

5.6 POWER SUPPLY A6

5.6.1 Description A6

Diagram 1

Diagram 1 comprises the following circuit parts:

- input circuit
- converter circuit
- line trigger circuit

Input circuit

Input to the circuit is the mains voltage. The following voltages are allowed:

- AC voltage between 90 and 250 V
- Theoretically a DC voltage between 100 and 380 V can be applied.

The mains input is primarily protected by a slow acting 1.6 A fuse (1.6 AT), which is located on the rear of the instrument.

Inrush current limiting is provided by NTC resistor R1001.

By means of the capacitors C1002, C1003, C1004 and C1006, an input signal for the line trigger generator is made. The capacitors form a voltage divider. This functions only if the mains voltage is AC.

C1001, 1002, 1006, 1007 and L1001 are for interference suppression.

The mains voltage is rectified by V1001 through 1004 and smoothed by C1008 and C1009.

The output voltage from the rectifier at C1009 can be between 100 and 380 V.

WARNING: For measurements in the primary circuit, the use of an isolating transformer is strongly recommended. If no isolating transformer is used, all measurements in the primary circuit must be carried out with floating measuring instruments.

Converter circuit

The power supply is a multiple output flyback converter of the SOPS (Self Oscillating Power Supply) principle. Basically, the converter consists of a switch with control circuitry (transistor V1019) and a transformer (T1001).

The first switching-on of V1019 is initiated by a small current via R1007/R1008. When V1019 is ON, the control voltage of T1001 pin 18 to C1011 is positive and this keeps V1016 and V1019 ON. During the ON or FORWARD cycle, the current through the primary winding of T1001 increases linearly, and energy ($0.5 LI^2$) is stored into this transformer. At about 2.5 A, this value is determined by the control circuit, thyristor V1014 is switched ON and due to this, V1019 is switched OFF. This is the beginning of the OFF or FLYBACK cycle. Now, the transformer voltages are reversed and the stored energy is transformed to the secondary windings. As long as the transformer is not fully demagnetized, the voltage from pin 18 to C1011 is negative and this will keep V1007, V1016 and V1019 switched OFF. As soon as the transformer demagnetizing has ended, this voltage becomes zero and so, a positive going voltage appears at C1011. Due to this, V1007, V1016 and V1019 are switched ON and the FORWARD cycle starts again.

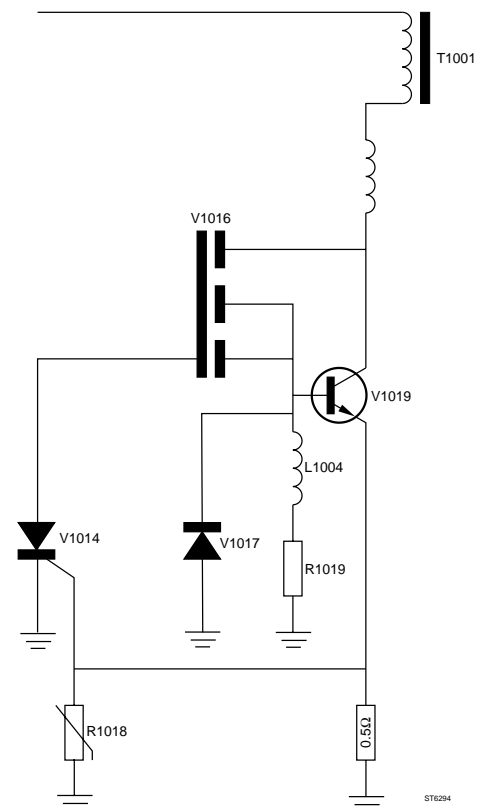


Figure 5.5 Converter circuit

To reduce the switching losses in V1019, a dV/dt limiter, often called "snubber", is used. C1021 decreases the dV/dt of the collector voltage of V1019 during switching off, as the current to the transistor can pass during a certain time through C1021. This slowing down of the collector voltage will reduce the switching losses during switching off. During the ON cycle, the energy in C1021 is transferred to L1006 and the capacitor is discharged. During the OFF cycle, the energy in L1006 is transferred to C1018 and during the next ON cycle, the energy in C1018 is delivered to the transformer. In that way, no energy is wasted. As a consequence of this system, the voltage at the transformer is slightly increased during the first part of the ON cycle, but this has no disadvantages.

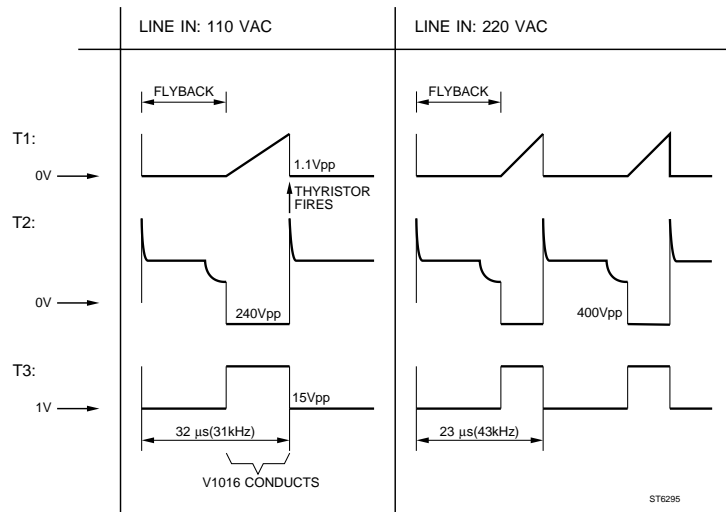


Figure 5.6 Timing diagram converter circuit

Voltage regulation takes place by varying the control voltage from R1046 to the gate of V1014. A more positive voltage will cause a smaller peak current through the transformer and this results in smaller output voltages. The converter frequency can be 20 to 50 kHz. This depends on the mains voltage and the load of the power supply. The lower the mains voltage, the lower the frequency. A lower load means a higher frequency. R1018 compensates for gate-cathode voltage variations of V1014 due to the temperature.

Line trigger circuit

For triggering purposes, a sinusoidal signal at the mains frequency is available. Of course there will be no LINE signal if the mains voltage is DC.

A small signal is picked up with capacitors C1002, C1003, C1004 and C1006 and amplified in N1046. This results in output signal at pin 1. This circuit provides a sine-wave with low distortion and with an amplitude of 3 to 8 V, depending on the mains voltage.

Diagram 2

Diagram 2 comprises the following circuit parts:

- trace rotation control
- fan control
- illumination control
- EHT converter

Trace rotation control

To supply the trace rotation coil, of which the resistance is about 200 Ω, a voltage of -10 V to +10 V is created in amplifier V1146-1147. Control takes place via a part of N1101 by means of the signal DAC3 which can be 1 to 10 V, together with the signal DAC0 with a level between 1 and 3V. The signals DAC3 and DAC0 originate from the microprocessor unit A3.

Fan control

The speed the cooling fan depends on the temperature in the oscilloscope. This temperature is measured at the microprocessor unit A3 by a NTC resistor. The microprocessor generates the signal DAC1 with a level of about 1.7 to 4 V. The fan is supplied by amplifier V1148 which is controlled by this signal. The output from the amplifier is a DC voltage of -10 to +10 V.

Illumination control

The illumination of the graticule must be variable. For this reason the illumination voltage can be varied between about 2 and 28 V. Control of the illumination amplifier V1148 takes place by means of the signal DAC2, level about 1.7 to 4 V. The output voltage from the amplifier is -16 to +10 V.

EHT converter

The EHT converter supplies three voltages.

- An AC voltage of 6,3 V (F1, F2), to supply the filament of the CRT.
- The cathode voltage to the CRT, a DC voltage of -2200 V.
- The post acceleration voltage to the CRT, a DC voltage of +14 kV.

These voltages are made in a separate converter, equipped with a separate transformer. The EHT converter is a resonant flyback converter, the output voltages of the transformer are sinusoidal.

Basically, the converter consists of a resonant LC circuit formed by the transformer with its parasitic capacitances. This resonance circuit defines the converter frequency which is about 80 kHz. Energy is supplied to this LC circuit by injecting current to it from the supply voltage, the +58 V, by switching ON V1109. Most of the time, V1109 is OFF. The primary peak to peak amplitude is about 200 V, the negative peak about -40 V. During the positive half of the sine-wave, capacitor C1111 is discharged very little via R1114.

When the sine-wave reaches its most negative value, a small current will pass through C1111 and V1106 and this acts as base current for V1102. Due to this, the thyristor configuration V1102-1109 will be switched ON and energy is supplied to the resonant circuit. The ON time of V1109 can be controlled by the operational amplifier N1101 pin 7.

To protect against too high voltages, e.g. caused by a defective N1101, the circuit is provided with an over-voltage protection. This circuit consists of V1103 and V1104. The maximum output voltage is defined by this circuit as it will overrule the control circuit at too high voltage.

The AC voltage at T1002 pins 4 and 5 is used to supply the CRT filament voltage of 6.3 V. The voltage at pins 11 and 3 is rectified and this -2200 V is used as CRT cathode voltage. The voltage at pins 11 and 2 is rectified and multiplied in a cascade circuit. The output, +14 kV, is used as post acceleration voltage to the CRT.

Diagram 3

Diagram 3 comprises the following circuit parts:

- secondary output circuitry
- over- and under-voltage protection
- power fail circuit
- temperature protection
- 10 V reference circuit
- +5V postregulator circuit

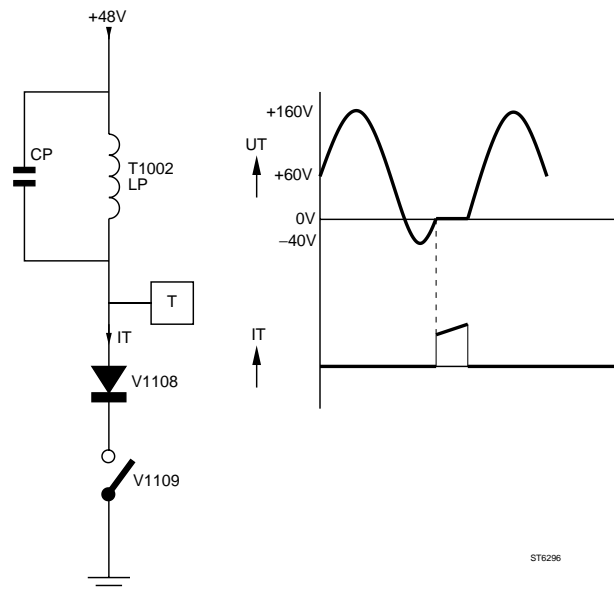


Figure 5.7 High tension generator

Secondary output circuitry

The secondary output circuits consist of rectifier diodes and buffer capacitors, followed by chokes and capacitors for ripple suppression. The output circuits are protected against overload by the under voltage protection.

Over and under-voltage protection

To protect the oscilloscope circuitry against over-voltage and the supply circuits against overload, the power supply is provided with a protection circuit. As, due to the multiple output principle, the output voltages are interdependent, it is sufficient to check only one voltage. In case of overload, the output voltages will decrease and this will be detected by the under-voltage detection, V1241, which monitors the -12 V. This will cause the collector of V1241 to be LOW. In case of over-voltage, the over-voltage detection detects a too high +12 V or +5 V and this will cause pin 13 of N1236 to be LOW. Due to this LOW signal, the intervention circuit V1241-1242-1243 will cause a current, the TPDOWN signal, to V1213. This will switch ON this thyristor and this causes switching off the converter by decreasing all output voltages to a very low, safe value.

Powerfail circuit

In normal cases, about 250 ms after switching on, the signal POWER HT will become HIGH and stay HIGH. In case of an over- or under-voltage failure, the signal will become LOW due to V1242. In case of a too low mains voltage, i.e. less than 80 V (AC) or 100 V (DC), the signal will become LOW due to N1236 pin 2. The signal POWER HT is a logic signal, it will not switch off the main convertor circuit, but it will shut down the EHT-convertor. POWER HT signals to the microprocessor unit A3 that power is going down. This gives the processor the opportunity to save important data.

Temperature protection.

To protect the circuits against too high temperatures, the oscilloscope is provided with an overheat shutdown circuit. The temperature of the power supply printed circuit board is monitored by NTC resistor R1231, which is located on the PCB. At temperatures higher than about +80 °C, pin 8 of N1236 will become HIGH and this will cause pin 14 to be LOW. Due to this, the TPDOWN signal becomes active and the converter is switched off by triggering V1213. This temperature protection is only meant for the power supply.

+10 V reference circuit

For application in the power supply and at other places in the oscilloscope, a stable +10 V reference voltage is needed. This voltage is made by N1226/V1226 in the power supply. The voltage is not adjustable. The accuracy is ± 5 mV. Temperature coefficient is $\pm 0,001^\circ\text{K}$. The load of the +10 V is about 10 mA.

+5 V postregulator circuit

The +5 V supply voltage originates from the T1001/16,15 transformer winding that supplies current during the forward stroke of the power supply: thus during the time that V1019 conducts. The current runs via transductor coil L1271, diode V1271 and the coils L1272/L1273. During the flyback stroke (power transistor V1019 off) the current runs via diode V1271 (anode connected to earth) and L1272/L1273.

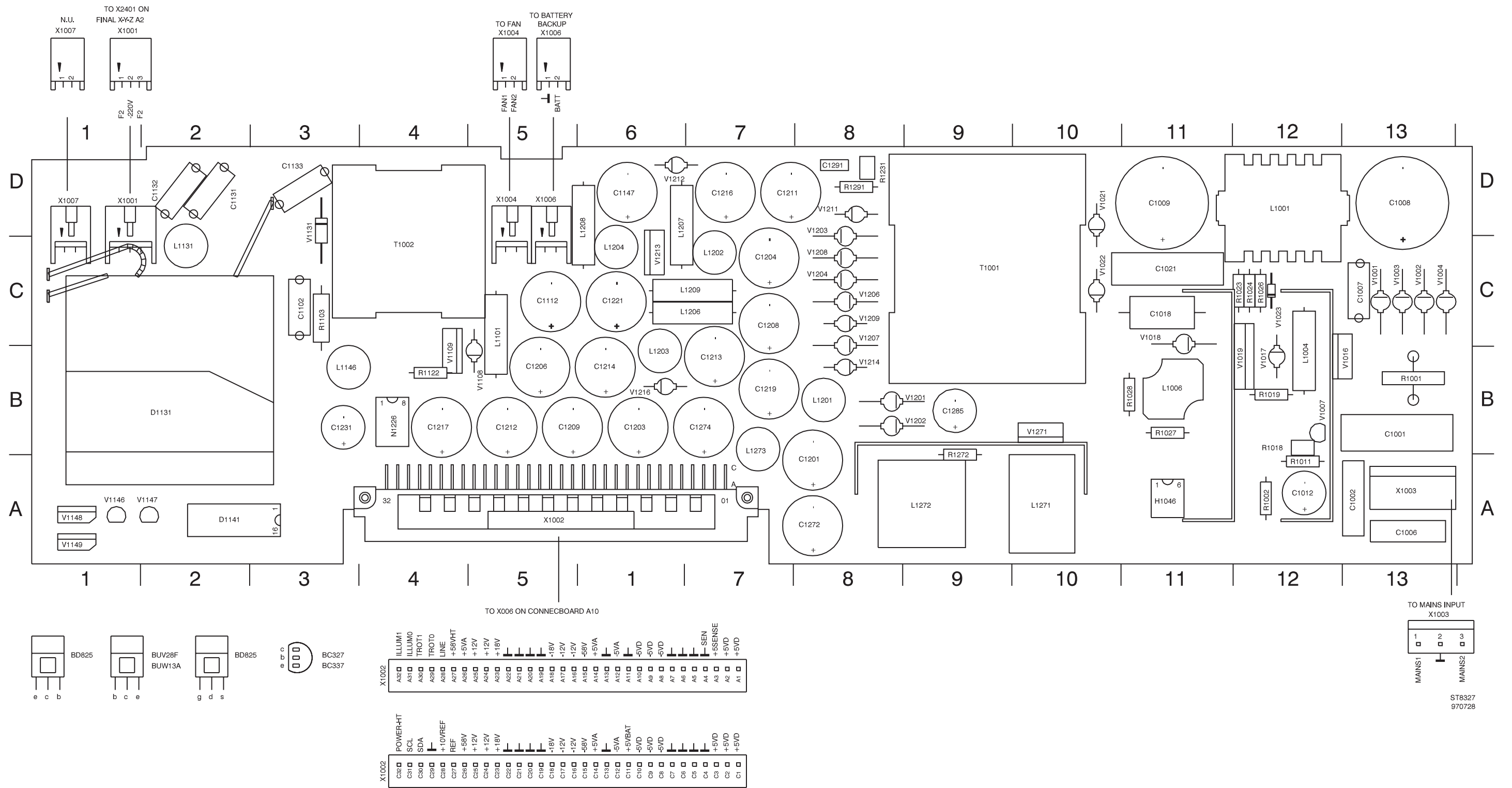
Output voltage regulation occurs via the operational amplifier N1251/1,2,2 and the paralleled transistors V1251/V1252. N1252 compares the actual +5 V output voltage with the +10 VREF reference voltage. Output N1251/1 becomes lower in case that the +5 V output voltage tends to become too high. The result is an increase of the collector current of V1252/V1252. This gives a current in L1271 opposite to the +5 V supply current. This delays the moment that L1271 comes into saturation. Thus L1271 behaves like a coil during a longer period of time with the result that a certain loss of voltage across it stays. As a result the output voltage becomes lower. If saturated the voltage loss across L1271 is 0 volt.

5.6.2 Signal name list A6

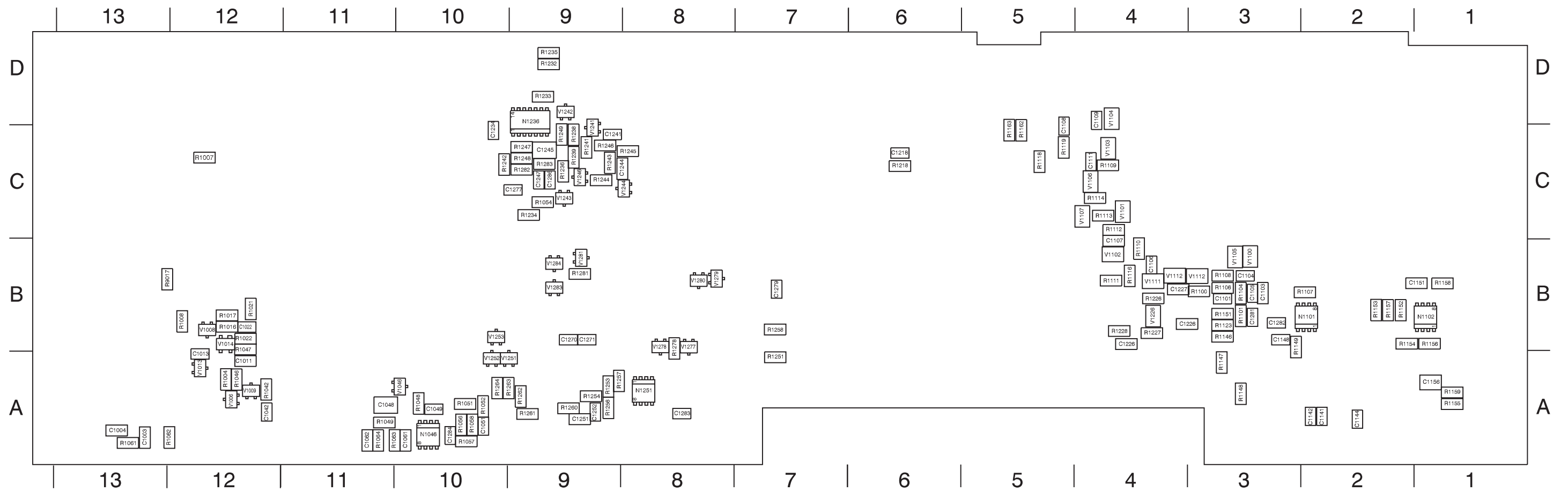
Note: In the signal name list you find the itemnumber of the component that is source or destination. Behind this itemnumber (separated by ":") you find the number of the diagram where the source/destination can be found.

NAME	MEANING	SOURCE	DESTINATION
+5 SENS	+5 V OUTPUT SENSE SIGNAL	X1002:02	R1253:03
FAN0	FAN SUPPLY 0	S-12V:02	X1004:02
FAN1	FAN SUPPLY 1	L1146:02	X1004:02
GNSENS	GROUND FOR +5 V SENSE SIGNAL	X1002:02	R1257:03
ILLUM0	GRATICULE ILLUMINATION 0	S-18V:02	X1002:02
ILLUM1	GRATICULE ILLUMINATION 1	V1149:02	X1002:02
LINE	LINE/MAINS TRIGGER SIGNAL	N1046:01	X1002:01
POWER-HT	POWER UP INDICATION SIGNAL	N1236:03	X1002:03
			V1111:02
SCL	SERIAL CLOCK	X1002:02	N1141:02
SDA	SERIAL DATA	X1002:02	N1141:02
TROT0	TRACE ROTATION 0	EARTH:02	X1002:02
TROT1	TRACE ROTATION 1	V1146:02	X1002:02

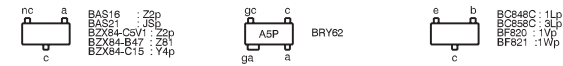
5.6.3 Unit lay-outs



Lay-out 1 - Large component side of Power Supply unit A6

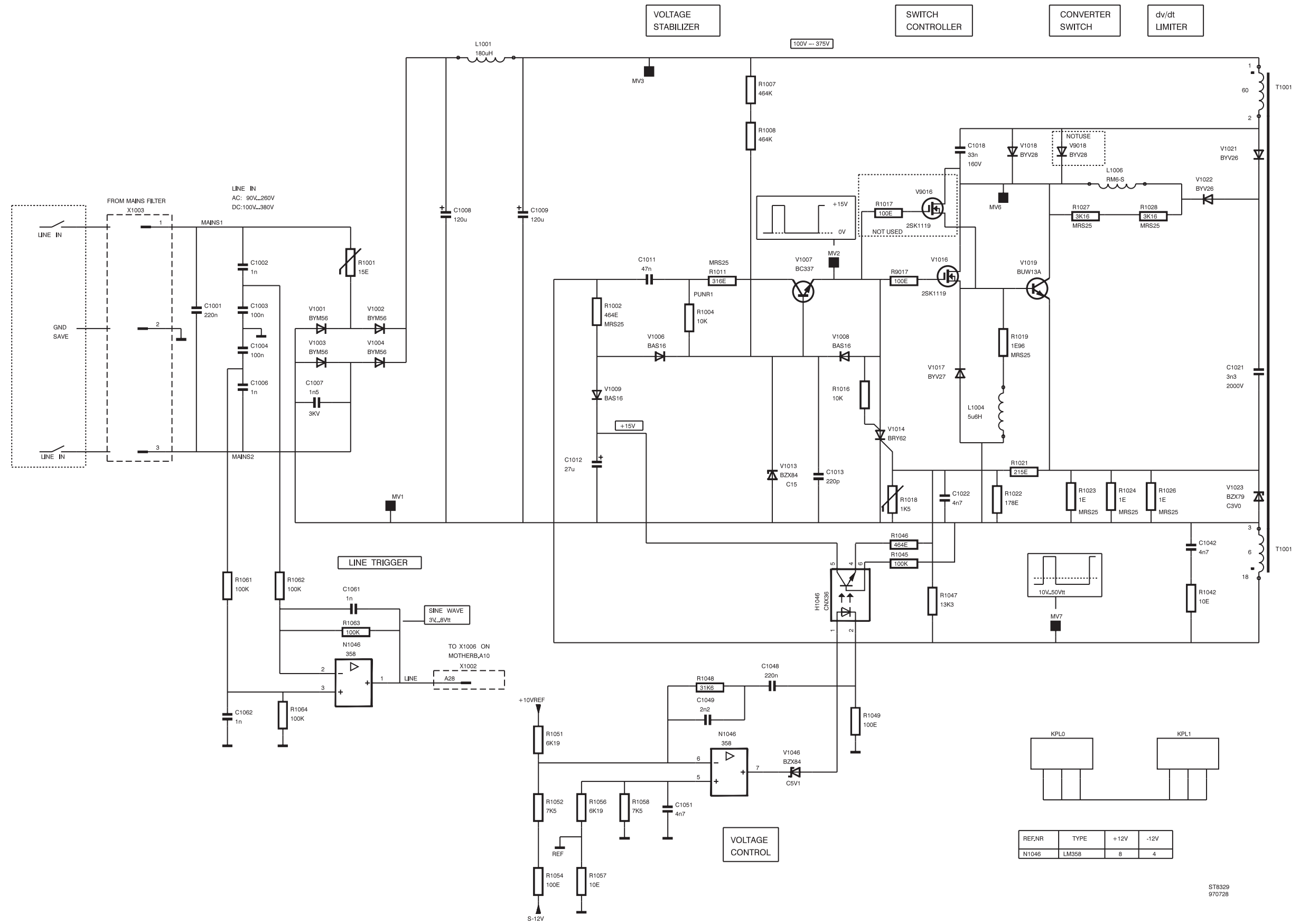


ST8328
970728



Lay-out 2 - Small component side of Power Supply unit A6

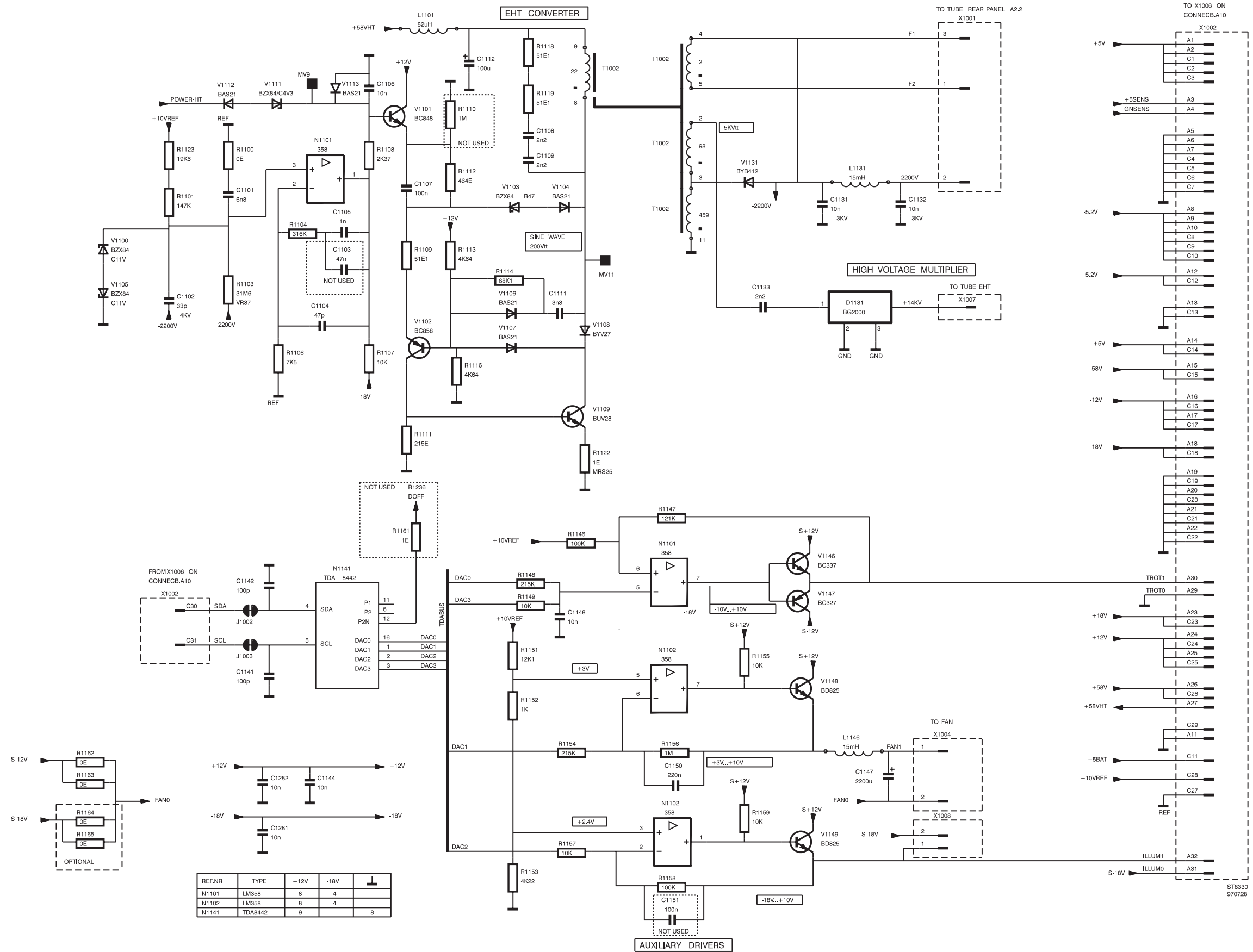
5.6.4 Circuit diagrams



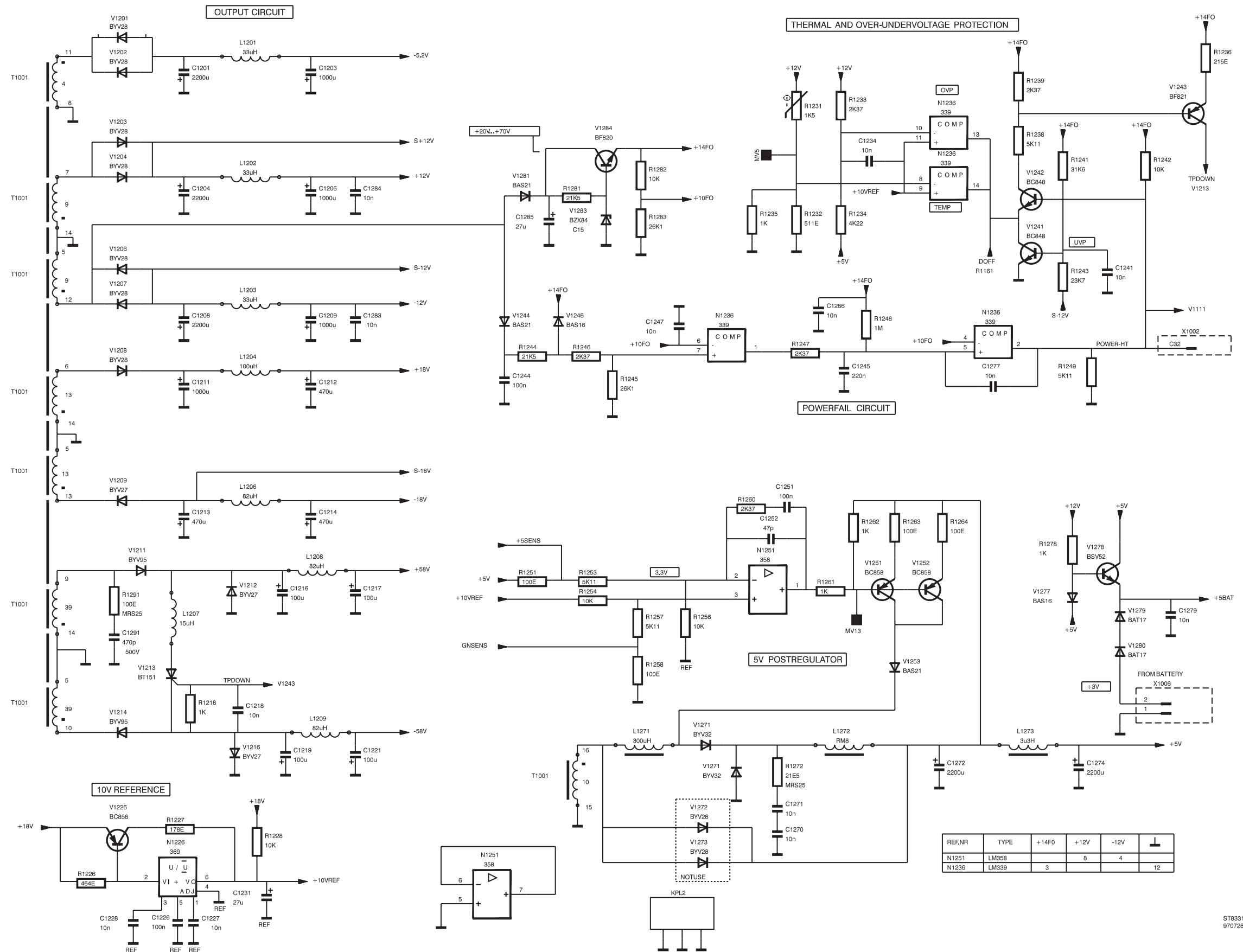
REFNR	TYPE	+12V	-12V
N1046	LM358	8	4

ST8329
970728

A6 - Diagram 1; Converter circuit



A6 - Diagram 2; EHT converter and auxiliary circuits



A6 - Diagram 3; Output circuit and protection circuits

Item	Description	Ordering code
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5.6.5 Parts list**CAPACITORS**

C1001	CAP.FOIL	250V 20% 220NF	5322 121 44372
C1002	CAP.FOIL	-20+20% 1NF	5322 121 43656
C1003	CAP.CHIP	AP 63V 10% 100NF	4822 122 33496
C1004	CAP.CHIP	AP 63V 10% 100NF	4822 122 33496
C1006	CAP.FOIL	-20+20% 1NF	5322 121 43656
C1007	CAP.CERAMIC	3KV -20+50% 1.5NF	5322 122 50092
C1008	CAP.ELECTROLYT.	400V 20% 120UF	5322 124 42231
C1009	CAP.ELECTROLYT.	400V 20% 120UF	5322 124 42231
C1011	CAP.CHIP	AP 63V 10% 47NF	4822 122 32542
C1012	CAP.ELECTROLYT.	100V 20% 27UF	5322 124 42193
C1013	CAP.CHIP	AP 63V 5% 220PF	4822 122 33575
C1018	CAP.FOIL	160V 1% 33NF	5322 121 50997
C1021	CAP.FOIL	2KV 5% 3.3NF	5322 121 70117
C1022	CAP.CHIP	AP 63V 10% 4.7NF	5322 126 10223
C1042	CAP.CHIP	AP 63V 10% 4.7NF	5322 126 10223
C1048	CAP.CHIP	AP 63V 10% 220NF	4822 122 32916
C1049	CAP.CHIP	AP 63V 10% 2.2NF	4822 122 33127
C1051	CAP.CHIP	AP 63V 10% 4.7NF	5322 126 10223
C1061	CAP.CHIP	AP 63V 10% 1NF	5322 126 10511
C1062	CAP.CHIP	AP 63V 10% 1NF	5322 126 10511
C1101	CAP.CHIP	AP 63V 10% 6.8NF	5322 122 31866
C1102	CAP.CERAMIC	4KV -10+10% 33PF	5322 122 33081
C1103	CAP.CHIP	AP 63V 10% 47NF	4822 122 32542
C1104	CAP.CERAMIC	AP 63V 5% 220PF	4822 122 33575
C1105	CAP.CHIP	AP 63V 10% 1NF	5322 126 10511
C1106	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1107	CAP.CHIP	AP 63V 10% 100NF	4822 122 33496
C1108	CAP.CHIP	AP 63V 10% 2.2NF	4822 122 33127
C1109	CAP.CHIP	AP 63V 10% 2.2NF	4822 122 33127
C1111	CAP.CHIP	AP 63V 10% 3.3NF	4822 122 33891
C1112	CAP.ELECTROLYT.	100V 20% 100UF	5322 124 42227
C1131	CAP.CERAMIC	3KV +50 -20% 10NF	5322 126 12921
C1132	CAP.CERAMIC	3KV +50 -20% 10NF	5322 126 12921
C1133	CAP.	-10+10% 2.2NF	5322 122 33851
C1141	CAP.CHIP	AP 63V 5% 100PF	5322 122 32531
C1142	CAP.CHIP	AP 63V 5% 100PF	5322 122 32531
C1144	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1147	CAP.ELECTROLYT.	25V 20% 2200UF	5322 124 42229
C1148	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1201	CAP.ELECTROLYT.	25V 20% 2200UF	5322 124 42229
C1203	CAP.	25V -20+20% 1000UF	5322 124 23276
C1204	CAP.ELECTROLYT.	25V 20% 2200UF	5322 124 42229
C1206	CAP.	25V -20+20% 1000UF	5322 124 23276
C1208	CAP.ELECTROLYT.	25V 20% 2200UF	5322 124 42229
C1209	CAP.	25V -20+20% 1000UF	5322 124 23276

Item	Description		Ordering code
C1211	CAP.	25V -20+20% 1000UF	5322 124 23276
C1212	CAP.FOIL	25V 20% 470UF	5322 121 43885
C1213	CAP.FOIL	25V 20% 470UF	5322 121 43885
C1214	CAP.FOIL	25V 20% 470UF	5322 121 43885
C1216	CAP.ELECTROLYT.	100V 20% 100UF	5322 124 42227
C1217	CAP.ELECTROLYT.	100V 20% 100UF	5322 124 42227
C1218	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1219	CAP.ELECTROLYT.	100V 20% 100UF	5322 124 42227
C1221	CAP.ELECTROLYT.	100V 20% 100UF	5322 124 42227
C1226	CAP.CHIP	AP 63V 10% 100NF	4822 122 33496
C1227	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1231	CAP.ELECTROLYT.	100V 20% 27UF	5322 124 42193
C1234	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1241	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1244	CAP.CHIP	AP 63V 10% 100NF	4822 122 33496
C1245	CAP.CHIP	AP 63V 10% 220NF	4822 122 32916
C1247	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1251	CAP.CHIP	AP 63V 10% 100NF	4822 122 33496
C1252	CAP.CERAMIC	AP 63V 5% 47PF	5322 122 32452
C1270	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1271	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1272	CAP.ELECTROLYT.	25V 20% 2200UF	5322 124 42229
C1274	CAP.ELECTROLYT.	25V 20% 2200UF	5322 124 42229
C1277	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1279	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1281	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1282	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1283	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1284	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1285	CAP.ELECTROLYT.	100V 20% 27UF	5322 124 42193
C1286	CAP.CHIP	AP 63V 10% 10NF	5322 122 34098
C1291	CAP.CERAMIC	500V 10% 470PF	4822 122 31177
C9972	CAP.ELECTROLYT.	25V 20% 2200UF	5322 124 42229

INTEGRATED CIRCUITS

D1131	UNIT,ELECTRICAL	BG2000-641-512	5322 130 10177
N1046	INTEGR.CIRCUIT	LM358M NSC	4822 209 60175
N1101	INTEGR.CIRCUIT	LM358M NSC	4822 209 60175
N1102	INTEGR.CIRCUIT	LM358M NSC	4822 209 60175
N1141	INTEGR.CIRCUIT	TDA8442/N3 PEL	4822 209 71703
N1226	INTEGR.CIRCUIT	LM369DN NSC	5322 209 30266
N1236	INTEGR.CIRCUIT	LM339D SIG	5322 209 70684
N1251	INTEGR.CIRCUIT	LM358M NSC	4822 209 60175

Item	Description		Ordering code
COILS			
L1001	COIL	ECH30 180UH TDK	5322 157 63378
L1004	COIL	5.6UH	4822 157 52259
L1006	COIL	PG1 RM6S T&M OSC.	5322 157 70858
L1101	COIL	82UH	4822 158 10563
L1131	COIL	0.015H TDK	5322 157 63383
L1146	COIL	0.015H TDK	5322 157 63383
L1201	COIL	33UH TDK	4822 157 62886
L1202	COIL	33UH TDK	4822 157 62886
L1203	COIL	33UH TDK	4822 157 62886
L1204	COIL	100UH TDK	5322 157 52363
L1206	COIL	82UH	4822 158 10563
L1207	COIL	15UH	4822 157 53066
L1208	COIL	82UH	4822 158 10563
L1209	COIL	82UH	4822 158 10563
L1271	COIL	TRANSDUCTORCOIL	5322 157 63931
L1273	COIL	3.3UH TDK	5322 157 53017
RESISTORS			
R1001	RES.N.T.C.	NTC 2.2A 15E	5322 116 34035
R1002	RES.METAL FILM	ST MRS25 1% 464E	4822 050 24641
R1004	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1007	RES.METAL FILM	HIP RC-02H 1% 464K	5322 117 10568
R1008	RES.METAL FILM	HIP RC-02H 1% 464K	5322 117 10568
R1011	RES.METAL FILM	ST MRS25 1% 316E	4822 050 23161
R1016	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1017	RES.CHIP	HIP RC-02H 1% 100E	4822 051 10101
R1018	RES.N.T.C.	NTC 0.5W 10% 1K5	4822 116 30248
R1019	RES.METAL FILM	ST MRS25 1% 1E96	4822 050 21968
R1021	RES.CHIP	HIP RC-02H 1% 215E	5322 117 10484
R1022	RES.METAL FILM	HIP RC-02H 1% 178E	5322 117 10534
R1023	RES.METAL FILM	ST MRS25 1% 1E	4822 050 21008
R1024	RES.METAL FILM	ST MRS25 1% 1E	4822 050 21008
R1026	RES.METAL FILM	ST MRS25 1% 1E	4822 050 21008
R1027	RES.METAL FILM	ST MRS25 1% 3K16	4822 050 23162
R1028	RES.METAL FILM	ST MRS25 1% 3K16	4822 050 23162
R1042	RES.CHIP	RMC1/8 1% 10E	4822 111 91885
R1045	RES.CHIP	RC-02H 1% 100K	4822 051 10104
R1046	RES.METAL FILM	HIP RC-02H 1% 464E	5322 117 10567
R1047	RES.METAL FILM	HIP RC-02H 1% 13K3	5322 117 10525
R1048	RES.METAL FILM	HIP RC-02H 1% 31K6	5322 117 10554
R1049	RES.CHIP	HIP RC-02H 1% 100E	4822 051 10101
R1051	RES.METAL FILM	HIP RC-02H 1% 6K19	5322 117 10577
R1052	RES.METAL FILM	HIP RC-02H 1% 7K5	5322 117 10583
R1054	RES.CHIP	HIP RC-02H 1% 100E	4822 051 10101
R1056	RES.METAL FILM	HIP RC-02H 1% 6K19	5322 117 10577

Item	Description		Ordering code
R1057	RES.CHIP	RMC1/8 1% 10E	4822 111 91885
R1058	RES.METAL FILM	HIP RC-02H 1% 7K5	5322 117 10583
R1061	RES.CHIP	HIP RC-02H 1% 100K	4822 051 10104
R1062	RES.CHIP	HIP RC-02H 1% 100K	4822 051 10104
R1063	RES.CHIP	HIP RC-02H 1% 100K	4822 051 10104
R1064	RES.CHIP	HIP RC-02H 1% 100K	4822 051 10104
R1100	RES.METAL FILM	HIP RC-02H 0E	4822 051 10008
R1101	RES.METAL FILM	HIP RC-02H 1% 121K	5322 117 10523
R1103	RES.HI-TENSION	RST VR37 1% 31M6	5322 116 64103
R1104	RES.METAL FILM	HIP RC-02H 1% 316K	5322 117 10555
R1106	RES.METAL FILM	HIP RC-02H 1% 7k5	5322 117 10583
R1107	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1108	RES.METAL FILM	HIP RC-02H 1% 2K37	5322 117 10545
R1109	RES.CHIP	RMC1/8 1% 51E1	5322 111 91893
R1111	RES.CHIP	HIP RC-02H 1% 215E	5322 117 10484
R1112	RES.METAL FILM	HIP RC-02H 1% 464E	5322 117 10567
R1113	RES.CHIP	HIP RC-02H 1% 4K64	4822 051 54642
R1114	RES.CHIP	HIP RC-02H 1% 68K1	4822 051 56813
R1116	RES.CHIP	HIP RC-02H 1% 4K64	4822 051 54642
R1118	RES.CHIP	RMC1/8 1% 51E1	5322 111 91893
R1119	RES.CHIP	RMC1/8 1% 51E1	5322 111 91893
R1122	RES.METAL FILM	ST MRS25 1% 1E	4822 050 21008
R1123	RES.METAL FILM	HIP RC-02H 1% 19K6	5322 117 10541
R1146	RES.CHIP	HIP RC-02H 1% 100K	4822 051 10104
R1147	RES.METAL FILM	HIP RC-02H 1% 121K	5322 117 10523
R1148	RES.METAL FILM	HIP RC-02H 1% 215K	5322 117 10543
R1149	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1151	RES.METAL FILM	HIP RC-02H 1% 12K1	5322 117 10522
R1152	RES.CHIP	HIP RC-02H 1% 1K	4822 051 10102
R1153	RES.METAL FILM	HIP RC-02H 1% 4K22	5322 117 10565
R1154	RES.METAL FILM	HIP RC-02H 1% 215K	5322 117 10543
R1155	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1156	RES.CHIP	HIP RC-02H 1% 1M	4822 051 10105
R1157	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1158	RES.CHIP	HIP RC-02H 1% 100K	4822 051 10104
R1159	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1161	RES.CHIP	HIP RC-01 5% 1E	4822 051 10108
R1162	RES.CHIP	HIP RC-02H 0E	4822 051 10008
R1163	RES.CHIP	HIP RC-02H 0E	4822 051 10008
R1218	RES.CHIP	HIP RC-02H 1% 1K	4822 051 10102
R1226	RES.METAL FILM	HIP RC-02H 1% 464E	5322 117 10567
R1227	RES.METAL FILM	HIP RC-02H 1% 178E	5322 117 10534
R1228	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1231	RES.N.T.C.	NTC 0.5W 10% 1K5	4822 116 30248
R1232	RES.METAL FILM	HIP RC-02H 1% 511E	5322 117 10569
R1233	RES.METAL FILM	HIP RC-02H 1% 2K37	5322 117 10545
R1234	RES.METAL FILM	HIP RC-02H 1% 4K22	5322 117 10565

Item	Description		Ordering code
R1235	RES.CHIP	HIP RC-02H 1% 1K	4822 051 10102
R1236	RES.CHIP	HIP RC-02H 1% 215E	5322 117 10484
R1238	RES.CHIP	HIP RC-02H 1% 5K11	5322 117 10487
R1239	RES.METAL FILM	HIP RC-02H 1% 2K37	5322 117 10545
R1241	RES.METAL FILM	HIP RC-02H 1% 31K6	5322 117 10554
R1242	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1243	RES.METAL FILM	HIP RC-02H 1% 23K7	5322 117 10546
R1244	RES.METAL FILM	HIP RC-02H 1% 21K5	5322 117 10542
R1245	RES.METAL FILM	HIP RC-02H 1% 26K1	5322 117 10548
R1246	RES.METAL FILM	HIP RC-02H 1% 2K37	5322 117 10545
R1247	RES.METAL FILM	HIP RC-02H 1% 2K37	5322 117 10545
R1248	RES.CHIP	HIP RC-02H 1% 1M	4822 051 10105
R1249	RES.CHIP	HIP RC-02H 1% 5K11	5322 117 10487
R1251	RES.CHIP	HIP RC-02H 1% 100E	4822 051 10101
R1253	RES.CHIP	HIP RC-02H 1% 5K11	5322 117 10487
R1254	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1256	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1257	RES.CHIP	HIP RC-02H 1% 5K11	5322 117 10487
R1258	RES.CHIP	HIP RC-02H 1% 100E	4822 051 10101
R1260	RES.CHIP	HIP RC-02H 1% 2K37	5322 117 10545
R1261	RES.CHIP	HIP RC-02H 1% 1K	4822 051 10102
R1262	RES.CHIP	HIP RC-02H 1% 1K	4822 051 10102
R1263	RES.CHIP	HIP RC-02H 1% 100E	4822 051 10101
R1264	RES.CHIP	HIP RC-02H 1% 100E	4822 051 10101
R1272	RES.METAL FILM	ST MRS25 1% 21E5	4822 050 22159
R1278	RES.CHIP	HIP RC-02H 1% 1K	4822 051 10102
R1281	RES.METAL FILM	HIP RC-02H 1% 21K5	5322 117 10542
R1282	RES.CHIP	HIP RC-02H 1% 10K	4822 051 10103
R1283	RES.METAL FILM	HIP RC-02H 1% 26K1	5322 117 10548
R1291	RES.METAL FILM	ST MRS25 1% 100E	4822 050 21001
R9017	RES.CHIP	HIP RC-02H 1% 100E	4822 051 10101

SEMICONDUCTORS

V1001	DIODE	BYM56E PEL	4822 130 80254
V1002	DIODE	BYM56E PEL	4822 130 80254
V1003	DIODE	BYM56E PEL	4822 130 80254
V1004	DIODE	BYM56E PEL	4822 130 80254
V1006	DIODE,CHIP	BAS16 PEL	5322 130 31928
V1007	TRANSISTOR	BC337 PEL	4822 130 40855
V1008	DIODE,CHIP	BAS16 PEL	5322 130 31928
V1009	DIODE,CHIP	BAS16 PEL	5322 130 31928
V1013	DIODE,REFERENCE	BZX84-C15 PEL	5322 130 33662
V1014	TRANSISTOR,CHIP	BRY62 PEL	5322 130 62661
V1016	TRANSISTOR	2SK119 TOS	5322 130 63358
V1017	RECTIFIER	BYV27-150 PEL	4822 130 31628
V1018	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1019	TRANSISTOR	BUW13A PEL	5322 130 42047
V1021	RECTIFIER	BYV26C PEL	4822 130 32343

Item	Description		Ordering code
V1022	RECTIFIER	BYV26C PEL	4822 130 32343
V1023	DIODE,REFERENCE	BZX79-C3V0 PEL	4822 130 31881
V1046	DIODE,REFERENCE	BZX84-C5V1 PEL	5322 130 32835
V1100	DIODE,REFERENCE	BZX84-C11 PEL	4822 130 81338
V1102	TRANSISTOR,CHIP	BC858C PEL	4822 130 42513
V1103	DIODE,REFERENCE	BZX84-B47 PEL	4822 130 82521
V1104	DIODE,CHIP	BAS21 PEL	4822 130 33702
V1105	DIODE,REFERENCE	BZX84-C11 PEL	4822 130 81338
V1106	DIODE,CHIP	BAS21 PEL	4822 130 33702
V1107	DIODE,CHIP	BAS21 PEL	4822 130 33702
V1108	RECTIFIER	BYV27-150 PEL	4822 130 31628
V1109	TRANSISTOR	BUL147 MOT	5322 130 63515
V1111	DIODE,REFERENCE	BZX84-C4V3 PEL	5322 130 80256
V1112	DIODE,CHIP	BAS21	4822 130 33702
V1113	DIODE,CHIP	BAS21	4822 130 33702
V1131	DIODE	BY709 PEL	5322 130 82711
V1146	TRANSISTOR	BC337 PEL	4822 130 40855
V1147	TRANSISTOR	BC327 PEL	4822 130 40854
V1148	TRANSISTOR	BD825 PEL	4822 130 41746
V1149	TRANSISTOR	BD825 PEL	4822 130 41746
V1201	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1202	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1203	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1204	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1206	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1207	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1208	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1209	RECTIFIER	BYV27-150 PEL	4822 130 31628
V1211	RECTIFIER	BYV95C PEL	4822 130 41487
V1212	RECTIFIER	BYV27-150 PEL	4822 130 31628
V1213	THYRISTOR	BT151-500R PEL	5322 130 24081
V1214	RECTIFIER	BYV95C PEL	4822 130 41487
V1216	RECTIFIER	BYV27-150 PEL	4822 130 31628
V1226	TRANSISTOR,CHIP	BC858C PEL	4822 130 42513
V1241	TRANSISTOR,CHIP	BC848C PEL	5322 130 42136
V1242	TRANSISTOR,CHIP	BC848C PEL	5322 130 42136
V1243	TRANSISTOR,CHIP	BF821 PEL	4822 130 61923
V1244	DIODE,CHIP	BAS21 PEL	4822 130 33702
V1246	DIODE,CHIP	BAS16 PEL	5322 130 31928
V1251	TRANSISTOR,CHIP	BC858C PEL	4822 130 42513
V1252	TRANSISTOR,CHIP	BC858C PEL	4822 130 42513
V1253	DIODE,CHIP	BAS21 PEL	4822 130 33702
V1271	RECTIFIER	BYV32-150E PEL	5322 130 83489
V1272	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1273	RECTIFIER	BYV28-150 PEL	5322 130 32043
V1277	DIODE,CHIP	BAS16 PEL	5322 130 31928
V1278	TRANSISTOR,CHIP	BSV52 PEL	5322 130 44336

Item	Description		Ordering code
V1279	DIODE,CHIP	BAT17 PEL	5322 130 31544
V1281	DIODE,CHIP	BAS21 PEL	4822 130 33702
V1283	DIODE,REFERENCE	BZX84-C15 PEL	5322 130 33662
V1284	TRANSISTOR,CHIP	BF820 PEL	5322 130 62802
V9016	TRANSISTOR	2SK119 TOS	5322 130 63358
V9018	RECTIFIER	BYV28-150 PEL	5322 130 32043

MISCELLANEOUS

T1001	TRANSF,INPUT	PG1 ETD44 TRANSF.	5322 142 50172
T1002	TRANSFORMER	PG1 TRANSFORMER	5322 148 60255
X1001	CONNECTOR	3-P SNG RT.ANG	5322 140 10587
X1002	CONNECTOR	64-P PIN 2.54	5322 265 61243
X1003	CONNECTOR	5-P SNG STRGHT	5322 265 30436

