

- Power Supply-

Technical description

Mains power is applied via a filter to the mains transformer Tr 1, whose output is rectified by rectifier GL 1 and fed to the charging capacitor C 10. When the receiver is switched to battery operation, the battery voltage is fed, instead of the output of rectifier GL 1, to charging capacitor C 10. The battery voltage from the rectifier passes via relay contact a (on AUTO.-MAINS/BATT: board) - socket Bu 1 pin 4 b - the MAINS switch - Bu 1 pin 2 b - to charging capacitor C 10 and then via the primary of transformer Tr 2 to the switching transistors T 2, T 4, whose emitters are connected to the negative side of charging capacitor C 10, thus completing the circuit. The current flowing in this circuit is now switched on and off at a frequency of 32-34 kHz by switching transistors T 2, T 4. Regulation is by pulse width control. The voltage induced in the secondary of transformer Tr 2 on switch-off causes a current to flow through the two switching diodes D 8 and D 9. D 9 is connected to a tapping on the transformer and via an output filter to the 5 V output of the power supply.

This 5 V voltage is used as a reference value. If it increases, the conducting time of the switching transistors T 2, T 4 falls slightly; if it falls, the conducting time increases and the 5 V output returns to its specified value; the tolerance is ± 0.2 V.

The pulse width and hence the switching time of the switching transistors is varied as follows:

The 5 V output voltage is fed to the non-inverted input of an operational amplifier IC - C, whose other input is at a fixed reference voltage: The output current of the operational amplifier flows through the diode of optocoupler OK 1 and is proportional to variations of the 5 V output voltage. The diode of the optocoupler controls the relevant phototransistor, which is in turn connected to the switching regulator IC which controls the pulse width determined by R 102 and C 102. The switching regulator IC (output 15) supplies control pulses to the gate of transistor T 101, which is in turn connected via transformer Tr 101 to the base of switching transistor T 2.

The 18 V output voltage is also obtained from transformer Tr 2. The current from the second output of the secondary of transformer Tr 2 flows via switching diode D 8 and the emitter and collector of transistor T 3 to the 18 V output of the power supply. The transistor provides secondary stabilization of the voltage from transformer Tr 2.

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The base of T 3 is driven by the second operational amplifier of IC - C. One input of the operational amplifier is again at a fixed reference voltage and the 18 Volt to be regulated is connected to its second input.

In addition to the 5 V and 18 V outputs already described, the power supply provides a 12 V supply which is also present when the equipment is switched off. This is produced by an independent second switching power supply consisting of switching transistor T 103, transformer Tr 102 and control transistor T 104. Transistor T 103 and the two windings 6/7 and 5/8 of transformer Tr 102 form a free-running generator with a frequency of approx. 30 kHz. Bias of the transistor T 104 is set by zenerdiode D 103 and changed with varying 12 V output voltage. Thus this voltage is held at a constant level.

If the mains supply or battery voltage falls too low or fails, a warning signal must be supplied to the microprocessor in the receiver; at the same time, the power supply outputs must hold long enough for the processor to go into a defined quiescent condition. This information is provided by the power failure pulse. This is done by monitoring the voltage at the charging capacitor C 10, which may be in the range 18 to 40 V depending on the supply voltage. The failure pulse is supplied by IC - B at about 20 V, controlling the gate of T 102 and passing via optocoupler OK 2 to the relevant output of the power supply. The voltage level at which the power failure pulse occurs must have a very narrow tolerance, as, firstly, it must not shut down the connected equipment too early and, secondly, the supply voltage must not have fallen too low, as the stored energy will then no longer suffice to keep the output voltages constant long enough (specified value: 1 ... 10 ms).

The outputs of the power supply are overload-protected. The overload sensor circuit monitors the collector-emitter saturation voltage of switching transistors T 2, T 4. An overload causes this voltage to rise and switches off the control circuit IC - A via Tr 1. T 2, T 4 are then cut off. After a time, IC - A is re-enabled via T 1 and the power supply unit again produces its output voltages, which however, is immediately disconnected again if the overload is still present. In this case there is a characteristic alternation of connection and disconnection of the power supply's 5 and 18 V outputs.

NOTE

The power fail pulse is not used in the RX 1001 M / RX 5001 / EX 1010. Monitoring of supply voltage is done on the CPU II board.

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The 12 V switching power supply is protected by R 126, a PTC resistor. If the current through transformer Tr 102 increases, the temperature of R 126 rises and its resistance therefore increases; the current is thus limited.

High voltages with reference to earth on the battery lines may be hazardous to transformers Tr 2 and Tr 102. These are connected to ground by voltage-dependent resistor R 129, whose resistance falls with increasing voltage.

Automatic mains/battery switchover

Mains voltage monitoring is accomplished on the auto mains/batt board. Secondary voltage of the mains transformer Tr1 is rectified by means of the diodes D53 and D54 and filtered with C58. The voltage is fed to the inverted input of the operational amplifier IC F, connected as a comparator, via the voltage divider R51/R54. The reference voltage is determined via D58, this diode is supplied from the voltage at the capacitor C10; or from the battery voltage via the diodes D51/D52, which are connected as OR gates. In the event of a mains failure the voltage across C58 drops faster than the voltage across C10. If the output voltage after voltage divider R51/R54 drops below the reference voltage, the output of the operational amplifier status jumps from LOW to HIGH, so T51 is turned on and the two relays A and B operate. When the contact is closed by relay B, the LED BAT on the front of the receiver lights up. The two relays can only switch if there is actually a battery supply with sufficient voltage. The series circuit R55/C60 in the negative feed back branch of the operational amplifier prevents oscillation during the switching process.

The three output voltages are compared in IC - G with a reference voltage generated by D 59. The 12 V is being tested for low voltage, 5 V for high voltage and 18 V for low and high voltage. If any voltage is incorrect, a fault signal is given by IC - J.

Finally, here are some notes on possible faults and their causes. As already stated, a short circuit or overload of the power supply is indicated by a continual ON-OFF output.

The following points should be noted when measuring the outputs: If the 5 V output is unloaded (current approx. 100 mA) - e.g., if only a high-resistance voltmeter is connected - usually nothing can be measured at the 18 V output, because the regulation does not work at low current.

If the 5 V is absent, the 18 V can also not be measured unless the output filter is defective.

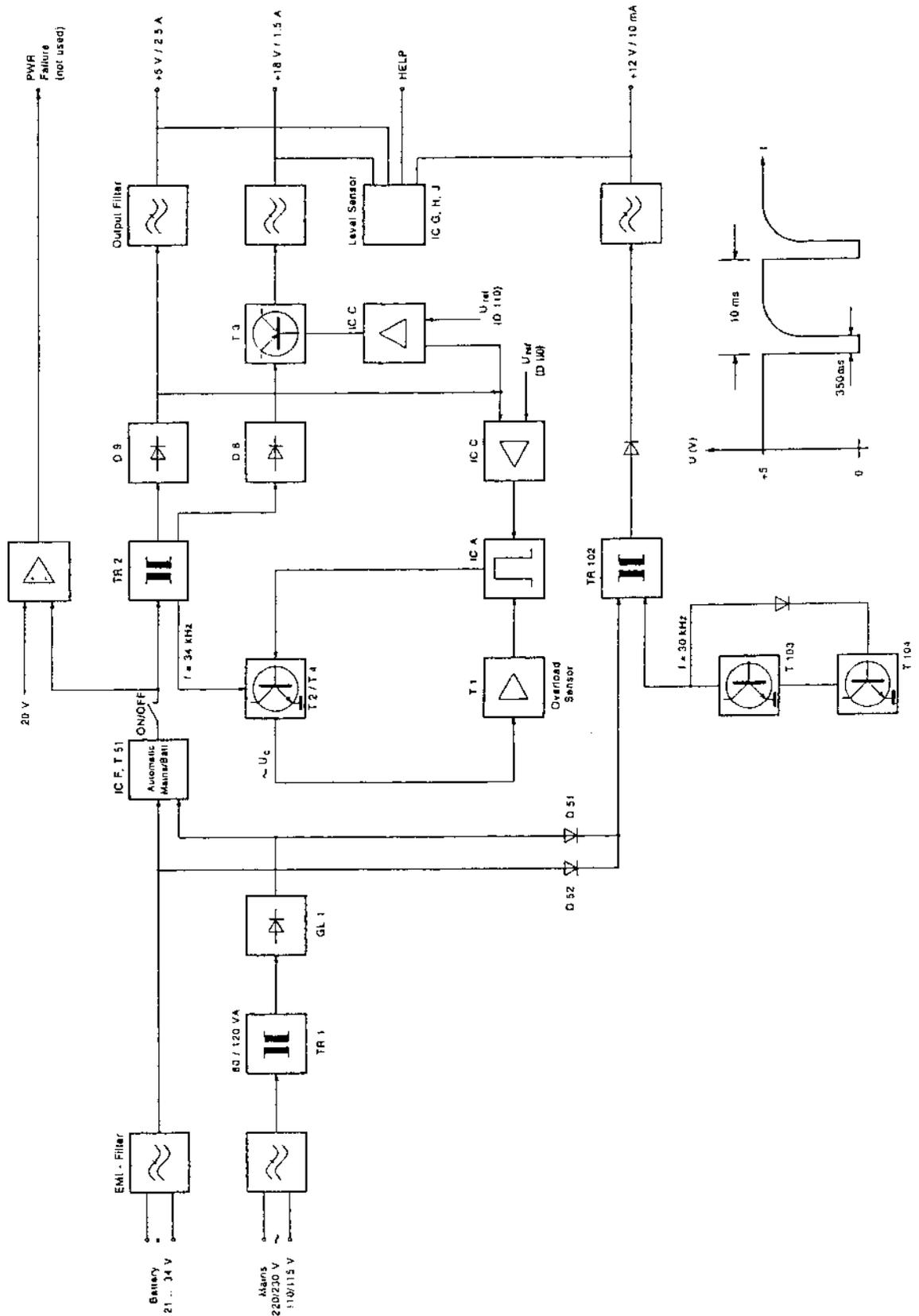
-Power Supply-**WARNING**

The power supply should never be connected to the receiver when switched on unloaded. When unloaded, the 5 V could go as high as 8 V (as the regulation does not work in the unloaded condition), or at least to a value above what is permissible for 5 V ICs.

Hence, if neither the 18 V nor the 5 V output is measurable, the next check should be to measure the control pulse for the switching transistors. Pulses of approx. 30 μ s period (= 33 kHz) and an amplitude of approx. 12 V_{pp} can be measured at pin 15 of the switching regulator IC - A. The pulse width may vary: it is narrow at high input voltage and increases with lower input voltage. Wide pulses and a hot or even a burnt-out resistor R 120 suggest defective switching transistors T 2, T 4 if the 5 V output voltage can not be measured as well. An apparently overloaded resistor R 120 (1 Ohm) must on no account be replaced by, for example, a 1 W type, as the transformer will burn out instead of the resistor in the event of a fault.

The presence of the 12 V supply is indicated by the LED D 107. As already stated, the 12 V is generated independently of the other two supplies.

-Power Supply-



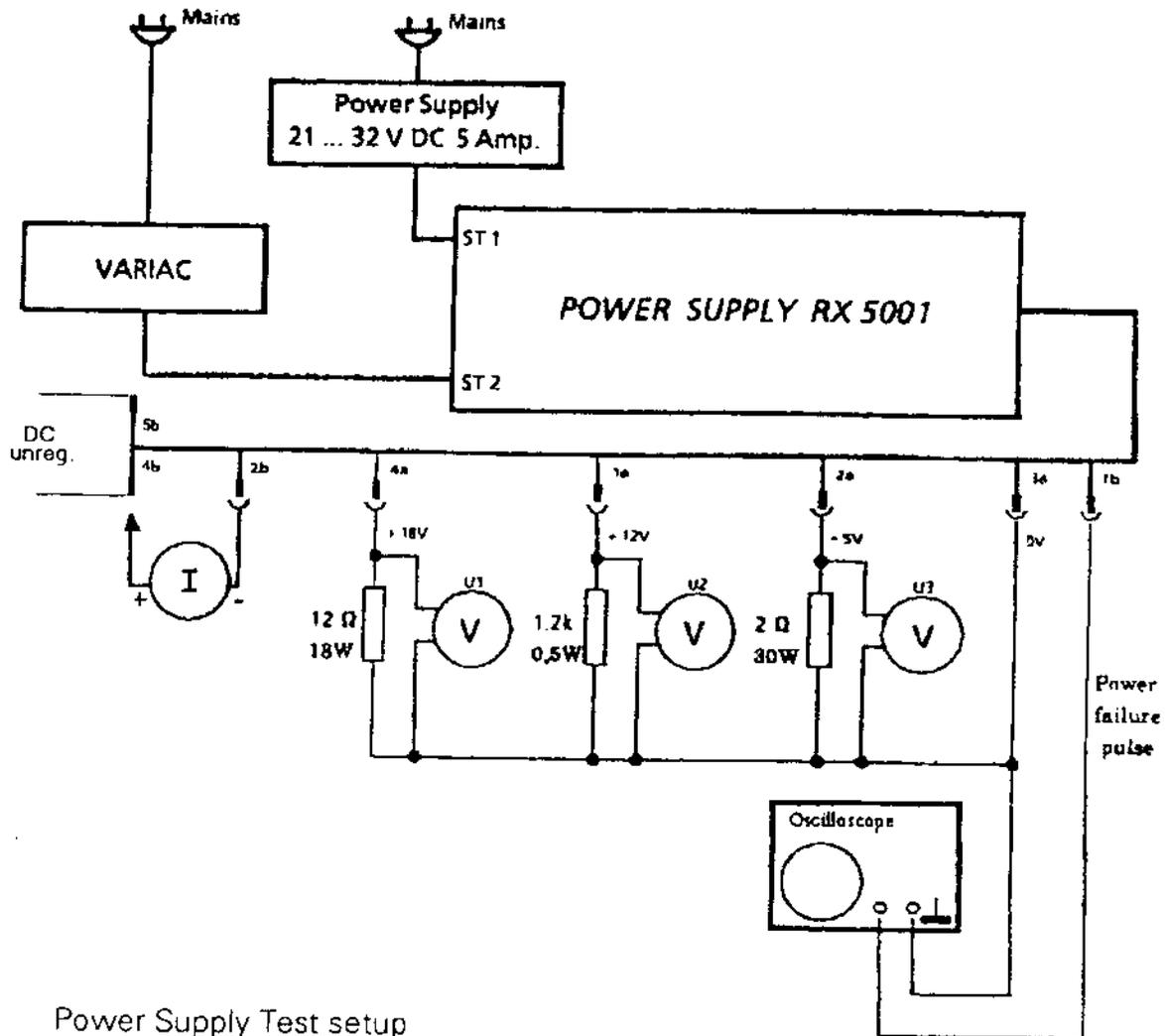
Blockdiagram - Power Supply

-Power Supply-

Test and alignment instructions

Required: Circuit diagram - POWER SUPPLY - Hagenuk Drawing No. 97 Sa B 2.155.21
Power supply, variable-ratio isolating transformer (VARIAC)

Test configuration: Connect up auxiliary circuit as illustrated in the sketch below.
Remove the POWER SUPPLY section and take off the cover.



Power Supply Test setup

-Power Supply-

Testing the power supply

Fit fuses for 110 V 2.0 A and battery 3.15 A.

Connect test power supply to plug St 1 pin A (negative) and ST 1 pin B (positiv). Set voltages to 24 V.

Connect socket Bu 1 pin 2 b to socket Bu 1 pin 4 b (thus switching on power supply)

Test values:

Functional test: LED D 107 on the switching regulator board ON.

Measure voltage U1 = +18 V, U2 = +12 V and
U3 = + 5 V.

Remove jumper across socket Bu 1 pins 2 b/4 b.

Connect VARIAC to plug ST 2 pins 1 and 2.

Set voltage to 110 V and refit jumper.

Test values: measure voltages U1 = +18 V, U2 = +12 V and
U3 = + 5 V.

Again remove jumper across pins 2 b/4 b of socket Bu 1. Remove 110 V fuse and replace by 220 V 1.6 A fuse. Set VARIAC to 220 V and refit jumper.

Test values: measure voltages U1 = +18 V, U2 = +12 V and
U3 = + 5 V.

Testing battery/mains switchover

Connect 24 V DC and 220 V mains voltage. Turn down VARIAC until switchover occurs at 24 V. Increase the voltage again.

Test values:

Voltage difference must be 20 V.

Testing the POWER FAILURE PULSE

Turn down variable-ratio isolating transformer until the POWER FAILURE PULSE appears on the oscilloscope.

NOTE

The voltage must be less than the mains/battery switchover voltage.

Testing the SWITCHING REGULATOR BOARD

Set variable-ratio isolating transformer to 195 V. Diode D 107 must illuminate:

Test values:

Power supply 5 V should be 5.1 V \pm 0.15 V.

Further reduce voltage on variable-ratio isolating transformer.

-Power Supply-

Testing the SWITCHING REGULATOR BOARD

Set variable-ratio isolating transformer to 195 V. Diode D 107 must illuminate:

Test values:

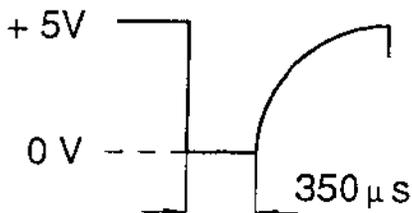
Power supply 5 V should be $5.1 \text{ V} \pm 0.15 \text{ V}$.

Further reduce voltage on variable-ratio isolating transformer.

-Power Supply-

Test values:

POWER FAILURE PULSE to appear at 160 - 195 V



Testing the reference voltage

Switch on power supply and fit jumper across socket BU 1 pins 2 b and 4 b. Then measure voltage on diode D 59.

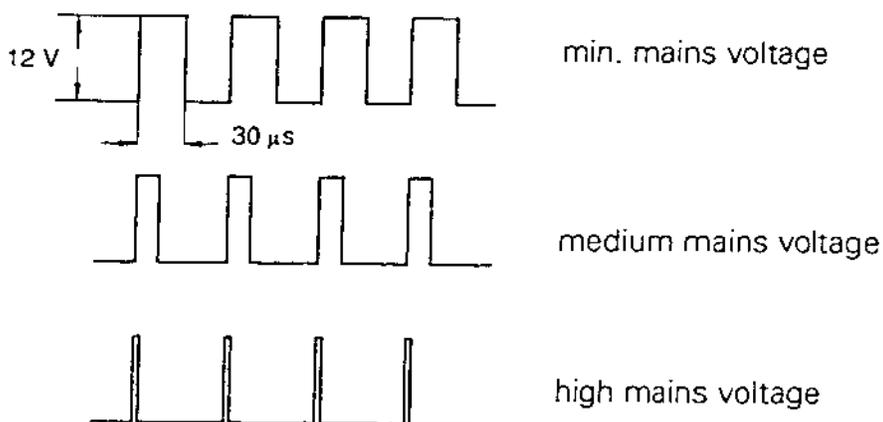
Test values:

Specified: 1.200 - 1.265 V (resistor R 65 may be shorted depending on component tolerances).

Check switching frequency at IC - A pin 15 with oscilloscope.

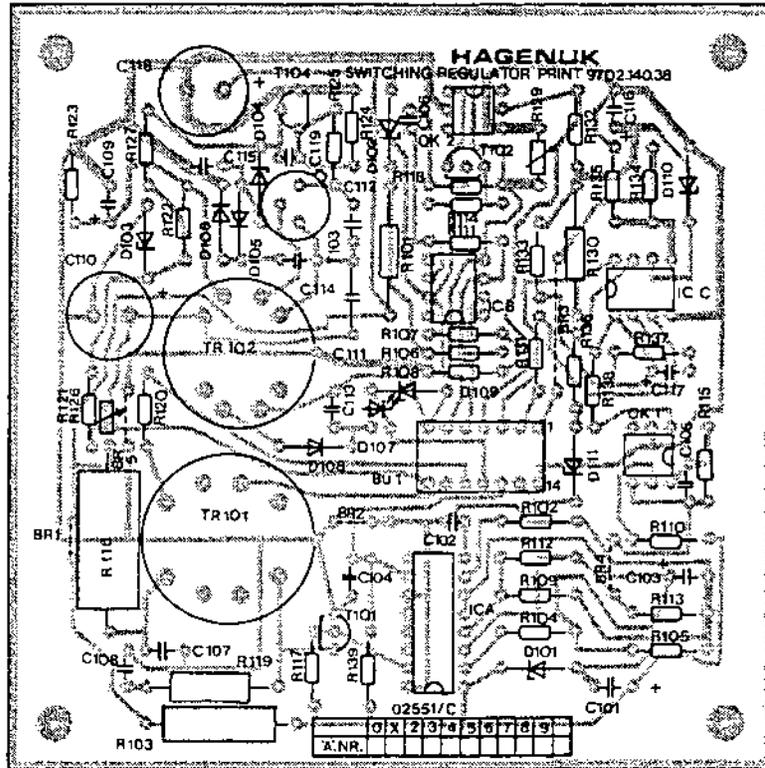
Test values:

Specified 30 kHz - 40 kHz.



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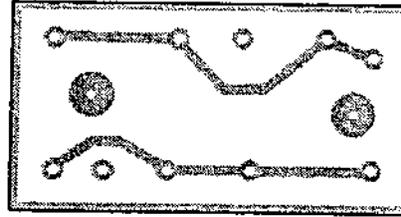
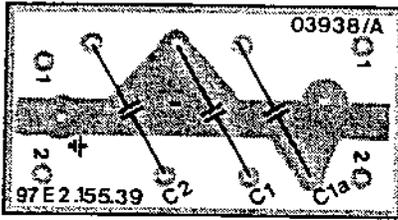
see circuit diagram - 97 Sa B 2.155.21



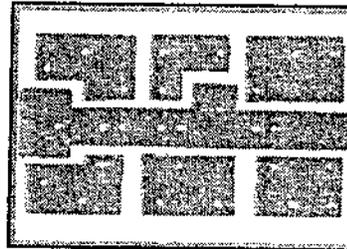
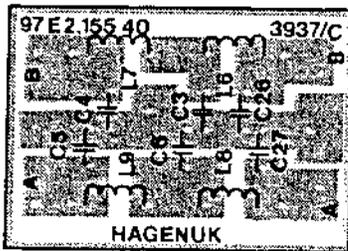
Switching Regulator Print - 97 D 2.140.38

-Power Supply-

see circuit diagram - 97 Sa B 2.155.21



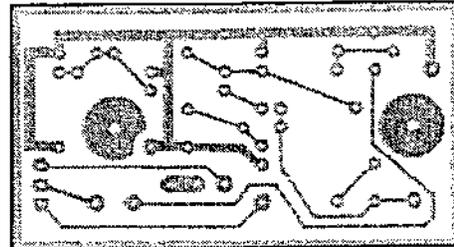
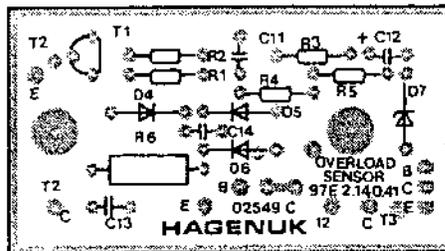
Filter Mains - 97 E 2.155.39



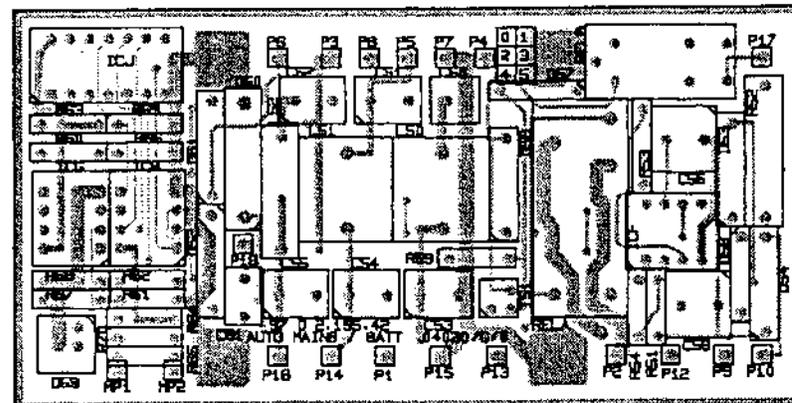
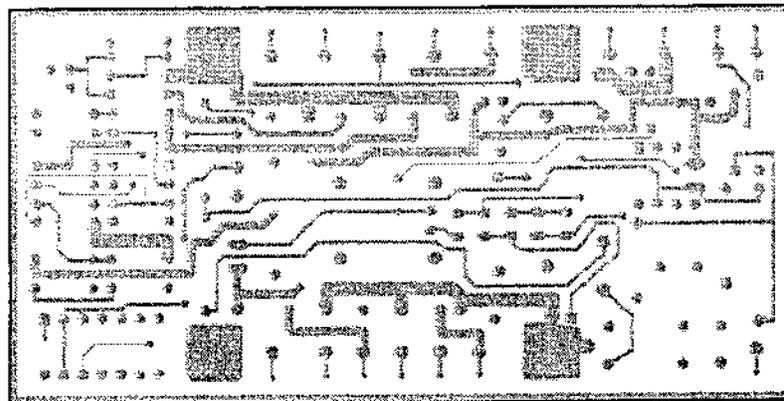
Filter Battery - 97 E 2.155.40

-Power Supply-

see circuit diagram - 97 Sa B 2.155.21



Overload Sensor - 97 E 2.140.41



Auto Mains/Batt. - 97 D 2.155.42

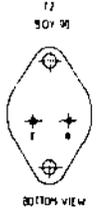
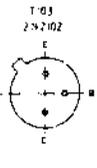
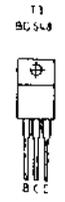
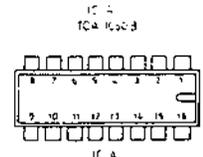
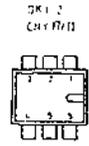
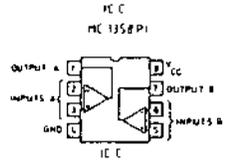
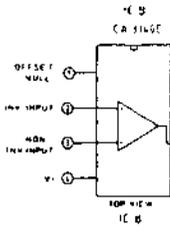
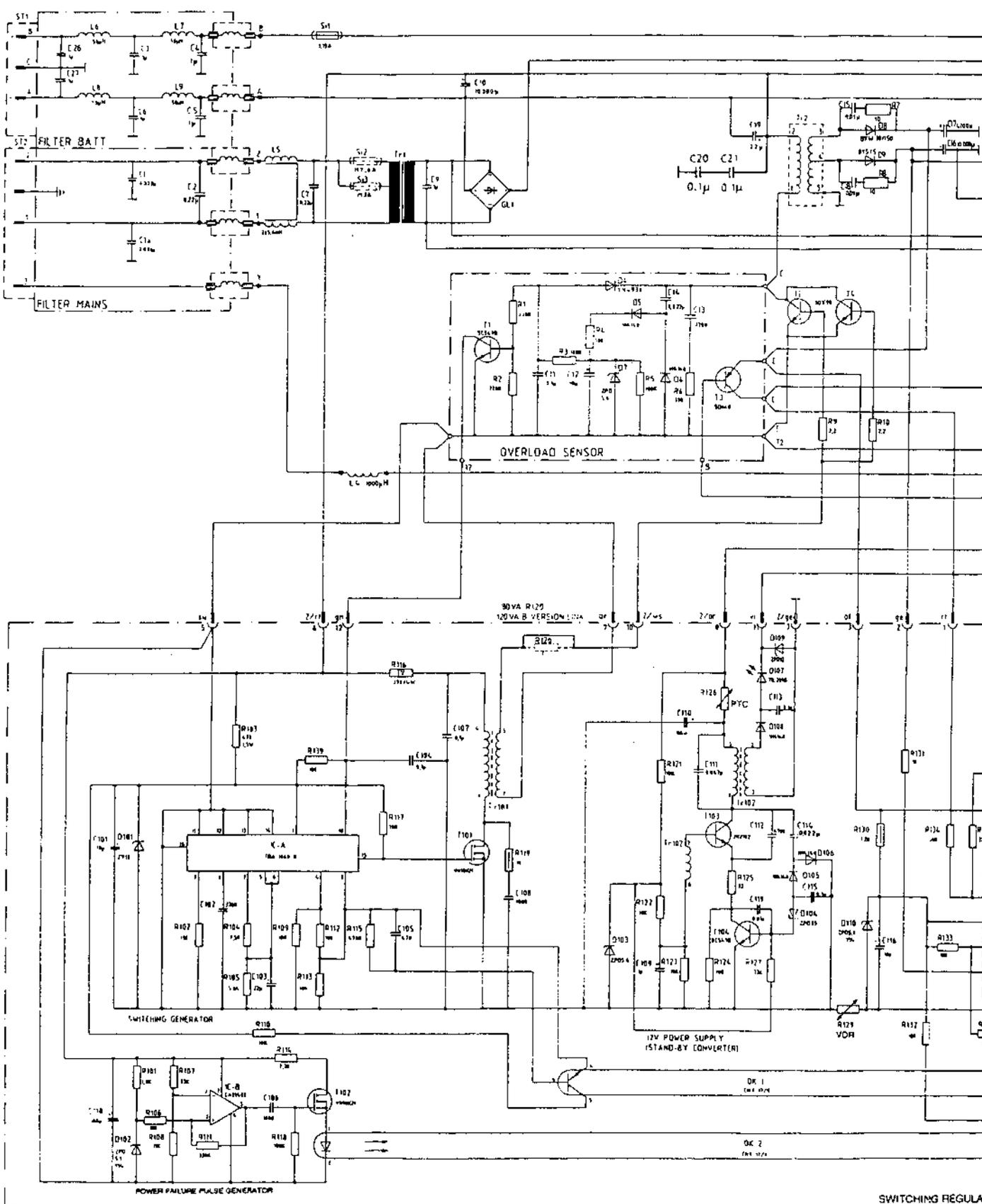
RX 1001 M / RX 5001
Part 4

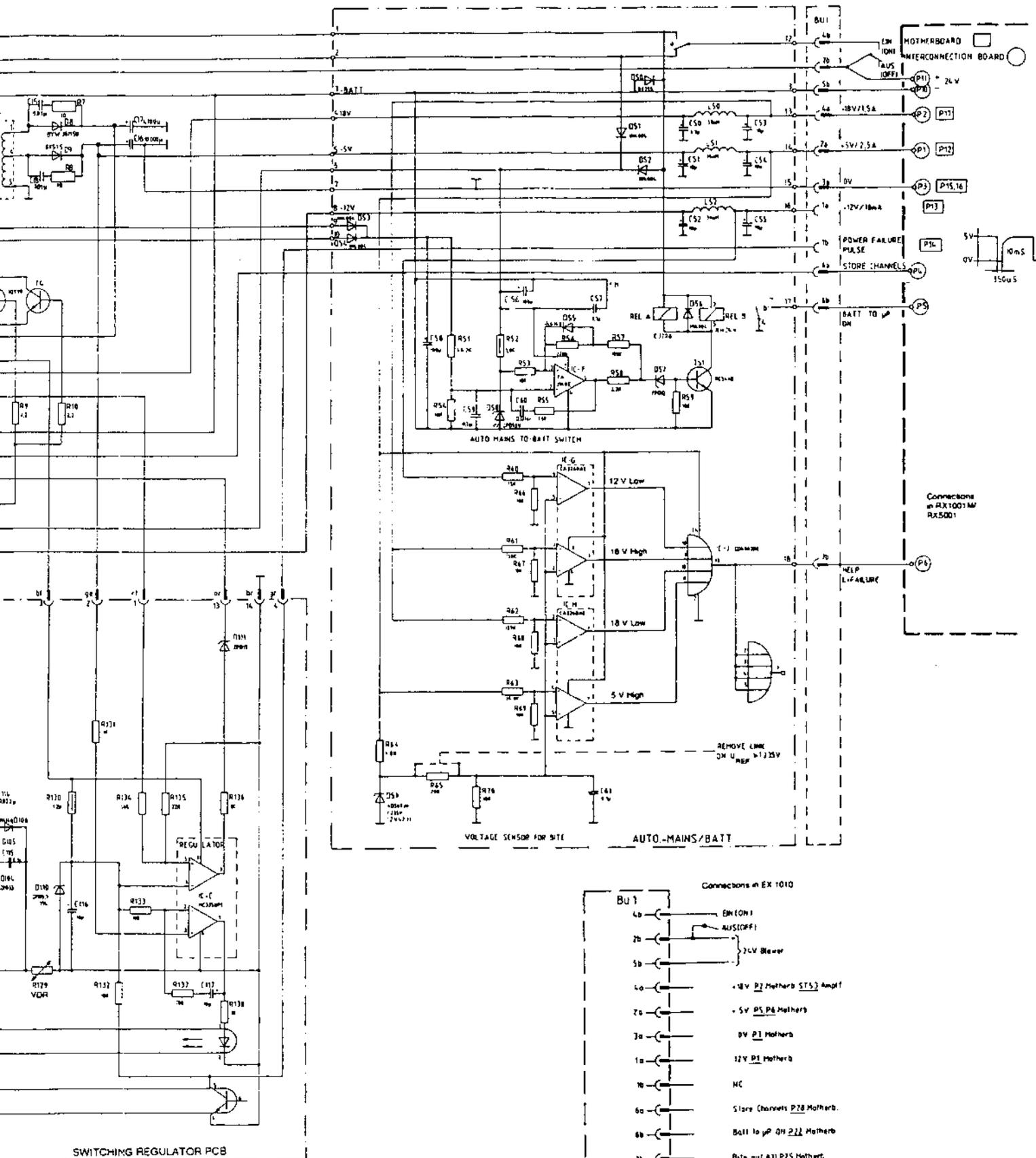
BATT
21-30V

FILTER BATT

MAIN
220/230V
10/105V

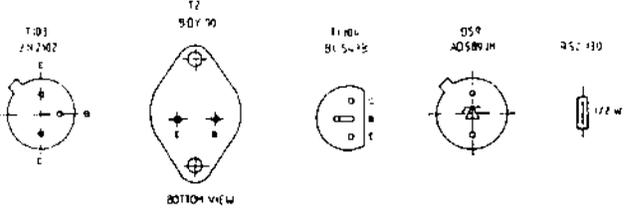
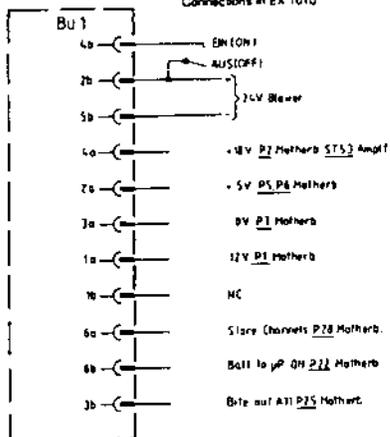
FILTER MAINS





Connections in RX1003 MR RX5001

Connections in EX 1010



Power Supply
Circuit Diagram
97 Sa B 2.155.21

Parts lists No.
97 Sa 2.155.21

-Power Supply-

Ident-No.	Mark	Electr. value	Identity	Manufacturer
Capacitors:				
1426.583	C1	0,033 μ F/380 V	PME 278	RAFI
1426.583	C1a	0,033 μ F/380 V	PME 278	RAFI
1426.591	C2	0,22 μ F/275 V	PMZ 2050	RAFI
1785.087	C3	1/20/50 V	X7R VPP 44	VITRAMON
1785.087	C4	1/20/50 V	X7R VPP 44	VITRAMON
1785.087	C5	1/20/50 V	X7R VPP 44	VITRAMON
1785.087	C6	1/20/50 V	X7R VPP 44	VITRAMON
1185.594	C7	0,22 μ 250 V	F1773-422-2000	RÖDERSTEIN
0923.796	C9	1 μ F/40 V	DIN 44111	
1961.136	C10	10000/20/40 V	2222051 67103	VALVO
1208.225	C11	0,1 μ F/100 V	CK 06 BX 104 M	SEC
1423.304	C12	10 μ F/25 V	2222.122.90006	VALVO
1426.575	C13	2200 pF/10 %/500 V	2222.655.03222	VALVO
1309.447	C14	0,022 μ F/100 V	CK 06 BX 223 K	SEC
1286.285	C15	0,01 μ F/200 V	CK 06 BX 103 M	VALVO
1433.911	C16	10000/10 V	2222050 64103	VALVO
1433.903	C17	4700 μ F/25 V	2222050 66472	VALVO
1286.285	C18	0,01 μ F/200 V	CK 06 BX 103 M	SEC
1179.209	C19	22 μ /100/40 V	EK 22/40	ROE
1208.255	C20	0,1 μ F/100 V	CK 06 BX 104 M	SEC
1208.255	C21	0,1 μ F/100 V	CK 06 BX 104 M	SEC
1785.087	C26	1/20/50 V	X7R VPP 44	VITRAMON
1785.087	C27	1/20/50 V	X7R VPP 44	VITRAMON
1815.377	C50	47/20/25 V		VALVO
1423.304	C51	10 μ F/25 V		VALVO
1423.304	C52	10 μ F/25 V		VALVO
1423.304	C53	10 μ F/25 V		VALVO
1423.304	C54	10 μ F/25 V		VALVO
1423.304	C55	10 μ F/25 V		VALVO
	C56	100 μ F/50 V	2222 035 90019	VALVO
1646.990	C57	0,1 μ F		
	C58	100 μ F/50 V	2222 035 90019	VALVO
1646.990	C59	0,1 μ F		
1674.897	C60	0,01 μ F		
1404.822	C61	0,1 μ F		WIMA
1423.304	C101	10 μ F/25 V	2222 122. 90006	VALVO
0945.765	C102	3300 pF/63 V	EDPU/0,6 K2000	VALVO
1189.441	C103	22 μ F/35 V	ETQ 5	ROE
1208.225	C104	0,1 μ F/100 V	CK 06 BX 104 M	SEC

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Parts lists No.
97 Sa 2.155.21

Ident-No.	Mark	Electr. value	Identity	Manufacturer
1061.070	C105	470 pF/63 V	EDPU/0,6 K2000	VALVO
0944.971	C106	1000 pF/63 V	EDPU/0,6 K2000	VALVO
1208.225	C107	0,1 μ F/100 V	CK 06 BX 104 M	SEC
1426.524	C108	1000 pF/500 V	2222.665.03102	VALVO
1118.013	C109	1 μ F/35 V	ETQ 2	ROE
1426.540	C110	100 μ F/40 V	EKM 100/40	ROE
1177.710	C111	0,047 μ F/100 V	MKT 1819-347/0	ROE
1208.217	C112	4700 pF/200 V	CK 06 BX 472 M	SEC
1208.225	C113	0,1 μ F/100 V	CK 06 BX 104 M	SEC
1309.447	C114	0,022 μ F/100 V	CK 06 BX 233 K	SEC
1208.225	C115	0,1 μ F/100 V	CK 06 BX 104 M	SEC
1423.304	C116	10 μ F/25 V	2222.122.90006	VALVO
1423.304	C117	10 μ F/25 V	2222.122.90006	VALVO
1426.540	C118	100 μ F/40 V	EKM 100/40	ROE
0904.988	C119	0,01 μ F/40 V	EDPU/0,6 K10000	VALVO

Diodes:

1630.512	D4		1 N 4936	MOTOROLA
0745.677	D5		1 N 4148	
0745.677	D6		1 N 4148	
0745.693	D7		ZPD 5,6	
1434.047	D8		BYW 30/150	VALVO
1434.055	D9		BY5 15	SIEMENS
1255.258	D50		BY 255	
0763.764	D51		1 N 4004	
0763.764	D52		1 N 4004	
0763.764	D53		1 N 4004	
0763.764	D54		1 N 4004	
1613.162	D55		LL 4148	
0763.764	D56		1 N 4004	
0922.684	D57		ZPD 12	
1713.221	D58	5,1 1%		
1469.983	D59		LM 385	
0940.127	D101		ZY 12	ITT
1717.221	D102		ZPD 5,1 1 %	ITT
0745.693	D103		ZPD 5,6	ITT
1426.346	D104		ZPD 33	ITT
0745.677	D105		1 N 4148	
0745.677	D106		1 N 4148	
1096.893	D107		TIL 209 B	TEXAS

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Ident-No.	Mark	Electr. value	Identity	Manufacturer
0745.677	D108		1 N 4148	
0922.684	D109		ZPD 12 V	ITT
1717.221	D110		ZPD 5,1 1%	ITT
0922.684	D111		ZPD 12	ITT

Resistors:

0744.788	R1	330 K 5 % 1/8 W	DIN 44052
0799.416	R2	220 K 5 % 1/8 W	DIN 44052
0911.976	R3	180 K 5 % 1/8 W	DIN 44052
0744.786	R4	18 K 5 % 1/8 W	DIN 44052
0767.190	R5	100 K 5 % 1/8 W	DIN 44052
0243.647	R6	390 5 % 1/2 W	DIN 44052
0626.708	R7	10 5 % 1/8 W	DIN 44052
0626.708	R8	10 5 % 1/8 W	DIN 44052
1186.981	R9	2,2 5 % 1/8 W	DIN 44052
1186.981	R10	2,2 5 % 1/8 W	DIN 44052
	R40	82 2 W	
1809.490	R51	40,2 k 1 % 0204	
0763.926	R52	1,8 k 5 % 1/2 W	0309
1190.725	R53	10 k-5-50-0207	
1683.977	R54	10 k 1 % 0204	
1642.227	R55	1,8 k 1 %	
1613.006	R56	220 k 5 %	
1672.827	R57	100 k 1 %	
1674.781	R58	2,2 k 1 %	
1683.977	R59	10 k-1-100-0204	
1756.257	R60	75 k 1 % 0204	
1684.558	R61	150 k 1 % 0204	
1809.512	R62	127 k 1 % 0204	
1809.482	R63	34,8 k 1 % 0204	
1809.474	R64	1,8 k 1 % 0204	
1809.466	R65	200 1 % 0204	
1683.077	R66	10 k 1 % 0204	
1683.077	R67	10 k 1 % 0204	
1683.077	R68	10 k 1 % 0204	
1683.077	R69	10 k 1 % 0204	
1683.077	R70	10 k 1 % 0204	
0181.390	R101	1,8 k 5 % 1/2 W	DIN 44052
1259.318	R102	11 K 1 % 1/8 W	DIN 44061

-Power Supply-

Parts lists No.

97 Sa 2.155.21

Ident-No.	Mark	Electr. value	Identity	Manufacturer
1427.865	R103	470/1,5 W	SXA 0617	
1297.074	R104	7,5 K 1 % 1/8 W	DIN 44061	
1060.015	R105	5,6 K 1 % 1/8 W	DIN 44061	
0179.701	R106	10 K 5 % 1/8 W	DIN 44052	
1083.304	R107	33 K 1 % 1/8 W	DIN 44061	
1259.318	R108	11 K 1 % 1/8 W	DIN 44061	
0179.701	R109	10 K 1 % 1/8 W	DIN 44052	
0179.701	R110	10 K 1 % 1/8 W	DIN 44052	
0744.778	R111	330 K 5 % 1/8 W	DIN 44052	
0179.701	R112	10 K 5 % 1/8 W	DIN 44052	
0179.701	R113	10 K 5 % 1/8 W	DIN 44052	
0744.808	R114	2,2 K 5 % 1/8 W	DIN 44052	
0837.075	R115	470 K 5 % 1/8 W	DIN 44052	
1426.532	R116	270/4 W	SXA 0922 DIN 44063	
0179.701	R117	10 K 5 % 1/8 W	DIN 44052	
0767.190	R118	100 K 5 % 1/8 W	DIN 44052	
0181.293	R119	1 K 5 % 1/2 W	DIN 44052	
	R120	1 k 1/8 W	DIN 44052	
0179.701	R121	10 K 5 % 1/8 W	DIN 44052	
0179.701	R122	10 K 5 % 1/8 W	DIN 44052	
0179.701	R123	10 K 5 % 1/8 W	DIN 44052	
0179.639	R124	100 5 % 1/8 W	DIN 44052	
0542.822	R125	33 5 % 1/8 W	DIN 44052	
1426.559	R126		672.91016	VALVO
0627.895	R127	33 K 5 % 1/8 W	DIN 44052	
1426.567	R129		592.12212	VALVO
0181.331	R130	1,3 K 5 % 1/2 W	DIN 44052	
0179.698	R131	1 K 5 % 1/8 W	DIN 44052	
0179.701	R132	10 K 5 % 1/8 W	DIN 44052	
0179.639	R133	100 5 % 1/8 W	DIN 44052	
1174.959	R134	56 K 1 % 1/8 W	DIN 44061	
1265.296	R135	22 K 1 % 1/8 W	DIN 44061	
0179.698	R136	1 K 5 % 1/8 W	DIN 44052	
0179.638	R137	100 5 % 1/8 W	DIN 44052	
0179.698	R138	1 K 5 % 1/8 W	DIN 44052	
0179.701	R139	10 K 5 % 1/8 W	DIN 44052	

Coils:

1433.954	L5	2 x 5,6 mH	B82723-E1-A10	SIEMENS
1426.478	L6		97 E 2.140.124	HAGENUK
1426.478	L7		97 E 2.140.124	HAGENUK
1426.478	L8		97 E 2.140.124	HAGENUK

Parts lists No.
97 Sa 2.155.21

-Power Supply-

Ident-No.	Mark	Electr. value	Identity	Manufacturer
1426.478	L9		97 E 2.140.124	HAGENUK
1426.478	L50		97 E 2.140.124	HAGENUK
1426.435	L51		97 E 2.140.126	HAGENUK
1068.172	L52	56 μ H/10 %		JAHRE

Integrated circuits:

1426.354	IC A		TDA 1060B	VALVO
1300.326	IC B		CA 3140 Ae	RCA
1422.715	IC C		MC 3358 P1	MOTOROLA
1300.326	IC F		CA 3140 AE	
1809.504	IC G		CA 3260 AE	
1809.504	IC H		CA 3260 AE	
1541.137	IC J		SCL 4002 BE	

Transistors:

1291.033	T1		BC 549 B	
1434.101	T2		BDY 90	VALVO
1426.400	T3		BD 648	VALVO
1434.101	T4		BDY 90	VALVO
1291.092	T51		BC 546 B	ITT,AEG
1426.362	T101		VN 10 KM	SILICONIX
1426.362	T102		VN 10 KM	SILICONIX
1147.765	T103		2 N 2102	
1291.033	T104		BC 549 B	

Supplements:

1226.169	OK1		CNY 17/II	
1226.169	OK2		CNY 17/II	
1059.378	Si1	M 3,15 A E	DIN 41571	WICKMANN
0215.805	Si2	M 1,6 A E	DIN 41571	WICKMANN
0215.821	Si3	M 2 A E	DIN 41571	WICKMANN

-Power Supply-

Parts lists No.

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Ident No.	Mark	Electr. value	Identity	Manufacturer
1432.958	Tr1		97 E 2.140.19 B	HAGENUK
	Tr2		97 E 2.140.18	HAGENUK
1426.303	Tr101		97 Bv 2.140.39	HAGENUK
1426.311	Tr102		97 Bv 2.140.40	HAGENUK
0206.652	Bu1	12-pins	DIN 41622	
1433.881	GI1		200 V KB PC 804/T 400 V	
1433.873	ST1		PT 02 E-12-3P	TELDIX
1168.185	ST2		MC 164-232F-4P	AMPHENOL
1175.394	Rel A		E 3206 NI:13	EICHHOFF
	Rel B	RH 24 V 1xU		