

# Repair Defect Power Supply

## Repair Defect Power Supply

### Log

01/05/2023 17:47

Initial removed Power supply check:

Set point	Actual value
5.05 V	5.0625 V
5 V	4.998 V
15 V	15.088 V
- 15V	died on Check

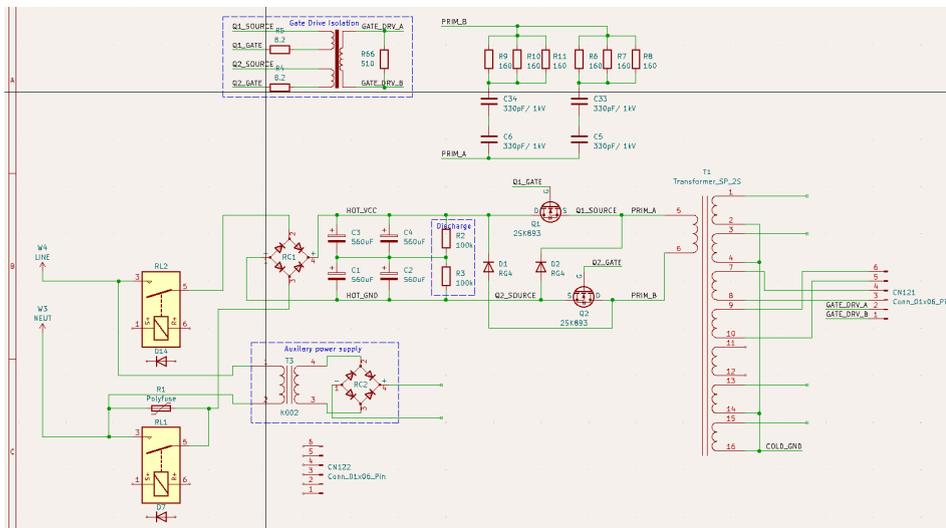
Dies after some where between 5min - 1h 20min depending on cooling and initial temperature. Guess: Some semiconductor starts dying.

10/05/2023 22:00

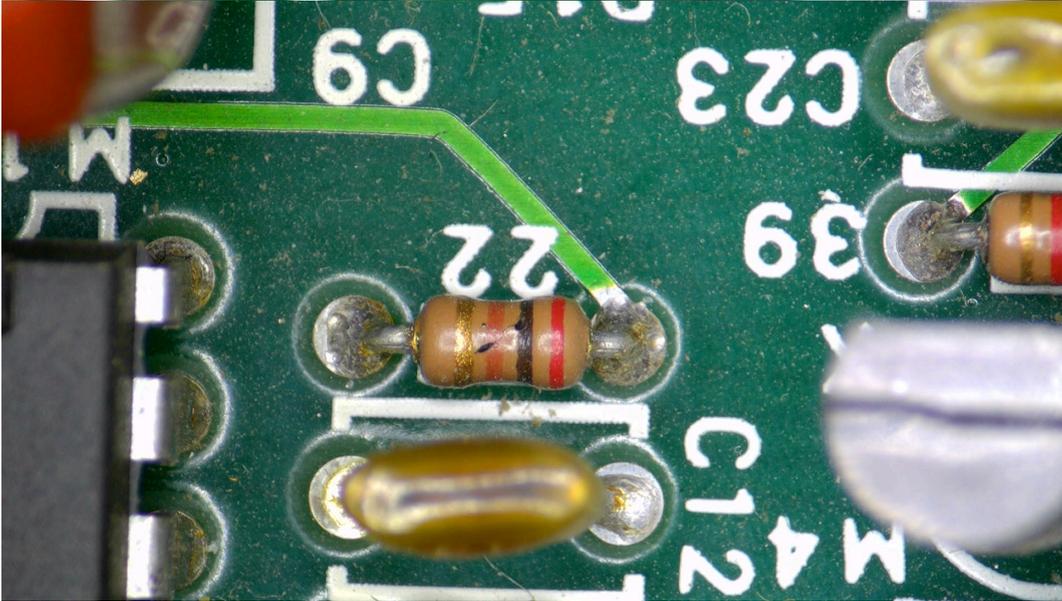
Started reverse engineering the circuit diagram in KiCad.

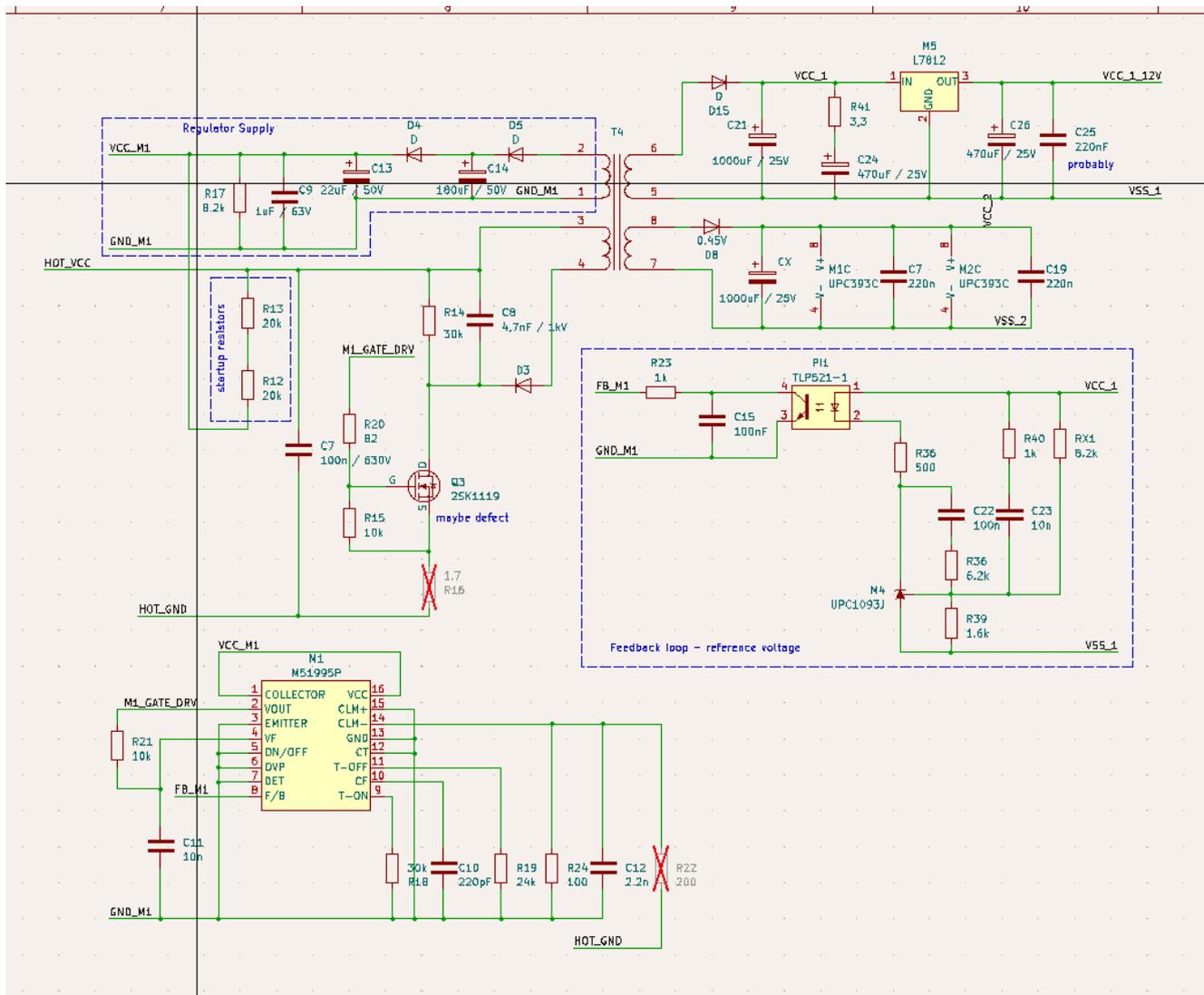
11/05/2023 22:50

Beginning to sett fruits of my reverse engineering:



12/05/2023 21:36





14/05/2023 11:18

Test of Q3: seems working. R16 is dead. Even though I replaced R16 with with 2.2 & 7.5 Ohm in parallel, but the first reversed engineered SMPS didn't start up. In the full circuit diagram it's apparent that the relay RL2 needs to be switched on before this one can power up.

20/05/2023 12:00

Verified circuit diagram at input section - there was a fault. The main switch mode power supply was directly connected to the mains voltage and not via a relay. The relay RL2 is meant to pull the hot ground to line neutral after startup. The resistor/thermal fuse R1 looks defect (should have 20 Ohm measures over 1 MOhm) and got bridged for further tests. R1 is limiting the inrush current while initial startup and gets later on bridged by realy RL1.

Replaced defect source resistor 1.7 Ohm with two parallel resistors.

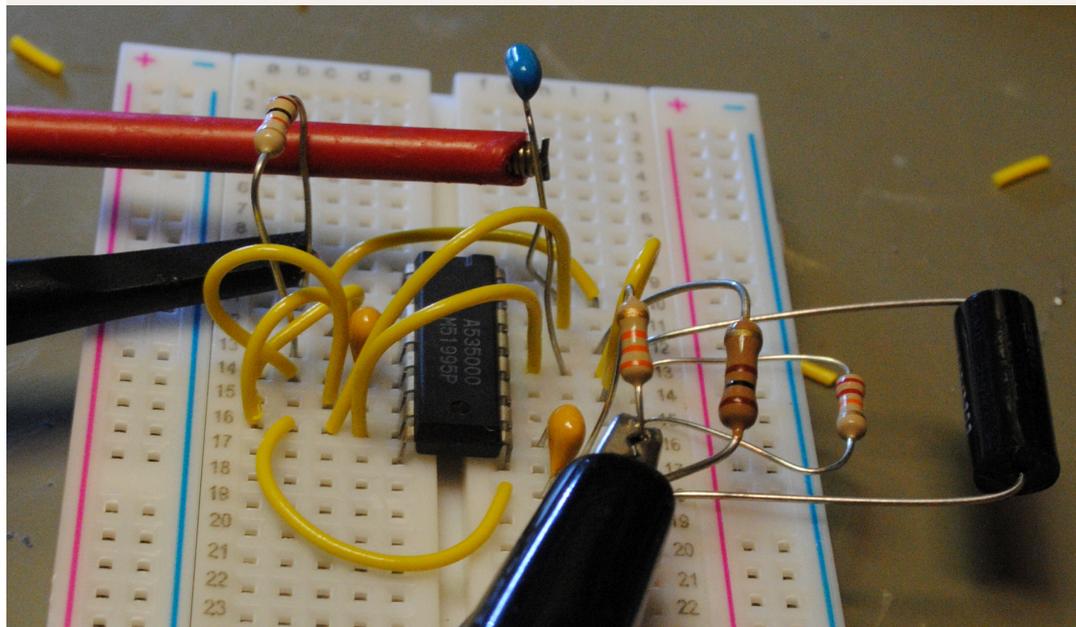
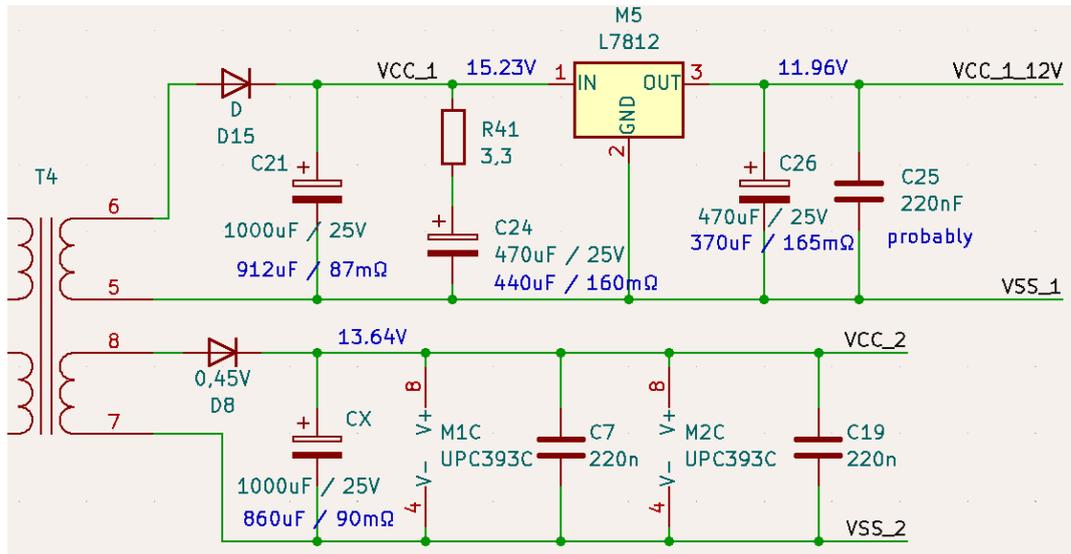
23/05/2023 23:00

Replaced the current limiting set point resistor connected to M1.

Tested Q3 with transistor tester and it works. But even with a proper startup voltage the switch mode controller M51995P (designator M1) doesn't pulse on the output. Ordered spare parts.

30/05/2023 22:04

Create a test fixture for M51995P. Tested the new M51995Ps they are working. Verified that the unsoldered unit from the power supply PCBA was indeed defect. Verified the power supply around M1 works and has a stable output voltage. Measured the ESR and Capacity values of the capacitors.



31/05/2023 23:43

Placed known good SMPS controller in the power supply PCBA. Power supply starts up all output voltages present. Testing parallel loading of three of the output voltages with power resistors and electronic load modules. I've seen weird issues regarding connecting loads to the output voltages. It seems like the power supply handles load spikes bad, what would make sense, because the load is connected while startup in the original circuit.

The power supply behaved well while warming up and being loaded.

## Parts

Designator	Type	Datasheet	Short description
	TD62001P	<a href="#">TD62001P.pdf</a>	Seven Darlingtons

Designator	Type	Datasheet	Short description
	uPC209C		Dual Op Amp
	2SA1010	<a href="#">datasheet.pdf</a>	PNP Transistor (-7A / -100V)
	2SC2334	<a href="#">2SC2334_SavantIC.pdf</a>	NPN Transistor (7A / 100V)
	uPC339C	<a href="#">UPC339.PDF</a>	Quad Comparator
	TLP521	<a href="#">TLP521-1.PDF</a>	Photocoupler (1 / 2 / 4)
	HD14081B	<a href="#">HD14081B.PDF</a>	Quad 2-input AND
	uPC358C	<a href="#">C358C_NEC.pdf</a>	Dual Op Amp
	MB3769A	<a href="#">0900766b800c6567.pdf</a>	Switching regulator controller
M1	M51995P	<a href="#">M51995P_MitsubishiElectric.pdf</a>	Switching regulator controller
M3, M2	uPC393	<a href="#">C393C_NEC.pdf</a>	Dual Comparator
M3	MB47393	<a href="#">MB47393.PDF</a>	Dual Comparator
	OP62	<a href="#">webSeihinOP6_ECOenglish.pdf</a>	Thermal Protector
R1	TF10 20ΩJ	<a href="#">202003170925269831.pdf</a> <a href="#">202003170925269831_en-US.pdf</a>	PTC Fuse (250V10A152°C)
Q1, Q2	2SK893	<a href="#">2SK893-InchangeSemiconductor.pdf</a>	MOSFET N-Channel (VDSS=500V / 5A)
D1, D2	RG4	<a href="#">RG4-EIC.pdf</a>	Rectifier Diode
M5	7812	<a href="#">L7800_C.pdf</a>	Voltage Regulator 12V
Q3	2SK1119	<a href="#">0900766b808dc0c6.pdf</a>	MOSFET N-Channel
M4	2SC1093	<a href="#">UPC1093.PDF</a>	Voltage Reference
Q4	SC1815	<a href="#">2SC1815_CDIL.pdf</a>	NPN Transistor
TH1	CW12		Thyristor

## Power requirements

Voltage	Current
12 V	1.0 A
24 V	1.0 A
34 V	0.4 A
20 V	0.4 A

Voltage	Current
-15 V	2.6 A
15 V	3.2 A
5 V	2.3 A
5.05 V	3.8 A

## Replacement power supplies

In case a repair isn't successful, the voltage rails could be replaced with the following meanwell SMPSs. The Line trigger wouldn't work in this case. Presumably it would make sense to use the output filters of the original power supply to decrease the ripple voltage of the meanwell power supplies.

Voltage	Required Current	Type	Provided Power	Size	Comment	Price
12 V	1.0 A	RT-65D	1 A	98 * 129 * 38	Triple Output	-
24 V	1.0 A	RT-65D	1.5 A	98 * 129 * 38	Triple Output	-
34 V	0.4 A	LRS-35-36	1 A	82 * 99 * 30	Single Output	17.99
20 V	0.4 A	DC / DC Conv			From the 34 V	12.49
-15 V	2.6 A	RS-50-15	15V / 3.4 A	97 * 99 * 36	Single Output	21.99
15 V	3.2 A	RS-50-15	15V / 3.4 A	97 * 99 * 36	Single Output	21.99
5 V	2.3 A	RS-15-5	3 A	51 * 62.5 * 28	Single Output	10
5.05 V	3.8 A	RT-65D	4 A	98 * 129 * 38	Triple Output	26.66

Total price: ~ 112