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PHILIPS

PM 5716

Operating Manual

Ordering number 9499 460 08511

PRELIMINARY

Printed in Sweden

1. Introduction

The PM 5716 provides pulses at a repetition frequency of 1 Hz to 50 MHz.
The pulse transition time is variable between 6 ns and 100 ms and independent of pulse amplitude.
The pulse out socket and limiter provide limited output pulses suitable for testing MOS circuits.
The auxiliary out and clock out outputs provide signals with fixed amplitude suitable for TTL applications.
The external input has an input impedance with variable triggering level.

2. Technical data

This instrument has been designed and tested in accordance with IEC Publication 348 for Class 1 instruments and has been supplied in a safe condition.
The present Operating Manual contains information and warnings which shall be followed by the purchaser to ensure safe operation and to retain the instrument in a safe condition.
Properties expressed in numerical values with statement of tolerances are guaranteed.
Numerical values without tolerances are intended for information purposes only and indicate the properties of an average instrument. The numerical values hold good for the nominal mains voltage.

2.1. Electrical

Repetition rate	
Internal	1 Hz...50 MHz variable in 8 ranges with continuous control within the ranges. Jitter $\leq$ 0.1 % or 50 ps whichever is greater.
External	DC...50 MHz.
Pulse delay	10 ns...100 ms variable in 7 ranges with continuous control within the ranges. Jitter $\leq$ 0.1 % or 50 ps whichever is greater.

Pulse duration	10 ns...100 ms variable in 7 ranges with continuous control within the ranges. Duty factor with normal mode > 0.5 and with complementary mode > 0.99. Jitter ≤ 0.1 % or 50 ps whichever is greater.
Pulse out	
Amplitude with 5 kΩ load	Minimum amplitude is 2 V and maximum is 20 V between -20 V...+20 V with independently variable upper and lower levels.
Amplitude with 50 Ω load	Minimum amplitude is 1 V and maximum is 10 V between -10 V...+10 V with independently variable upper and lower levels.
Rise and fall times with 5 kΩ load	Independently variable in 8 ranges with continuous control within the ranges from ≤ 6 ns...100 ms at an amplitude of ≥ 4 V and from 8 ns...100 ms of an amplitude below 4 V. Set times remain constant when the pulse amplitude is varied.
Rise and fall times with 50 Ω load	Independent variable in 8 ranges with continuous control within the ranges from ≤ 6 ns...100 ms at an amplitude of ≥ 2 V and from 8 ns...100 ms at an amplitude below 2 V. Set times remain constant when the pulse amplitude is varied.

Amplitude limiter with 5 kΩ load at PULSE OUT	By an external d.c. source the upper pulse level may be limited to any value between -18 V and +20 V and the lower pulse level to any value between +18 V and -20 V. The input resistance of the limiter measured between upper or lower terminals and earth is more than 1 kΩ.
Amplitude limiter with 50 Ω load at PULSE OUT	The upper and lower limits are 50 % of those at 5 kΩ load.
Protection	Short and open circuit safe protected against transients and d.c. voltages between +20 V and -20 V.
Timing	The pulse is delayed 50 ns plus set delay from an external triggering pulse.

Clock out

Amplitude	+2.5 V into 50 Ω and +5 V into 5 kΩ
Source impedance	50 Ω
Rise and fall times	Approximately 6 ns
Duty factor	In fastest range 0.25 to 0.45, in the other ranges 0.5 $\pm$0.05.
Protection	Short and open circuit safe with diode protection against transients
Timing	Pulse occurs approximately 15 ns plus set delay ahead of main pulse and 15 ns after an external triggering pulse.

Auxiliary out

Amplitude	+2.5 V into 50 Ω and +5 V into 5 kΩ
Source impedance	50 Ω
Rise and fall times	Approximately 6 ns
Duty factor	As set by DURATION Controls
Pulse mode	Single or double pulses
Protection	Short and open circuit safe with diode protection against transients
Timing	Pulse occurs approximately 15 ns plus set delay ahead of main pulse and 35 ns after external trigg pulse

External in

Frequency range	DC to 50 MHz
Sensitivity	200 mV_{p-p}
Trigg level	Variable from -2 V to +2 V and from -20 V to +20 V with 10:1 probe
Trigg slope	Selectable leading or trailing edge
Maximum voltage in	±20 V
Input impedance	1 MΩ//20 pF suitable for probes PM 9327 (DC to 15 MHz) and PM 9350 (DC to 50 MHz)

Manual

Single shot by means of a push button.

2.2. General

Mains voltage	85 to 115 V, 100 to 130 V and 200 to 265 V switchable between the ranges
Mains frequency	50 Hz or 60 Hz solderable between the ranges
Power consumption	90 VA
Dimensions	Width 280 mm Height 133 mm Depth 360 mm
Weight	9 kg

3. Accessories

3.1. Standard accessories supplied with the instrument

1 mains cable
1 manual

3.2. Accessories to be ordered separately

50 Ω feed through termination 3 W PM 9581
50 Ω T-piece, power splitter PM 9584
50 Ω feed through termination 1 W PM 9585
Coaxial cable set 5 x 1 ns, 4 x 2 ns, 3 x 3 ns and 3 x 10 ns PM 9588

10:1 attenuator probe DC to 15 MHz PM 9327
10:1 attenuator probe DC to 50 MHz PM 9350.

4. Block diagram description

4.1. Internal clock

The internal clock generates square wave pulses from which all internal pulses are derived.
Switch REPETITION TIME and its vernier give repetition times between 1 s and 20 ns.
The internal clock is switched on when push button INT. CLOCK is depressed.

4.2. Trigger circuit and gating

In EXT. TRIGG mode the pulse generator can be triggered by the positive or negative slope of an external signal applied to EXT IN, the trigger level is set with potentiometer LEVEL between + 2 V and - 2 V.
The triggering signal is fed via an amplifier and impedance converter to a Schmitt trigger where the signal is made suitable for the remaining circuits of the generator.
With no triggering signal applied, a single pulse is generated by the Schmitt trigger when push button SINGLE SHOT is depressed.
With switch REPETITION TIME set to any of its time positions the Schmitt trigger can be gated by a signal applied to EXT IN.
Bursts of pulses which are synchronized with the positive or negative slope of the gating signal are then obtained.

4.3. Clock out amplifier and first pulse shaper

In external triggering mode the input to the clock out amplifier and first pulse shaper is fed from the Schmitt trigger, in gate and internal mode the input is fed from the internal clock.
In external triggering mode the output from the clock out amplifier is a pulse with fixed amplitude and has the same time parameters as the input signal at socket EXT. IN, the output from the pulse shaper is needle pulses with the same repetition time as input signal at socket EXT. IN.
In external gate and internal mode the output from the clock out amplifier is square wave pulses with fixed amplitude and set repetition time, the output from the pulse shaper is needle pulses with set repetition time.

4.4. Delay circuit, second pulse shaper, gate, duration circuit and auxiliary out amplifier.
The delay circuit gives pulses with set delay to the second pulse shaper which feeds needle pulses to the duration circuit and the gate circuit.
In double pulse mode a gate signal is fed from the gate circuit to the duration circuit which gives a double pulse.
The output from the duration circuit is single or double pulses with set duration which are fed to the pulse mode circuit and the auxiliary out amplifier.
Socket AUX OUT gives the output from the auxiliary out amplifier, a single or double pulse with fixed amplitude and set duration and delay.
The repetition time is determined by the external signal at EXT. IN in external triggering mode and by switch REPETITION TIME and its vernier in gate and internal clock mode.

4.5. Pulse mode circuit, differential amplifier and ramp generator.

The inputs to the pulse mode circuit are square waves from the internal clock or single/double pulses from the duration circuit or external pulses from the Schmitt trigger.

The selected output from the pulse mode circuit is fed via differential amplifier to the ramp generator circuit where the rise and fall time is settled.

4.6. Output stage and amplitude limiter

From the ramp generator the signal is fed via a multiplier circuit to the linear output amplifier, the amplitude is set with the upper and lower potentiometers and normal or complementary pulse mode is chosen by means of push buttons.

By connecting a d.c. voltage to the input sockets of the limiter the pulse out amplitude can be limited and prevent damage of circuits connected to the socket.

5. Installation

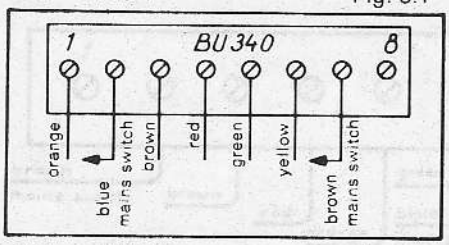
Before any other connection is made, the protective earth terminal shall be connected to a protective conductor. (See section earthing).

5.1. Mains adjustment and fuse

The PM 5716 can be converted into three mains voltage ranges by shifting the wires at BU340.
Before inserting the mains plug into the mains socket, make sure that the instrument is set to the local mains voltage and frequency.
When the pulse generator is wired for 85 V to 115 V (fig. 5.1.) or 100 V to 130 V (fig. 5.2.) the mains fuse should be 6.3 A delayed action and when it is wired for 200 V to 265 V (fig. 5.3.) it should be 3.15 A delayed action.
Make sure that only fuses with the required rated current and of the specified type are used for replacement.
The use of mended fuses and the short-circuiting of fuse holders shall be avoided. The instrument shall be disconnected from all voltage sources when a fuse is to be replaced or when the instrument is to be adapted to a different mains voltage. The fuse shall be replaced only by a skilled person who is aware of the danger involved.
Mains frequency can be set to either 50 Hz or 60 Hz by interchanging the wires between BU320 and BU330.
Figure 5.4. shows the pulse generator wired for a mains frequency of 50 Hz and figure 5.5. a mains frequency of 60 Hz.
The instrument shall be set to the local mains voltage and frequency only by a skilled person who is aware of the hazard involved.

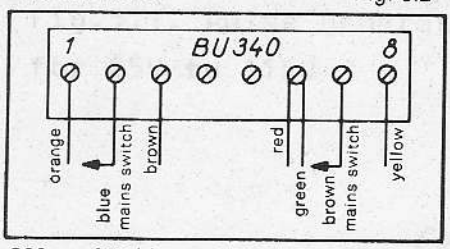
85 . . . 115 V

Fig. 5.1



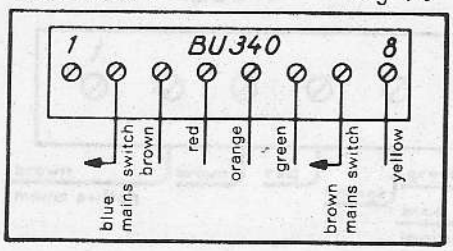
100 . . . 130 V

Fig. 5.2



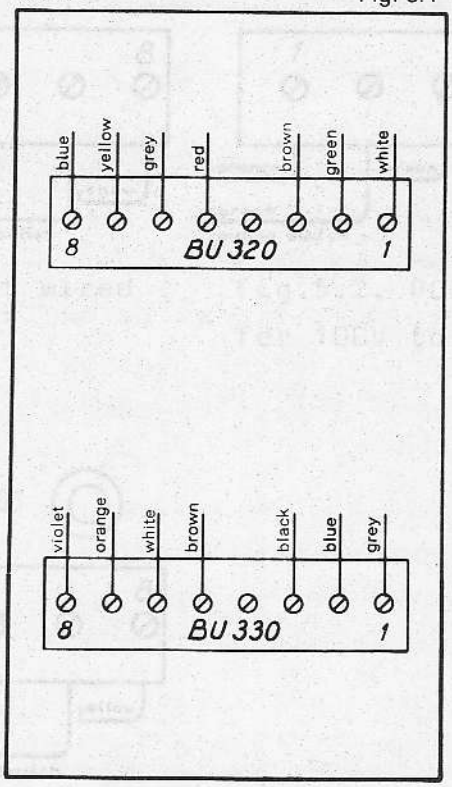
200 . . . 265 V

Fig. 5.3



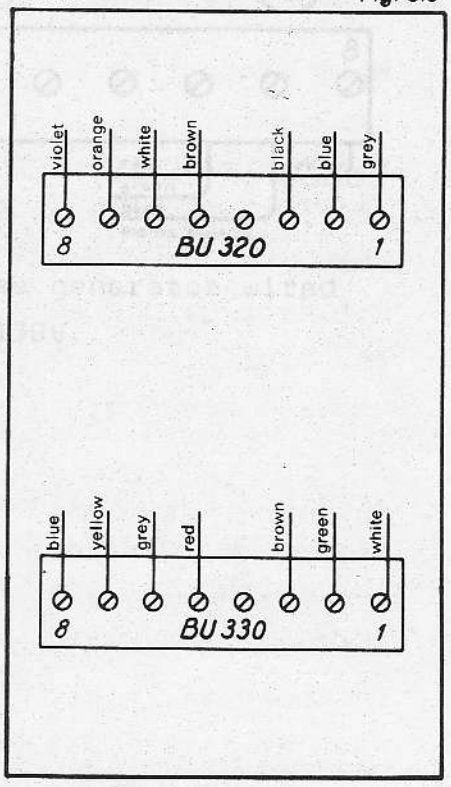
50 Hz

Fig. 5.4



60 Hz

Fig. 5.5



5.2. Earthing

Before switching on, the instrument shall be connected to a protective earth conductor in one of the following two ways:
via the protective earth terminal or
via the three core mains cable.
The mains plug shall only be inserted into a socket outlet provided with a protective earth contact.
The protective action shall not be negated by the use of an extension cord without protective conductor.

WARNING: Any interruption of the protective conductor inside or outside the instrument, or disconnection of the protective earth terminal, is likely to make the instrument dangerous.
Intentional interruption is prohibited.
When an instrument is brought from a cold into a warm environment, condensation may cause a hazardous condition.
Therefore, make sure that the earthing requirements are strictly adhered to.

6. Controls, input and output connectors

(1)	REPETITION TIME	Sets pulse repetition time in 8 steps.
(2)		Pulse repetition time vernier. Provides overlap between ranges, white dot indicates zero position.
(3)	DELAY	Sets pulse delay in 7 steps.
(4)		Pulse delay vernier. Provides overlap between ranges, white dot indicates zero position.
(5)	DURATION	Sets pulse duration in 7 steps.
(6)		Pulse duration vernier. Provides overlap between ranges, white dot indicates zero position.
(7)	TRANSITION TIME	Sets transition time in 8 steps.
(8)	RISE	Continuous setting of pulse rise time within transition range set with switch TRANSITION TIME.
(9)	FALL	Continuous setting of pulse fall time within transition range set with switch TRANSITION TIME.
(10)	INT. CLOCK	Sets pulse generator to internal operating mode.
(11)	MAN. TRIGG	Allows single shot operation with push-button SINGLE SHOT.

(12) EXT. GATE

Sets generator to gated operation when gating signal is applied to socket EXT. IN.
Positive-going edge of gating signal opens gate.

(13) EXT. GATE

Sets generator to gated operation when gating signal is applied to socket EXT. IN.
Negative-going edge of gating signal opens gate.

(14) EXT. TRIGG

Sets generator to external triggering operation when external triggering signal is applied to socket EXT. IN.
Positive-going edge of signal starts the triggering.

(15) EXT. TRIGG

Sets pulse generator to external triggering operation when external triggering signal is applied to socket EXT. IN.
Negative-going edge of signal starts the triggering.

(16) EXT. DUR

External signal applied to EXT. IN. determines pulse duration.
Rep. time, delay and duration controls are disconnected.

PULSE MODE

(17) ⊓⊔ Sets pulse generator to square wave mode. Delay and duration controls are disconnected.

(18) ⊓_ Sets pulse generator to single pulse mode operation.

(19) ⊓⊓ Sets pulse generator to double pulse mode operation.

(20) NORM Sets generator to normal pulse mode operation.

(21) COMPL Sets generator to complementary pulse mode operation.

OUTPUT LEVELS

(22) UPPER Sets upper pulse level from + 20 V to -20 V at 5 kΩ load, and from +10 V to -10 V at 50 Ω load.

(23) LOWER Sets lower pulse level from +20 V to -20 V at 5 kΩ load and +10 V to -10 V at 50 Ω load. NOTE: Maximum difference between UPPER and LOWER settings is mechanically interlocked to 20 V with 5 kΩ load and to 10 V with 50 Ω load.

AMPLITUDE LIMITER

(24) UPPER

(25) ⊥ An external d.c. voltage limits output voltage at 5 kΩ load to applied d.c. level.

(26) LOWER

(27)	PULSE OUT	Provides output pulse.
(28)	AUX OUT	Provides output pulse with fixed levels and transition time suitable for TTL applications. Delay and duration manually set in all modes.
(29)	CLOCK OUT	Provides internal clock frequency in EXT. GATE and INT. CLOCK modes. In EXT. TRIGG and EXT. DUR modes it provides a shaped waveform with the frequency of the external signal applied to socket EXT. IN.
(30)	EXT. IN	Accepts external triggering or gating signals. Minimum amplitude 0.2 V. Input impedance is 1 MΩ//20 pF suitable for passive 1:10 probes.
(31)	LEVEL	Defines the threshold level of external input over a range of -2 V to +2 V.
(32)	SINGLE SHOT	Pulse generator provides one single pulse when push-button MAN. TRIGG is depressed.
(33)	POWER	Mains switch
(34)		Input connector for mains supply
(35)		Protection earth connector.

7. Operation

7.1. Output levels and amplitude limiter

The output level at PULSE OUT is set with the two slide potentiometers UPPER and LOWER.
The UPPER potentiometer sets the upper pulse level from +10 V to -9 V at 50 Ω load and from +20 V to -18 V at 5 kΩ load.
The LOWER potentiometer sets the lower pulse level from +9 V to -10 V at 50 Ω load and from +18 V to -20 V at 5 kΩ load.
Maximum difference between UPPER and LOWER settings is mechanically interlocked to 20 V at 5 kΩ load and to 10 V at 50 Ω load.
Minimum difference is interlocked to 1 V at 50 Ω load and to 2 V at 5 kΩ load.
By connecting an external d.c. source to the AMPLITUDE LIMITER'S sockets the upper and lower pulse levels at PULSE OUT is limited to the applied d c. level e.g. supply voltage of CMOS circuit.

7.2. Auxiliary out and clock out in internal and external operation

AUX OUT gives a normal signal with an amplitude of +2.5 V into 50 Ω and +5 V at open circuit.
All time parameters except for the transition time are variable.
CLOCK OUT is connected to the clock in internal operation and to EXT.IN. in external operation.
The output is a normal square wave signal with set repetition time in internal mode, in external mode the repetition time and duration is determined by the external signal.
The output stays unaffected by the settings of the other controls in both internal and external operation and has an amplitude of +2.5 V into 50 Ω and +5 V at open circuit.

7.3. Pulse modes at pulse out in internal operation

PULSE OUT gives a square wave a single pulse or a double pulse, both normal and complementary mode is possible. All time and amplitude parameters are variable in single and double pulse mode, in square wave mode all parameters except for delay and duration are variable.

7.4. Pulse shaping

- Connect the input signal to EXT IN.
- Depress push button EXT DUR and select normal or complementary mode
- Set the triggering LEVEL
  The PULSE OUT now gives a signal with the same repetition time as the input signal and duration as set with the triggering level control. Transition time and output levels are variable.

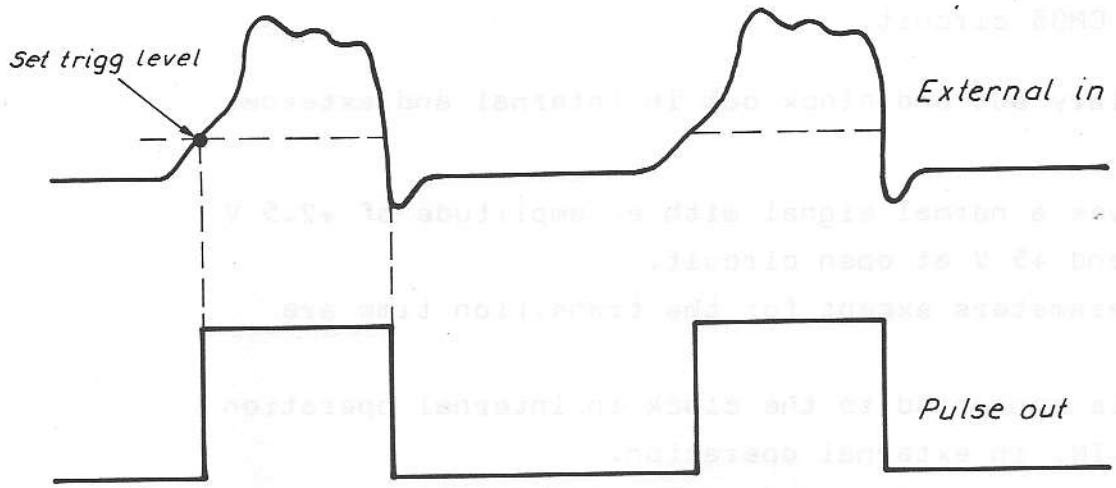


Fig 7.1. Pulse shaping

7.5. Single shot

- Depress MAN TRIGG push button and set desired duration and transition time
- Select normal or complementary mode and set the output levels
  The PULSE OUT now gives one single pulse with set pulse parameters when push button SINGLE SHOT is depressed

7.6. External triggering

- Connect the triggering signal to EXT IN.

- Select positive or negative slope triggering with push buttons EXT TRIGG and set the triggering LEVEL
- Select single or double pulse and normal or complementary PULSE MODE.
- Select desired pulse parameters except for the repetition time which is determined by the triggering signal.
  The PULSE OUT now gives a signal with the same repetition time as the triggering signal and the rest of the pulse parameters as set with the front panel controls.

7.7. External gating

- Connect the external gating signal to EXT IN.

- Select gating on negative or positive slope of gating signal with push button EXT GATE and set the triggering LEVEL.
- Select the desired pulse parameters of the gated signal with the front panel controls.
  Positive-going slope of the gating signal turns the internal clock on in positive gate mode.

  In negative gate mode the negative-going slope of the gating signal will turn the clock on.
  The first gating pulse will always fall exactly together with positive or negative slope of the gated signal.
  The last pulse maintains the set duration even if the gating pulse ends during the last gated pulse.

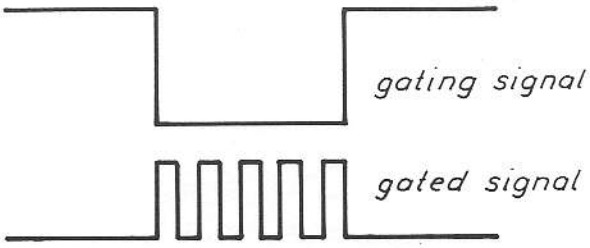


Fig.7.2. Gating on negative slope

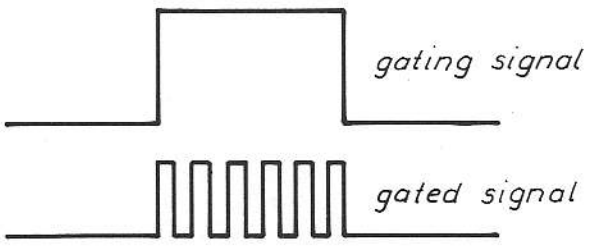
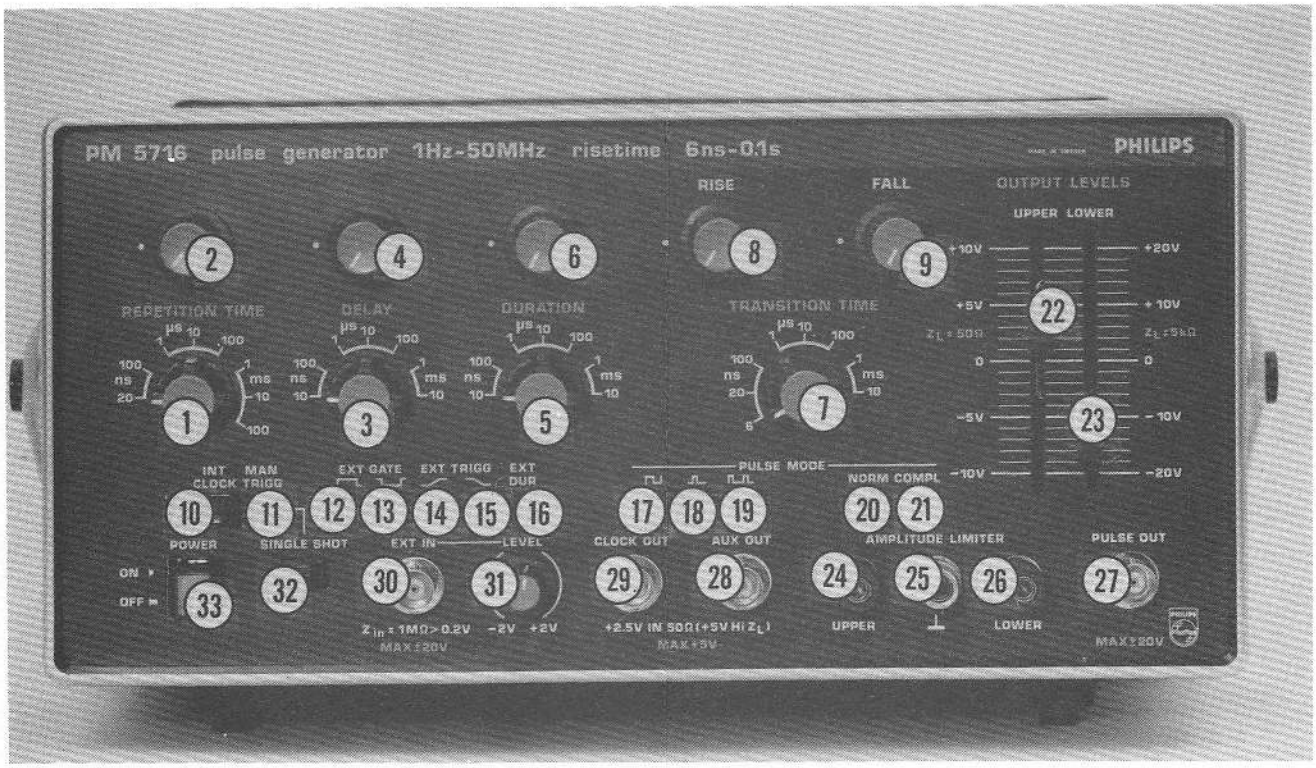
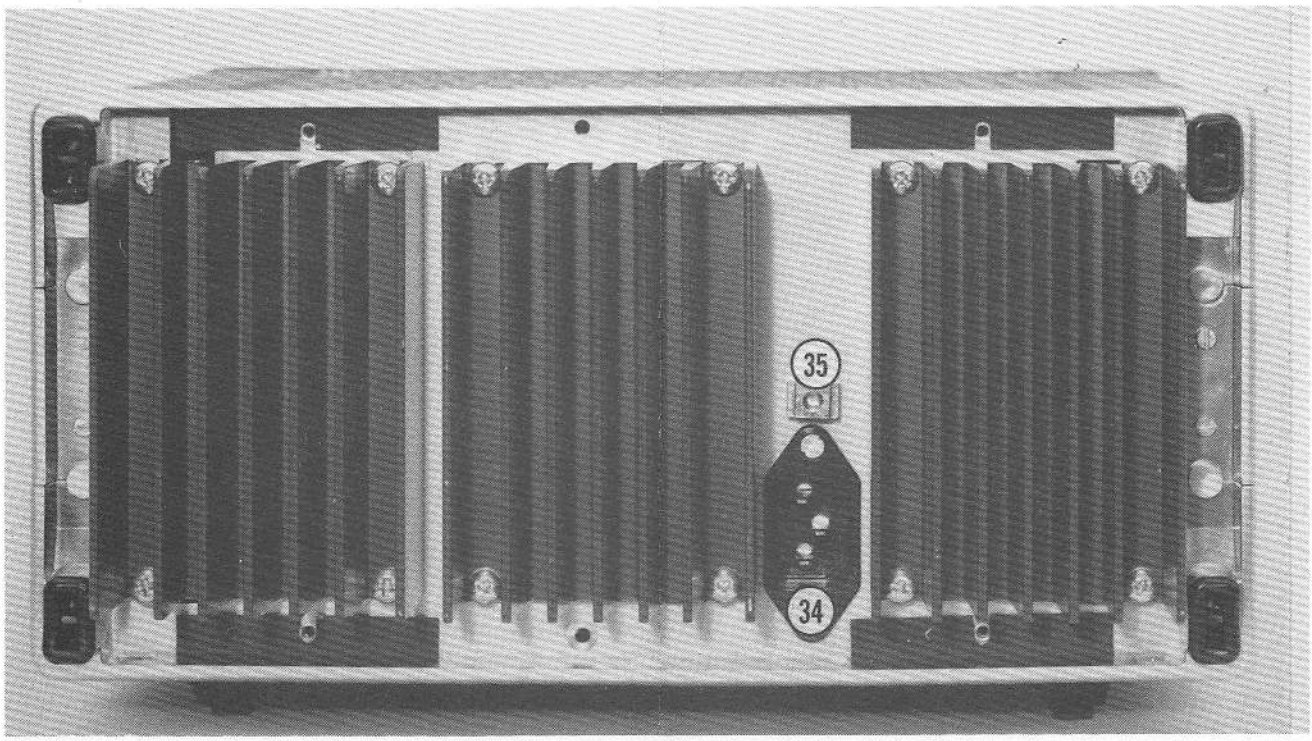


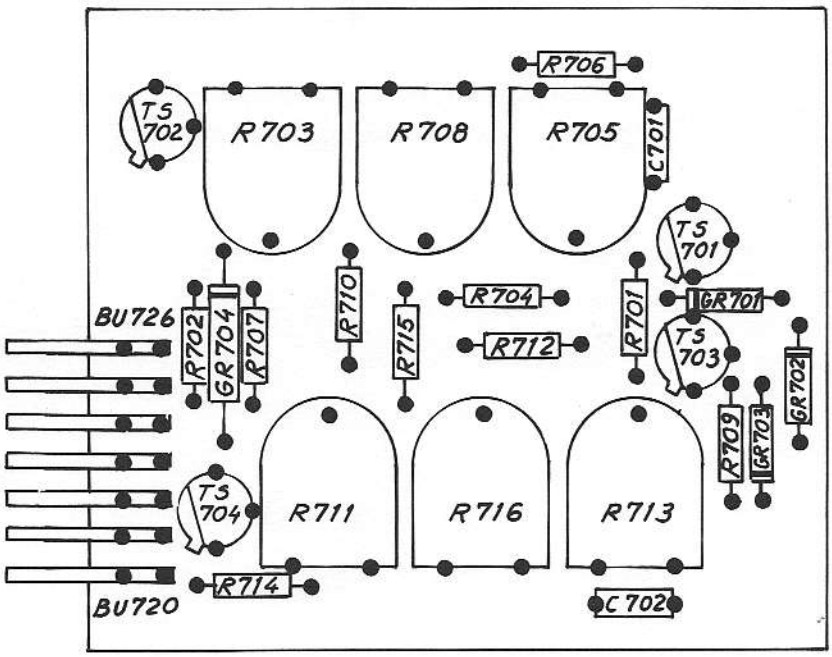
Fig.7.3. Gating on positive slope



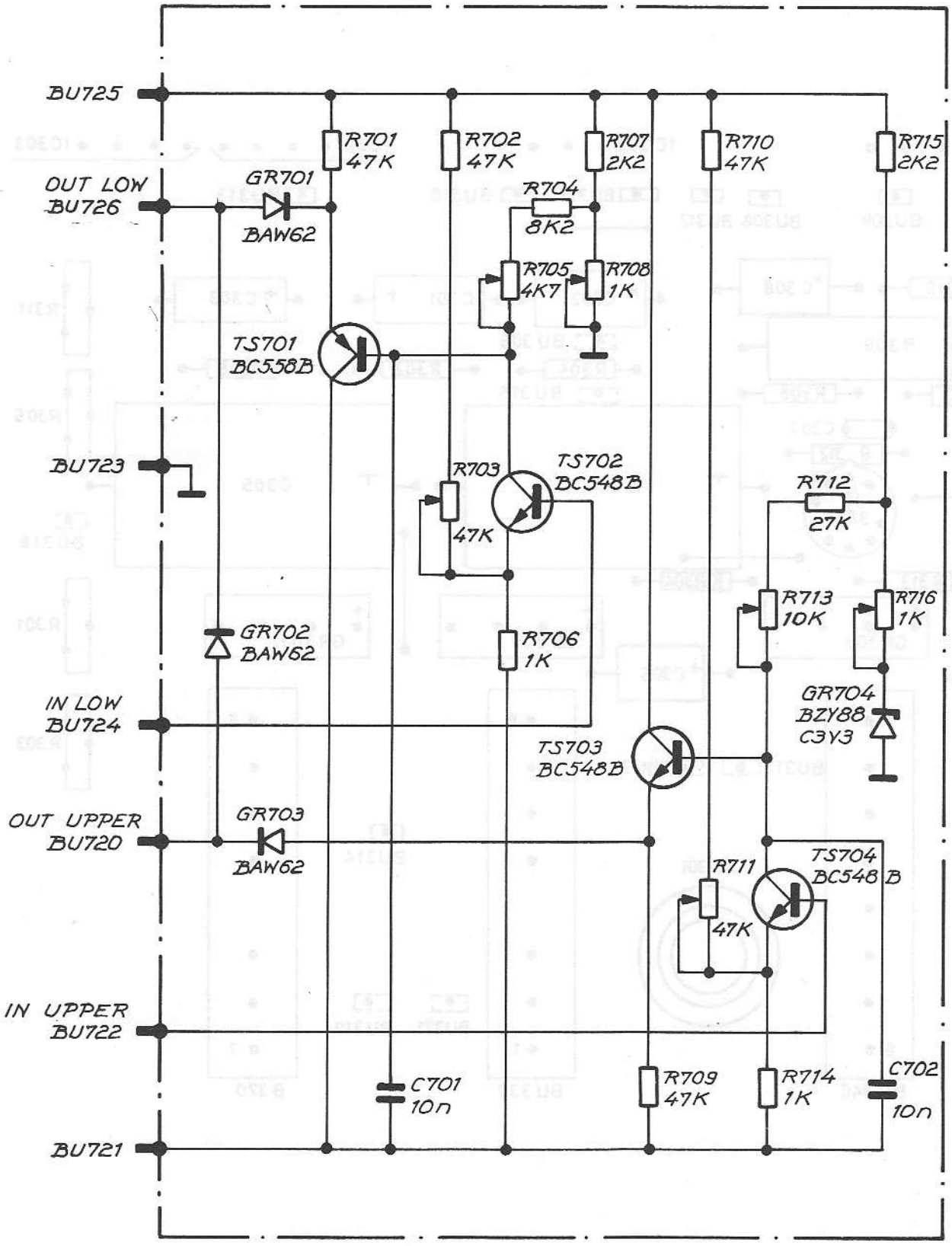
Front panel



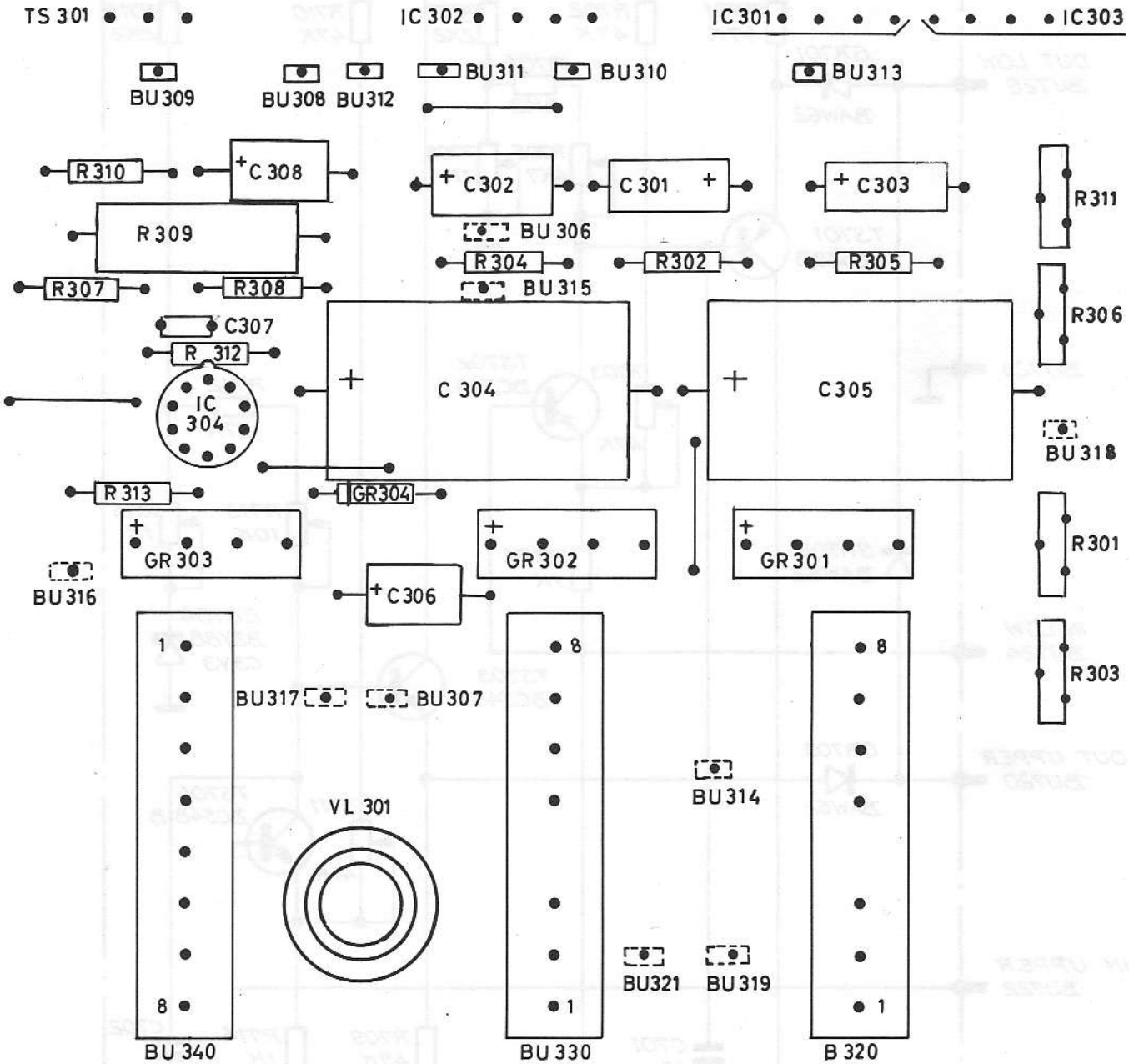
Rear panel



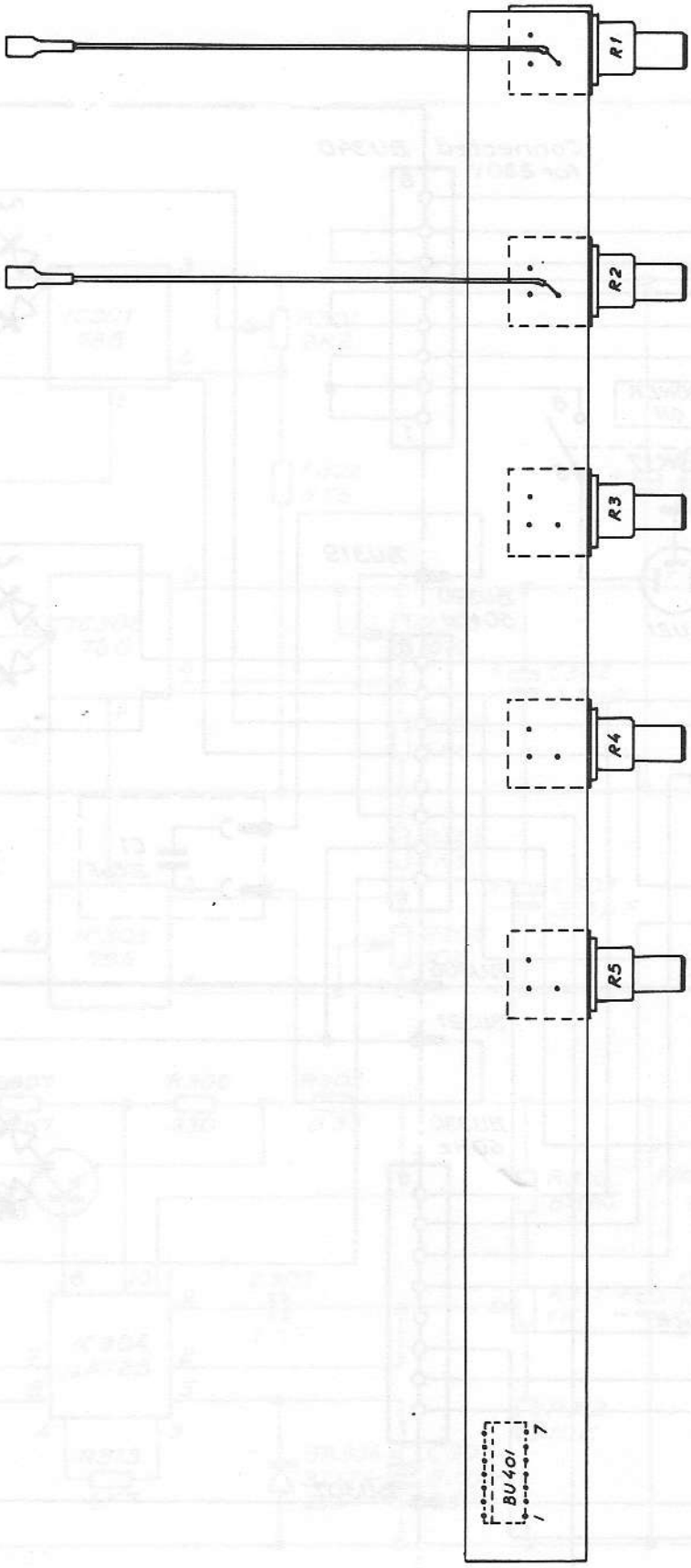
Component layout limiter



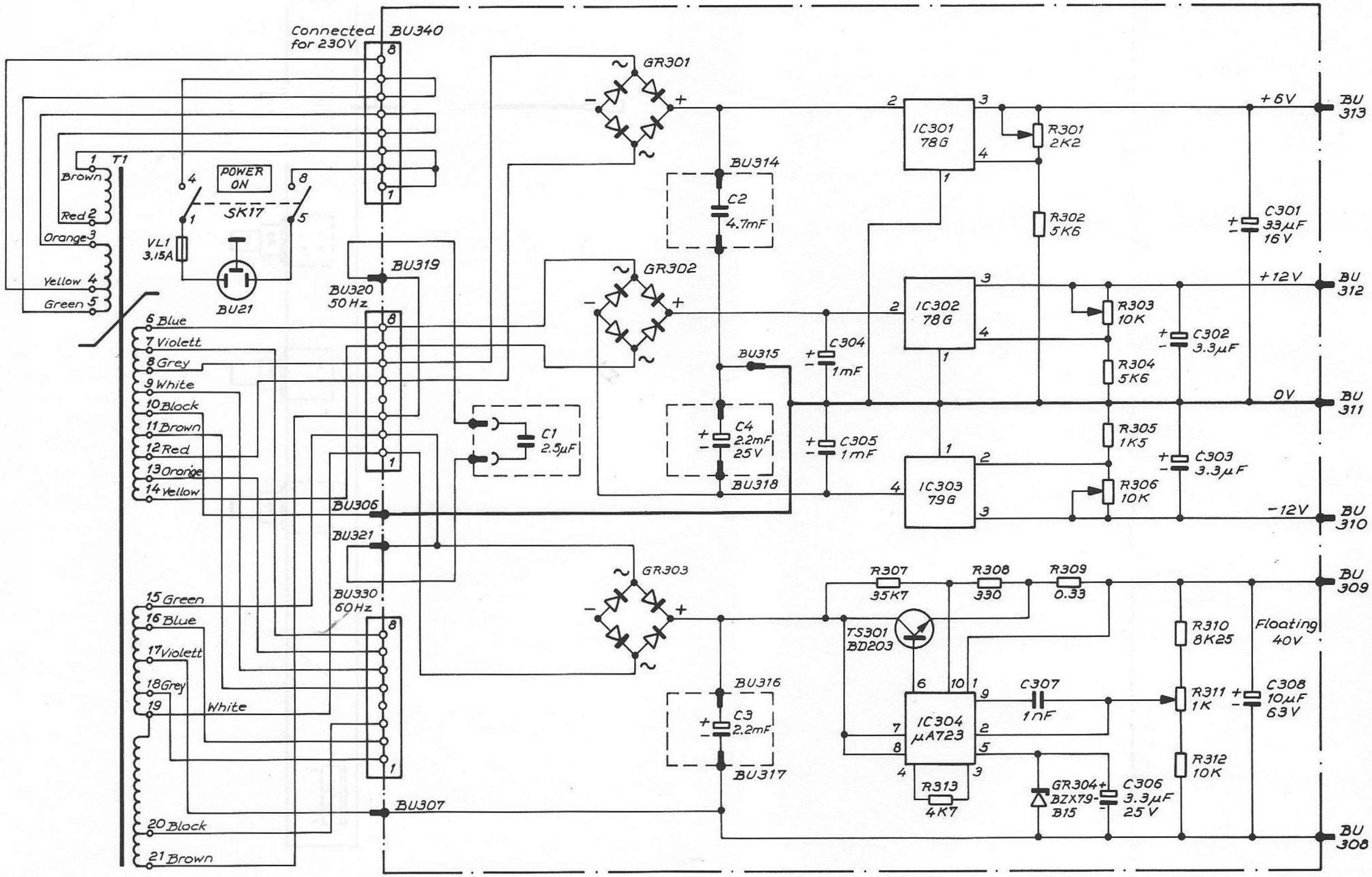
Circuit diagram limiter



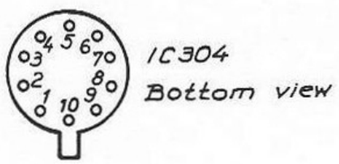
Component layout power supply

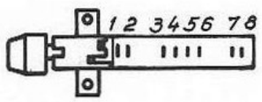


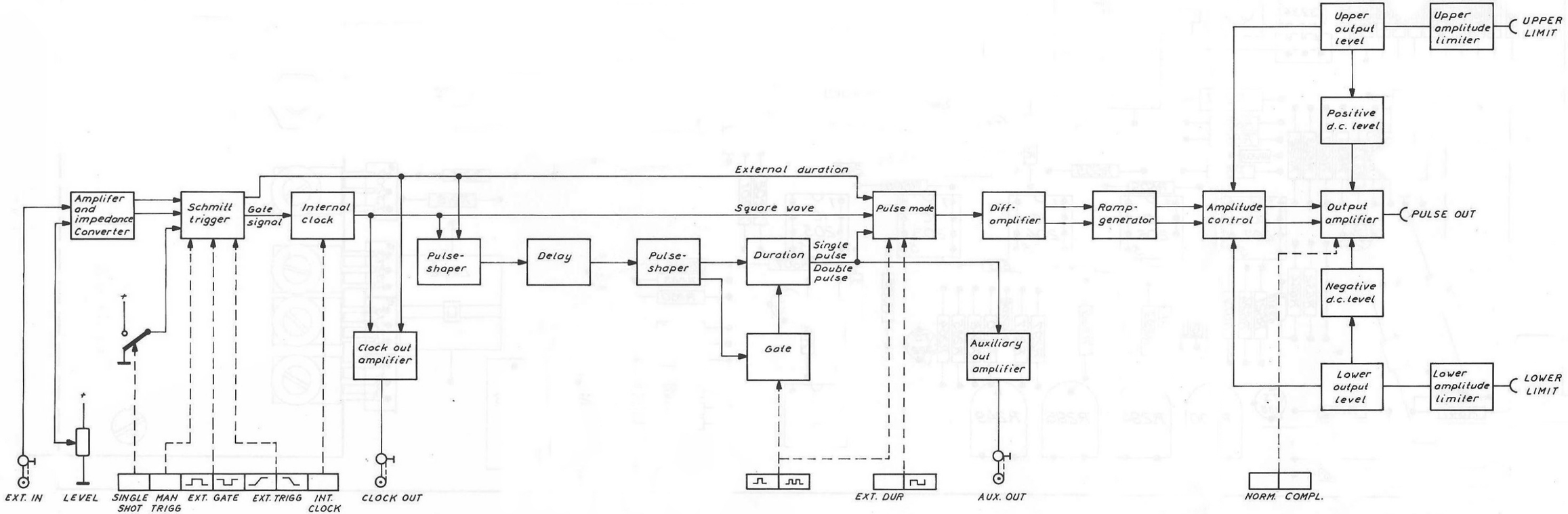
Flexible board



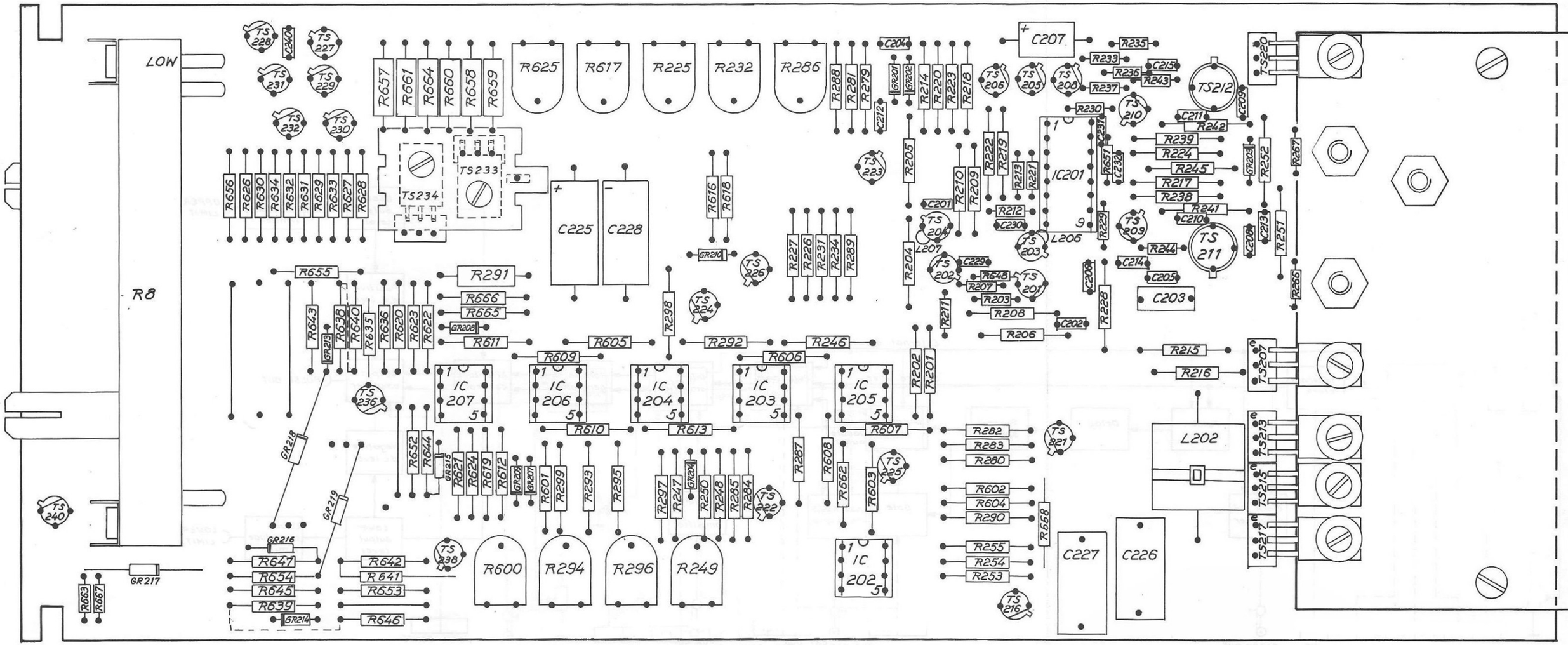
Circuit diagram power supply



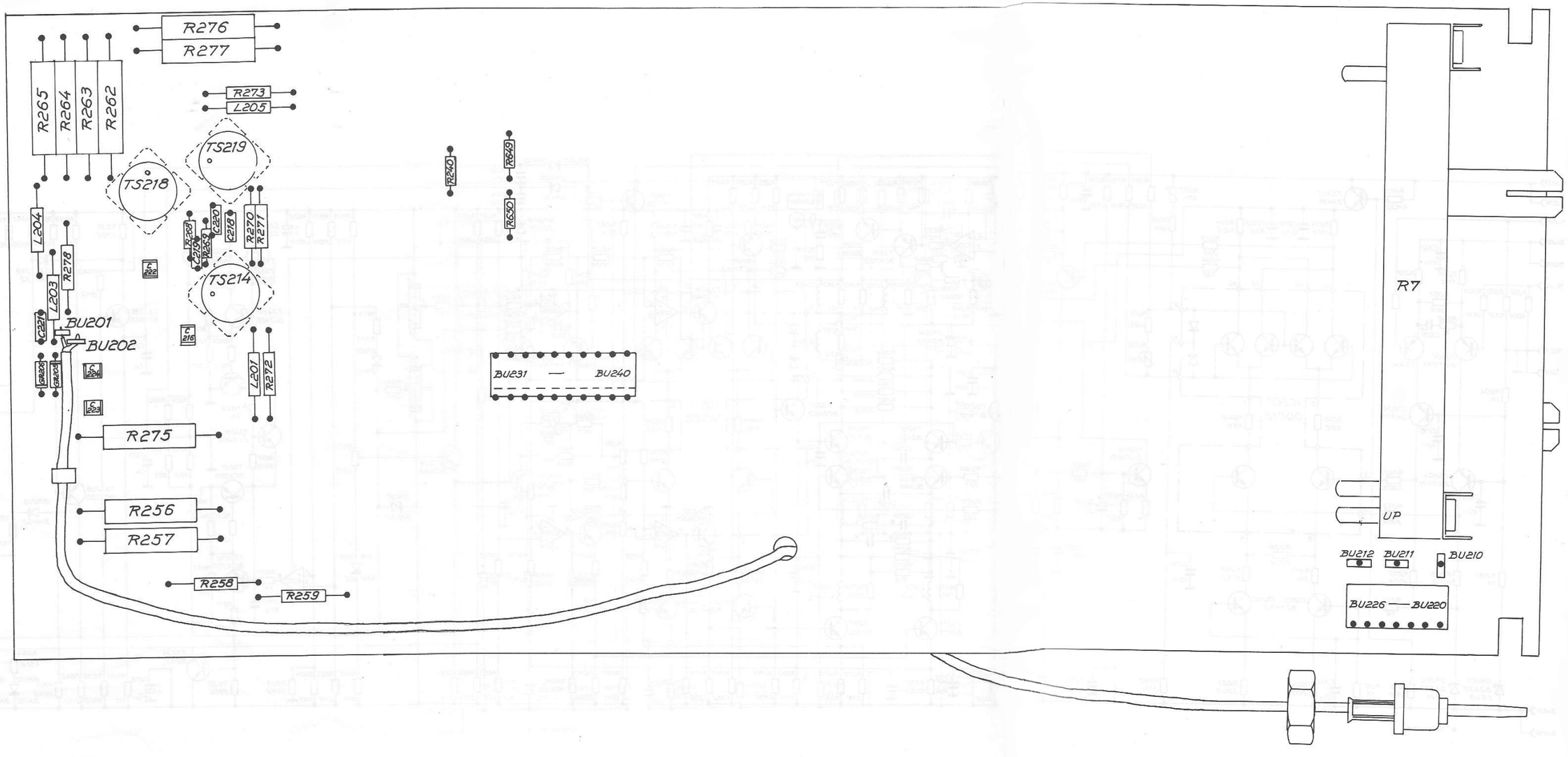




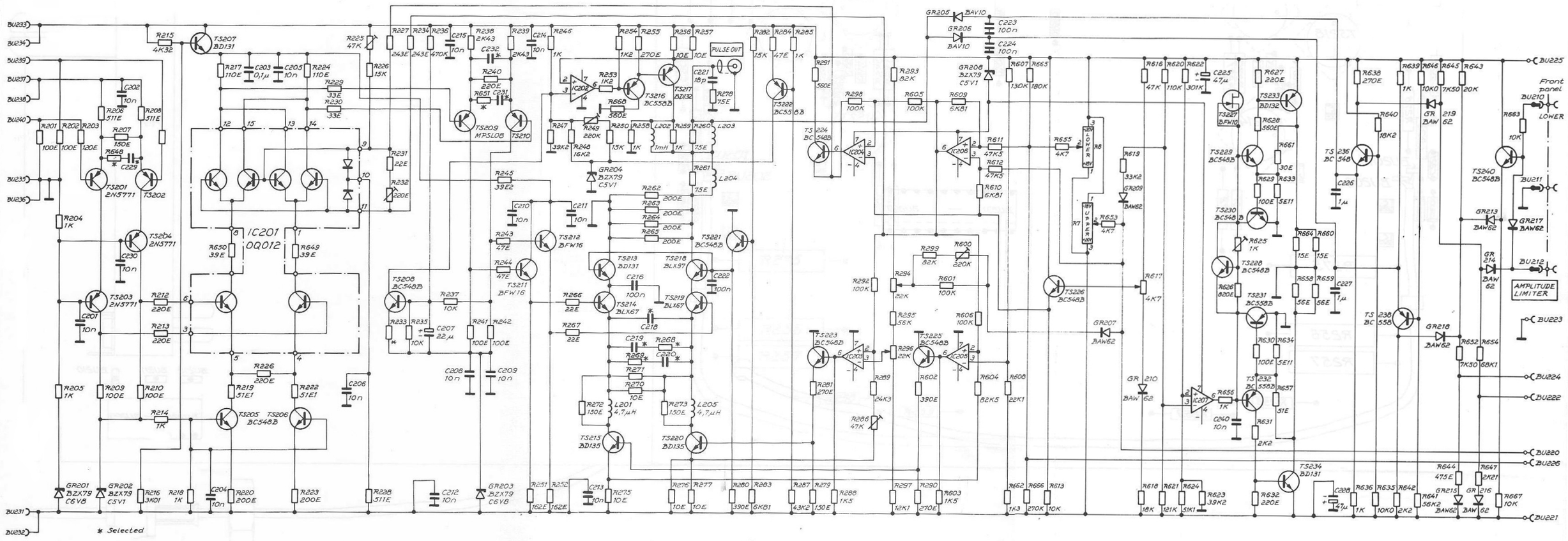
Block diagram



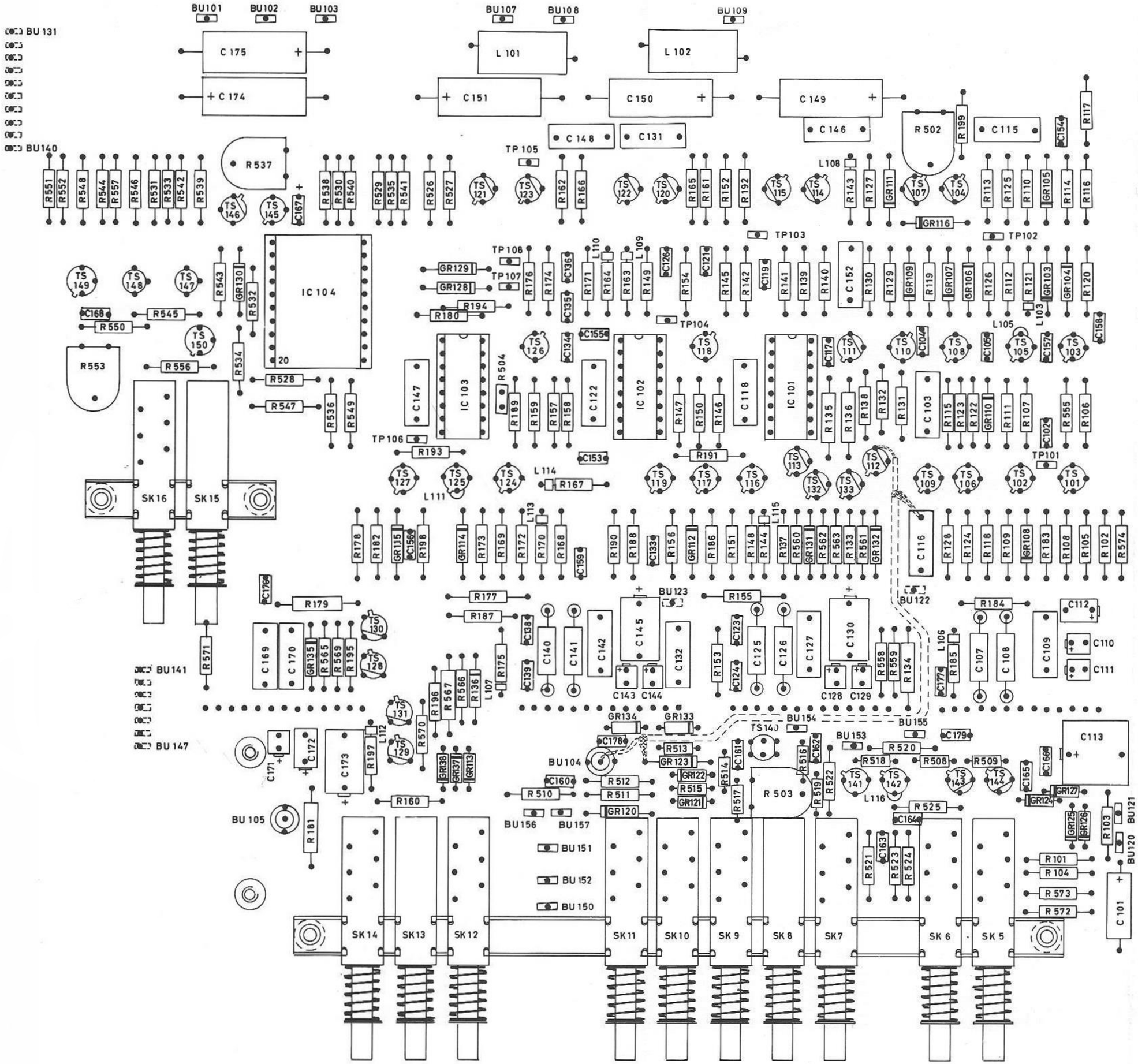
Component side output amplifier



Soldering side output amplifier

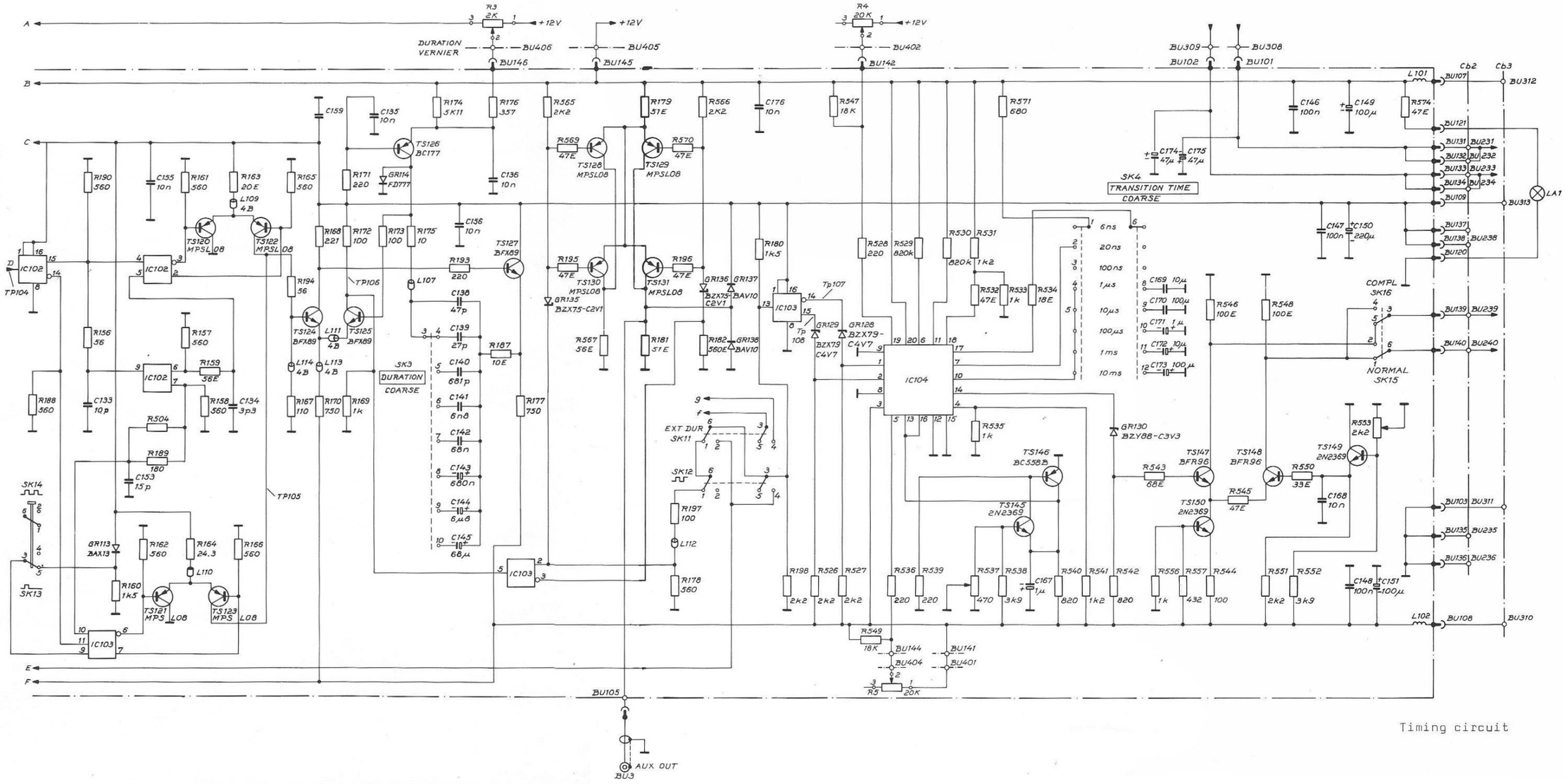


Circuit diagram output amplifier



Component layout time circuit

Timing circuit



Timing circuit