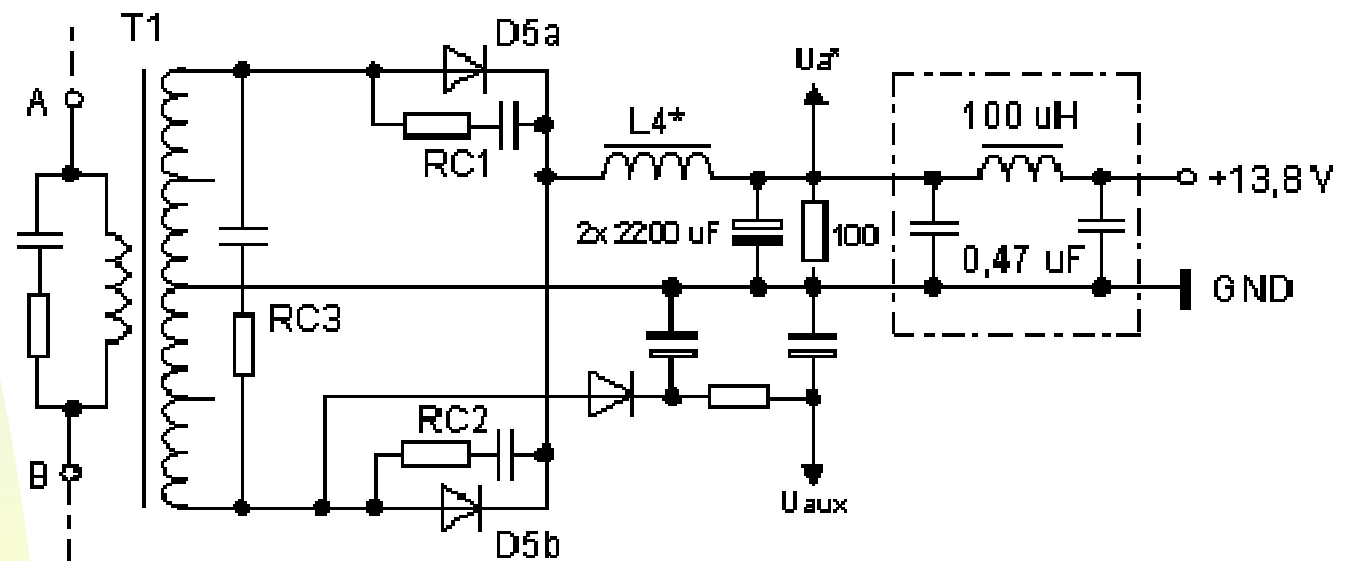
More representative circuit part 1



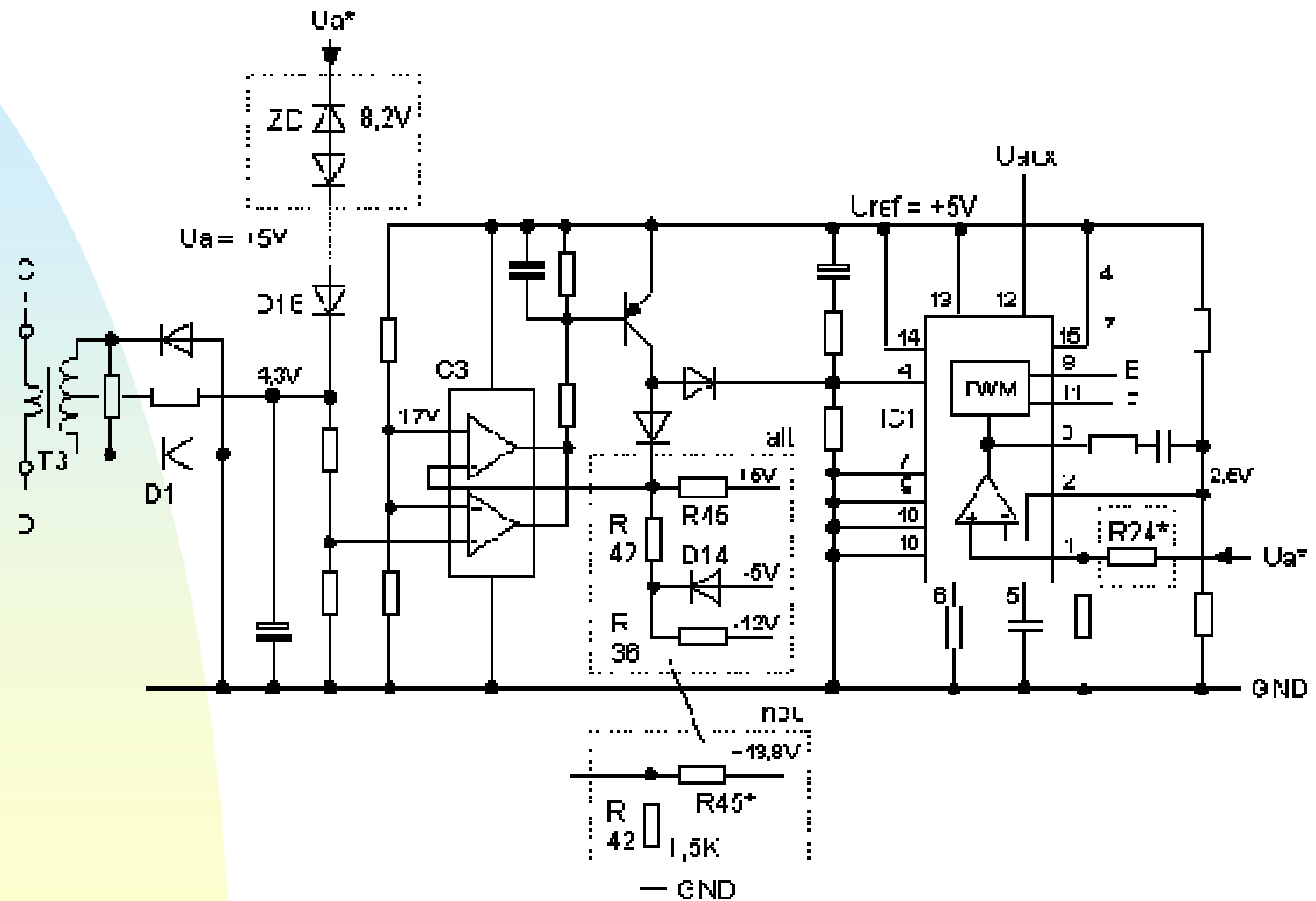
More representative circuit part 2



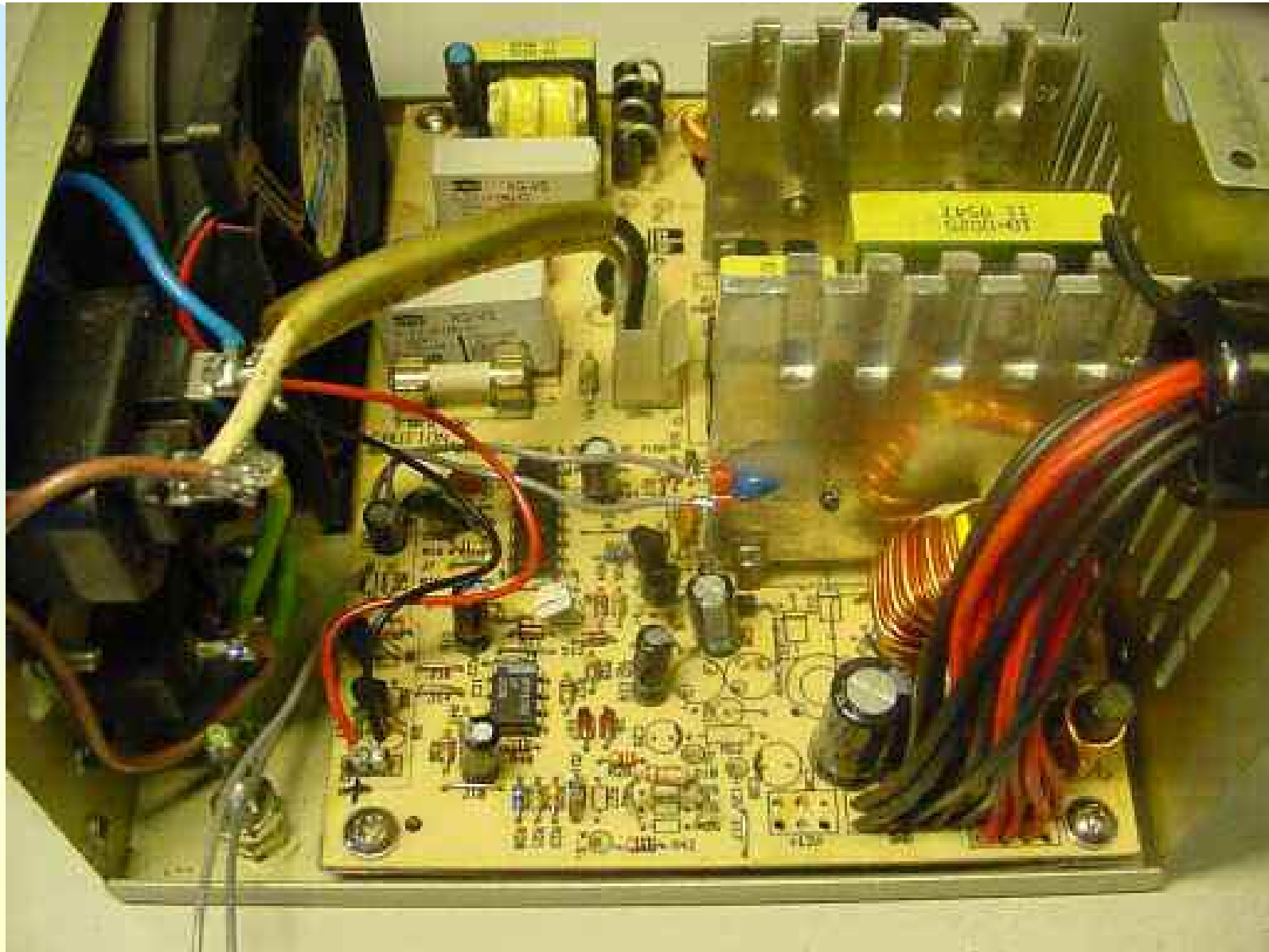
Modified output circuit



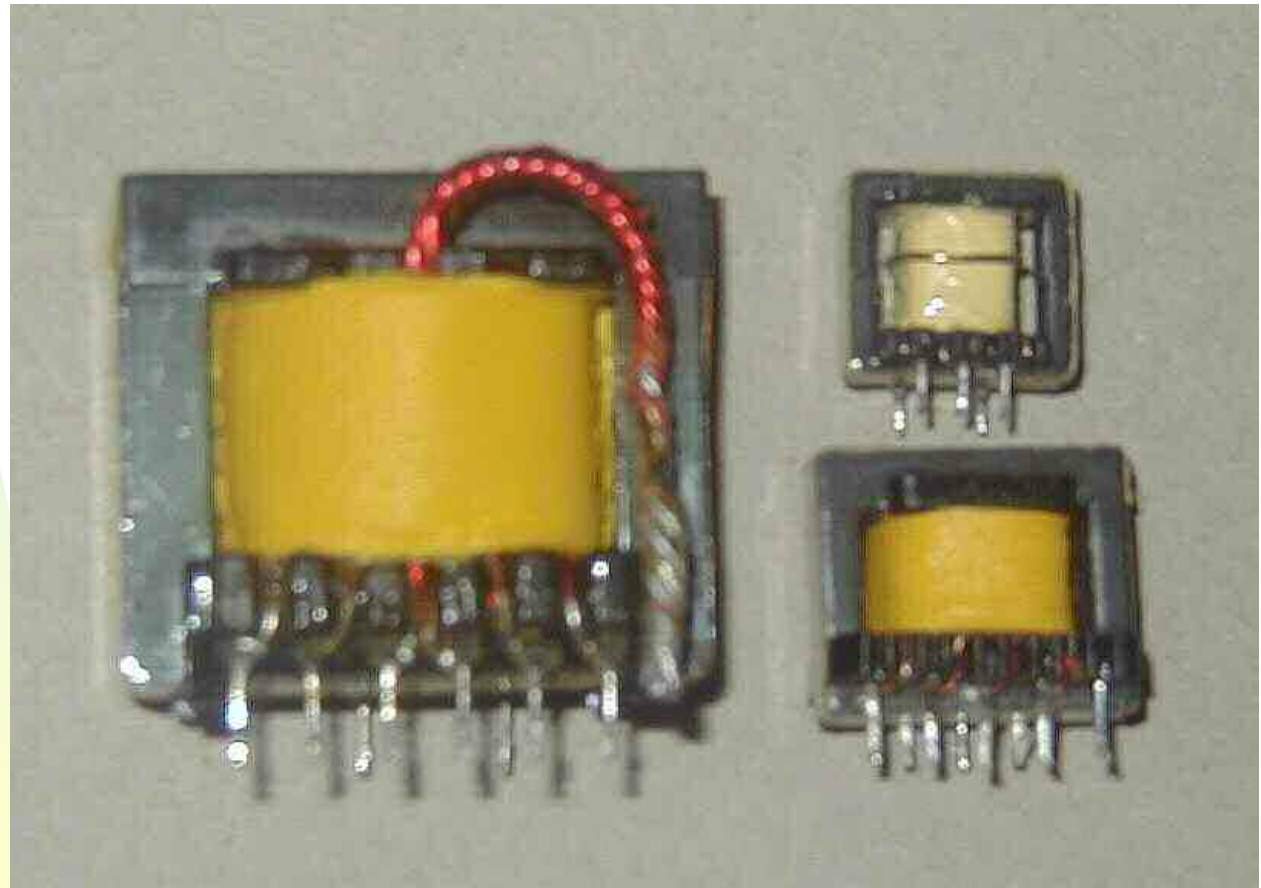
Control circuitry



Inside the PSU



Identifying the components





Stopping Interference and noise

- ***Use a combined encapsulated IEC socket and filter instead of the usual unfiltered socket***
- ***A better PI filter on the DC out***
- ***Common mode choking on mains in and dc out if necessary***

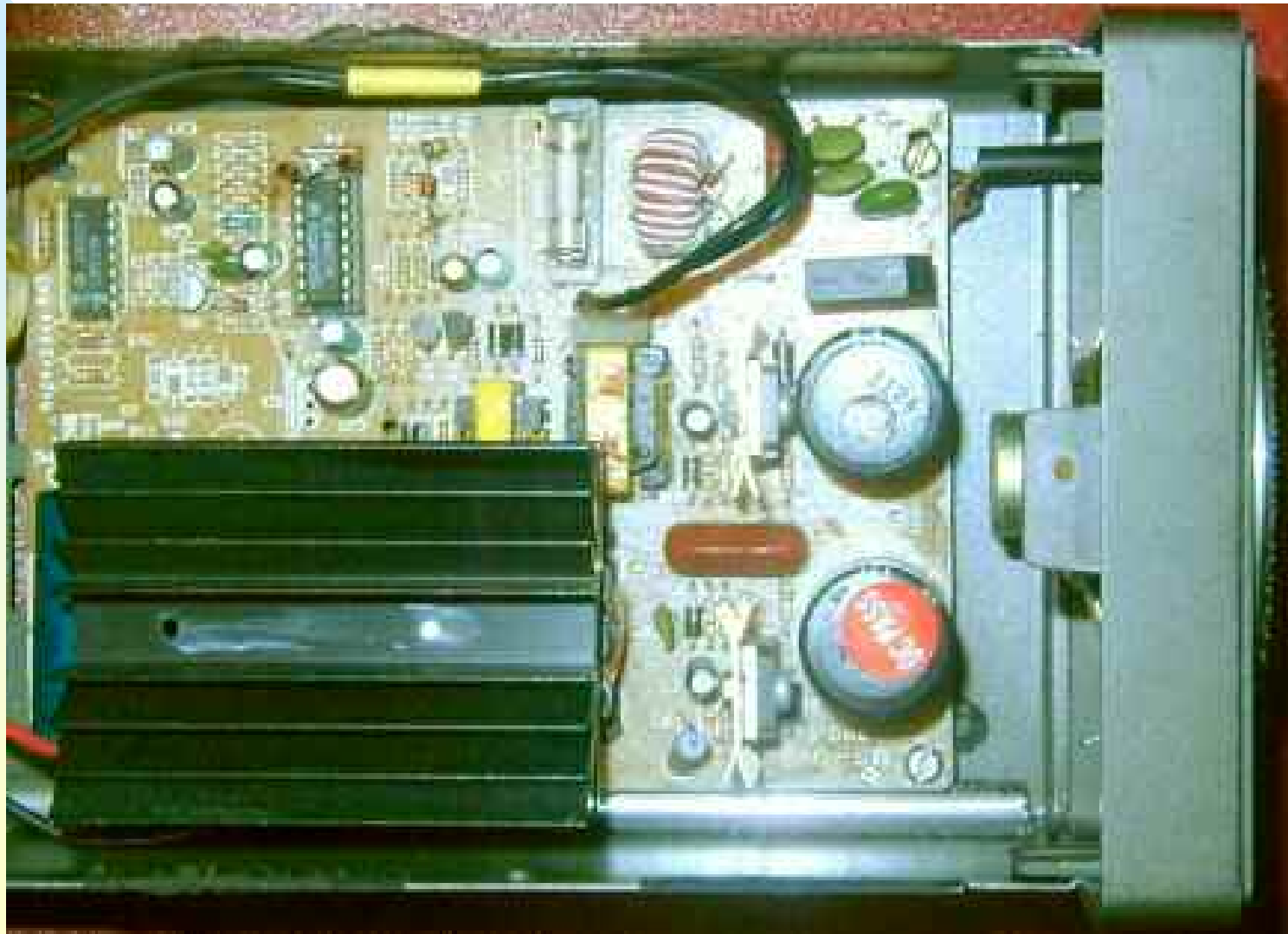
Improving regulation and smoothing

- Doubling the value of the reservoir capacitors on the HV and LV sides approximately improves the regulation by a factor of 2 and ripple by even more.
- The PC tracks can have excessive volt drop - bypass leads help
- Replace output leads with ones suitable for your application

Improving cooling & acoustic noise

- **Replacement case - transceiver speaker cases are ideal**
- **Meatier heatsinks for transistors & rectifiers can obviate need for fan**

Modified computer PSU inside Transceiver speaker case



What voltages are easy to get?

- **24-28V**
- **12-14V**
- **6-6.6V**
- **9-10V**

What's involved in the mods?

- **Swapping over rectifiers**
- **Disconnecting unwanted outputs**
- **Replacing feedback potential divider resistor to get wanted V**
- **Replacing full-wave centre tap rectifier configuration for bridge (e.g to get 6.3V from 3.3V part of circuit)**

What if you want HV DC?

Solution?


- ***Rewind or replace the main transformer***
- ***Replace the rectifiers with HV high speed recovery types e.g. BY289***
- ***Replace output capacitors with HV ones***
- ***Modify feedback potential divider***

Rewind Transformer or Replace?

- Most transformers are doped or lacquered and it is necessary to 'dissolve this to get at the windings. Most have 'E' type cores
- Secondary windings may be separate or a single winding with taps.
- If you have a suitable LF ferrite toroid then this is a good replacement - easy to wind - single layer per winding.

Common Component Failures

- Fans - failure causes overheating then secondary component failures
- Electrolytic capacitors
- Switching transistors
- On/off switches
- Rectifiers
- Surge limiter



Questions?
Tea?
The End?