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18. CIRCUIT DESCRIPTION OF PRIMARY CONVERTER UNIT (See fig.18.4.)

WARNING : The complete circuit is at mains potential up to transformer T6201.

The block diagram, Fig.18.1, shows the connections of the primary converter within the power supply. In order to produce the 48V supply for the secondary converter, two identical standard 24 V units are used with outputs series-connected; primary converter I and primary converter II.

Each primary converter basically consists of:

- a mains filter and bridge rectifier circuit
- a forward converter (moulded part)
- a secondary rectifier circuit with over voltage protection.

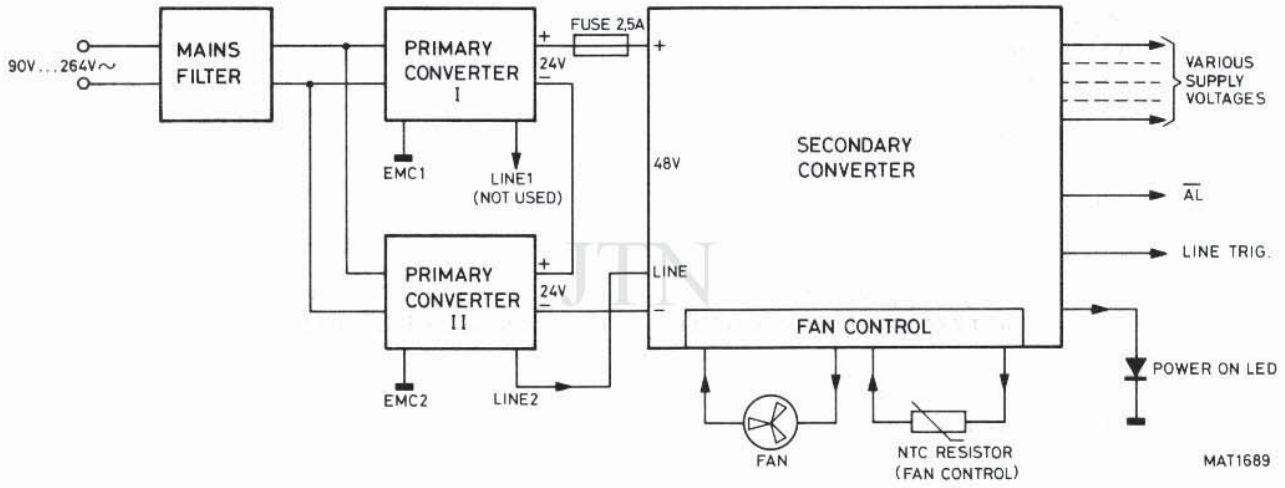

Fig.18.1. Interconnections of primary converters.

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The mains filter and bridge recifier

The mains input (90 V...246 V ac) from the mains socket with filter and routed via double-pole switch S65, fuse F1 to connections X6204 and X6202. Resistor R6201 has a surge current limiting function.Capacitor C6201 across the input acts as an interference limiter.
At this point, the X6201 and X6203 connectors of the primary converters are paralleled with the X6202 and X6204 connectors.
A capacitive network C6202 ... C6209 across the input serves to reduce interference, the centre-point being coupled to earth to provide electromagnetic compatibility (EMC1).
In the primary converter II the other half of the capacitive network (C6206, R6203) is used as a trigger pick-off point for LINE triggering.
The full-wave diode bridge V6201 ... V6204 rectifies the input voltage, which is fed to forward converter.

The forward converter

Since the forward converter is a moulded part of the unit, the components are note accessible. Therefore, only a brief description of its operation is given.

The d.c. input from the bridge rectifier is smoothed in C6211, L6203, C6212 and C6213. To limit power surges at start-up, the base current (Ib) for V6222 of the converter Darlington circuit V6222/V6223 is initially blocked via the series diodes V6206, V6207, V6208, and Ib is only supplied via the limiting resistor R6213.

However, after start-up, V6206 ... V6208 conduct and constant base current is supplied via R6211, regulated by V6211. The constant base current is stabilized by the network R6211, C6217, V6218, V6219, V6221 and V6234.Zener diode V6212 provides a constant 7.5 V level on the base of series regulator V6211. This network, together with diode V6209 provides a voltage stabiliser to give 6.9 V on the emitter of V6211 independent of the mains voltage. In turn, this gives a constant base current via R6209, R6211 to V6222 as shown in fig.18.2.A. As a result, V6223 conducts and its collector current Ic increases linearly as shown in fig.18.2.B. This increase continues until the control voltage from the feedback winding (9 turns) (equal to the secondary voltage), rectified and stabilised by V6217, V6233 and V6216, is sufficient to fire thyristor V6213, which blocks the series regulator V6211.
The output feedback voltage accross V6214 determines the converter frequency (20 kHz approx.); -0.5 V ... +0.6 V gives an Ic of 0 A ... 2.2 A.
The NTC resistor R6214 gives temperature compensation for the thyristor V6213.
At high mains voltages, power limiting is achieved during the forward stroke by resistor R6207.
The maximum Ic of V6223 is also regulated by the current measuring resistors R6216 and R6217.
Capacitor C6217 charges during the forward stroke and provides a negative-voltage source for fast switch-off of V6222-V6223.
Chokes L6207, L6208 in series with the primary windings of T6201saturate (low-reactance) during normal operation, but have considerable reactance at start-up, thus limiting peak currents.
Snubbing circuits C6219, V6224, V6226; C6221, V6227 and the coil (8t),protect the Darlington transistors V6222/V6223 against fast positive peaks at the moment that they are switched-off.
During the forward stroke energy is build-up in the converter transformer T6201.
During the fly-back stroke this energy is discharged via the secondary winding over the secondary rectifier circuit.

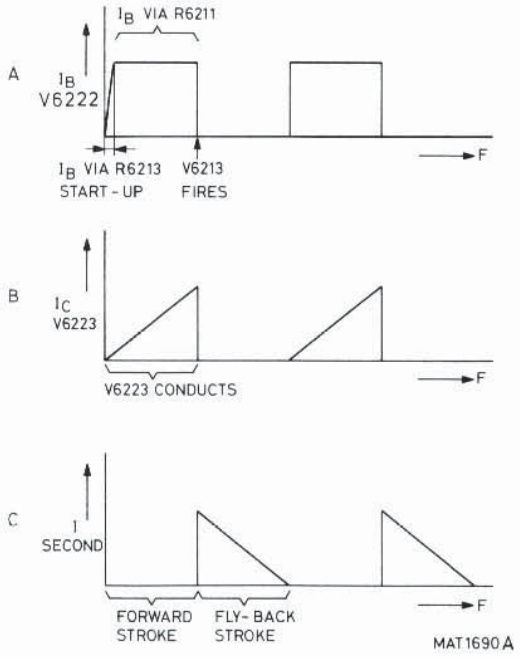
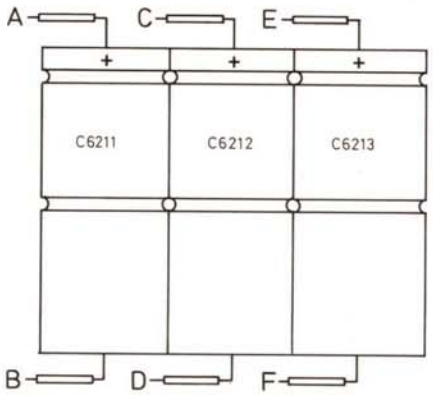


Fig.18.2. Waveforms in primary converter.

Secondary rectifier circuit

The current in the secondary winding of T6201 during the flyback stroke of the converter i.e. when V6223 blocks, decreases linearly as shown in fig.18.2.C. The current is half-wave rectified by diodes V6228, V6229 and smoothed by C6223. The flywheel diode V6232 prevents inverse currents appearing in the secondary winding.

Overvoltage protection is provided by zener diode V6231 in series with R6219 across the secondary output.
The secondary outputs of primary converter I and primary converter II are series connected to give a smoothed 48 V to the secondary converter unit.



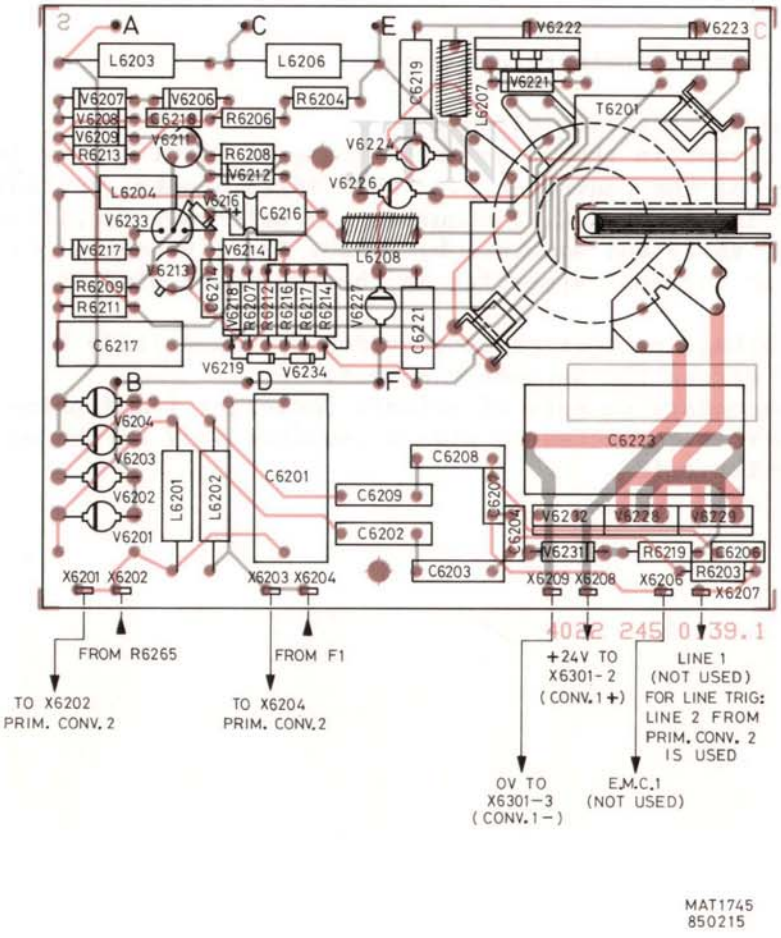


Fig.18.3. Primary converter unit, p.c.b. lay-out.

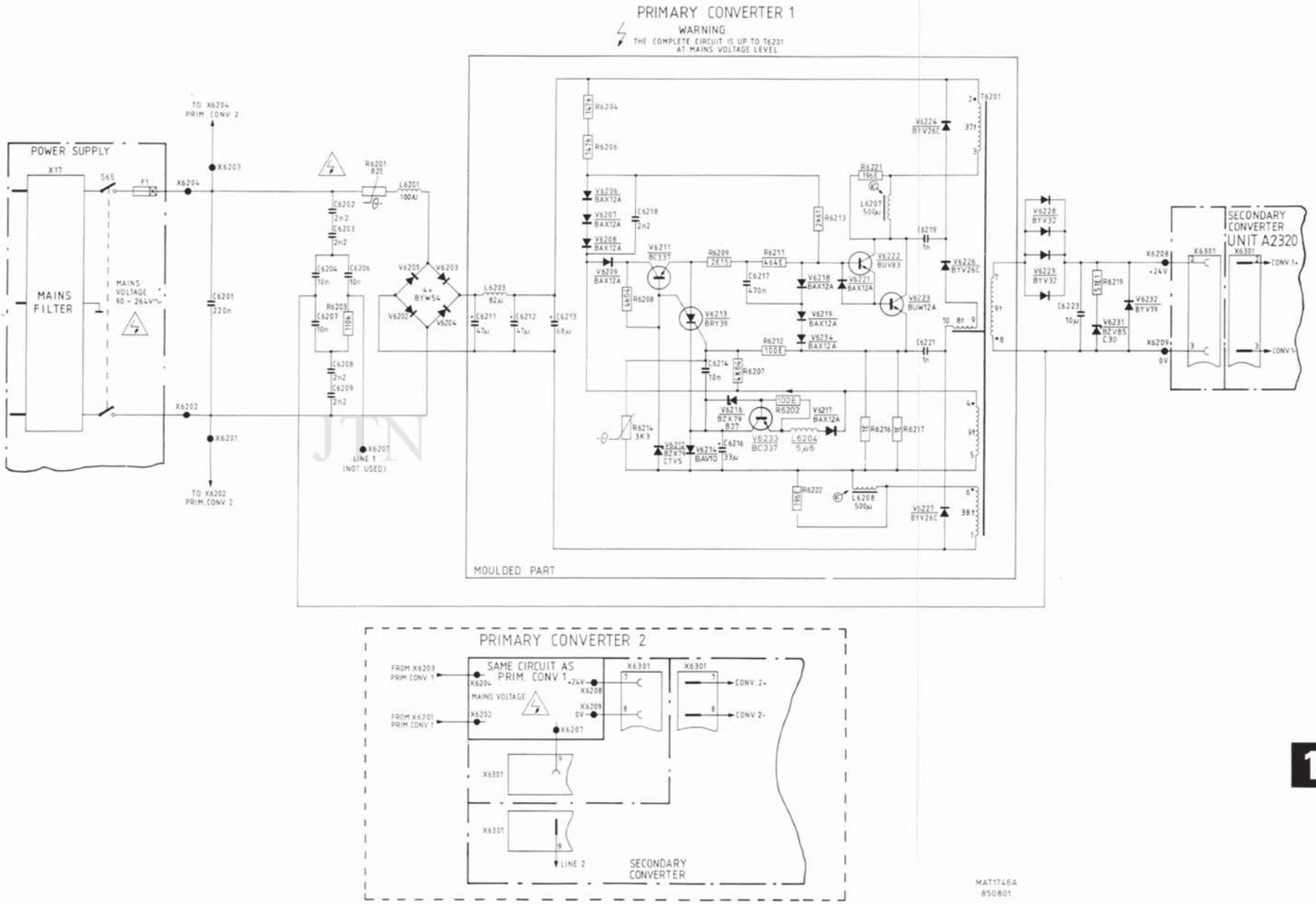


Fig.18.4. Primary converter unit, circuit diagram.

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18.1 PARTS LIST

In this section only electrical parts present on this unit are listed. Mechanical parts, including cables and connectors, are given in section 28.

SUBJECT TO ALTERATION WITHOUT NOTICE

18.1.1 CAPACITORS

POSNR	DESCRIPTION		ORDERING CODE
C 6201	CAP.PAPER	250V 10% 220NF	5322 121 44142
C 6202	CAP.PAPER	ME265 20% 2.2NF	5322 121 20232
C 6203	CAP.PAPER	ME265 20% 2.2NF	5322 121 20232
C 6204	CAP.CERAMIC	-20+50% 10NF	4822 122 31414
C 6206	CAP.CERAMIC	-20+50% 10NF	4822 122 31414
C 6207	CAP.CERAMIC	-20+50% 10NF	4822 122 31414
C 6208	CAP.PAPER	ME265 20% 2.2NF	5322 121 20232
C 6209	CAP.PAPER	ME265 20% 2.2NF	5322 121 20232
C 6223	CAP.FOIL	100V 10% 10UF	5322 121 41727

18.1.2 RESISTORS

R 6203	RES.METAL FILM	MR25	1% 110K	5322 116 54701
R 6219	RES.METAL FILM	MR25	1% 51E1	5322 116 54442

18.1.3 SEMI CONDUCTORS

V 6201	DIODE	BYW54	PEL	5322 130 34919
V 6202	DIODE	BYW54	PEL	5322 130 34919
V 6203	DIODE	BYW54	PEL	5322 130 34919
V 6204	DIODE	BYW54	PEL	5322 130 34919
V 6228	DIODE	BYV32-150	PEL	5322 130 31637
V 6229	DIODE	BYV32-150	PEL	5322 130 31637

18.1.4 MISCELLANEOUS

L 6201	COIL	100UH	TDK	5322 157 52363

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FIGURES

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19.5. Secondary converter unit, circuit diagram. 19-10

19. CIRCUIT DESCRIPTION OF SECONDARY CONVERTER UNIT (See fig.19.5)

The secondary converter is similar in principle to the primary converter. It basically consists of:

- a flyback converter circuit
- a voltage regulator
- a control circuit
- a line trigger circuit
- a fan control circuit.

The flyback converter (V6306, V6342)
The flyback converter consists of transistors V6306 and V6342 and their associated components. The normal converter frequency is ≃ 25 kHz. For waveforms, see fig. 19.1.
Transistor V6342 conducts on the forward stroke and charges transformer T6301. The thyristor V6303 fires when the current measuring resistor R6309 has approximately 0.57 V accross it. Consequently, V6342 blocks (FET V6306 blocks) for the duration of the flyback stroke, during which the secondary windings discharge via the diode rectifiers into the smoothing capacitors.
The NTC resistor R6301 provides temperature compensation for the firing point of the thyristor. The zener diode V6341 gives over-voltage protection to prevent the cathode gate voltage of the thyristor exceeding 15.5.V.
The waveforms present on the gate (X29) and the drain (X28) of the FET V6306 and over R6309 (X27) are given in fig.19.1.

The CON-signal (X32) is according the output of comparator D6302-6-7-1 (open collector output) under normal conditions constantly high (27 V), but at the moment that the thyristor V6303 fires (every 40 us) this level is low for 4 us.

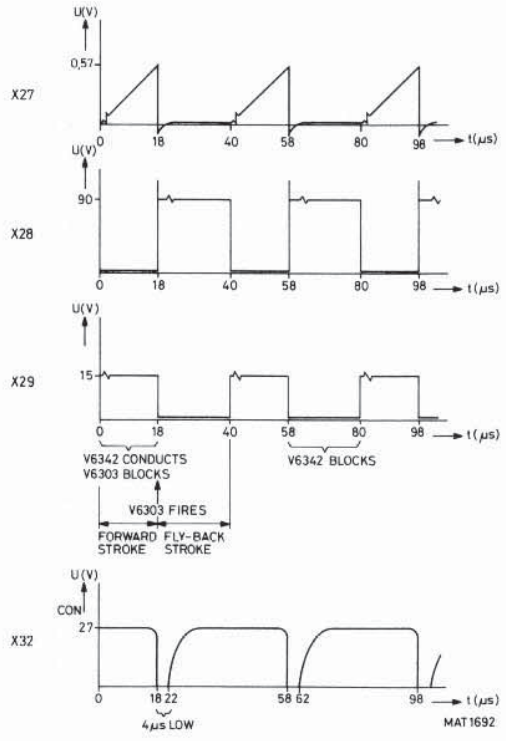

Fig.19.1. Voltage waveforms in the flyback converter.

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Voltage regulator circuit (D6301)
The voltage regulator uses an integrated circuit D6301 to ensure a very constant output voltage.
The 5 V U REF voltage from the control circuit is applied to the positive input (pin 5) of a unity gain operational amplifier D6301 and provides the reference input (pin 2) for the comparator D6301. The other input is a +5 V feedback voltage from the rectified secondary of T6301. The resulting output voltage on pin 1 of D6301 is used to control the primary current through T6301. Its value is greater than 0.7 V, typicallly 1.5 V, and has a maximum of 12 V. If this voltage is negative, the converter is overloaded. The voltage is aplied via diode V6309 as the control voltage (CONTR) to the cathode gate of the thyristor V6303.
If the +5 VA feedback voltage is for instance too high, D6301-3 gets higher and D6301-1 will be higher than 1,5 V. As a result the thyristor V6303 will fire earlier (faster). This means that the forward stroke gets shorter, so the converter transformer T6301 will be less charged and the output voltages will decrease.

Control circuit (D6302)
The control supply voltages are derived from the +50 V [PRIM] supply. Fed via the two parallel resistors R6314, R6316, zener diode V6311 provides a +27 V for comparators D6302. Likewise, zener diode V6312 gives an output to a voltage divider that is adjustable by R6318 to give a 5 V U REF output on test-point X30.

The 5 V U REF output is also fed to input 10 of comparator D6302 where it is compared with a sampled potential on input 11, obtained from voltage divider R6323, R6324 across the +50 V [PRIM] supply. The circuit detects whether the supply is too low. A temperature compensation stage, V6339 controlled by a PTC resistor R6308 in its base circuit is also connected to input 11. At temperatures higher than 80 degrees C V6339 conducts and reduces the potential on input 11 of the comparator.
Therefore, is the 50 V [PRIM] input is low, or the circuit temperature is greater than 80 degrees C, output 13 of D6302 goes low, C6313 discharges in 50 us and output 2 of D6302 goes low (AL-). This alarm signal is routed to output connector X6302-32.
The low output from C6313 is also applied to the lower comparator in input 7. Since input 6 is at a lower potential than input 4 there is a delay of 1.5. ms after which the output on pin 1 goes low and switchesoff the converter by the low on the anode gate of the thyristor V6303 (CON: converter on signal).
The alarm signal AL-, routed via the motherboard to the CPU unit,thus saves the memory contents of the uP before the power is off.
At switch-on, AL- becomes high after 150 ms (the starting-up time determined by the charging time of C6313)

Line trigger circuit
The LINE 2 input from primary converter 2 is a mains-voltage related signal. To ensure that the line trigger signal has constant amplitude this circuit provides automatic gain control. The LINE 2 input is fed to a feedback operational amplifier D6301 with a gain of 1000 (R6341/R6339). The output on pin 14 is fed to a comparator input D6301-10. The other input carries the 5 V U REF. This stage operates as a top detector. The output on pin 8 is a rectangular waveform

(+14V ... -14 V) the pulse width being dependent on the amplitude of the sinewave input D6301-10 (see also fig.19.2). These pulses are rectified by diode V6313 and charge capacitor C6316 to give a negative control voltage on the base of FET V6314.This FET conducts to regulate the amplitude of the LINE 2 signal. If, for instance, the mains voltage increases, LINE 2 also increases. Than output D6301-14 also increases. As a result the pulse width of the square wave signal on D6301-8 will get wider (see fig.19.2). FET V6314 will conduct more, which decreases the sine wave signal on D6301-12. This results in a direct correction of the output sine wave on D6301-14. The output on D6301-14 provides the constant LINE TRIG signal on X34 (0.24 V eff), which is routed via the motherboard to the adaptation unit.

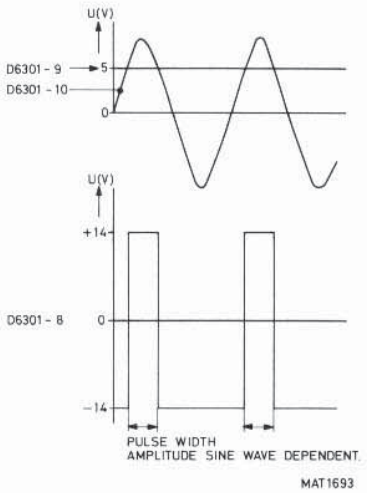

Fig.19.2. Voltage waveforms in the line trigger circuit.

Fan-control circuit

This consists of a highly-efficient switched series-regulator for determining the supply voltage to the fan, controlled by an NTC resistor on the Mother Board.
The sensing input NTC-1 is applied to the comparator positive input D6302-9. A U REF of 5.1 V derived from zener diode V6329 is applied to input D6302-8 together with the switch hysteresis input via R6351. For waveforms, see fig.19.3.
With input D6302-9 low (high temperature) output D6302-14 is low, which gives a low switch signal via zener diode V6332 to the base of the pnp series-regulator V6331. This conducts to provide a current (I) to charge L6317 and C6343. Output voltage U out is increased to the fan. With input D6302-9 high (normal temperature) output D6302-14 is high. Consequently, V6331 blocks and L6317 discharges (I_D) via diode V6333 in V6334 via R6357. Lower output voltage is supplied to the fan.

Current-limiting at switch-on is given by transistor V6334 (off before C6343 charges). It also provides short-circuit protection for V6331.

Overvoltage protection for the fan is given by V6337, V6338 at 33 V. Transistor V6338 conducts when the output voltage exceeds 33V and the output voltage will be reduced via the emitter of V6331. Resistor R6345 reduces the current which is fed through V6338.

At 25 degrees C the supply to the fan is ≈10 V. It increases at higher temperatures to a maximum of 28 V, when it is limited by zener diode V6336, which gives a feedback voltage to comparator input pin 9.

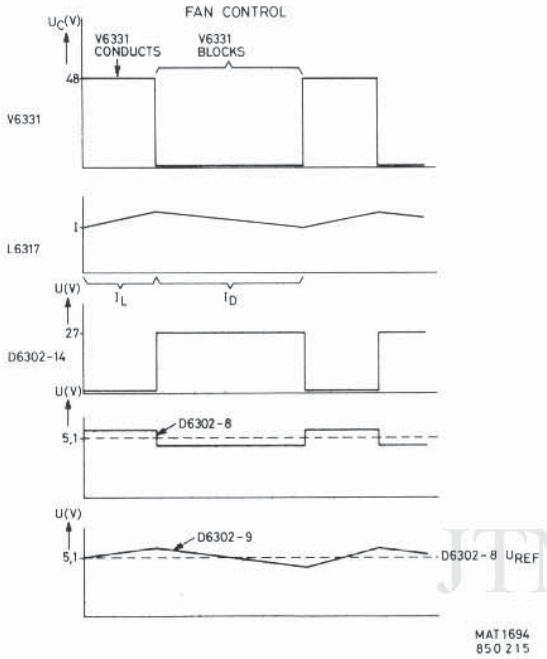

Fig.19.3. Waveforms in fan control circuit.

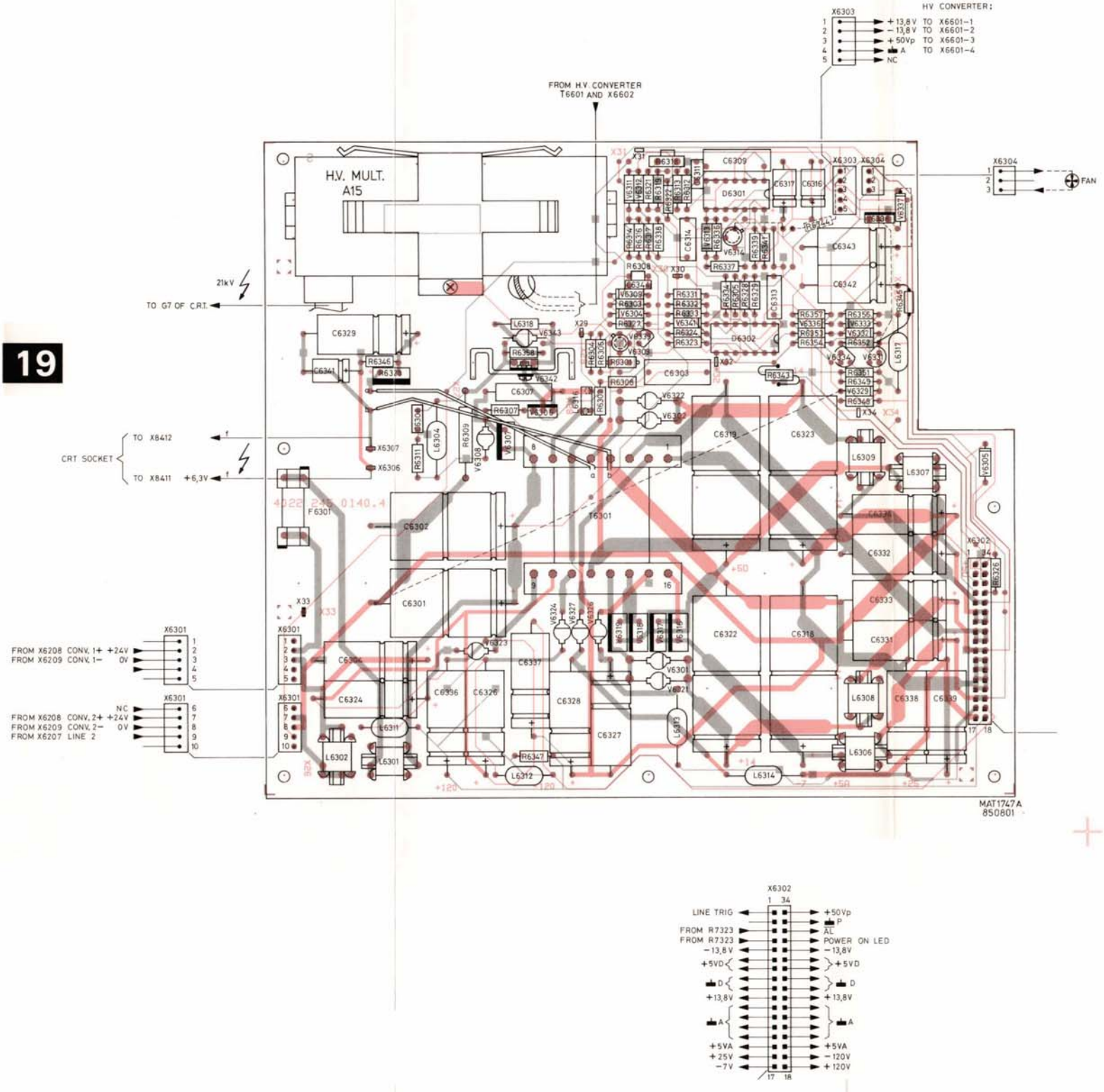

Fig.19.4. Secondary converter unit, p.c.b. lay-out.

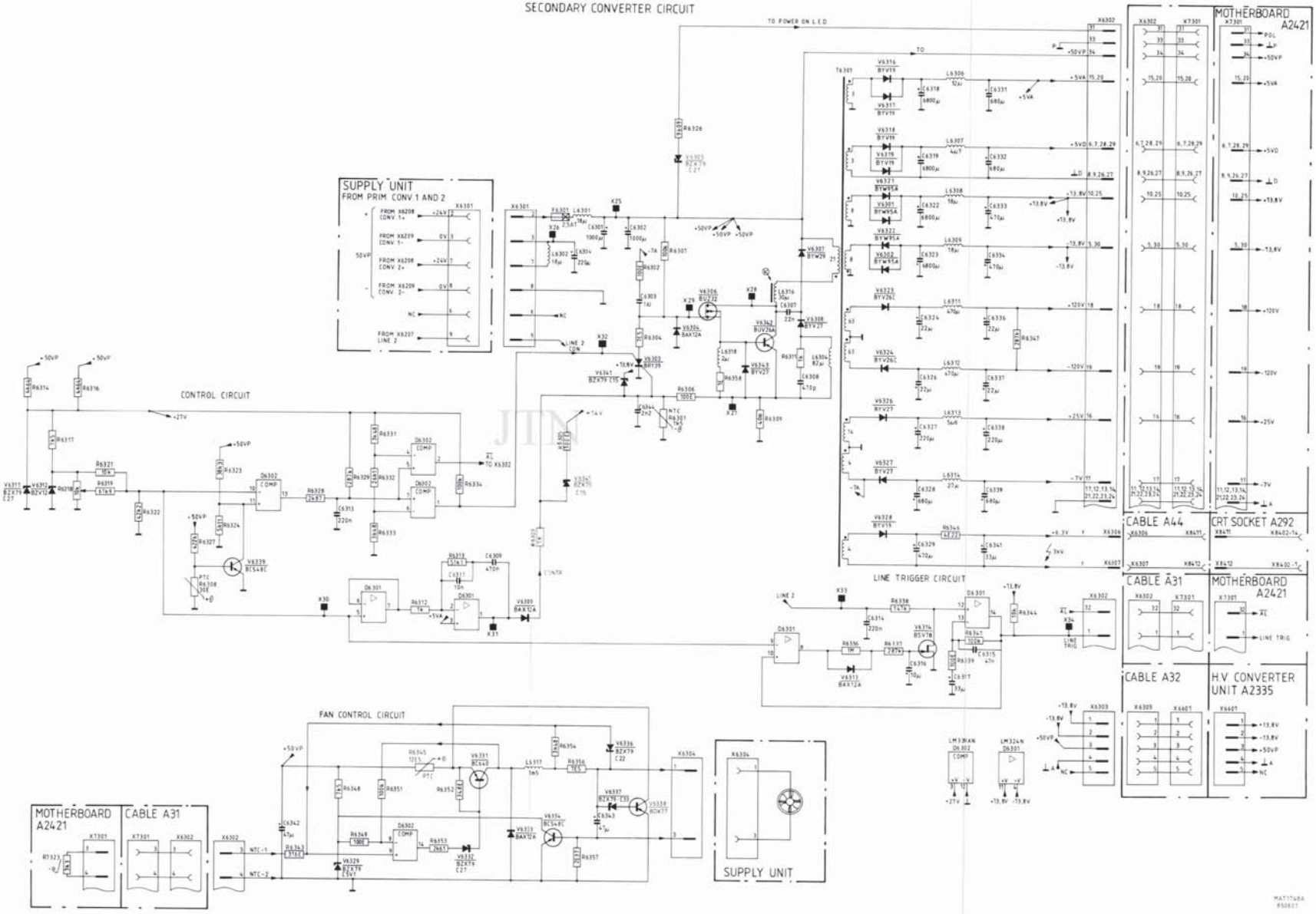

Fig.19.5. Secondary converter unit, circuit diagram.

19

19.1 PARTS LIST

In this section only electrical parts present on this unit are listed. Mechanical parts, including cables and connectors, are given in section 28.

SUBJECT TO ALTERATION WITHOUT NOTICE

19.1.1 CAPACITORS

POSNR	DESCRIPTION			ORDERING CODE
C 6301	CAP.ELECTROLYT.	-20+20%	1000UF	5322 124 21541
C 6302	CAP.ELECTROLYT.	-20+20%	1000UF	5322 124 21541
C 6303	CAP.FOIL	100V 10%	1UF	5322 121 40197
C 6304	CAP.ELECTROLYT.	-10+50%	220UF	4822 124 20717
C 6307	CAP.FOIL	160V 5%	22NF	5322 121 50983
C 6308	CAP.CERAMIC	10%	470PF	4822 122 30034
C 6309	CAP.FOIL	100V 10%	470NF	5322 121 40175
C 6311	CAP.CERAMIC	-20+50%	10NF	4822 122 31414
C 6313	CAP.FOIL	100V 10%	220NF	4822 121 40232
C 6314	CAP.FOIL	100V 10%	220NF	4822 121 40232
C 6315	CAP.FOIL	100V 10%	47NF	5322 121 42491
C 6316	CAP.ELECTROLYT.	-10+50%	10UF	4822 124 20728
C 6317	CAP.ELECTROLYT.	-10+50%	33UF	4822 124 20688
C 6318	CAP.ELECTROLYT.	-20+20%	6800UF	4822 124 20783
C 6319	CAP.ELECTROLYT.	-20+20%	6800UF	4822 124 20783
C 6322	CAP.ELECTROLYT.	-20+20%	6800UF	4822 124 20783
C 6323	CAP.ELECTROLYT.	-20+20%	6800UF	4822 124 20783
C 6324	CAP.ELECTROLYT.	-10+50%	22UF	5322 124 21768
C 6326	CAP.ELECTROLYT.	-10+50%	22UF	5322 124 21768
C 6327	CAP.ELECTROLYT.	-10+50%	220UF	4822 124 20717
C 6328	CAP.ELECTROLYT.	-10+50%	680UF	4822 124 20685
C 6329	CAP.ELECTROLYT.	-10+50%	470UF	4822 124 20695
C 6331	CAP.ELECTROLYT.	-10+50%	680UF	4822 124 20685
C 6332	CAP.ELECTROLYT.	-10+50%	680UF	4822 124 20685
C 6333	CAP.ELECTROLYT.	-10+50%	470UF	4822 124 20695
C 6334	CAP.ELECTROLYT.	-10+50%	470UF	4822 124 20695
C 6336	CAP.ELECTROLYT.	-10+50%	22UF	5322 124 21768
C 6337	CAP.ELECTROLYT.	-10+50%	22UF	5322 124 21768
C 6338	CAP.ELECTROLYT.	-10+50%	220UF	4822 124 20717
C 6339	CAP.ELECTROLYT.	-10+50%	680UF	4822 124 20685
C 6341	CAP.ELECTROLYT.	-10+50%	33UF	4822 124 20688
C 6342	CAP.ELECTROLYT.	-10+50%	47UF	4822 124 20733
C 6343	CAP.ELECTROLYT.	-10+50%	47UF	4822 124 20733
C 6344	CAP.CERAMIC	10%	2.2NF	4822 122 30114

19.1.2 INTEGRATED CIRCUITS

N 6301	INTEGR.CIRCUIT	UA324PC	FSC	5322 209 82561
N 6302	INTEGR.CIRCUIT	LM339AN	N.S	4822 209 80631

19.1.3 RESISTORS

R 6301	RES.N.T.C.	0.5W	10%	1K5	4822 116 30248
R 6302	RES.METAL FILM	MR25	1%	100E	5322 116 55549
R 6303	RES.METAL FILM	MR25	1%	1K	4822 116 51235
R 6304	RES.METAL FILM	MR25	1%	7E5	5322 116 54417
R 6305	RES.METAL FILM	MR25	1%	100E	5322 116 55549
R 6306	RES.METAL FILM	MR25	1%	100E	5322 116 55549
R 6307	RES.METAL FILM	MR25	1%	100K	4822 116 51268
R 6308	RES.P.T.C.	70 DEG C			5322 116 40093
R 6309	RES.WIREWOUND		5%	0E04	5322 113 41159
R 6311	RES.METAL FILM	MR25	1%	1K	4822 116 51235
R 6312	RES.METAL FILM	MR25	1%	1K	4822 116 51235
R 6313	RES.METAL FILM	MR25	1%	51K1	5322 116 50672

R 6314	RES.METAL FILM	MR25	1%	4K64	5322 116 50484
R 6316	RES.METAL FILM	MR25	1%	4K64	5322 116 50484
R 6317	RES.METAL FILM	MR25	1%	7K5	5322 116 54608
R 6318	POTM.TRIMMER	MTP10	20%	10K	5322 101 14066
R 6319	RES.METAL FILM	MR25	1%	61K9	4822 116 51265
R 6321	RES.METAL FILM	MR25	1%	10K	4822 116 51253
R 6322	RES.METAL FILM	MR25	1%	42K2	5322 116 50474
R 6323	RES.METAL FILM	MR25	1%	38K3	5322 116 55369
R 6324	RES.METAL FILM	MR25	1%	5K11	5322 116 54595
R 6326	RES.METAL FILM	MR25	1%	9K09	4822 116 51284
R 6327	RES.METAL FILM	MR25	1%	422K	5322 116 55247
R 6328	RES.METAL FILM	MR25	1%	2K87	5322 116 55279
R 6329	RES.METAL FILM	MR25	1%	287K	5322 116 55463
R 6331	RES.METAL FILM	MR25	1%	3K48	5322 116 55367
R 6332	RES.METAL FILM	MR25	1%	26K1	5322 116 54651
R 6333	RES.METAL FILM	MR25	1%	3K48	5322 116 55367
R 6334	RES.METAL FILM	MR25	1%	100K	4822 116 51268
R 6336	RES.METAL FILM	MR25	1%	1M	5322 116 55535
R 6337	RES.METAL FILM	MR25	1%	287K	5322 116 55463
R 6338	RES.METAL FILM	MR25	1%	147K	5322 116 54712
R 6339	RES.METAL FILM	MR25	1%	100E	5322 116 55549
R 6341	RES.METAL FILM	MR25	1%	100K	4822 116 51268
R 6343	RES.METAL FILM	MR25	1%	316E	5322 116 54511
R 6344	RES.METAL FILM	MR25	1%	10K	4822 116 51253
R 6346	RES.METAL FILM	MR25	1%	4E22	5322 116 53181
R 6347	RES.METAL FILM	MR25	1%	287K	5322 116 55463
R 6348	RES.METAL FILM	MR25	1%	7K5	5322 116 54608
R 6349	RES.METAL FILM	MR25	1%	100E	5322 116 55549
R 6351	RES.METAL FILM	MR25	1%	100K	4822 116 51268
R 6352	RES.METAL FILM	MR25	1%	348E	5322 116 54515
R 6353	RES.METAL FILM	MR25	1%	2K61	5322 116 50671
R 6354	RES.METAL FILM	MR25	1%	3K48	5322 116 55367
R 6356	RES.METAL FILM	MR25	1%	7E5	5322 116 54417
R 6357	RES.METAL FILM	MR25	1%	2E37	5322 116 52683
R 6358	RES.METAL FILM	MR25	1%	1E	4822 116 51179

19.1.4 SEMI CONDUCTORS

V 6231	DIODE	BZV85-C30	PEL	5322 130 32702
V 6232	DIODE	BYV19-45	PEL	5322 130 32703
V 6301	DIODE	BYW95A	PEL	5322 130 31925
V 6302	DIODE	BYW95A	PEL	5322 130 31925
V 6303	THYRISTOR	BRY39	PEL	5322 130 40482
V 6304	DIODE	BAX12A	PEL	5322 130 34605
V 6305	DIODE,REFERENCE	BZX79-C27	PEL	4822 130 34379
V 6306	TRANSISTOR	BUZ32	PEL	5322 130 42721
V 6307	DIODE	BYW29-150	PEL	5322 130 34711
V 6308	DIODE	BYV27-150	PEL	4822 130 31628
V 6309	DIODE	BAX12A	PEL	5322 130 34605
V 6311	DIODE,REFERENCE	BZX79-C27	PEL	4822 130 34379
V 6312	DIODE,REFERENCE	BZV12	PEL	5322 130 34269
V 6313	DIODE	BAX12A	PEL	5322 130 34605
V 6314	TRANSISTOR,FET	BSV78	PEL	5322 130 44093
V 6316	DIODE	BYV19-40	PEL	5322 130 32937
V 6317	DIODE	BYV19-40	PEL	5322 130 32937
V 6318	DIODE	BYV19-40	PEL	5322 130 32937
V 6319	DIODE	BYV19-40	PEL	5322 130 32937
V 6321	DIODE	BYW95A	PEL	5322 130 31925
V 6322	DIODE	BYW95A	PEL	5322 130 31925
V 6323	DIODE	BYV26C	PEL	4822 130 32343
V 6324	DIODE	BYV26C	PEL	4822 130 32343
V 6326	DIODE	BYV27-150	PEL	4822 130 31628
V 6327	DIODE	BYV27-150	PEL	4822 130 31628
V 6328	DIODE	BYV19-40	PEL	5322 130 32937
V 6329	DIODE,REFERENCE	BZX79-C5V1	PEL	4822 130 34233
V 6331	TRANSISTOR	BC640	PEL	4822 130 41078

V 6332	DIODE,REFERENCE	BZX79-C27	PEL	4822 130 34379
V 6333	DIODE	BAX12A	PEL	5322 130 34605
V 6334	TRANSISTOR	BC548C	PEL	4822 130 44196
V 6336	DIODE,REFERENCE	BZX79-C22	PEL	4822 130 34441
V 6337	DIODE,REFERENCE	BZX79-C33	PEL	4822 130 34142
V 6338	TRANSISTOR	BDX77	PEL	5322 130 44553
V 6339	TRANSISTOR	BC548C	PEL	4822 130 44196
V 6341	DIODE,REFERENCE	BZX79-C15	PEL	4822 130 34281
V 6342	TRANSISTOR	BUV26A	PEL	5322 130 42722
V 6343	DIODE	BYV27-150	PEL	4822 130 31628

19.1.5 MISCELLANEOUS

G 8201	CRYSTAL	6000,000KHZ		4822 242 70392
L 6304	COIL	82UH		4822 158 10563
L 6311	COIL	470UH	TDK	5322 157 52362
L 6312	COIL	470UH	TDK	5322 157 52362
L 6313	COIL	5.6UH		4822 157 52259
L 6314	COIL	27UH		4822 158 10551
L 6317	COIL	1500UH	TDK	4822 156 21293
L 6318	COIL	2.2UH	TDK	4822 157 51757