PHILIPS

Pulse generator

PM 5771

9446 057 71..1

9499 460 06901

731015/1/01...03

PHILIPS

SERVICE

Scientific & Analytical Equipment
Test & Measuring Instruments
Industrial Controls
Welding
Industrial Data-processing Systems

Scientific & Industrial Equipment Division

780629 | PM 5771 | SPC 33

1. CHANGED ORDERING NUMBER IN SPARE PARTS LIST

R4 Carbon potentiometer 5322 102 30115

R5,R6 Carbon potentiometer 5322 101 20256

2. NEW ORDERING NUMBER

Push-button 5322 414 25511

3. ERROR IN MANUAL

Chapter XI, page 87:

"1. Unsolder wires from tags 1 and 4..." should read
"1. Unsolder wires from tags 1 and 3..."

4. CHANGED TECHNICAL DATA (page 7)

2. External triggering

Triggering:	input voltage	+1.2V gate the generator on. Input current min. 6mA.
	input impedance	< 1.5V: approx. 270 ohm > 1.5V: approx. 3kohm.

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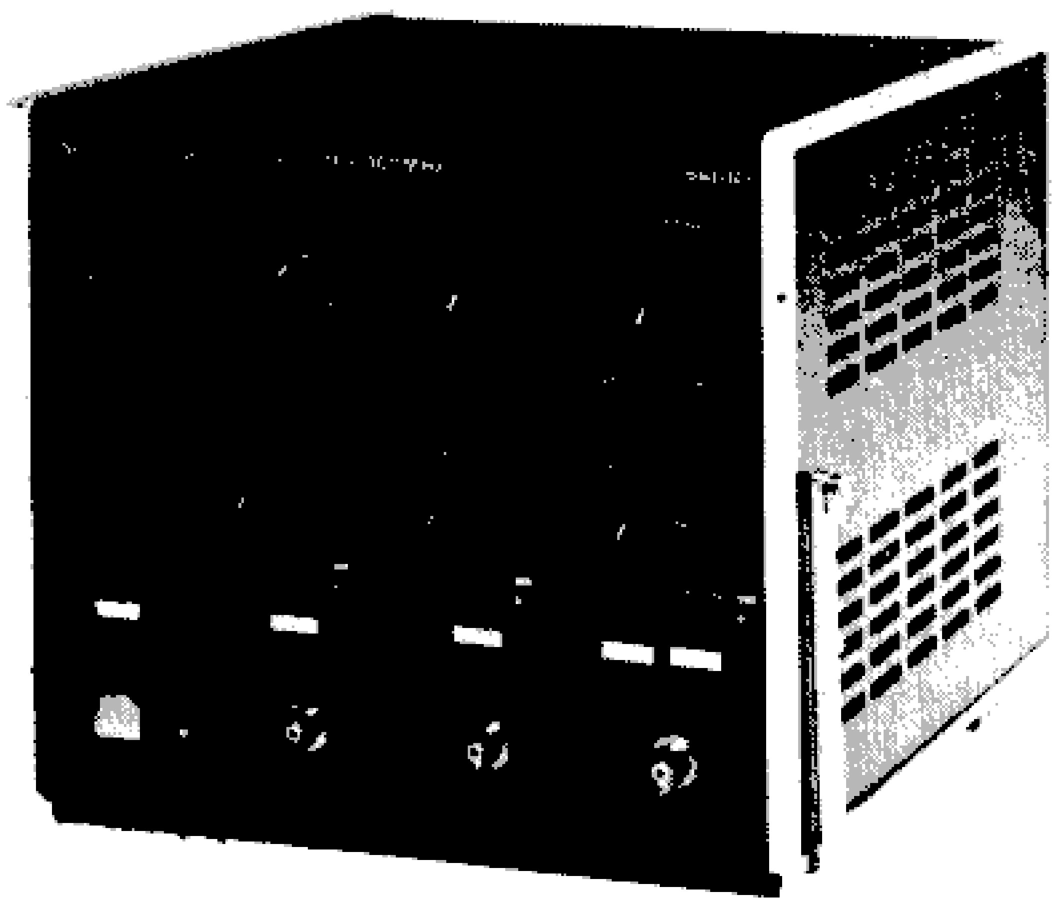


INSTRUCTION MANUAL
ANLEITUNG
NOTICE D'EMPLOI ET D'ENTRETIEN

PULSE GENERATOR 1 Hz - 100 MHz
IMPULS GENERATOR 1 Hz - 100 MHz
GENERATEUR D'IMPULSIONS 1 Hz - 100 MHz

PM 5771

9446 057 71..1

9499 460 06901

731015/1/01...03

Important

In correspondance concerning this instrument, please quote the type number and the serial numbers as given on the type plate at the rear of the instrument.

Wichtig

Beim Schriftwechsel über dieses Gerät geben Sie bitte die Typennummer und die Serienummer an, die auf dem Typenschild an der Rückseite des Gerätes stehen.

Important

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le numéro de type et le numéro de série qui sont marqués sur la plaquette de caractéristiques fixée à la paroi arrière de l'appareil.
Lorsque l'appareil doit être retourné à notre Dépt. Service pour réparations importantes, il doit être muni d'une étiquette comportant, outre les indications de série et le nom du propriétaire, les renseignements indispensables, concernant les défauts constatés; ceci permet une immobilisation plus réduite de l'appareil et diminue considérablement le prix de revient de la réparation. Emballer l'appareil avec précaution si possible dans son emballage d'origine.

↑ CACHET DU SERVICE TECHNIQUE

Contents

I. Introduction

The PM 5771 provides pulses at a repetition frequency of 1 Hz to 100 MHz. The pulse transition time is variable between 2.4 ns and 100 μs.
Other important pulse parameters such as delay and duration are variable from 5 ns to 100 ms. The PM 5771 can also be triggered or gated externally, generate double pulses or operate in the single shot mode.
The output pulse can have positive or negative polarity and be inverted to obtain a maximum duty factor.
A d.c. offset can also be introduced.
This variety of operating modes combined with the wide transition time range and an 80 mV - 10 V output amplitude make the PM 5771 particularly useful when testing or simulating various types of logic circuits, such as CML, Schottky-TTL or HNIL.
Other application areas include test of delay lines and magnetic memories, or simulation of pulse degrading.

II. Technical data

Properties, expressed in numerical values with statement of tolerances are guaranteed by the factory.
Numerical values without tolerances are intended for information purposes only and indicate the properties of an average instrument.
The numerical values hold good for nominal mains voltage unless otherwise stated.

A. ELECTRICAL

1. Internal triggering

Repetition rate	1 Hz ... 100 MHz Variable in 9 ranges with continuous control within the ranges
Jitter	⩽ 0.1 % or 50 ps whichever is greater
Average temperature drift	0.1 % per °C

2. External triggering

Triggering: input voltage	+1.2 V to gate the generator on
input impedance	approx. 1 kΩ
frequency input	DC ... 50 MHz. Max. voltage ±20 V
Gating : input voltage	+1.2 V
Delay from trigger (or gate) input signal to sync. output signal	approx. 12 ns

3. Single shot operation

Single shot facility by means of push-button

4. Main pulse output from DC-coupled source	80 mV ... 10 V into 50 Ω Variable in 6 ranges with continuous control within the ranges. In the 10 V position maximum amplitude may decrease from 10 V at 50 MHz to 7 V at 100 MHz
Source impedance	50 Ω on the 5 V and lower ranges (operates as current source in the 10 V range)
Rise and fall time (referred to 10 % - 90 % levels)	5 V and lower ranges : 2.4 ns to 100 μs (positive fall time 2.6 ns to 100 μs) 10 V range : 4 ns to 100 μs in 4 ranges with independent continuous control between ranges. Slope remains constant when amplitude vernier is varied, which means that rise and fall times decrease when amplitude is decreased by vernier.
Waveform aberration	⩽ ±5 % of set amplitude with rise and fall time > 2.5 ns in the 5 V and lower ranges ⩽ ±5 % of set amplitude with rise and fall time > 4 ns in the 10 V range
Protection	Short and open circuit safe
Polarity	Positive or negative Normal or inverted
5. Pulse duration	
Range	5 ns ... 100 ms Variable in 8 ranges with continuous control within the ranges
Duty cycle	Approaching 100 % using inverted pulse output (limited only by minimum duration) Greater than 50 % in normal operation
Jitter	< 0.1 % or 50 ps whichever is greater
Average temperature drift	0.1 % per °C
6. Pulse delay	
Range	5 ns ... 100 ms Variable in 8 ranges with continuous control within the ranges
Jitter	< 0.1 % or 50 ps whichever is greater
Average temperature drift	0.1 % per °C
Double pulse	Double pulse mode provides "twin" pulses at set delay with simultaneously controlled pulse duration
7. Sync. output	Square wave, amplitude +1.5 V into 50 Ω (+5 V open circuit) Pulse occurs approx. 30 ns ahead of the main pulse
8. Base line offset	Continuously variable (into 50 Ω) from 0 V to ±2.5 V at 5 V pulse output and lower; from 0 V to ±5 V on the 10 V range. Pulse amplitude plus base line offset max. ±10 V.

9. Mains supply

Mains voltage	100 ... 130 V and 200 ... 260 V, switchable 85 ... 115 V and 170 ... 230 V, solderable
Mains frequency	50 ... 400 Hz
Power consumption	90 VA

10. Temperature range 0 ... +40 °C

B. MECHANICAL

Dimensions	Depth	265 mm
	Width	215 mm
	Height	195 mm
Weight	Approx. 7 kg	

III. Accessories

Standard accessories (included in the delivery)

1 mains cable
1 manual

Optional accessories (to be ordered separately)

50 Ω - termination (3 W)	PM 9581
50 Ω - T-piece	PM 9584
Coaxial cable set, 50 Ω	PM 9588 *)

*) Contains the following cables, type RG58A/U with BNC connectors

Qty	*Delay (ns)*	*Length (mm)*	*Separately available under service code number*
5	1	200	5322 320 10009
4	2	400	5322 320 10011
3	3	600	5322 320 10012
3	10	1980	5322 320 10013

IV. Description of the block diagram

Trigger circuit

The pulse generator can be triggered either externally or internally.
The trigger circuit (I) consists of a Schmitt-trigger controlled by external trigger or gate pulses which are applied to socket TRIGG/GATE IN, BU1.
When switch REPETITION TIME, SK2, is in position TRIGG. OR SINGLE SHOT, a single pulse is obtained by depressing push-button SINGLE SHOT, SK6.

Astable multivibrator

This multivibrator (II) supplies square-wave pulses from which all internal pulses are derived. Controls REPETITION TIME, SK2 and R4, enable adjustment of the repetition time between 10 ns and 1 s, both in steps and continuously.
The multivibrator is inoperative when switch REPETITION TIME, SK2, is in position TRIGG OR SINGLE SHOT.

Gate

Both the external and internal trigger pulses are fed to gate III.
With switch CONT. GATED, SK7, in position CONT. the internal trigger pulses will pass the gate directly.
If, however, switch SK7 is set to position GATED the internal trigger pulses will pass the gate only when a gate signal is applied to socket TRIGG/GATE IN, BU1.
This means that a pulse train can be obtained which is synchronised with the applied gate pulse.

Differential amplifier and delay circuit

The square-wave pulses, either from the multivibrator or from the trigger circuit, are applied via the sync. output pulse amplifier (IV) to differential amplifier (V).
From socket SYNC. OUT, BU2, square-wave pulses can be taken with an amplitude of 1.2 V. In the differential amplifier V the square-wave pulses are converted into needle pulses of 4 ns width which control the delay-time circuit (VI). In the latter square-wave pulses are formed whose width can be adjusted from 5 ns ... 0.1 s by means of the DELAY controls, SK3 and R5.
After amplification in the differential amplifier (VII) positive as well as negative square-wave pulses are obtained which are differentiated directly. The needle pulses which originate from the trailing edges can be delayed with respect to the needle pulses that originate from the leading edges.
The following differential amplifier (VIII) delivers a trigger pulse when a negative and a positive needle pulse are applied simultaneously. When switch SINGLE DOUBLE, SK8, is set to position SINGLE, the amplifier is controlled by the delayed needle pulses, whereas in position DOUBLE the amplifier is controlled both by the delayed and the initial needle pulses.
In this way single or double needle pulses are obtained at the output of the amplifier.

Differential amplifier and duration circuit

The duration circuit (IX) is triggered by the needle pulses coming from the amplifier circuit (VIII). In this circuit square-wave pulses are formed, whose pulse width is adjustable from 5 ns ... 0.1 s with controls DURATION, SK4 and R6.
When switch SINGLE DOUBLE, SK8, is in position SINGLE only a single pulse is obtained. By switching to position DOUBLE the width circuit is also triggered by the needle pulse which originates from the leading edge of the "delay pulse".
Consequently double pulses are obtained. The second pulse can be delayed with respect to the first one but both pulses have the same pulse duration.

Ramp generator and amplitude limiter

The pulses are fed to the amplifier (X) from which normal or inverted pulses can be taken, depending on the position of switch NORM./INV, SK10. The pulses are further applied to the ramp generator circuit (XII) via the amplifier stage (XI) in order to enable rise and fall time adjustment.
The ramp range can be selected by means of the switch RAMP RANGE, SK1.

The rise and fall times are selected with controls RISE, R1, and FALL, R2, respectively.
The ramp generator is followed by an amplitude limiter circuit (XIII) which permits continuous pulse amplitude adjustment with the AMPLITUDE vernier, R7. This control limits the amplitude which means that the slope of the leading edge and trailing edge is kept constant when the amplitude is changed.

Output circuit

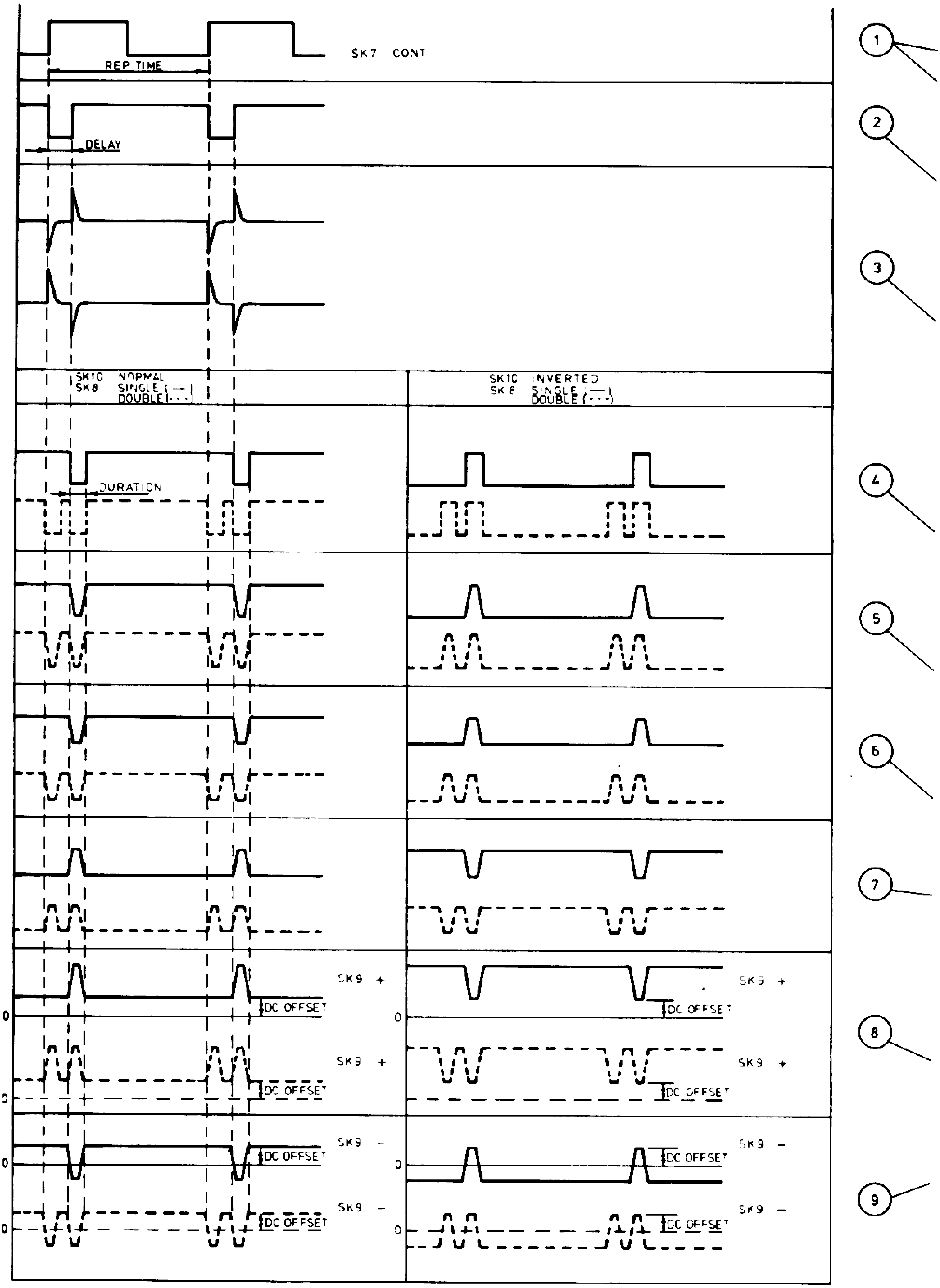
Via an emitter-follower stage (XIV) the pulses are fed to the positive or negative output channel, depending on the position of switch "+ –", SK9. With SK9 in position "–" the pulses will pass the attenuator XIX via the negative output pulse amplifier XVII. In this case the positive output channel is cut off.
When SK9 is set to "+" the negative output channel is cut off and the pulses pass through phase inverter XV before they reach the positive output pulse amplifier XVI.
The attenuator is controlled by switch AMPLITUDE, SK5.

DC-offset circuit

Base-line shift both in positive and negative direction is possible by adding a positive or negative d.c. current to the output pulse at socket PULSE OUT, BU3: The current is supplied by the d.c.-offset circuit and is adjustable with control DC OFFSET in 50 Ω, R3.

Protection circuit

The output stage is protected against certain transients by a special diode circuit.


SK7 CONT
REP TIME
DELAY
SK10 NORMAL
SK8 SINGLE (—)
DOUBLE (- - -)
SK10 INVERTED
SK 8 SINGLE (—)
DOUBLE (- - -)
DURATION
SK9 +
DC OFFSET
SK9 −
0
1
2
3
4
5
6
7
8
9

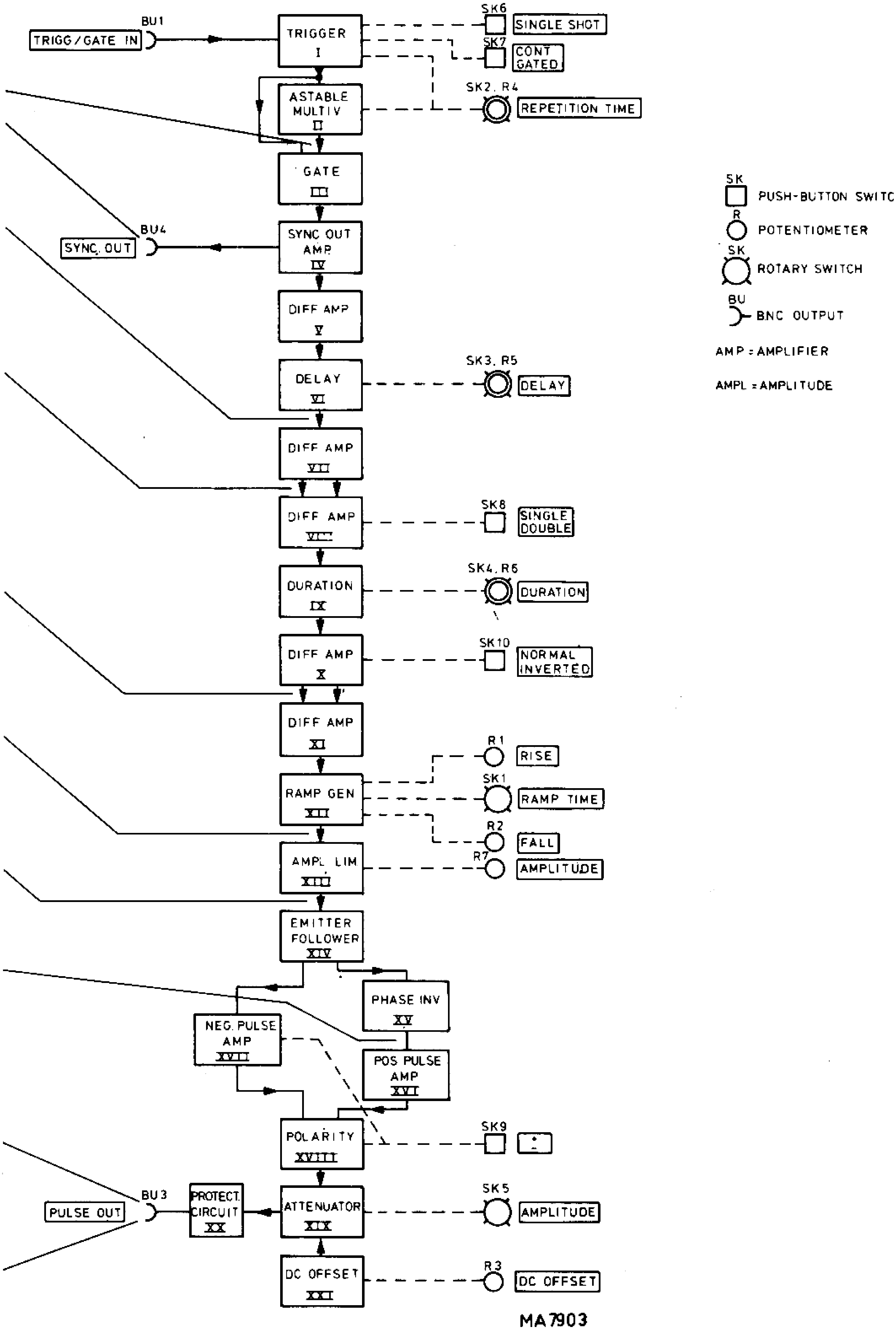


Fig. IV-1. Block diagram

V. Installation

A. SETTING UP

Always place the instrument so that the air circulation through the airvents in the bottom plate and the top cover is not impeded.
The ambient temperature should be between 0 °C to +40 °C for operating within the specification.

B. ADJUSTMENT TO THE LOCAL MAINS VOLTAGE

The mains voltage selector SK12 at the rear of the generator can be set to two ranges:

Position	Voltage range	
110 V	100 ... 130 V	Frequency 50 Hz ... 400 Hz
220 V	200 ... 260 V	

Two other ranges, 85 ... 115 V and 170 ... 230 V can be achieved by changing the connection of the mains transformer as described in the Service Manual, chapter XI.

C. EARTHING

The generator should be earthed according to the local safety regulations. This may be effected as follows:

- Via the earthing terminal BU5 at the rear panel
- Via the 3-core mains flex. The mains plug should only be inserted in a socket outlet provided with a protective earth contact, the protective action of which is not be cancelled by the use of an extension cord or device which does not have a protective conductor.

Double earth connection should be avoided as this will give rise to hum!

D. SWITCHING ON

The instrument is switched on by depressing push-button POWER ON, SK11. The indicator lamp in the push-button will then light up.

E. FUSES

The instrument is provided with three fuses:

- one thermal fuse mounted on the primary of the mains transformer.
- two 3A, delayed-action fuses on the secondary side of the mains transformer, located on printed wiring board 3 (power supply).

F. CONTROLS, INPUT AND OUTPUT CONNECTORS

Control or connector	*Designation*	*Purpose*
R1	RISE	Continuous setting of pulse rise time within ramp range set with SK1.
SK1	RAMP RANGE	Selection of ramp range.
R2	FALL	Continuous setting of pulse fall time within ramp range set with SK1.
R3	DC OFFSET IN 50 Ω	Base-line shift between ±5 V with SK5 set to 10 V; between ±2.5 V in all remaining settings of SK5.
SK2 R4	REPETITION TIME	Selection of repetition time in 9 ranges and external triggering or single shot operation. Vernier R4 provides continuous and overlapping setting of repetition time between each range.
SK3 R5	DELAY	Selection of pulse delay in 8 ranges. Vernier R5 provides continuous and overlapping setting of pulse delay between each range. In the DOUBLE pulse mode, spacing between "twin" pulses is set with these controls.
SK4 R6	DURATION	Selection of pulse duration in 8 ranges. Vernier R6 provides continuous and overlapping setting of duration between each range.
SK5 R7	AMPLITUDE IN 50 Ω	Selection of output pulse amplitude in 6 ranges. Vernier R7 provides continuous and overlapping setting of amplitude between each range.
SK6	SINGLE SHOT	When SK2 is set to position TRIGG, OR SINGLE SHOT, one single pulse with set delay and duration is generated when SK6 is depressed.
SK7	CONT. GATED	Selection of continuous or gated pulse mode.
SK8	SINGLE DOUBLE	Selection of single or double pulse mode.
SK9	+ –	Selection of positive or negative polarity of output pulse.
SK10	NORM. INV.	Selection of normal or inverted output pulses
SK11	POWER	Mains switch. Illuminated when depressed.
BU1	TRIGG./GATE IN	Accepts external triggering signal when SK2 is set to position TRIGG. OR SINGLE SHOT. External signal gates the generator in all remaining positions of SK2. Required signal amplitude in excess of +1.2 V.
BU2	SYNC. OUT	Provides square-wave signal derived from the internal source or external trigger signal. Amplitude +1.5 V into 50 Ω load. Pulse appears approx. 30 ns ahead of main pulse at BU3.
BU3	PULSE OUT	Provides main pulses. 50 Ω source impedance at 5 V and lower settings of SK4. Current source in the 10 V range.
BU4 (rear)		Input connector for mains supply.
BU5 (rear)		Protection earth connector.
SK12 (rear)		Mains voltage selector.

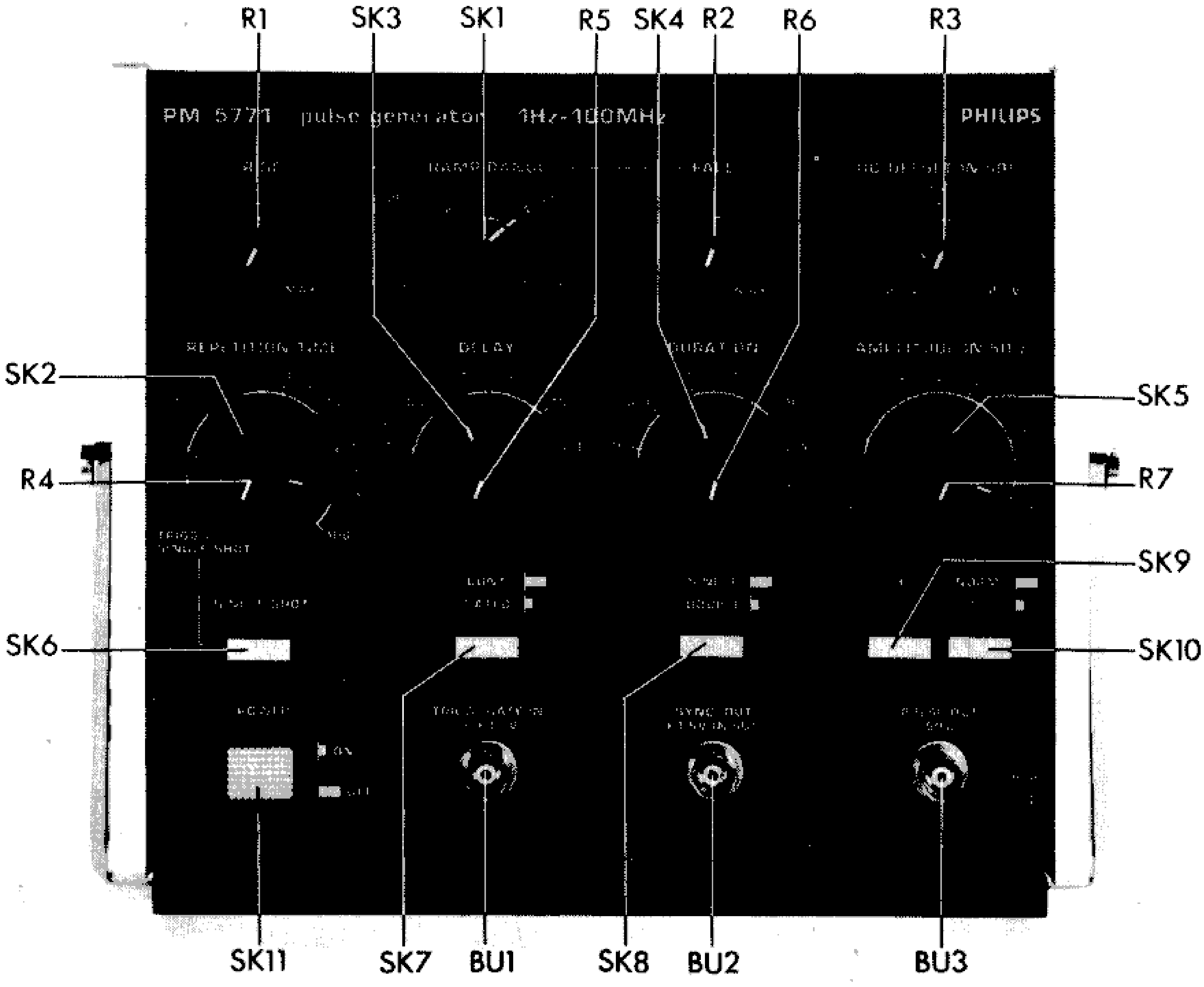


Fig. V-1. Indication of controls, input/output sockets at the front

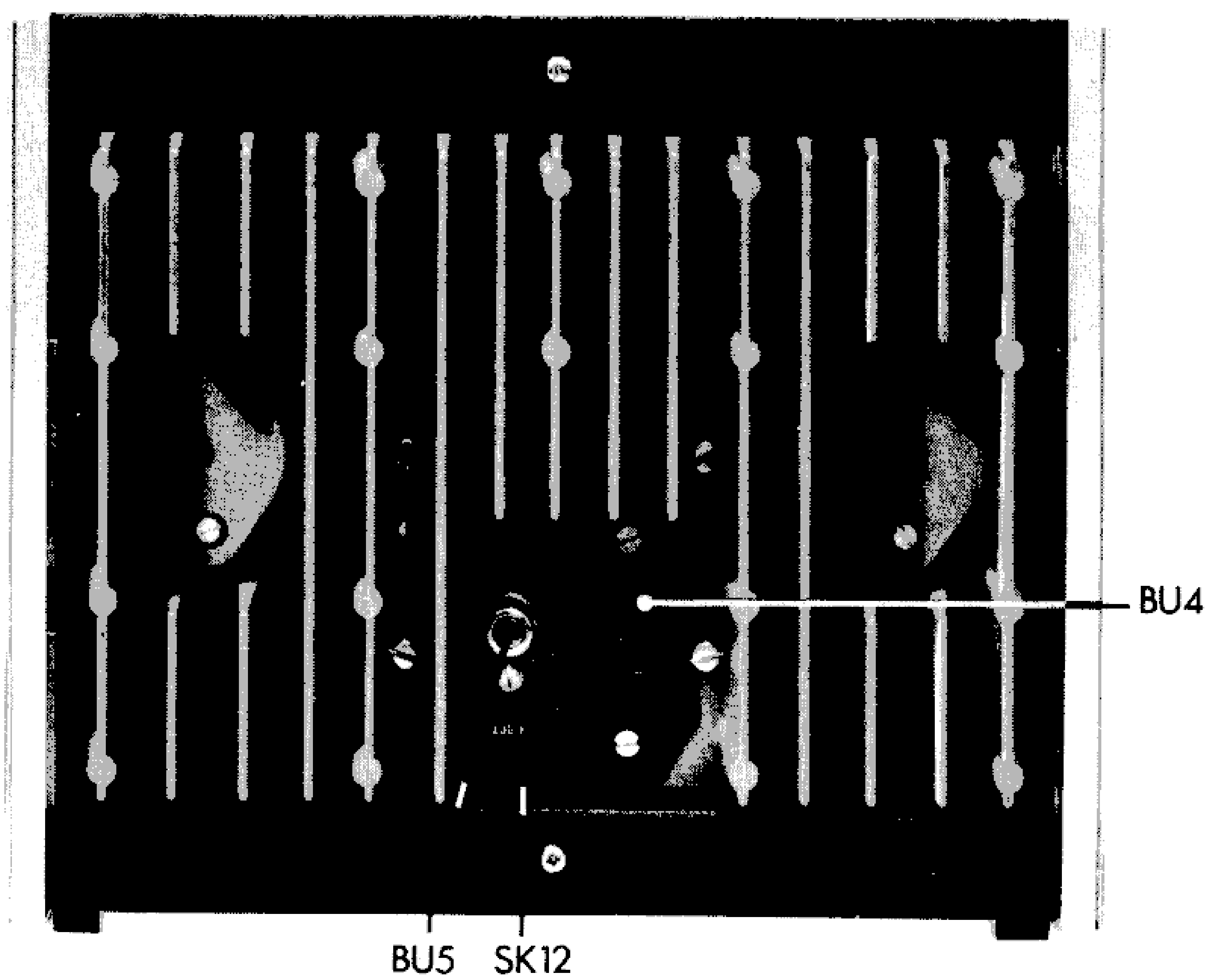


Fig. V-2. Input sockets at the rear

VI. Operation

A. INTERNAL OPERATION

- Set switches SK7 ... SK10 to positions "CONT.", "SINGLE", "+" and "NORM.".
- Set "DC OFFSET IN 50 Ω" R3 to position ' 0 V".
- Set "DELAY", SK3, to position "5 ns" and turn vernier R5 fully counter-clockwise.
- Choose an arbitrary repetition time and check that the pulse width is less than half the repetition time and that the rise and fall time settings are short with respect to the pulse width.
- Set the amplitude to required level.
  The amplitude corresponds to the indicated values when AMPLITUDE vernier, R7 is in position "MAX.".
  "REPETITION TIME", "DELAY" and "DURATION" correspond to the indicated values if the continuous controls R4, R5, R6 on the white "dots". These "dots" do not coincide with the lowest position of the continuous controls in order to ensure sufficient overlap between the ranges.
  (Example: with the repetition time switch in position "10 µs" the continuous control corresponds to the range 9 µs up to 110 µs).
- Connect "PULSE OUT", BU3, to the test object via a 50 Ω termination (e.g. 3 W, 50 Ω termination PM 9581).
  The polarity can be selected with switch "+/–", SK9.
  The polarity can be inverted by means of switch "NORM. INV.", SK10.

Example:

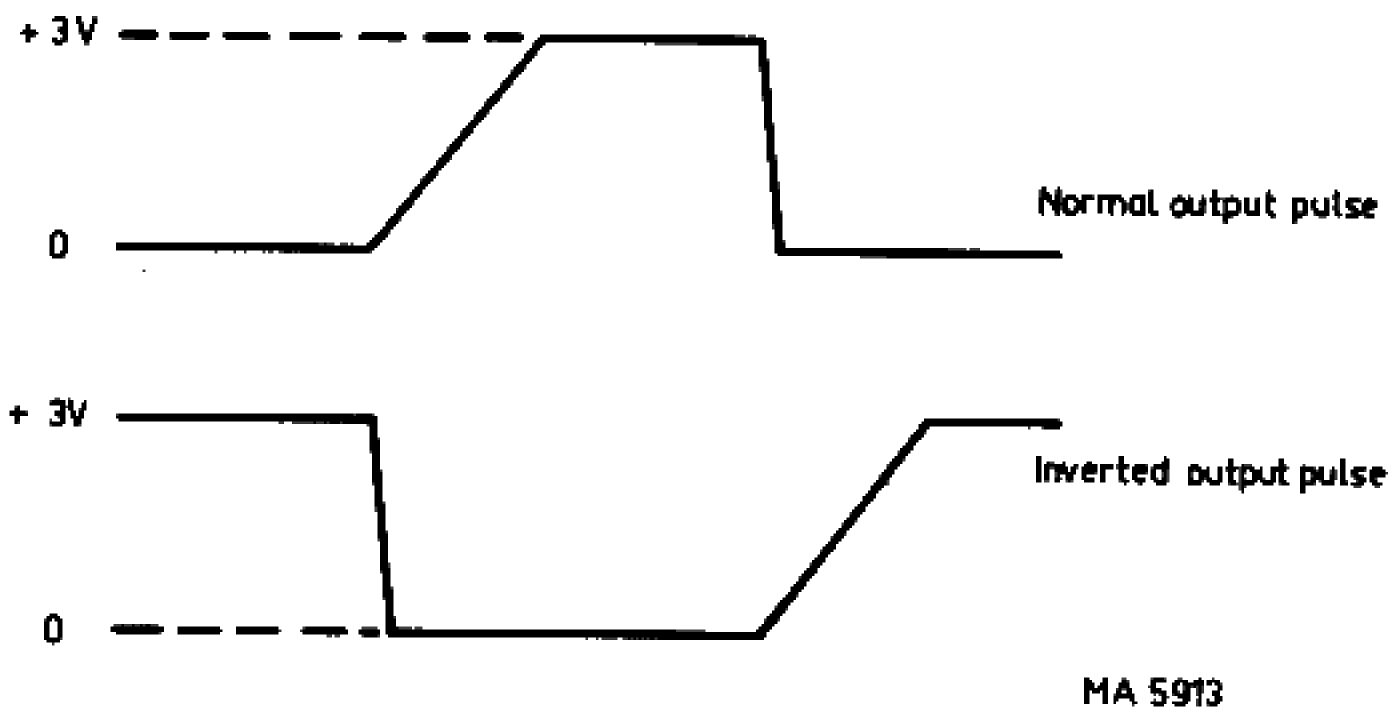
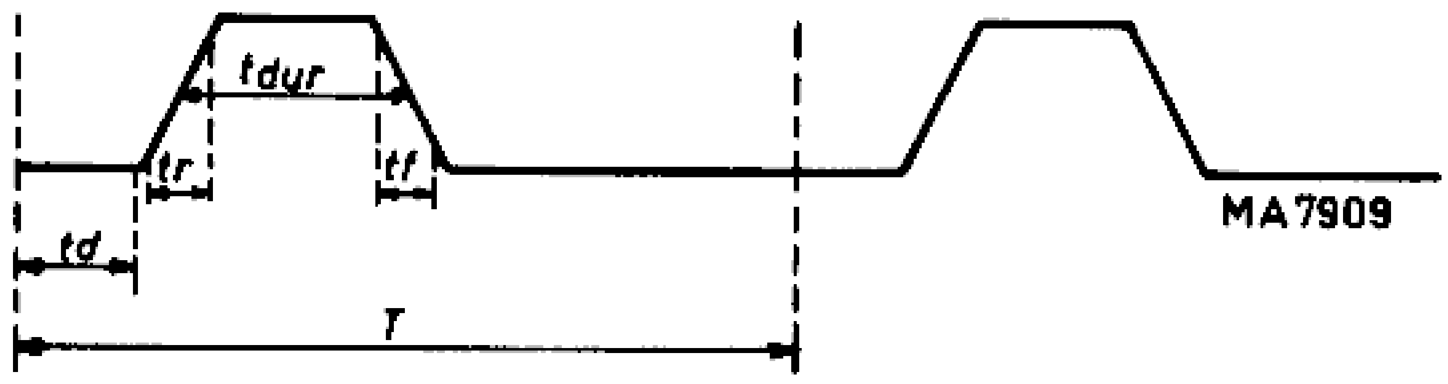


Fig. VI-1. Normal and inverted output pulse

Inverted pulse operation provides a facility to increase the duty cycle to almost 100 %, limited only by the minimum pulse width.
When switching from "NORM." to "INV." the rise time still refers to the positive-going edge and the fall time to the negative-going edge of the output pulse.
To trigger external equipment e.g. oscilloscopes a "sync. out" square-wave pulse is available whose leading edge starts 25 ns before the leading edge of the main pulse.

Fig. VI-2. Sync. pulse

Delaying the main pulse is possible by means of the "DELAY" controls (S3, R6).
Check always that the "REPETITION TIME", "DELAY", "DURATION" and "RISE/FALL" time settings are in correct relationship (see Fig. VI-3).



tr = rise time
tf = fall time
t_{dur} = pulse duration

td = delay time
T = repetition time

$tr/tf < t_{dur}$
$td < T$
$t_{dur} < T$

Fig. VI-3. Time settings at single pulse operation

In mode "NORMAL", $\frac{\text{"DURATION"}}{\text{"REP. TIME"}}$ x 100 % (duty factor) may exceed 50 %.

Base-line shift can be introduced between –5 V ... +5 V and –2.5 V ... +2.5 V by turning knob "DC OFFSET IN 50 Ω", R3.
This control is locked in position "0 V" to ensure that no d.c. offset is introduced by accident.
The markings "+5 V" and "–5 V" are indicated in blue and correspond to amplitude marking "10 V" which is also indicated in blue.
The indications "+2.5 V" and "–2.5 V", relate to the amplitude setting "5 V" and lower.
The total sum of d.c. offset and pulse amplitude both in positive and negative direction does not exceed 10 V.
Erroneous settings (e.g. pulse ampl. "+10 V" and DC offset "+5 V") will not cause any damage to the instrument.

Influence on pulse duration at unequal rise and fall times

The rise time starts at point A and the fall time at moment B (Figs. VI-4 and VI-5).
This implies that the pulse duration measured at 50 % amplitude remains constant only if rise and fall times are equal.
As the slope remains constant when the amplitude is decreased the pulse duration at 50 % amplitude is again constant if rise and fall times are equal (Fig. VI-6).
The pulse duration increases if the rise time is longer than the fall time and vice versa (Fig. VI-7).

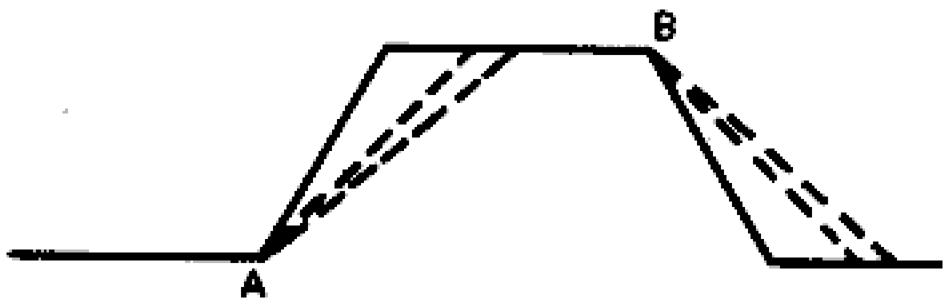


Fig. VI-4. Constant pulse duration at equal rise and fall times

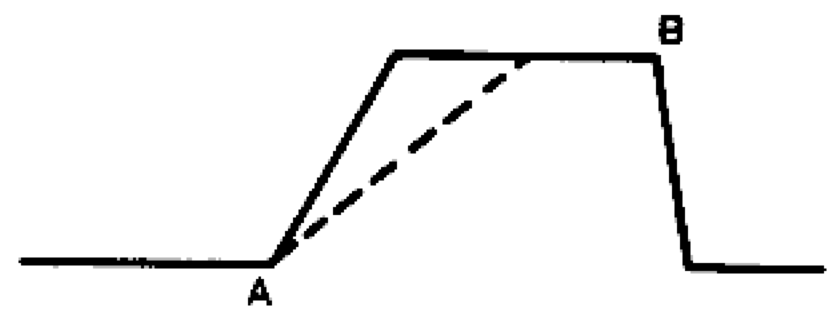


Fig. VI-5. Pulse duration will vary when the fall and rise times are unequal at a constant amplitude

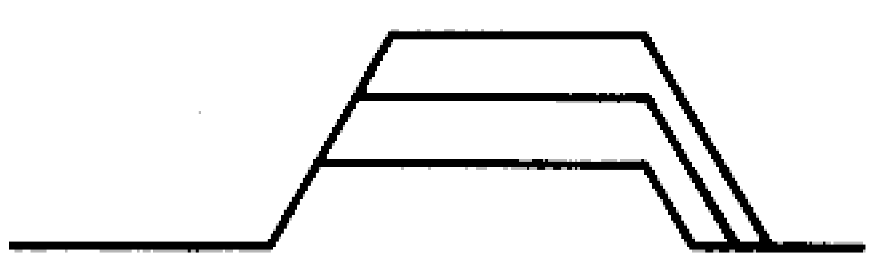


Fig. VI-6. Constant pulse duration at equal rise and fall times when varying the amplitude

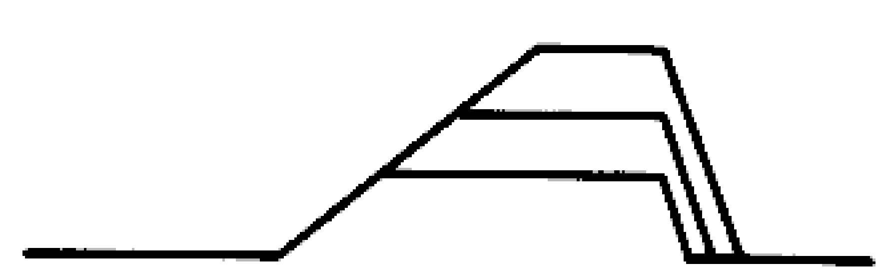
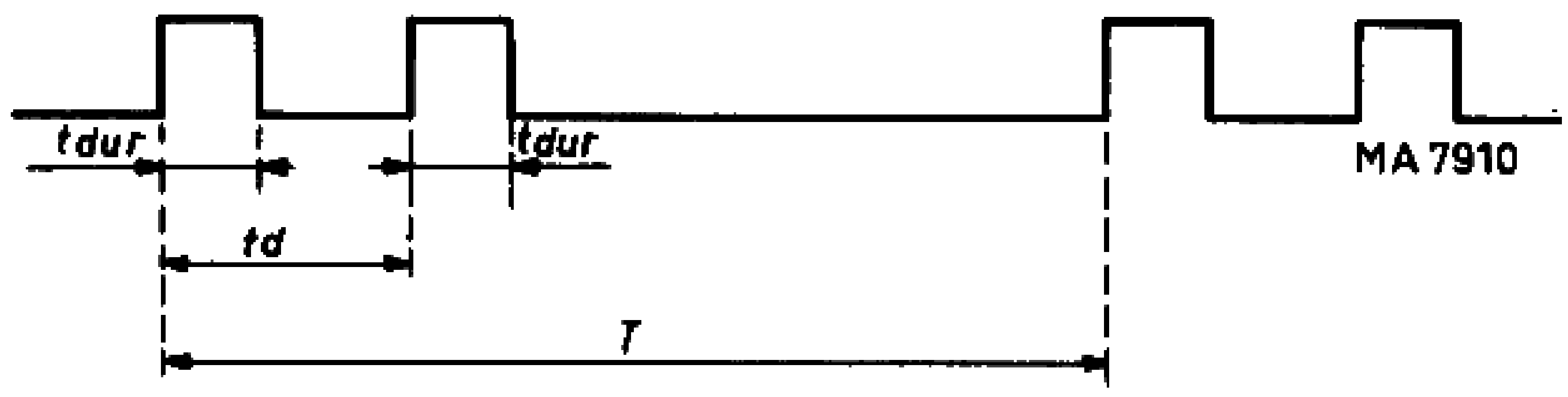


Fig. VI-7. Pulse duration changes when amplitude is varied and rise and fall times are unequal

B. INTERNAL DOUBLE PULSE OPERATION

- Set switches SK7 ... SK10 to position "CONT.", "DOUBLE", "+" and "NORM.".
- Check that "DELAY" SK3, R5, and "DURATION" SK4, R6, are set correctly.
  Correct duty cycle: < 50 % in normal operation.
  The pulse duration "t_{dur}" of both pulses is simultaneously adjusted by the "DURATION" controls.

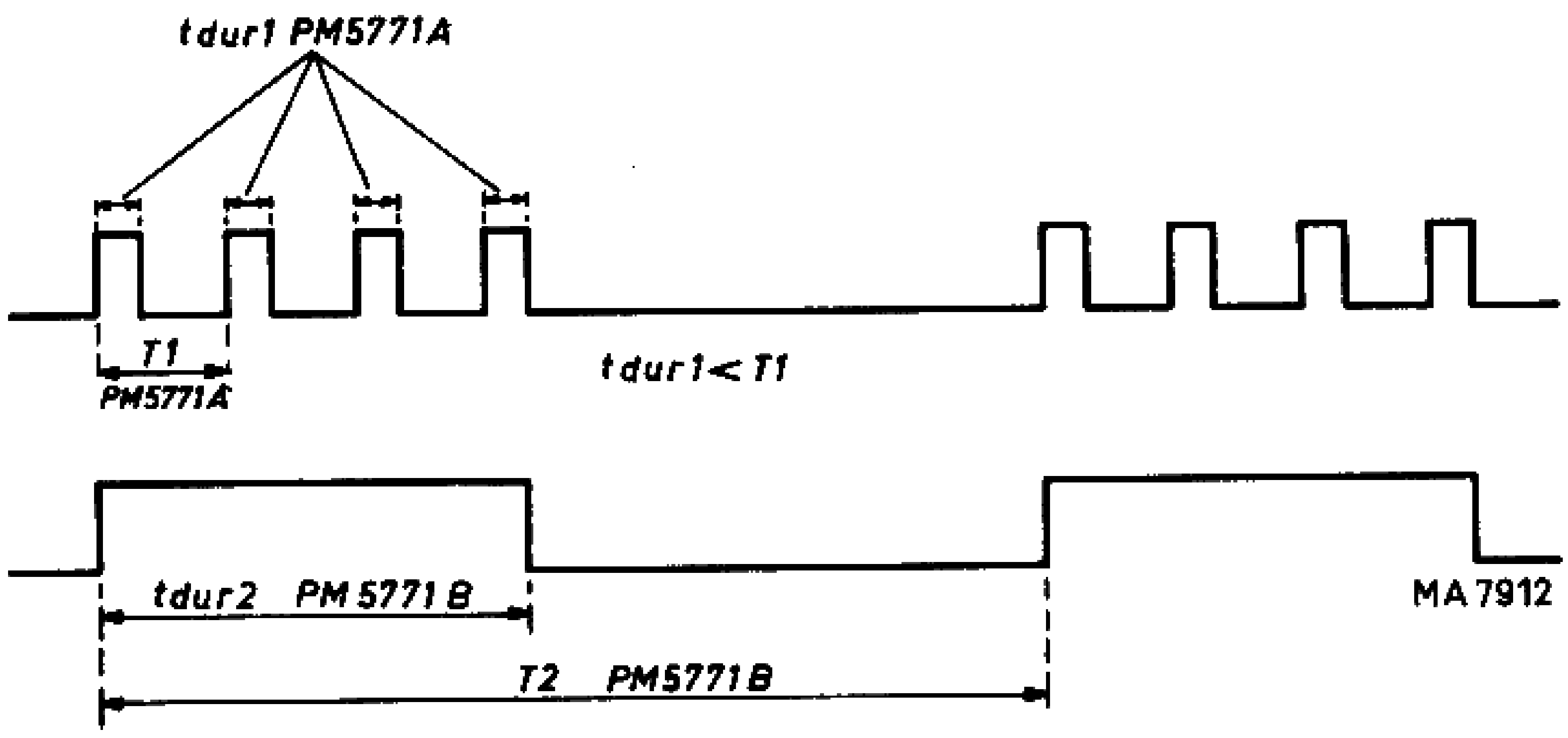


$$t_{dur} < t_d < T$$

Fig. VI-8. Time settings at double pulse operation

C. INTERNAL OPERATION, EXTERNALLY GATED

- Set switches SK7 ... SK10 to positions "GATED", "SINGLE", "+" and "NORM.".
- Set "DC OFFSET IN 50 Ω" R3 to position "0 V".
- Set "DELAY" SK3, to "5 ns" and turn R5 fully counter-clockwise.
- Check that the relationship between pulse duration and repetition time of PM 5771 and the pulse width of second PM 5771 or PM 5712 or 5715 or other external source is correct.



$$t_{dur2} = n \times T1$$
$$t_{dur2} < T2$$

Fig. VI-9. Time settings at internal operation, externally gated

In the case of gated double pulse operation, check both the conditions for "double pulse" and "gated pulse" mode (VI-B and VI-C).
Due to internal synchronisation the PM 5771 frequency and the external gate frequency (e.g. from PM 5715) are automatically locked to ensure jitter-free operation.

D. EXTERNAL TRIGGERING AND SINGLE-SHOT OPERATION

- Set switches SK7 ... SK10 to positions "CONT.", "SINGLE", "+" and "NORM.".
- Set "DC OFFSET IN 50 Ω" R3 to position "0 V".
- Set "REPETITION TIME" SK2 to position "TRIGG. OR SINGLE SHOT".
- Set the correct values for "DELAY", "DURATION" and "RISE/FALL" time (in accordance with the external frequency).
- Select the correct amplitude.
- Depress "SINGLE SHOT", SK6.

One and only one pulse is now generated. Electronic switching circuits ensure bounce-free switching.

E. DUAL CHANNEL ARRANGEMENT

By combining two PM 5771 a true dual channel generator is achieved. This combination represents an ideal dual channel test arrangement for all kinds of logic testing such as shift registers, AND-gates etc.

– Check the conditions for internal operation of generator A (Chapt. VI-A) and for external operation of generator B (Chapt. VI-D).

The delay and pulse duration of the two pulses A and B can be varied independently.
To ensure that both pulses generators are synchronised, generator B is triggered externally by generator A. Consequently the repetition time of both pulses is determined by the repetition time setting of generator A.

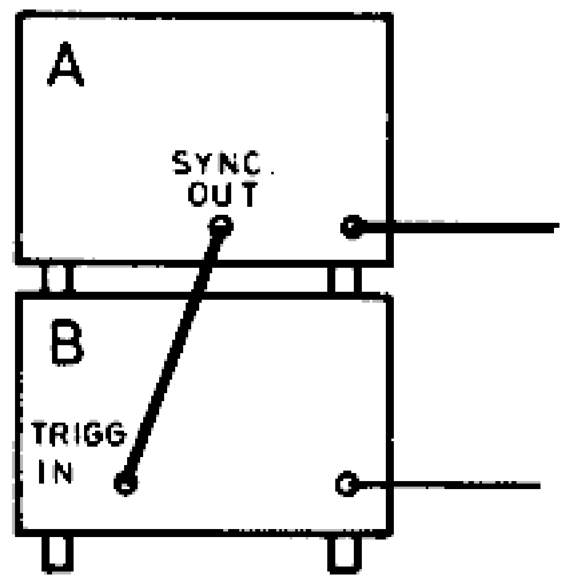
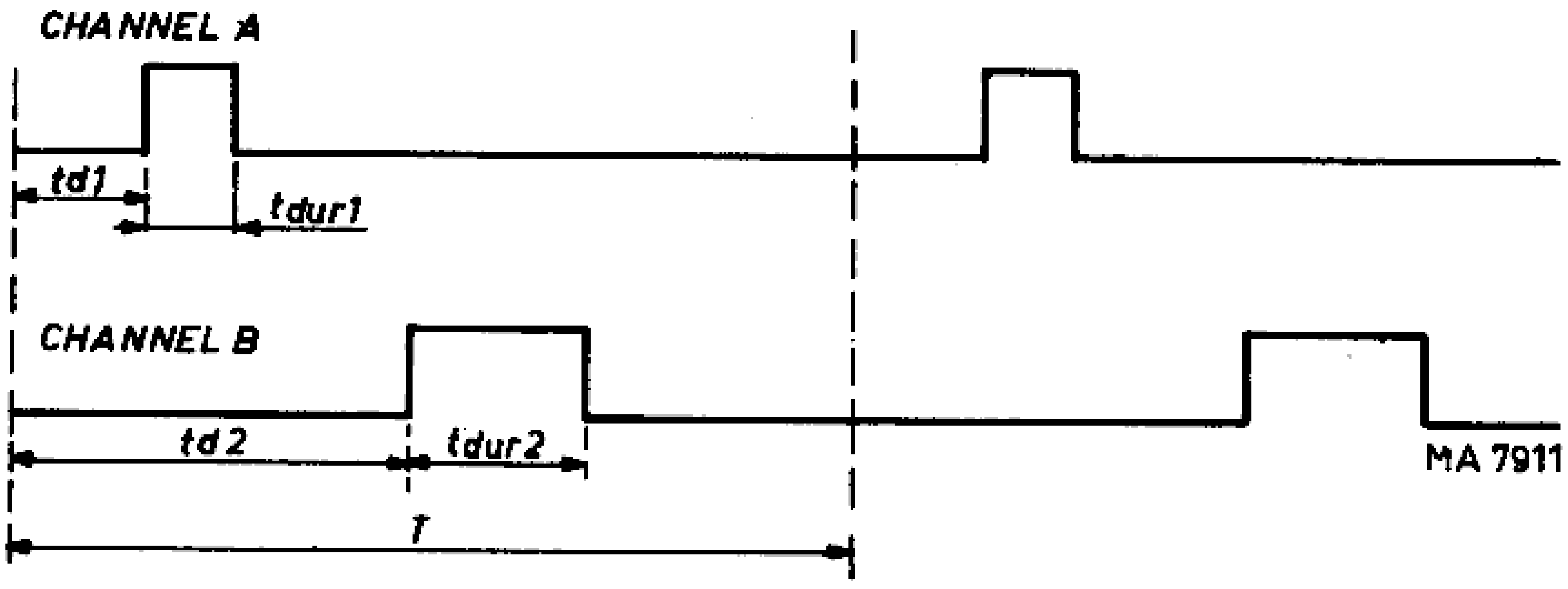


Fig. VI-10. Dual channel arrangement



$t_{dur1} < T$ $\quad$ $t_{dur2} < T$

$t_{d1} < T$ $\quad$ $t_{d2} < T$

Fig. VI-11. Time settings of the pulse generators A and B in a dual channel arrangement

F. MIXING THE OUTPUT SIGNALS OF TWO GENERATORS

To generate more complex pulse patterns it is feasible to interconnect two PM 5771 and mix their output signals.
The pulse waveform is best preserved by using a resistive 50 Ω T-piece, e.g. Philips type PM 9584. One can also mix the outputs via a normal BNC T-piece if the pulse distortion can be tolerated.
The cables from the outputs should be of equal length and kept as short as possible.

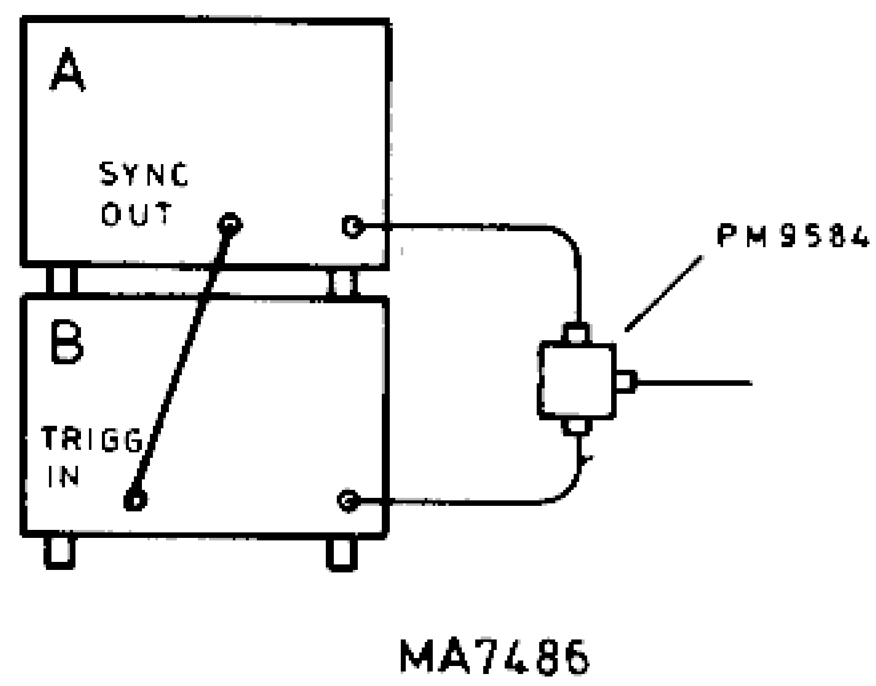


Fig. VI-12. Set-up for mixing two outputs

However, because of the direct connection between the outputs of the generators, some precautions as regards amplitude and duty cycle must be taken to avoid damage to the output stage.
Two alternatives are described below.

1. Mixing when at least one output is at or below 5 V

When at least one of the generators is set to 5 V or lower amplitude there is no risk of any damage.

2. Mixing when both outputs exceed 5 V

This combination is **NOT** 100 % open circuit safe.
If the load is disconnected and the duty cycle exceeds 50 % the output transistors dissipate more power than in normal short-circuit conditions. These three rules, therefore, must be followed:

1. Make sure that the 50 Ω load is connected **before** the generators are switched on.
2. Check the time settings so that each generator does not deliver more than 50 % duty cycle. Special care must be taken when switching over from NORMAL to INVERTED. A duty cycle of 30 % in the NORMAL mode becomes 70 % in the INVERTED mode.
3. Avoid such conditions when pulses overlap eachother. When pulses are of the same polarity, the output stages will be saturated.
   Although harmless, this is no real operating condition.
   If pulses are of opposite polarity the output currents cancel each other only at the load.

Service documentation

Contents

LIST OF FIGURES

VII. Circuit description

A. TIMING CIRCUIT (Fig. XIII-5)

The timing circuit consists of a variable oscillator circuit with trigger and gate functions, a pulse delay circuit, a circuit for single or double pulses and a pulse duration circuit. The timing circuit delivers output sync. pulses and pulses for the output circuit.
Connector BU1, TRIGG GATE IN, accepts either trigger pulses or gate signals.

1. Trigger circuit

Diodes GR201 and GR202 are connected as a current switch and voltage limiter.
Transistors TS203 and TS204 form a Schmitt-trigger circuit.
When switch SK2 is in position EXT. - or switch SK7 is in position GATED - TS204 is conducting and TS201 is cut off.
When a signal is applied to BU1 (trigger signal or gate signal - depending on the position of SK2) the Schmitt-trigger switches over.

SK2 in position EXT.

In this position switch SK7 is short-circuited by SK2.
From the +5 V a current will flow through R201-GR202-R203-R204 to the −20 V (point 32). If a trigger signal of +1.2 V is applied to BU1 the Schmitt-trigger switches over and positive pulses appear across the collector resistor of TS204.
If no trigger pulses are applied to BU1 a single positive pulse arises across R209 when push-button SK6 is depressed.
This is because the −20 V is disconnected at R204 which results in a positive voltage step at the cathode of GR202.

SK2 in one of the positions REPETITION TIME

In these positions switch SK6 is short-circuited by SK2.
When SK7 is in position GATED transistor TS203 is cut off because the cathode of GR202 is connected to −20 V via R203 and R204. However, a positive gate pulse supplied to BU1 will open TS203, and consequently the Schmitt-trigger switches over during the time of gate pulse.
If SK7 is in position CONT. the −20 V is switched off and this is also the case if a gate pulse is supplied to BU1; i.e. TS203 will be conducting and TS204 will be cut off.

2. Sync. output amplifier

When the Schmitt-trigger is switched over by a trigger pulse at BU1, a positive pulse appears at the collector of TS204.
This positive pulse is fed to the cathode of the diode GR212, which will be cut off. As a result the voltage on the base of TS215 increases suddenly. TS215 and TS216 form a differential amplifier which is switched over by a positive pulse at the base of TS215, i.e. TS216 conducting and TS215 cut-off.
This differential amplifier is followed by a second balanced differential amplifier consisting of TS217 and TS220.
In the rest position TS217 is conducting and TS220 cut off.
TS217 delivers output sync. pulses, and because TS217 is conducting when the differential amplifier is in the rest position, the level of the signal at socket BU2 is almost 0 V.
When the differential amplifier switches over TS217 is cut off and TS220 conducts via R237 and delay line DL201. The sync. output pulse at BU2 will be +1.5 V into 50 Ω.

3. Astable multivibrator

The oscillator is an emitter-coupled astable multivibrator consisting of transistors TS206 and TS208. The time determining elements R and C are represented by R211, R213, R286, R287, R4A, C209 and C1...C9.
Capacitors C1...C9 are connected in parallel with C209.
Via zener diode GR205 and resistors R212 and R284 a bias voltage of 5 V is fed to the base of TS206.
The currents through TS206 and TS208 are delivered by transistors TS207 and TS259 which may be regarded as constant current sources. The bases of the latter are biased to about −10 V, while the total current is adjustable by means of R4B.

The frequency setting of the multivibrator is effected by SK2 and potentiometer R4A. This potentiometer is incorporated in the collector circuit of TS206. This means that the amplitude of the multivibrator signal depends on the frequency.
This amplitude variation, however, is reduced by potentiometer R4B which is coupled with R4A.
When the frequency of the multivibrator is e.g. increased by a decrease of R4A this will result in a smaller amplitude.
However, the current through TS207 and TS259 will increase because the setting of R4B is varied at the same time.
The degree of this current increase is such that the amplitude variation will be eliminated.

4. Gate

The output signal from the multivibrator is fed from the collector of TS208 to the cathode of GR213.
GR212 and GR213 form an AND-gate, i.e. both the cathode of GR212 and the cathode of GR213 should be positive to affect TS215. In position EXT. of SK2 the emitter of TS208 is connected to earth and TS208 is cut off. When TS208 is cut off the collector voltage is high and consequently GR213 also is cut off. Trigger pulses supplied to BU1 can now pass GR212 to the base of TS215.
In order to obtain a pulse train a gate signal is applied to BU1. In this case switch SK2 should be set to one of the positions 10 ns ... 100 ms and SK7 to position GATED.
Before the gate pulse arrives or during the time interval between two gate pulses the level at the collector of TS204 is low, and consequently the level at the cathode of GR212.

Via voltage divider R217, R289 and R218 the level at the base of TS211 is also low - and TS211 is conducting.
The multivibrator is cut off and the level at the cathode of GR213 is high.
When the gate pulse arrives a positive step appears at the cathode of GR212 and the first pulse arises in the same way as with EXT. operation.
At the same time a negative step appears at the base of TS211.
TS211 will be cut off, and the multivibrator starts oscillating.
The signal from the multivibrator can now pass GR213 during the time of the gate pulse.

5. Pulse delay circuit

The pulse delay circuit is controlled by a 4 ns pulse produced in the collector of transistor TS224.
TS223/TS224 form a differential amplifier whose bases are connected to the emitter resistors R233 and R236 of the emitter followers TS222 and TS225 respectively (Fig. VII-1).

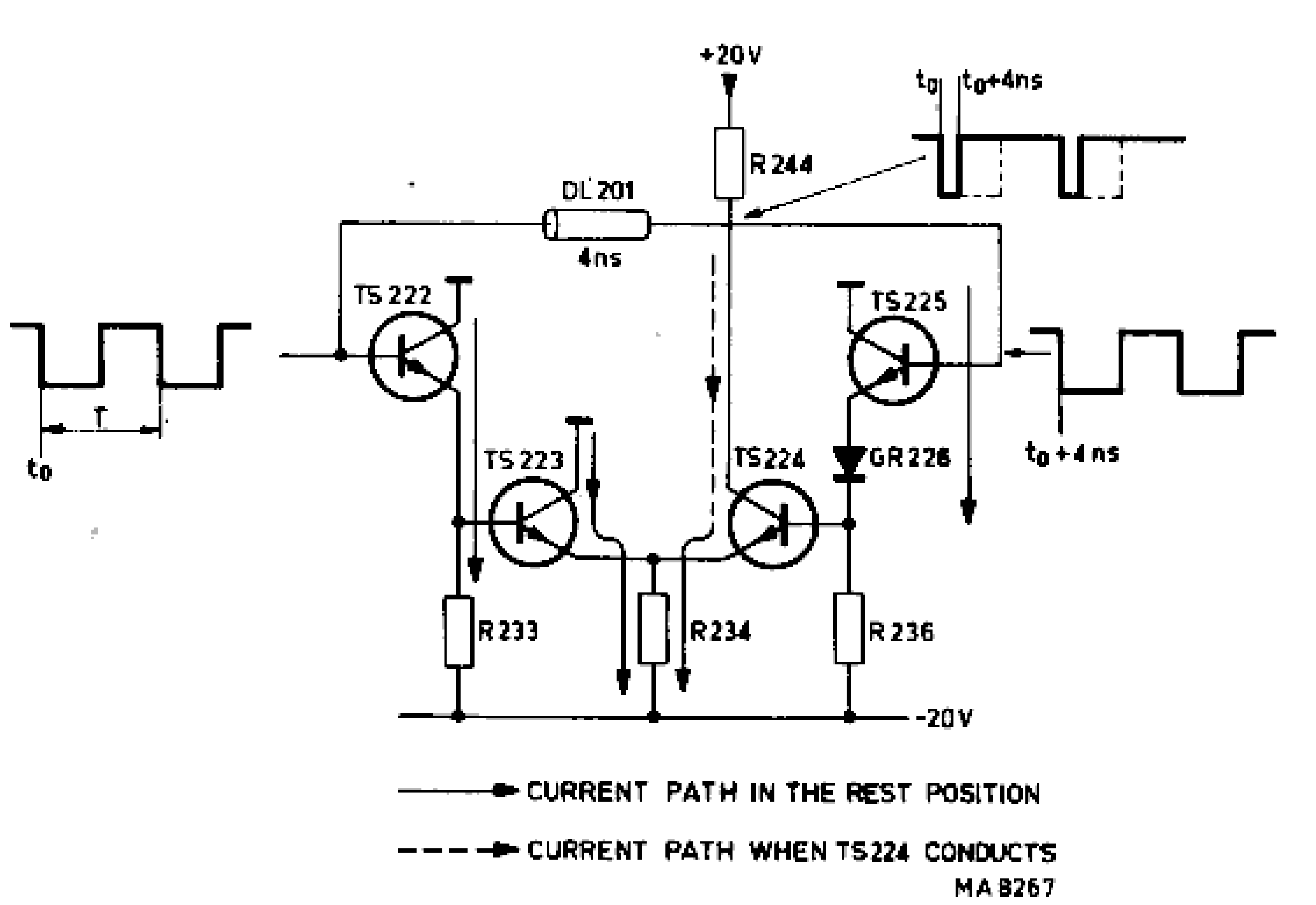


Fig. VII-1. Simplified diagram of pulse delay trigger circuit

In the rest position the voltage levels at the bases of TS222 and TS225 are the same and consequently also the emitter levels.
TS223 is conducting and due to diode GR226, transistor TS224 is cut off. When a negative pulse coming from TS220 is injected into the base of TS222, the differential amplifier TS223/TS224 switches over (moment t_0) and the collector of TS224 goes negative.
The base signal of TS220 is also injected into the base of transistor TS225, however 4 ns later, because this pulse has to pass the delay line DL201 which has a delay time of 4 ns.
As result of the emitter follower action of TS225 the negative delayed pulse turns off transistor TS224 so that in the collector of TS224 a pulse will be produced with a pulse width of 4 ns.
The 4 ns pulse is used to trigger the pulse delay timing circuit consisting of the differential amplifier TS229/TS230, emitter follower TS234, transistor TS231 and the timing capacitors C228//C12...C18 (Fig. VII-2).

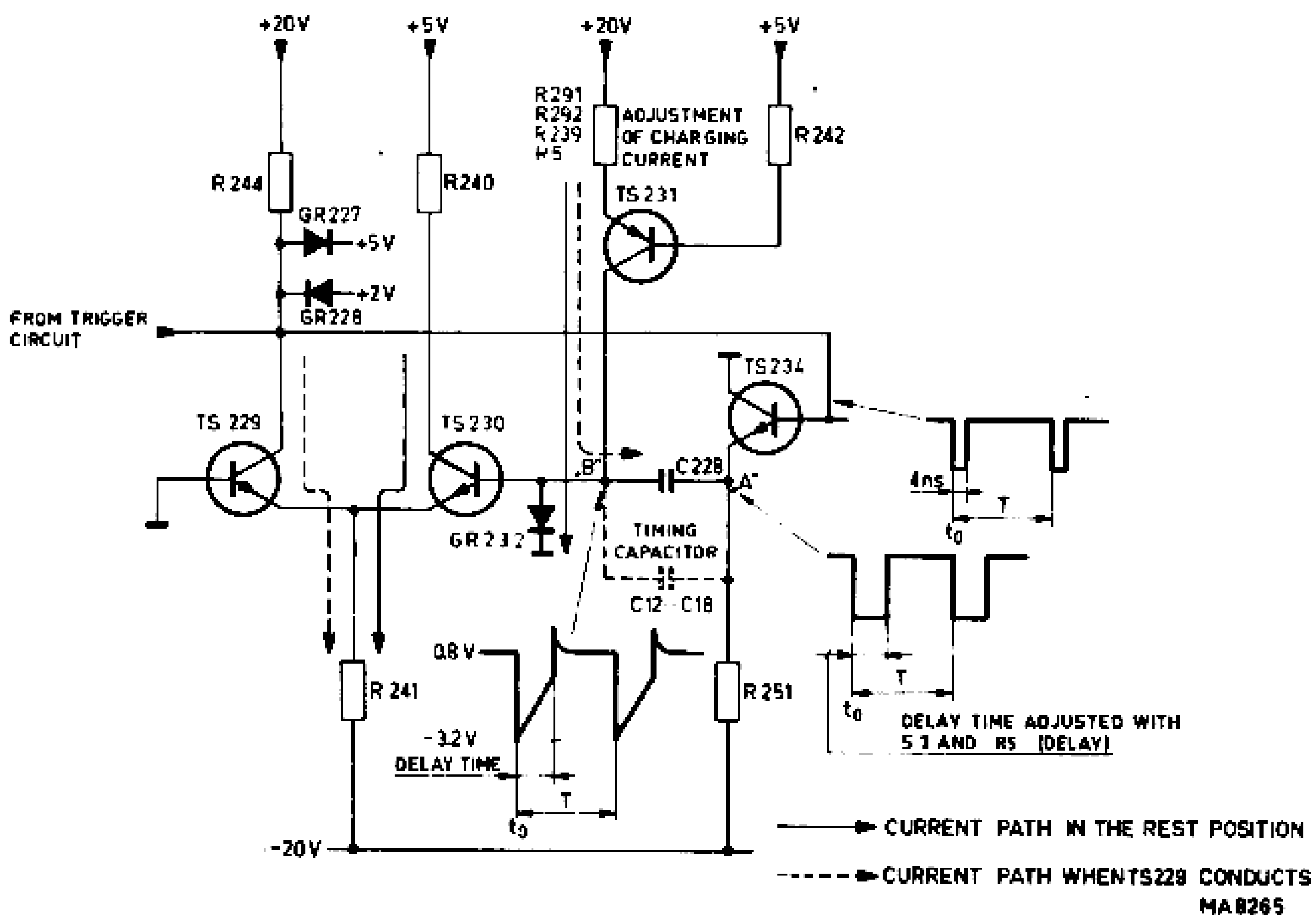


Fig. VII-2. Simplified diagram of pulse delay circuit

The pulse is fed into the base of emitter follower TS234 through which the voltage at "A" decreases abruptly from −4 V to approx. −8 V.
The voltage at "B" drops by the same amount namely from +0.8 V to approx. −3.2 V. Consequently the differential amplifier TS229/TS230 switches over and TS230 will be cut off just like diode GR232. Transistor TS234 remains cut off as result of the low collector voltage of TS229. This situation will be maintained until the timing capacitor C228 is charged to 0 V.
Timing capacitor C228, to which capacitors C12...C18 can be connected in parallel by means of switch SK3, DELAY, is charged by the collector current of transistor TS231, which acts as a constant current source. The charge current is adjustable by means of the potentiometers R291, R292 and R5, DELAY.
The voltage level at "B" increases linearly, and when it reaches the zero level, transistor TS230 starts conducting and the differential amplifier switches back to its initial state.
The collector voltage of TS229 changes then from +2 V to +6 V so that TS234 will conduct again.
The timing capacitors will now be discharged via diode GR232 because the collector current delivered by TS231 is forced to flow through GR232 to earth.

From the foregoing it follows that the width of the "delay pulse" at the emitter of TS234 depends on the value of the charging current and the values of the timing capacitors C228//C12...C18.
Transistor TS221 and diodes GR227 and GR228 form a clipping circuit that limits the collector voltages of TS224 and TS229 between approx. +6 V and +2 V.

6. Single and double pulse operation

Transistors TS235 and TS236 form a differential amplifier from which transistor TS235 is conducting in the rest position.

The base of TS236 is kept at a reference voltage which is adjustable with potentiometer.R293 (Fig. VII-3).

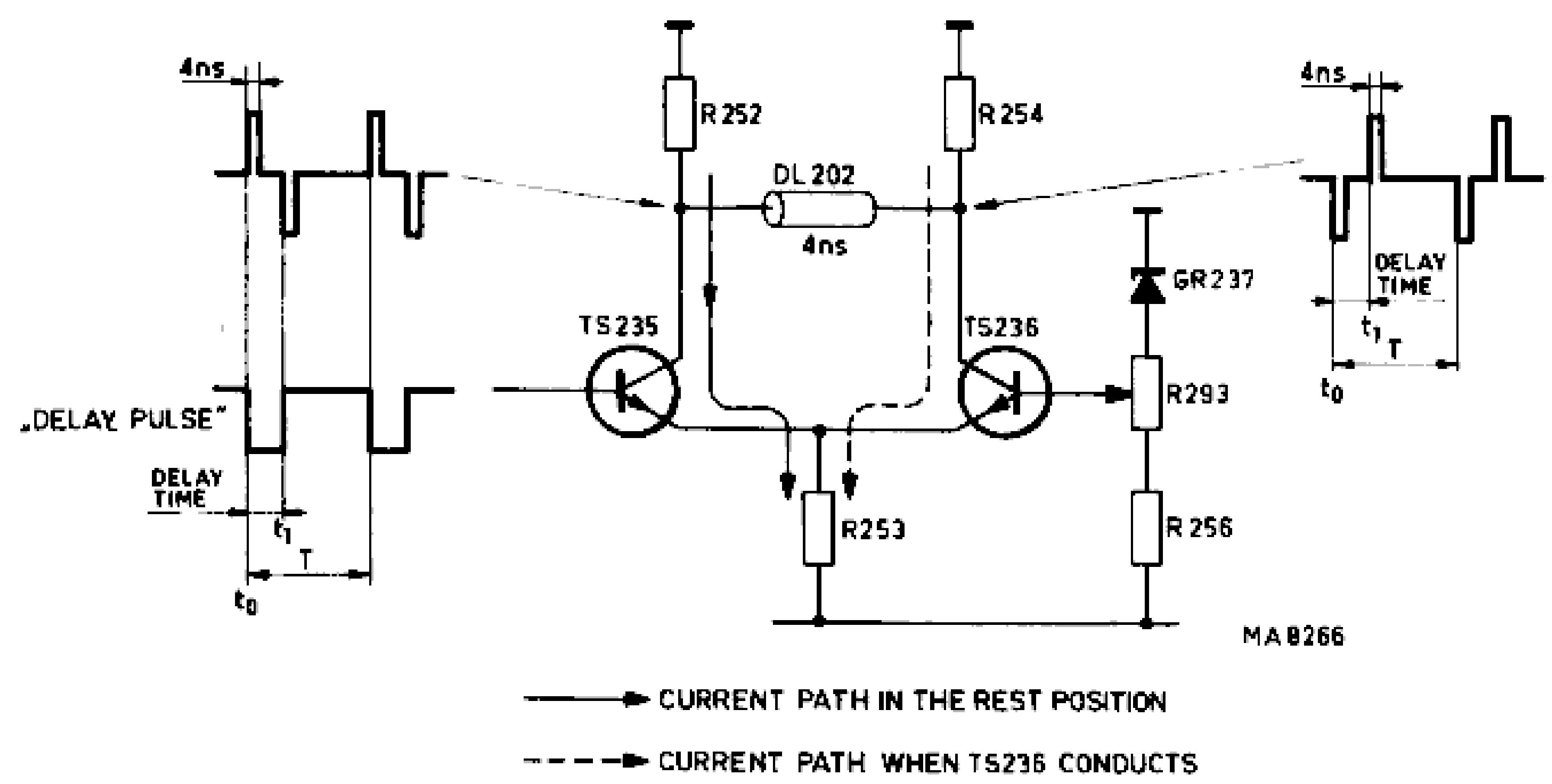


Fig. VII-3. Simplified diagram of pulse duration trigger circuit

When the negative going "delay pulse" coming from the emitter of TS234 exceeds the reference voltage level, the differential amplifier switches over.

Consequently, a positive going voltage step arises at the collector of TS235 and at the same time a negative going step at the collector of TS236 (moment t_0). The positive voltage step is transmitted through the delay line DL 202 to the right and reaches the end after a delay time of 4 ns.

The positive voltage step cancels out the negative going voltage step at the collector of TS236 so that here a negative going pulse arises with a pulse width of 4 ns.

The positive voltage step cancels out the negative going voltage step at the collector of TS236 so that here a negative going pulse arises with a pulse width of 4 ns.

In the same way the negative going voltage step at the collector of TS236 cancels out the positive going step at the collector of TS235.

This results in a positive going pulse, with a pulse width of 4 ns on the collector of TS235.

At moment t_I, the differential amplifier TS235/TS236 switches over to its initial state and the same procedure described above is repeated, however in the reverse direction.

The result is now that a negative going and positive going pulse appears at the collectors of TS235 and TS236 respectively.

The pulses are fed to differential amplifiers TS240/TS245 and TS241/TS244 via emitter followers TS238 and TS246 respectively.

When switch SK8 (PULSE MODE) is in position SINGLE, the differential amplifier TS241/TS244 is inoperative because emitter resistor R259 is connected to earth.

In the rest position, transistor TS240 is conducting and TS245 cut off.

When a positive pulse is injected into the base of TS240 and a negative pulse into the base of TS245, the differential amplifier will remain in its initial state. These pulses are present the moment t_0 as can be seen in the diagram of Fig. VII-3, thus at the begin of the pulse delay time.

When, however, at the same time a negative and a positive pulse - which are formed at the end of the delay time - are simultaneously injected into the bases of TS240 and TS245 respectively, the differential amplifier TS240/TS245 switches over and a negative pulse arises in the collector circuit of TS245.

This pulse is taken from the collector of Z243 and further fed to the pulse width circuit.

When switch SK8 (PULSE MODE) is in position DOUBLE, the differential amplifier TS241/TS244 becomes operative.

In the rest position TS241 is cut off and TS244 is conducting.

Switching over of the differential amplifier occurs when at the same time a positive and a negative pulse is injected into the bases of TS241 and TS244 respectively. As can be seen in Fig. VII-3, these pulses are present at the start of the delay time.

The resulting negative pulse is also taken from the collector of TS244.
Resuming one can say that negative trigger pulses are produced by the differential amplifiers TS240/TS245 and TS241/TS244.
With switch SK8, PULSE MODE, is position DOUBLE, two negative pulses are generated whose time interval between the negative going flanks equals the delay time which is adjustable with switch SK3 (DELAY) and fine delay control R5, DELAY.

7. Pulse duration circuit

The operation principle of the pulse duration circuit (TS250/TS251, TS255, TS252 and timing capacitors C229//C22...C28) is exactly the same as that of the pulse delay circuit.
Transistor TS242 and diodes GR248 and GR249 form the clipping circuit. The pulse duration is adjustable both in steps and continuously by means of switch SK4, DURATION, and potentiometer R296, DURATION, respectively.
The differential amplifier TS256/TS257 is controlled by the negative trigger pulses coming from the emitter of TS255.

To enable normal or inverted pulse operation one has to dispose of positive or negative pulses. By means of switch SK10, NORM INV., positive and negative pulses can be taken from the collectors of TS256 and TS257 respectively.
The selected pulses are fed to the output circuit (printed circuit board PM 5771-3).

B. OUTPUT CIRCUIT (Figs. XIII-7 and XIII-8)

The signals from the timing circuit enter the output section at terminals 301 and 302. A chain of four similar differential amplifiers provide the amplified signals to the ramp generator, that enables adjustment of the pulse rise and fall times.
Fig. VII-4 shows a simplified diagram of the ramp generator circuit.

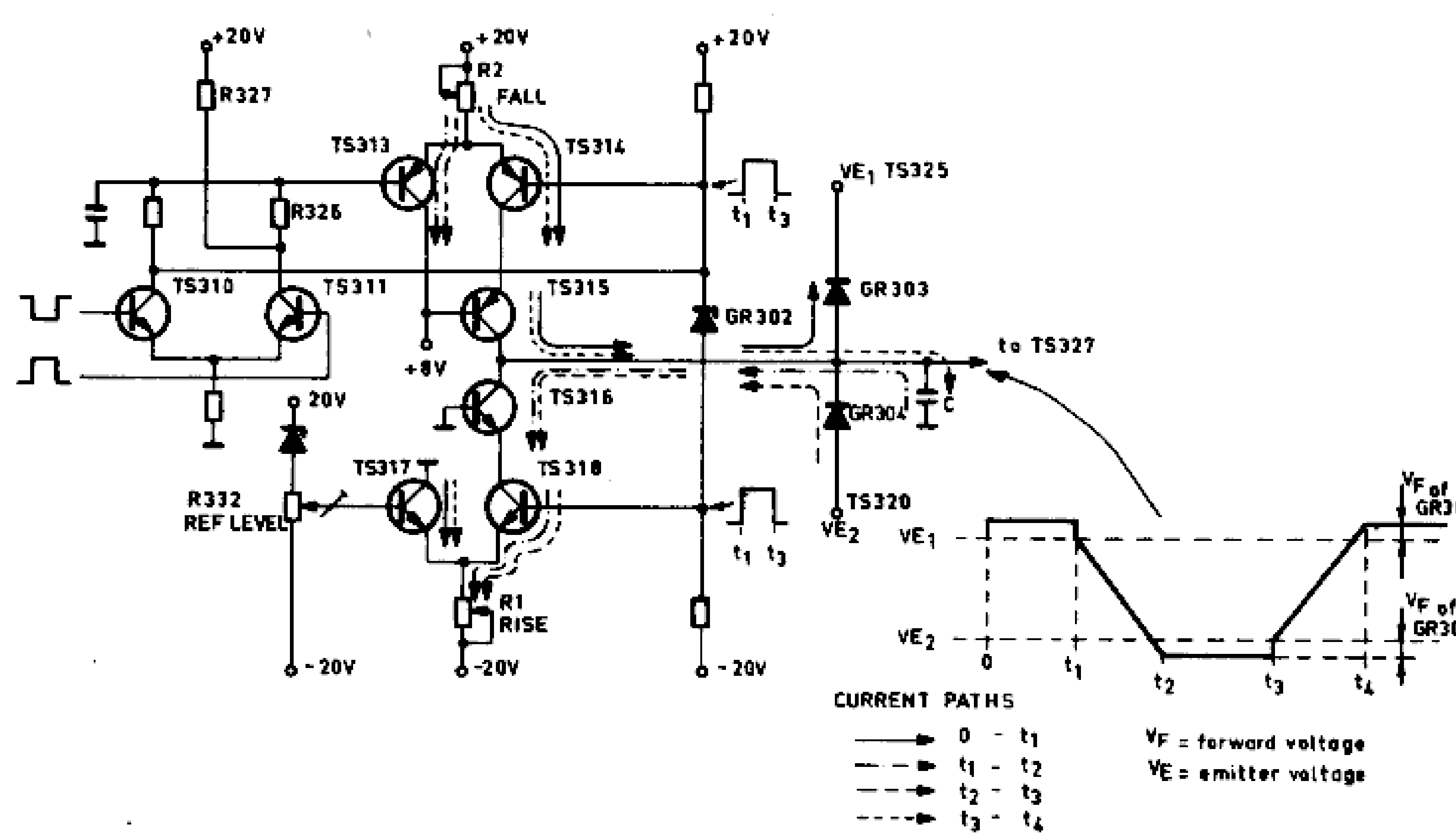


Fig. VII-4. Simplified diagram of ramp generator cricuit

The pulse fall time is set with vernier R2, FALL, that controls the current through differential amplifiers TS313, TS314.
TS313 is biased via R327, R326. The bias of TS317 is preset with R332, REF. LEVEL. The signal from the amplifier stage is fed to the base of TS314 and via zener diode GR302 to the base of TS318.

Before moment T_1, the current path is through TS314, TS315 and GR303. TS318 is cut-off because its base level is lower than that of the conducting TS317.
At moment t_1, the differential amplifiers switch over, GR303 will turn off and capacitor C is discharging through TS316 and TS318.

This capacitor represents capacitors C312, C314, and C316 plus a certain controlled stray capacitance. The discharging current and thus the slope between t_1 and t_2 is set with vernier R1, RISE.

At moment t_2, diode GR304 turns on. The current path is now diverted through this diode and TS316, TS318.

At moment t_3, the differential amplifiers switch over again, GR304 turns off and a current whose magnitude is controlled with vernier R2, FALL, is supplied through TS314, TS315, and is charging capacitor C.

At t_4, again, diode GR303 turns on and takes over the current from TS314, TS315, and a new cycle starts.

The connection of the capacitors that are charged and discharged is shown in the simplified diagram Fig. VII-5.

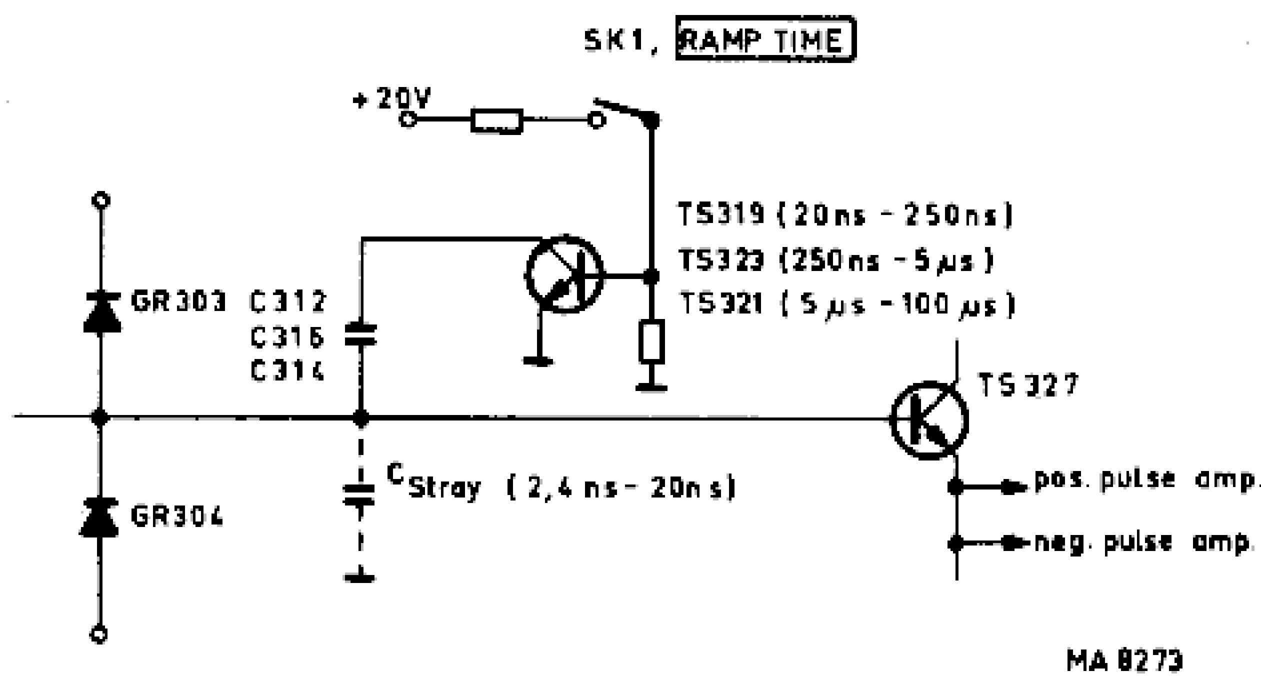


Fig. VII-5. Simplified diagram of ramp timing capacitor network

In the fastest ramp time range, 2.4 ns to 20 ns, only the stray capacitance is connected. In the next range, 20 ns to 250 ns, switch SK1 connects TS319 to the +20 V supply.
The transistor turns on and is connecting C312 in parallel with the stray capacitance. Similarly, capacitors C314 and C316 are connected via transistors TS321 and TS323 resp. when the two remaining ramp time ranges are selected.

The amplitude of the pulse at the collectors of TS315 and TS316 is determined by the forward bias of diode GR304.
This biasing voltage is provided by TS320 that is controlled by preset potentiometer R350, MAX. AMPL. ADJ, and front panel vernier R7, AMPLITUDE.

The pulse zero level is preset with potentiometer R372 controlling transistor TS325. Its emitter voltage is biasing diode GR303 which determines the pulse zero level during its conducting interval.

Temperature compensation is provided by diodes GR305 ... GR307.

The signal with set rise and fall times is fed to emitter follower TS327 and further via isolating diode GR309 to TS329 that provides the signal for the positive output amplifier.

Emitter follower TS328 supplies the signal to the negative output amplifier.

Transistors TS330 and TS331 provide the +8 V stabilized supply voltage for the ramp generator circuit.

Positive output amplifier

The signal from the emitter of TS329 is fed to a phase inverter TS333 and further to two series connected emitter followers TS338 and TS339.
Preset potentiometer R3102, ZERO LEVEL ADJ., is biasing transistor TS335, which sets the zero level of the pulse.

The output stage consists of parallel coupled emitter followers TS342 and TS343. The resistive emitter network of these transistors determines the gain. The required output power is provided by parallel coupled transistors TS347 and TS348 whose collectors are connected to the reed switches on the output line. Transistor TS352 supplies the current required for driving the output transistors.

Negative output amplifier

The zero level of the pulse is determined by clipping diode GR312 that is biased by the emitter voltage of TS332. The base voltage of this transistor is preset by potentiometer R387, ZERO LEVEL ADJ. The clipped signal is fed via emitter follower TS334 to the negative output amplifier which principally has the same configuration as the positive output amplifier.

Two parallel coupled emitter followers TS336 and TS337 feed another pair of parallel coupled emitter followers TS340 and TS341. Power transistor TS344 provides the output signal to the reed relays on the output line.

Configuration TS345, TS346, TS349, and TS350, TS351, provide temperature compensation and the driving current for the output stage.

Attenuator

The signals from the positive and negative output amplifiers are fed to reed switch RE301, INTERNAL 50 Ω. This switch connects the 50 Ohm termination R3144//R3145 to the output line at all amplitude settings except 10 V. Both RE301 and the next reed switch RE302, POLARITY SWITCH, are operated by the "+ –" switch SK9. The third reed switch, RE303, ATTENUATOR SWITCH, is controlled by the AMPLITUDE switch SK5 in the 5 V and 10 V positions.

The principal function at different polarity and amplitude settings appear from the simplified diagrams Figs. VII-6 through VII-9.

1. **SK9, "+ –", set to "–", SK5, AMPLITUDE, to 1 V** (refer to Fig. VII-6)

   The signal passes through the negative pulse amplifier to RE301, that connects the 50 Ohm termination. No current flows through the coil of RE302 and the signal goes on to RE303.
   Since this reed switch is only activated in the 5 V and 10 V positions, the signal passes a resistive network incorporated in the AMPLITUDE switch, SK5, is fed back to RE303 and further to the output connector BU3, PULSE OUT.

2. **SK9, "+ –", set to "+", SK5, AMPLITUDE, to 1 V** (refer to Fig. VII-7)

   Switch SK9 now disconnects the –20 V supply of the negative pulse amplifier that will be cut off. Moreover, no current flows through the coil of reed switch RE301 that connects the 50 Ohm termination to the output of the positive pulse amplifier.
   RE302 is activated enabling the positive pulse signal to pass on to RE303 and via the attenuator network of SK5 to the output connector, BU3.

3. **SK9, "+ –", set to "+", SK5, AMPLITUDE, to 5 V** (refer to Fig. VII-8)

   The signal path up to RE303 is now the same as in the 1 V position.
   The 50 Ohm internal termination loads via RE301 the output of the positive output amplifier.

   The main difference is that the signal passes RE303 directly to the output connector BU3, PULSE OUT, without attenuation.
   This is achieved by switch SK5, AMPLITUDE, that connects +20 V to the coil of RE303 that is activated.

4. **SK9, "+ –", set to "+", SK5, AMPLITUDE, set to 10 V** (refer to Fig. VII-9)

   The signal path is exactly the same as in the 5 V position.
   Switch SK5, however, now also connects the +20 V to RE301 that is activated and thus disconnecting the 50 Ohm termination from the output of the positive pulse amplifier. The output has then no defined impedance but acts as a current source.

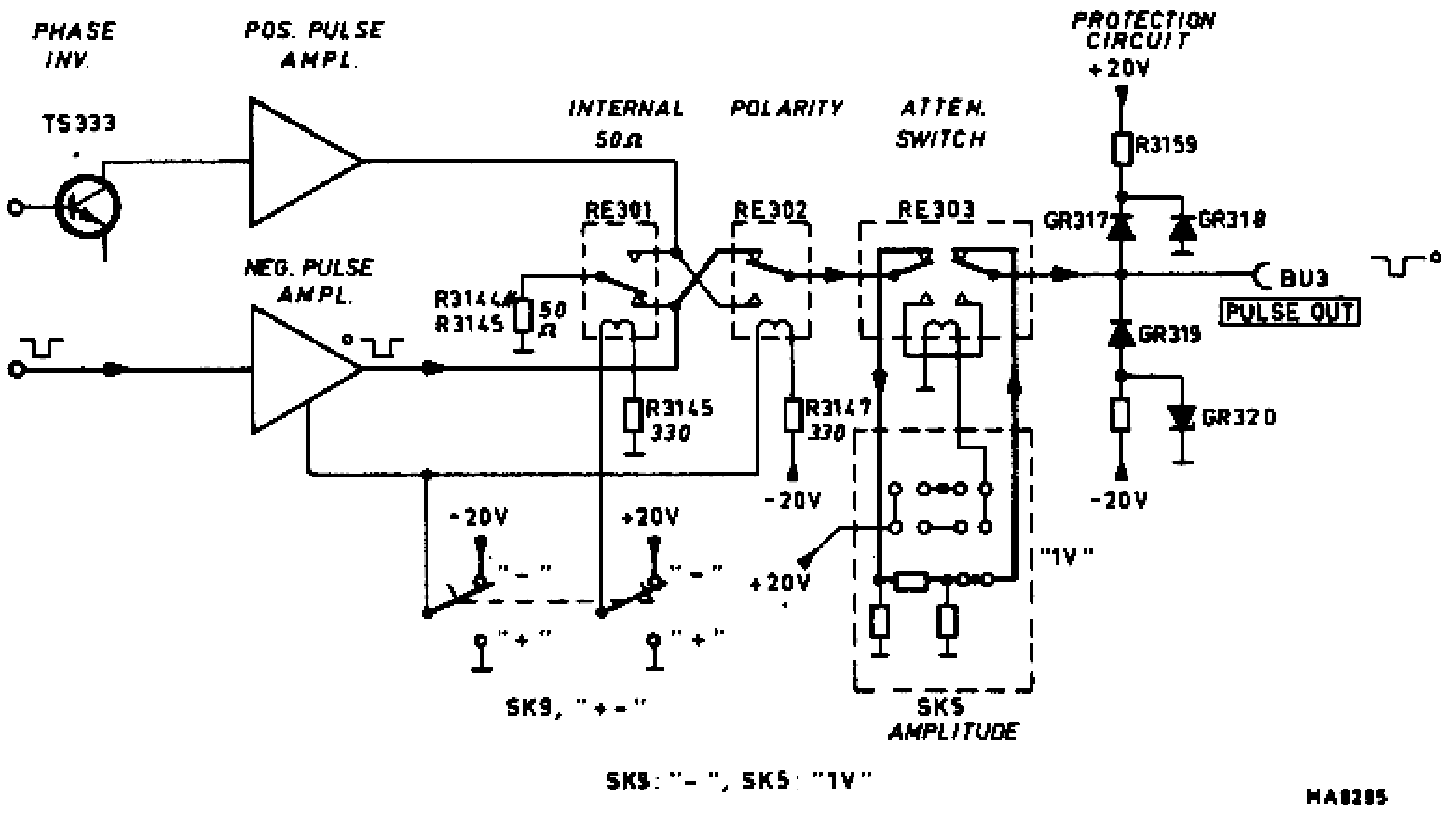


Fig. VII-6

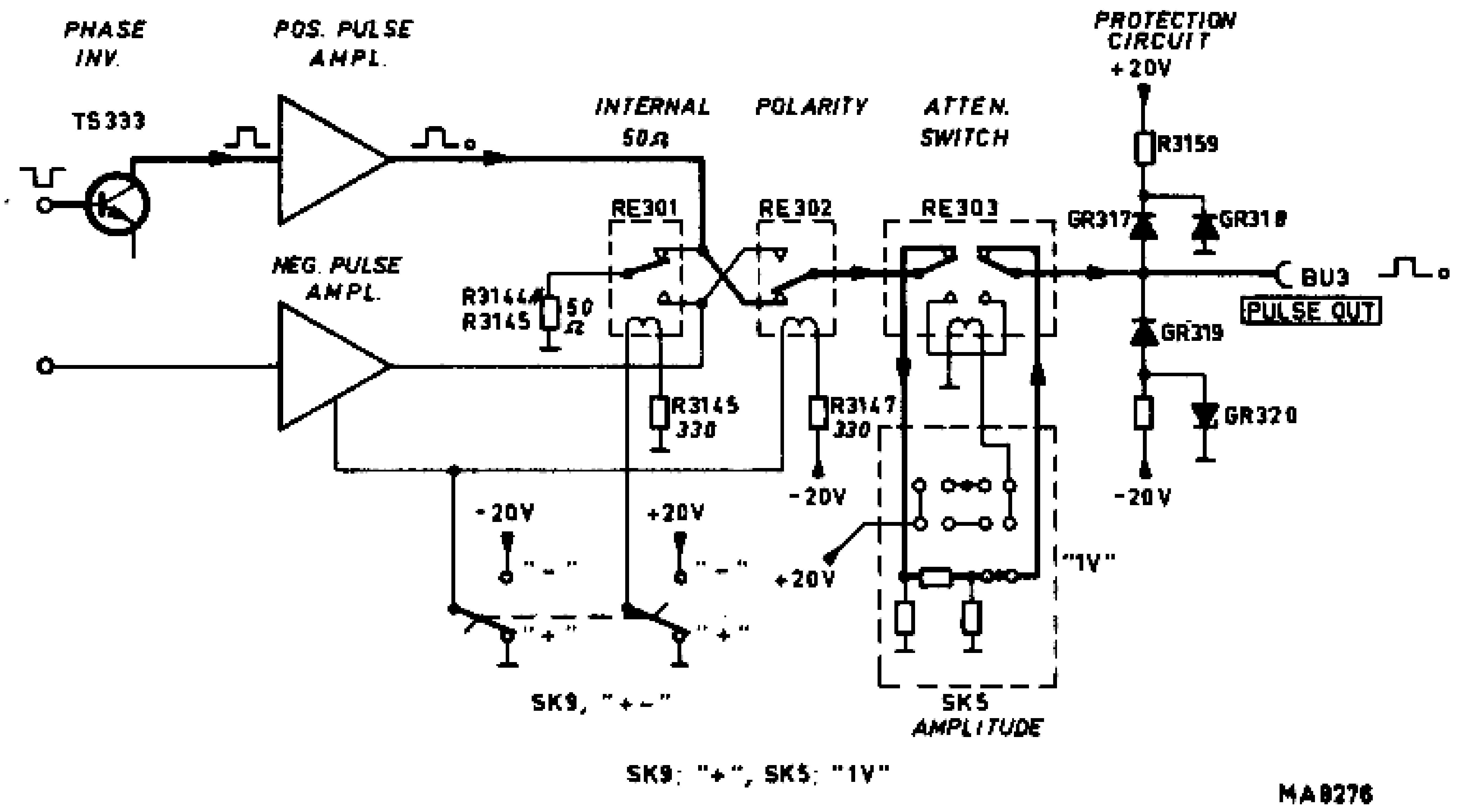


Fig. VII-7

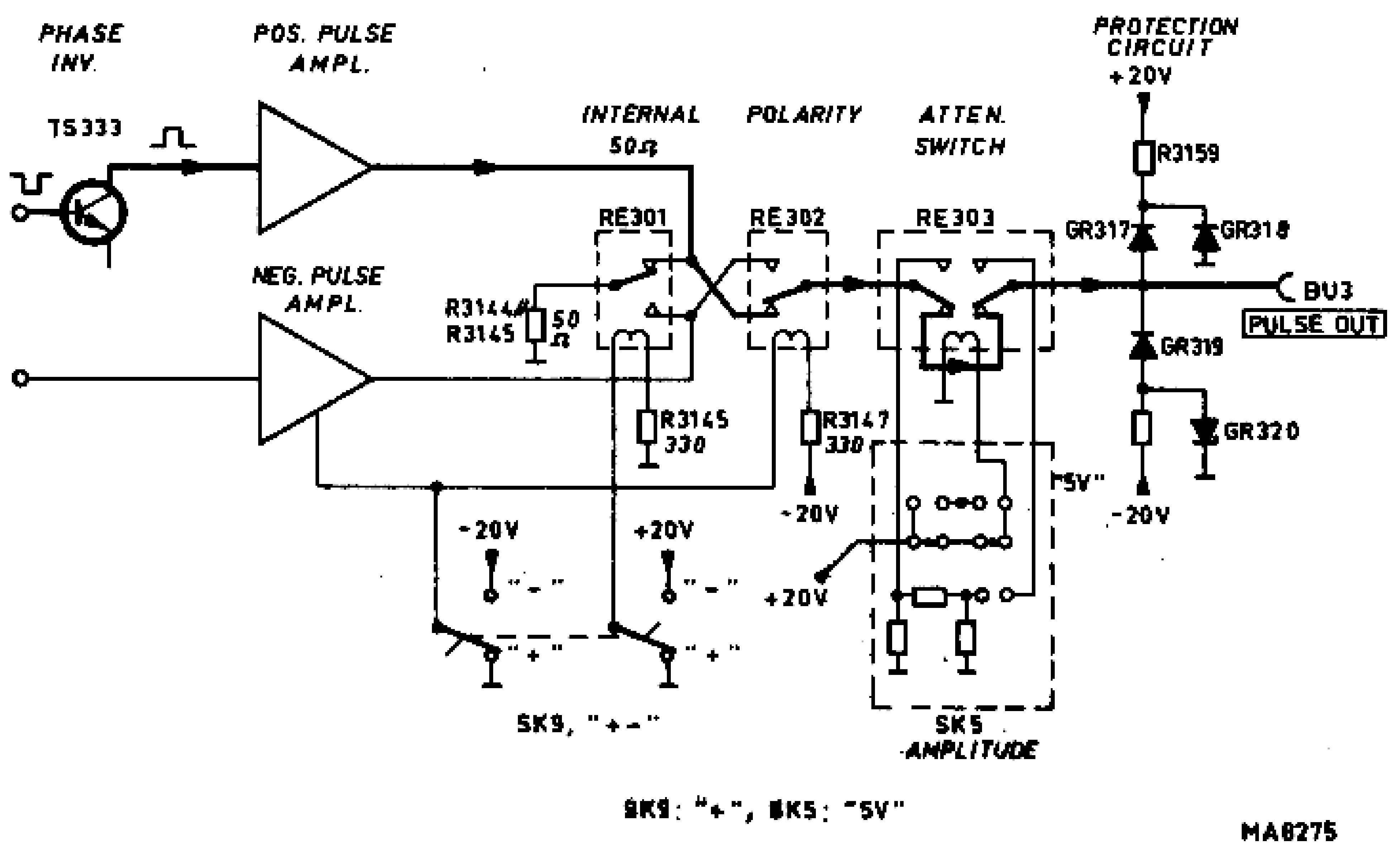


Fig. VII-8

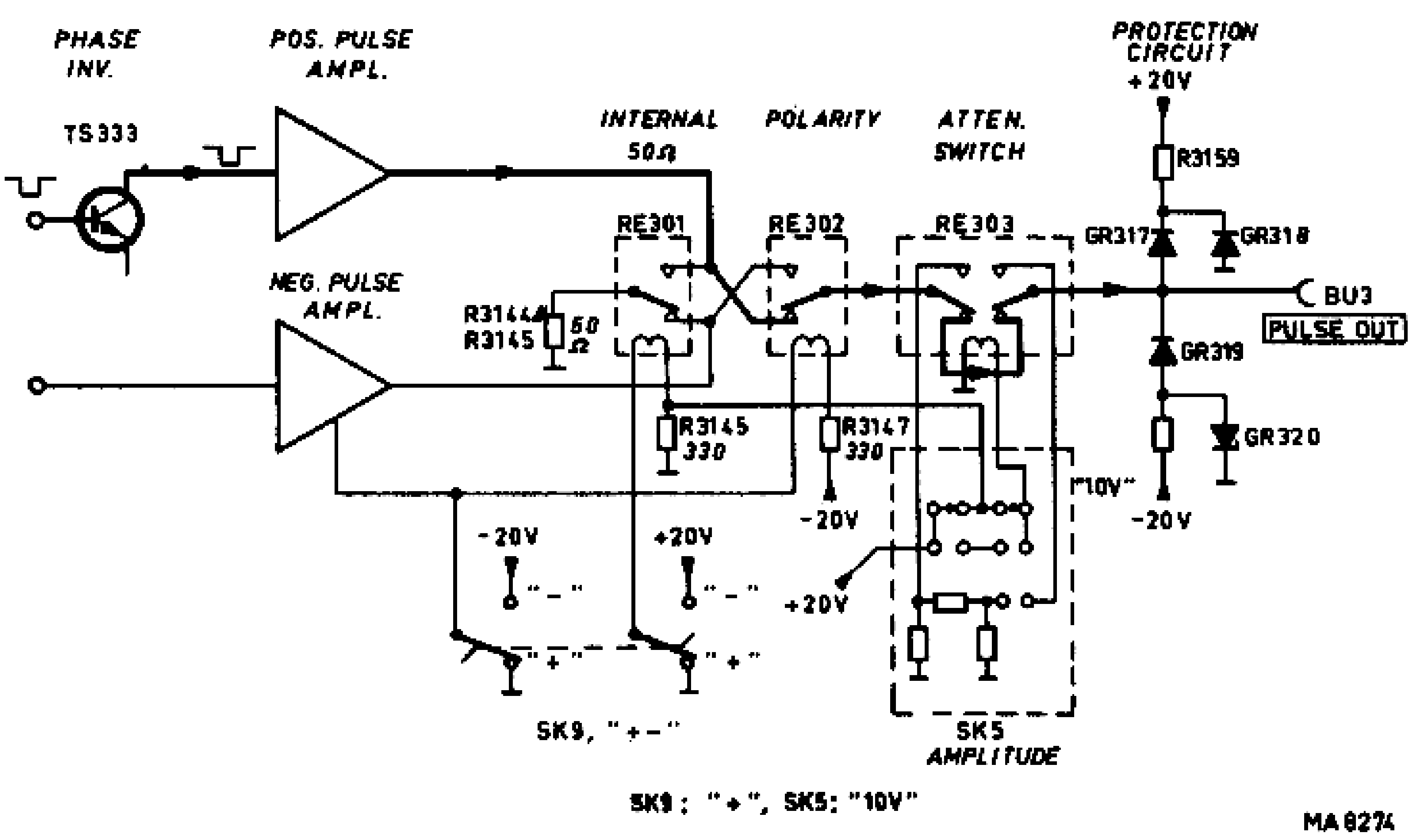


Fig. VII-9

C. POWER SUPPLY (Fig. XIII-3)

From socket BU4 the mains voltage is applied to the primary winding of mains transformer T1, via mains switch SK11 and voltage adapter SK12. The voltage adapter has two positions: 115 V and 230 V (±15 %).
The secondary winding of T1 has a centre tapping which is connected to earth, and full-wave rectification is obtained by means of diode bridge GR1. The voltages on points 6 and 3 are +32 V and –30 V respectively.
The voltage on point 6 is fed to the collector of a series regulator transistor TS1 by means of which the stabilised +20 V is obtained.
The stabilizer circuit consists of zener diode GR110, resistor R108, transistor TS109 and resistors R109, R120 and R110.
Across the zener diode a reference voltage appears which is fed to the emitter of TS109. The base of TS109 is connected to a voltage divider, and the voltage at the collector will consequently change in accordance with the change of the +20 V output voltage.
The collector of TS109 is connected to the base of driver transistor TS101. TS101 is an emitter-follower, whose emitter is connected to the base of regulator transistor TS1. In this way the +20 V output voltage is stabilised.
C101 and C105 are filter capacitors. R101 is connected in the collector circuit of TS101 in order to limit the current through the transistor in case the +20 V would be short-circuited.
The stabilising circuit for the –20 V output voltage is almost equal to the circuit described above. However, because the same type of regulator transistor (TS2) is used - i.e. NPN-type - the zener diode is connected between +20 V and –20 V.
Apart from the voltages +20 V and –20 V a voltage of +5 V is available. The +5 V is obtained from the sum of the voltage across GR119 (4.3 V) and the base-emitter voltage of TS111 (0.7 V).
If the +5 V voltage changes the base-emitter voltage of TS111 will change, and the current through TS111 will also change.
Because the collector of TS111 is connected to the base of TS112 the voltage of +5 V will be regulated to its initial value.
The regulation can only be effected within a certain limited range because part of the current through the voltage divider also flows through resistor R116 which is connected in parallel with TS112.
By this arrangement transistor TS112 is protected against overload.

VIII. Disassembling and replacing parts

A. CABINET

1. Removing the left-hand and right-hand side plates

- Loosen the screws of the handle
- Remove the handle
- Pull out the side plates in backward direction.

2. Removing the cover plate and bottom plate

- Loosen the screws at the rear
- Pull out the plates in backward direction
- When refitting the bottom plate it should be observed that the notch in the bottom plate is slipped underneath the fitting assy.

3. Removing the tilting assembly

- Move the small outermost nylon slides "A" inward (Fig. VIII-1).
- Remove the tilting assembly.

Fig. VIII-1. Tilting assembly

B. KNOBS AND PUSH-BUTTONS

1. Knobs

- Pull out cap of knob
- Loosen nut and pull off knob
- When fitting the knob, ensure that the white indications are positioned as before removal.

2. Push-buttons

- Pull out the button using a pair of pliers.

C. LAMP LA1 IN THE POWER ON SWITCH

- Turn the instrument upside down.
- Remove the transparent cap from the button by inserting a screwdriver as shown in Fig. VIII-2 and gently twisting it.
- Pull out the lamp by means of tweezers.
  The removal is facilitated if the tweezers are provided with double-adhesive tape.

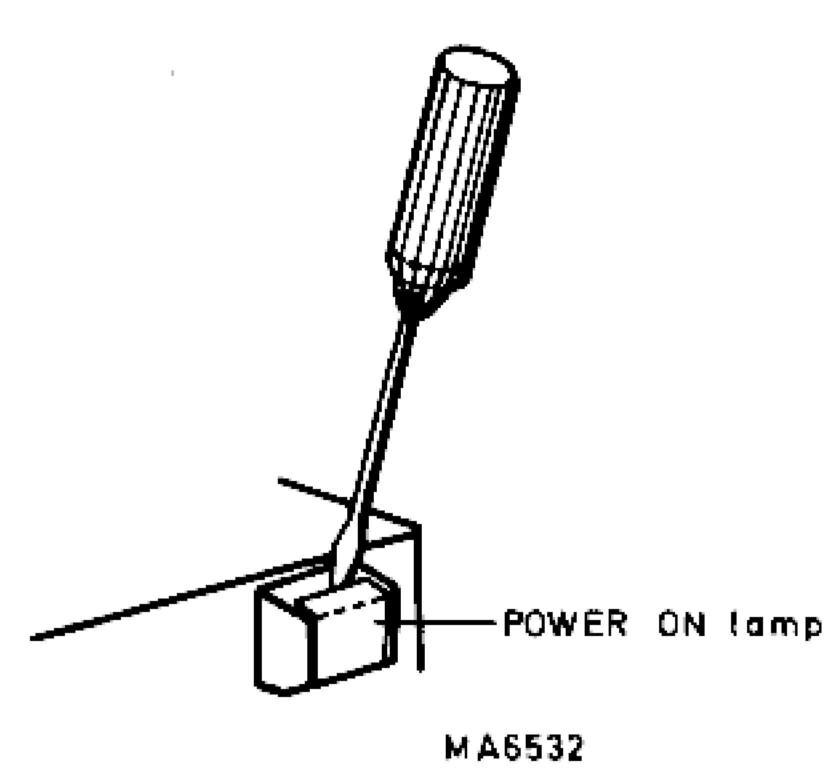


Fig. VIII-2. Removing POWER ON switch

D. CIRCUIT BOARD 3 (Fig. VIII-3)

- Remove the two coaxial cables from the connectors on the soldering side.
- Loosen the two screws "B".
- Loosen nut "A" at the output connector P3, and pull out the coaxial cable.
- Pull up the board.

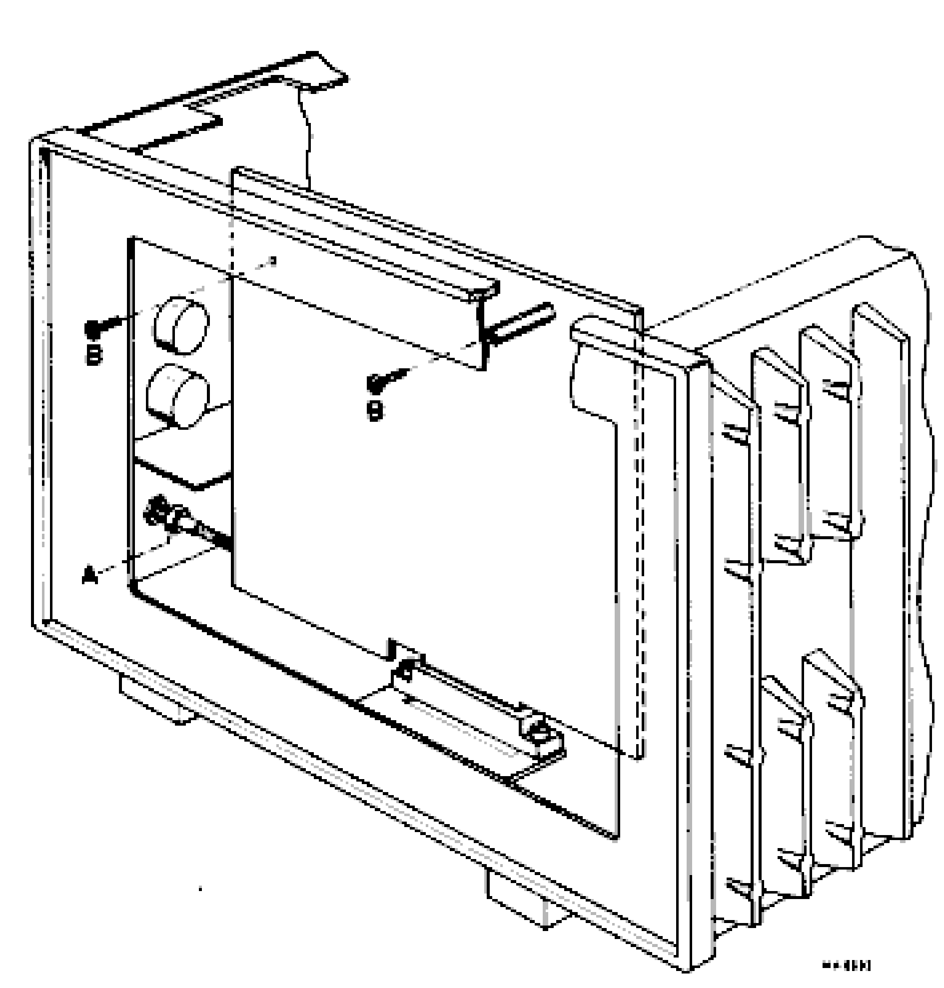


Fig. VIII-3. Removing output unit (circuit board 3)

E. TRANSISTORS TS336, 337, 339, 342 AND 343

To ensure a proper cooling of these transistors a special silicone compound (e.g. Midland Silicones Ltd. Type MS 2623, service code no. 5322 390 20019) should be applied between the transistor and the P.C. board.

Note:

The silicone compound should not be applied at soldering points or the transistor leads since this make soldering impossible.
Proceed as follows:

- Remove the faulty transistor. Clean the P.C. board with Isopropyl alcohol.
- Apply a thin coating of the silicone compound of the transistor bottom of the new transistor. Do not overclose!
- Mount the transistor tight to the P.C. board.
- Ensure that the soldering is proper by bending the transistor slightly from side to side.

F. REED RELAYS RE301, 302 AND 303

To remove RE301 and RE302 proceed as follows:

- Remove transistors TS247 and TS248 from their sockets.
- Remove the heat sink by loosening a screw accessible from the soldering side of the board.
- Unsolder the relay.
- After replacement of relay RE303 make sure that the two earth pins are soldered properly to the board.

G. CERAMIC CHIP CAPACITORS (e.g. C305, 306 and others)

These ceramic chip capacitors are silver end terminated.
Using ordinary 60/40 Sn/Pb solder may cause leaching of the silver into the solder resulting in loss of bond strength. Therefore, a silver bearing solder should be used, e.g. 62 % tin, 36 % lead and 2 % silver (service code no.: 5322 390 84001, melting point 180 °C).

The following points should be noted when replacing a chip capacitor:

- The silver end terminations may leach into the solder if they are immersed in molten solder for too long a period of time. Remember that soldering iron temperatures are often well above the melting point of the solder.
- Corners and edges may be chipped if capacitors are roughly handled with metal tweezers. To avoid chipping, use plastic tweezers.

H. ATTENUATOR (Fig. XII-7)

- Remove knobs R7, SK5 and printed wiring board PM 5771-3 (refer to section D).
- Unsolder 4 cable connections, remove 2 fast-on and 2 coaxial connectors.
- Remove nut fixing attenuator to the front panel and take out the complete unit.
- Loosen 2 screws Ⓐ and remove the bottom plate.
- Remove 2 screws Ⓑ and pull out index mechanism with rotor.
- Pull out printed wiring board with cables if to be replaced.
- Pull out slide contacts if to be replaced
- Remove pin Ⓒ and pull rotor off the shaft. Now the rotor can be replaced.
- Assemble the attenuator in reverse order.

IX. Performance check

A. INTRODUCTION

These instructions are intended for checking the electrical performance of the PM 5771. Refer to chapter X for calibration instructions.

B. EQUIPMENT REQUIRED

Instruments or device	*Specification*	*Suggested type*
Counter/timer	0 - 110 MHz resolution 10 ns - 1 s	PHILIPS PM 6630A, E
Oscilloscope	Bandwidth 50 MHz	PHILIPS PM 3250
Sampling oscilloscope	bandwidth > 1 GHz	PHILIPS PM 3400
Attenuators (2 required)	20 dB, 1 W	Texscan FP50 BNC
Coaxial cable set	50 Ω	PHILIPS PM 9588

C. CHECK SYNC. OUT PULSE

1. Check – Amplitude
– Pulse shape
– Repetition time

– Test set-up is shown in Fig. IX-1.

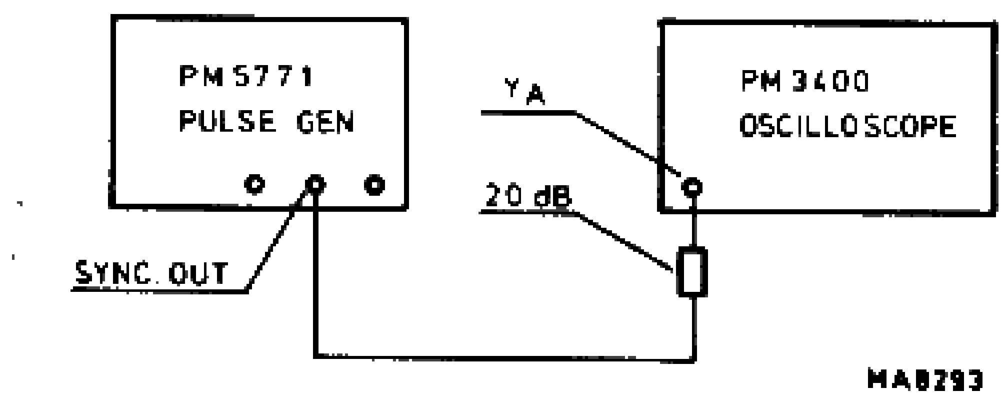


Fig. IX-1. Test set-up for checking SYNC OUT

– Refer to Fig. IX-2 and check

Amplitude	+1.5 V
Pulse shape	Square-wave
Repetition time	10 ns

– Turn repetition time VERNIER clockwise and check that duty factor remains 50 %.

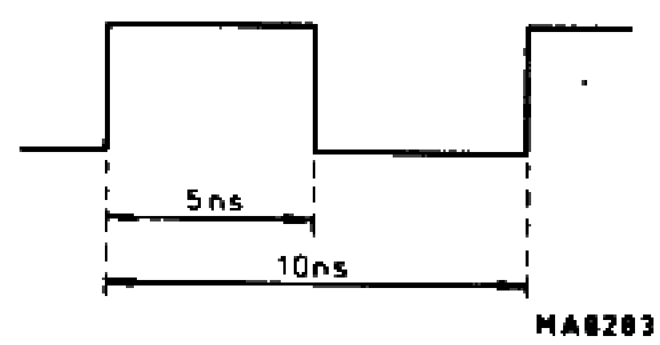


Fig. IX-2. SYNC OUT pulse

2. Check Pulse delay

– Test set-up is shown in Fig. IX-3.

– Set the PM 5771 controls:

REPETITION TIME	SK2	150 ns
DELAY	SK3	5 ns
DELAY VERNIER	R4	c.c.w.
DURATION	SK4	5 ns
CONT. GATED	SK7	CONT.
SINGLE DOUBLE	SK8	SINGLE
"+ –"	SK9	"+"
NORM. INV.	SK10	NORM
AMPLITUDE	SK5, R7	1 V

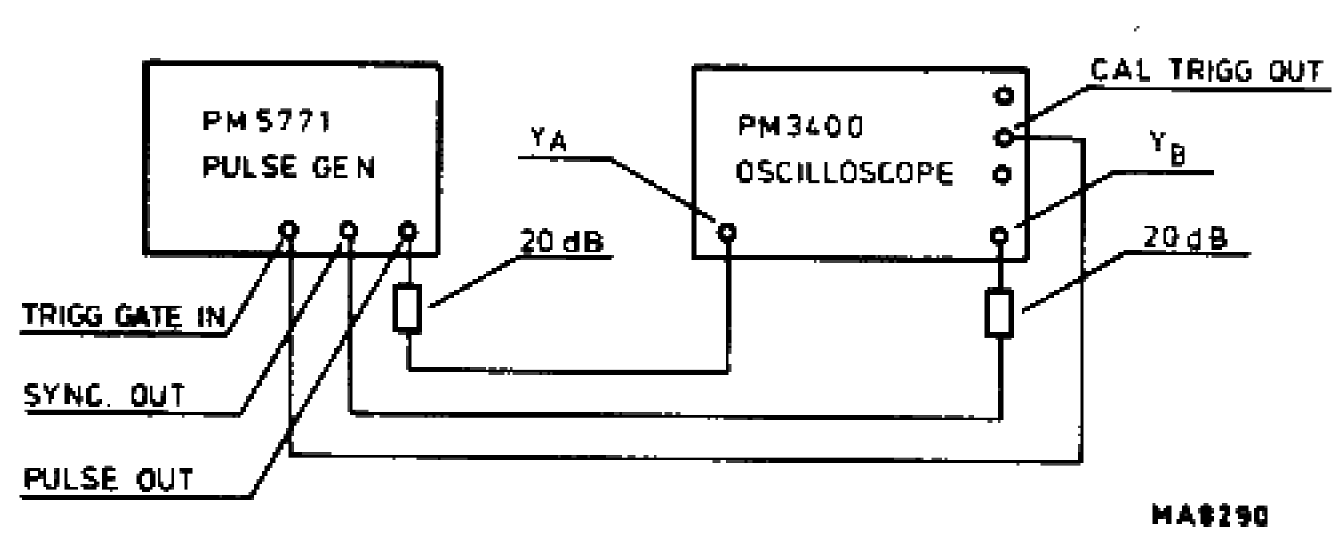


Fig. IX-3. Test set-up for checking SYNC OUT delay

– Refer to Fig. IX-4 and check:

Sync. pulse appears approximately 30 ns ahead of main pulse out.

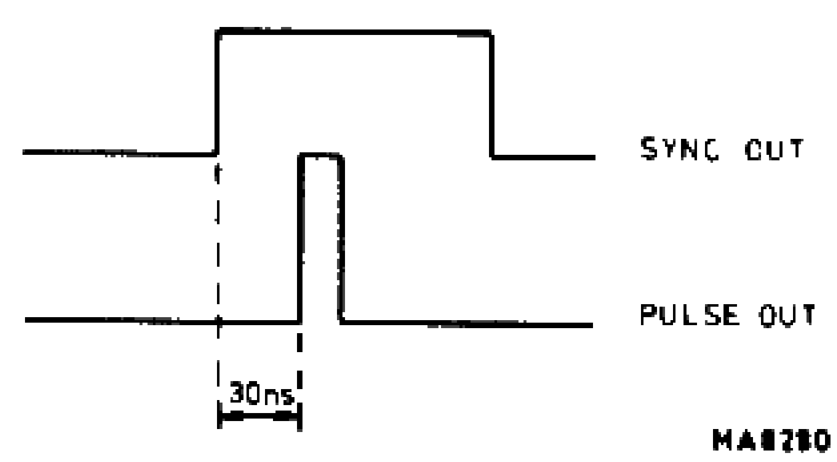


Fig. IX-4. Correct delay between SYNC OUT and PULSE OUT

3. Check 100 MHz pulse

– Test set-up is shown in Fig. IX-5.

– Change the PM 5771 control settings:
REPETITION TIME 10 ns
REPETITION TIME VERNIER c.c.w.

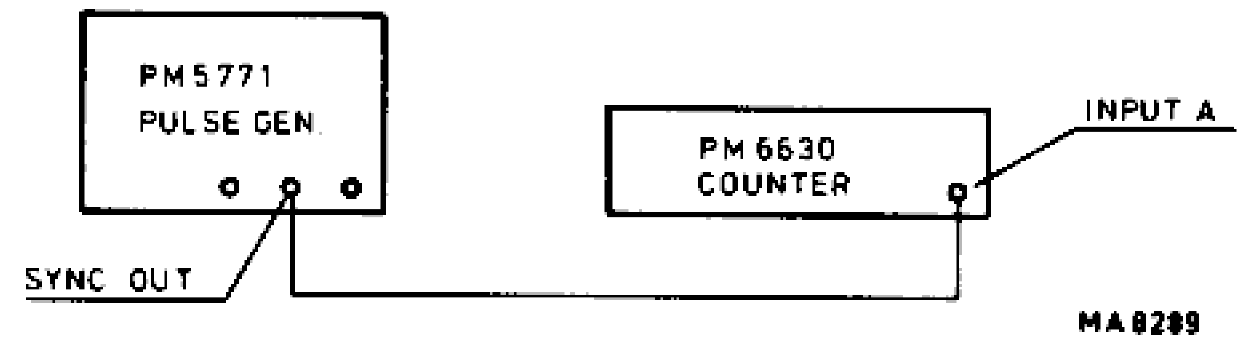


Fig. IX-5. Test set-up for checking SYNC OUT, maximum frequency

– Check that the frequency is > 100 MHz (typical 102-108 MHz).

D. CHECK REPETITION TIME

– Test set-up Fig. IX-6

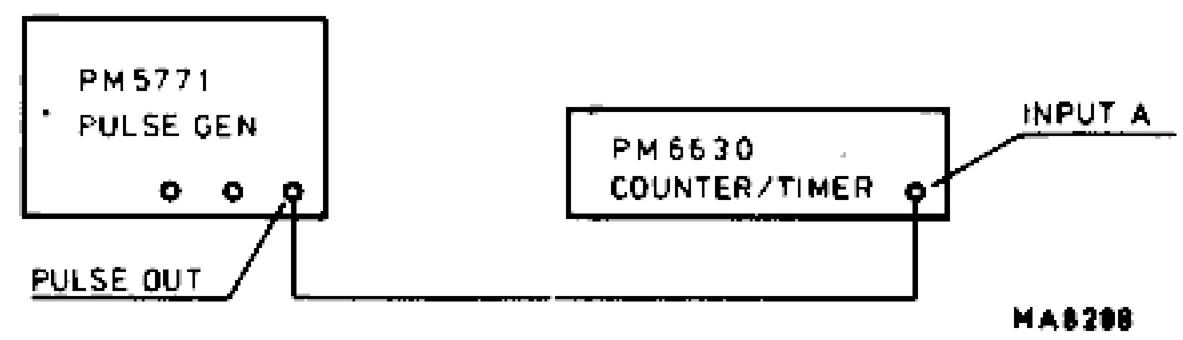


Fig. IX-6. Test set-up for checking repetition time

– Set the PM 5771 controls:

RAMP TIME	SK1	2.4 - 20 ns
RISE	R1	c.c.w.
FALL	R2	c.c.w.
REPETITION TIME	SK2	10 ns
VERNIER	R4	c.c.w.
DELAY	SK3	5 ns
VERNIER	R5	c.c.w.
DURATION	SK4	5 ns
VERNIER	R6	c.c.w.
CONT. GATED	SK7	CONT
SINGLE DOUBLE	SK8	SINGLE
"+ –"	SK9	"+"
NORM. INV	SK10	NORM
AMPLITUDE	SK5	1 V

– Check the repetition time for each set of control settings given in table:

REPETITION TIME SK2	VERNIER R4 max. c.c.w.	VERNIER R4 max. c.w.
10 ns	102 - 108 MHz	< 40 MHz
30 ns	33 - 40 MHz	> 15 ns
150 ns	100 - 150 ns	> 0.98 μs
1 μs	0.82 - 0.98 μs	> 9.2 μs
10 μs	8.8 - 9.2 μs	> 100 μs
100 μs	80 - 100 μs	> 1.0 ms
1 ms	0.8 - 1.0 ms	> 10.0 ms
10 ms	8 - 10.0 ms	> 100 ms
100 ms	80 - 100 ms	> 1 s

E. CHECK DELAY

– Test set-up Fig. IX-7

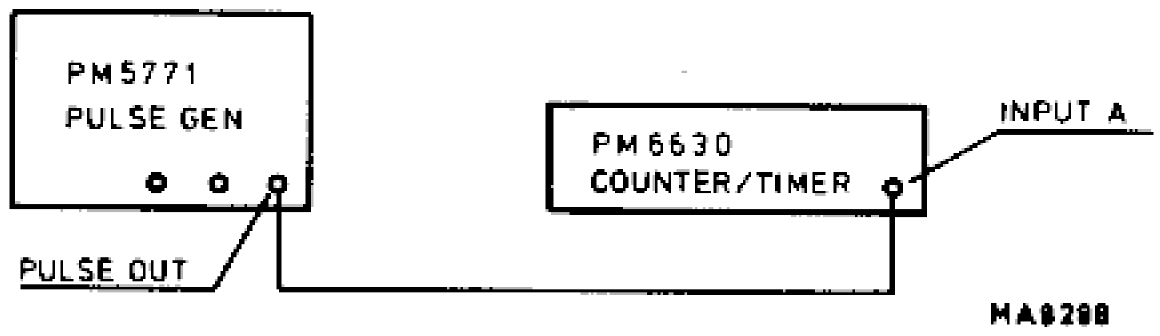


Fig. IX-7. Test set-up for checking delay

– Set the PM 5771 controls:

RAMP TIME	SK1	2.4 - 20 ns
REPETITION TIME	SK2	100 ms
VERNIER	R4	c.w.
DURATION	SK4	15 ns
CONT. GATED	SK7	CONT
SINGLE DOUBLE	SK8	DOUBLE
"+ –"	SK9	"+"
NORM. INV	SK10	NORM
AMPLITUDE IN 50 Ω	SK5	1 V

– Set the TIME BASE control of the counter/timer to 10 ns.

– Check delay time for each set of control settings given in table.

DELAY SK3	VERNIER R5 max. c.c.w.	VERNIER R5 max. c.w.
100 ns	80 - 100 ns	> 0.95 μs
1 μs	0.85 - 0.95 μs	> 9.2 μs
10 μs	8.8 - 9.2 μs	> 100 μs
100 μs	80 - 100 μs	> 1.0 ms
1 ms	0.8 - 1.0 ms	> 10.0 ms
10 ms	8.0 - 10.0 ms	> 100 ms

F. CHECK DURATION

– Test set-up Fig. IX-8

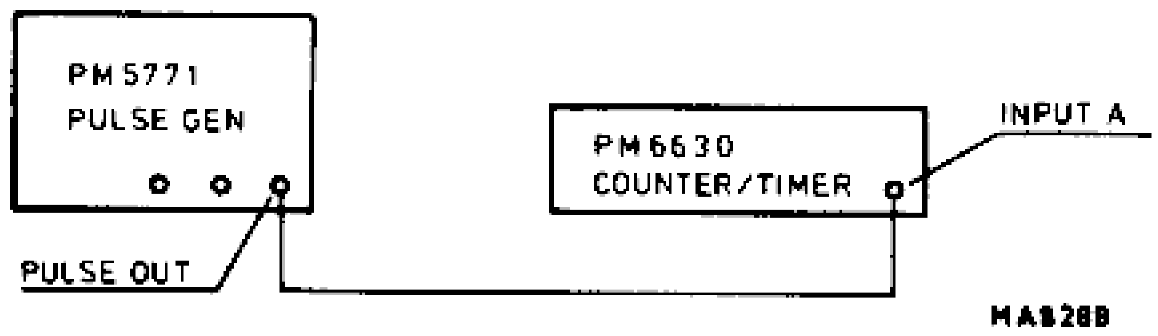


Fig. IX-8. Test set-up for checking duration

– Set the PM 5771 controls:

RAMP TIME	SK1	2.4 - 20 ns
REPETITION TIME	SK2	100 ms
VERNIER	R4	c.w.
DELAY	SK3	5 ns
CONT. GATED	SK7	CONT
SINGLE DOUBLE	SK8	SINGLE
"+ –"	SK9	"+"
NORM. INV	SK10	NORM
AMPLITUDE IN 50 Ω	SK5	1 V

– Set the TIME BASE control of the counter/timer to 10 ns, and the FUNCTION control to WIDTH.

– Check duration for each set of control settings given in table.

DURATION SK4	VERNIER R6 max. c.c.w.	VERNIER R6 max. c.w.
100 ns	80 - 100 ns	> 0.95 μs
1 μs	0.85 - 0.95 μs	> 9.2 μs
10 μs	8.8 - 9.2 μs	> 100 μs
100 μs	80 - 100 μs	> 1.0 ms
1 ms	0.8 - 1.0 ms	> 10.0 ms
10 ms	8.0 - 10.0 ms	> 100 ms

G. CHECK DC OFFSET

– Test set-up Fig. IX-9

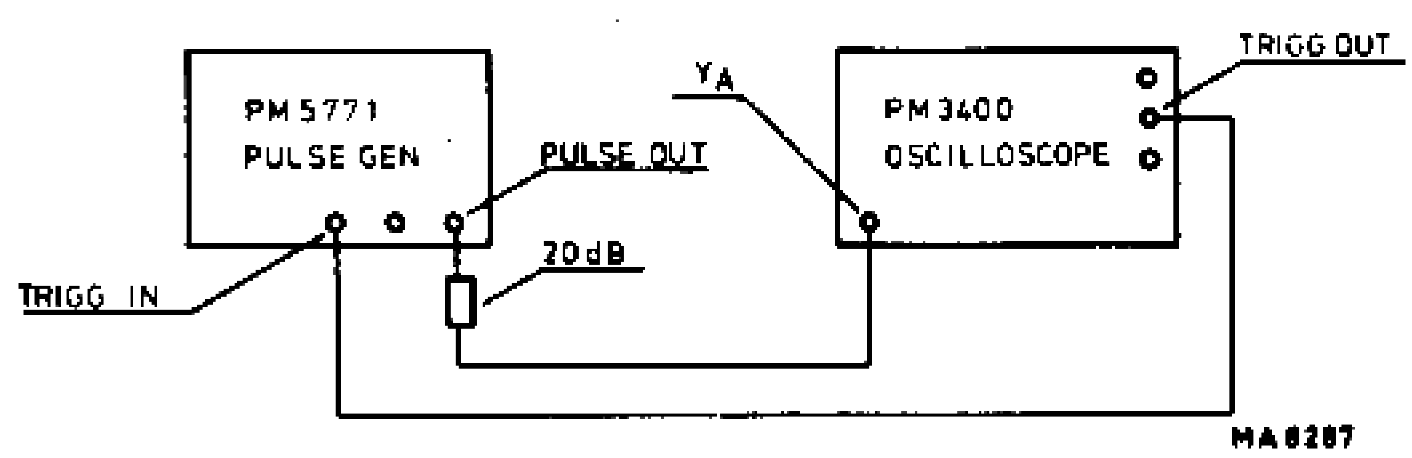


Fig. IX-9. Test set-up for checking d.c. offset

– Set the PM 5771 controls:

RISE	R1	c.c.w.
RAMP RANGE	SK1	2.4 - 20 ns
FALL	R2	c.c.w.
DC OFFSET IN 50 Ω	R3	0 V
REPETITION TIME	SK2	TRIGG OR SINGLE SHOT
DELAY	SK3	5 ns
DURATION	SK4	100 ns
AMPLITUDE IN 50 Ω	SK5, R7	5 V
"+ –"	SK4	"–"
CONT. GATED	SK7	CONT
SINGLE DOUBLE	SK8	SINGLE
NORM. INV	SK10	NORM

– Turn control DC OFFSET IN 50 Ω to max. c.c.w. and c.w. positions and check on the oscilloscope that the d.c. voltage is $\pm 2.65\ ^{+0.5\ V}_{-0.1\ V}$.

H. CHECK RISE AND FALL TIME

– Test set-up Fig. IX-10

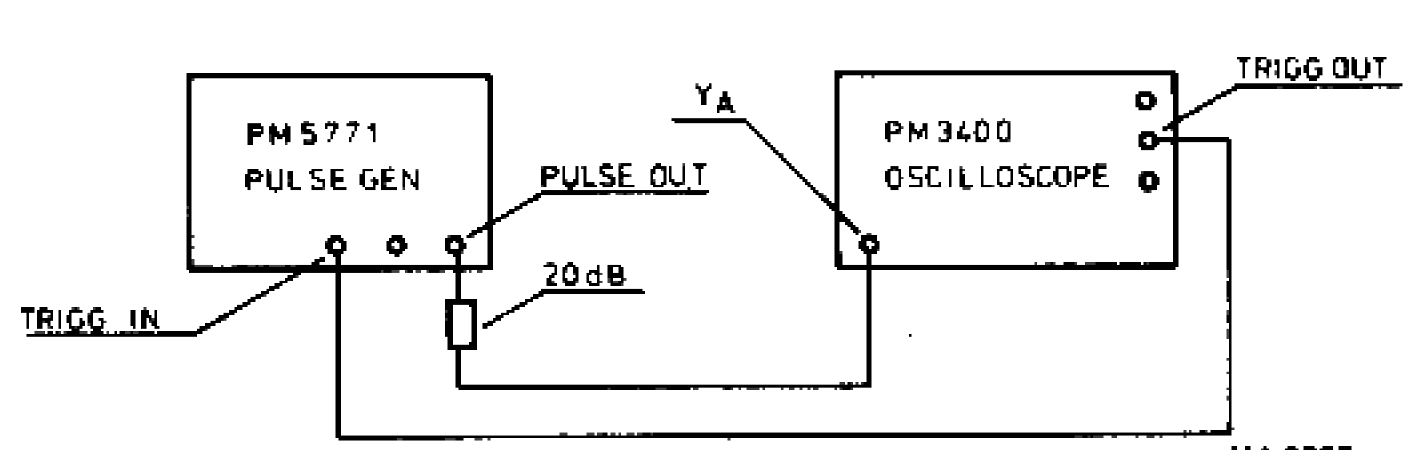


Fig. IX-10. Test set-up for checking rise and fall time

– Set the PM 5771 controls:

DC OFFSET IN 50 Ω	R3	0 V
REPETITION TIME	SK2	TRIGG/SINGLE SHOT
DELAY	SK3	5 ns
AMPLITUDE IN 50 Ω	SK5, R7	5 V
SINGLE DOUBLE	SK8	SINGLE
NORM INV	SK10	NORM
"+ –"	SK9	"+"

– Check rise and fall time at 10 % and 90 % levels for each set of control settings given in the table.

DURATION SK4	RAMP RANGE SK1	RISE R1	FALL R2	READING
150 ns	2.5 - 20	min.		⩽ 2.4 ns
150 ns	2.5 - 20	max.		> 20 ns
150 ns	2.5 - 20		min	⩽ 2.6 ns
150 ns	2.5 - 20		max.	> 20 ns
150 ns	20 - 250	min.		< 20 ns
150 ns	20 - 250		min.	< 20 ns
150 ns	2.5 - 20		max.	> 20 ns
15 μs	20 - 250	max.		> 0.25 μs
15 μs	20 - 250		max.	> 0.25 μs
15 μs	0.25 - 5		min.	< 0.25 μs
15 μs	0.25 - 5	min.		< 0.25 μs
300 μs	0.25 - 5	max.		> 5 μs
300 μs	0.25 - 5		max.	> 5 μs
300 μs	5 - 100		min.	< 5 μs
300 μs	5 - 100	min.		< 5 μs
300 μs	5 - 100	max.		> 100 μs
300 μs	5 - 100		max.	> 100 μs

– Depress push-button "+ –", SK9, and once more repeat the checking procedure.

I. CHECK PULSE DISTORTION

– Test set-up Fig. IX-11
– Set the PM 5771 controls:

RISE	R1	c.c.w.
RAMP RANGE	SK1	2.5 - 20 ns
FALL	R2	c.c.w.
REPETITION TIME	SK2	TRIGG. SINGLE SHOT
DELAY	SK3, R5	5 ns
DURATION	SK4, R6	100 ns
AMPLITUDE IN 50 Ω	SK5	5 V
SINGLE DOUBLE	SK8	SINGLE
NORM. INV	SK10	NORM

– Check preshoot, overshoot and undershoot (see Fig. IX-12) for each set of control settings given in table:

AMPLITUDE IN 50 Ω SK7	AMPLITUDE VERNIER R7	PRESHOOT UNDERSHOOT OVERSHOOT
+5 V	max. c.w.	⩽ ±5 % of
+5 V	max. c.c.w.	total amplitude

– Depress push-button "+ –", SK9, and once more repeat the checking procedure.

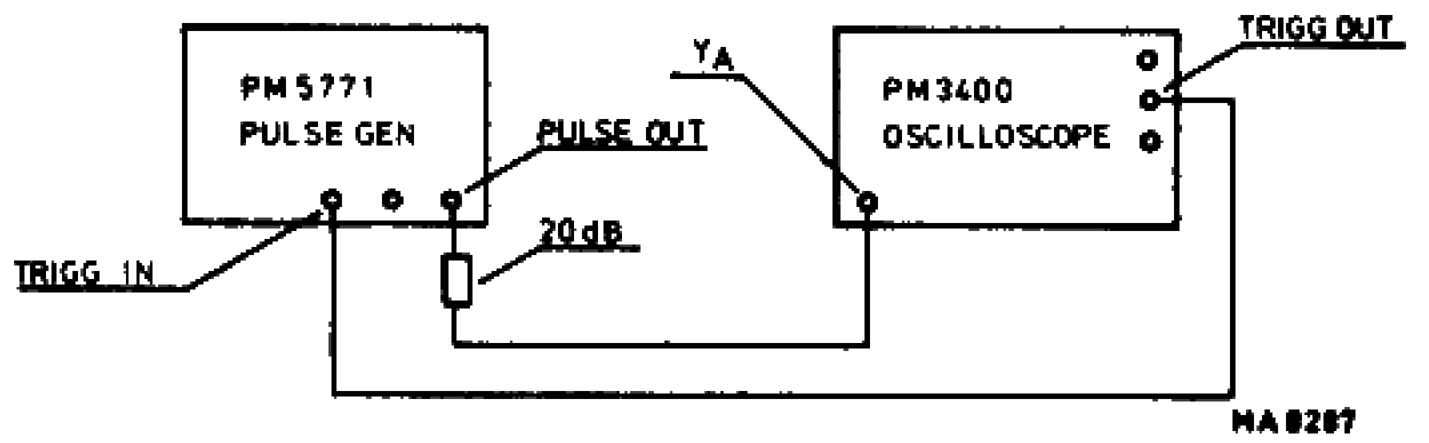


Fig. IX-11. Test set-up for checking pulse distortion

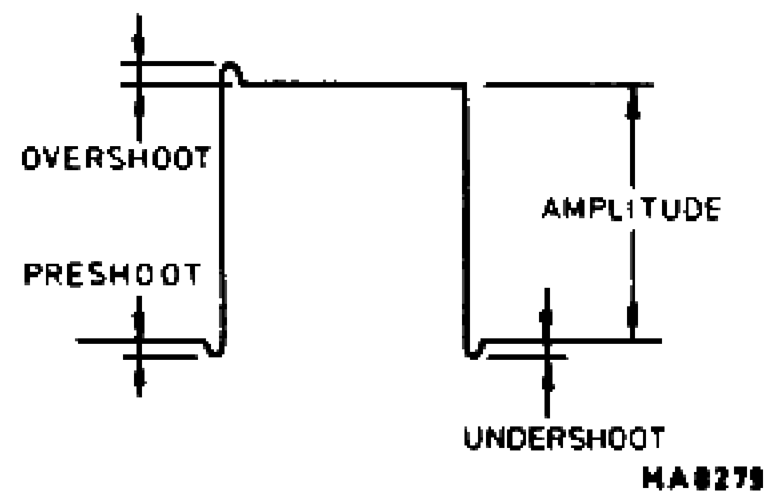


Fig. IX-12. Definition of distortion

J. CHECK PULSE SHAPE AT HIGH AND LOW FREQUENCY

1. High frequency check

– Test set-up Fig. IX-13.

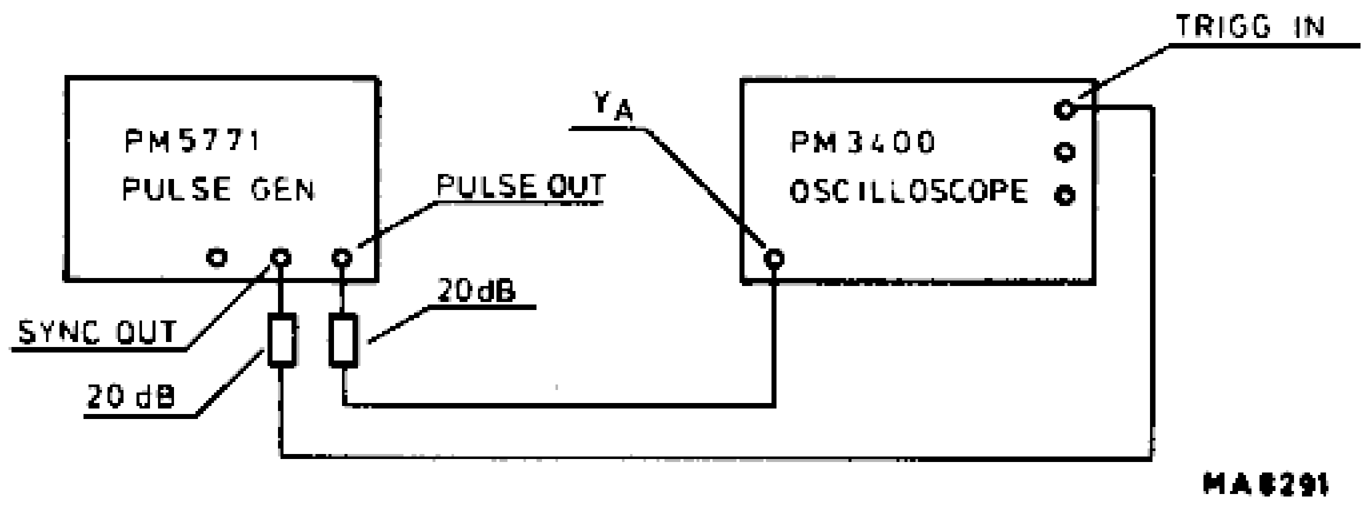


Fig. IX-13. Test set-up for checking pulse shape at high frequency

– Set the PM 5771 controls:

RISE	R1	c.c.w.
RAMP RANGE	SK1	2.5 - 20
FALL	R2	c.c.w.
REPETITION TIME	SK2	10 ns
VERNIER	R4	c.c.w.
DELAY	SK3	5 ns
VERNIER	R5	c.c.w.
DURATION	SK4	5 ns
VERNIER	R6	c.c.w.
CONT. GATED	SK7	CONT
SINGLE DOUBLE	SK8	SINGLE
NORM INV	SK10	NORM
"+ –"	SK9	"+"

– Set switch AMPLITUDE IN 50 Ω, SK5 and its vernier, R7, to position 5 V.

– Check that no ringing occurs and that edges are linear.

– Depress push-button "+ –", SK9, and repeat the checking procedure.

2. Low frequency check

– Test set-up Fig. IX-14

– Maintain the control settings of J1.

– Set REPETITION TIME, SK2, to 1 ms

– Set DURATION, SK4, to 100 ns

– Check that no ringing occurs and that edges are linear.

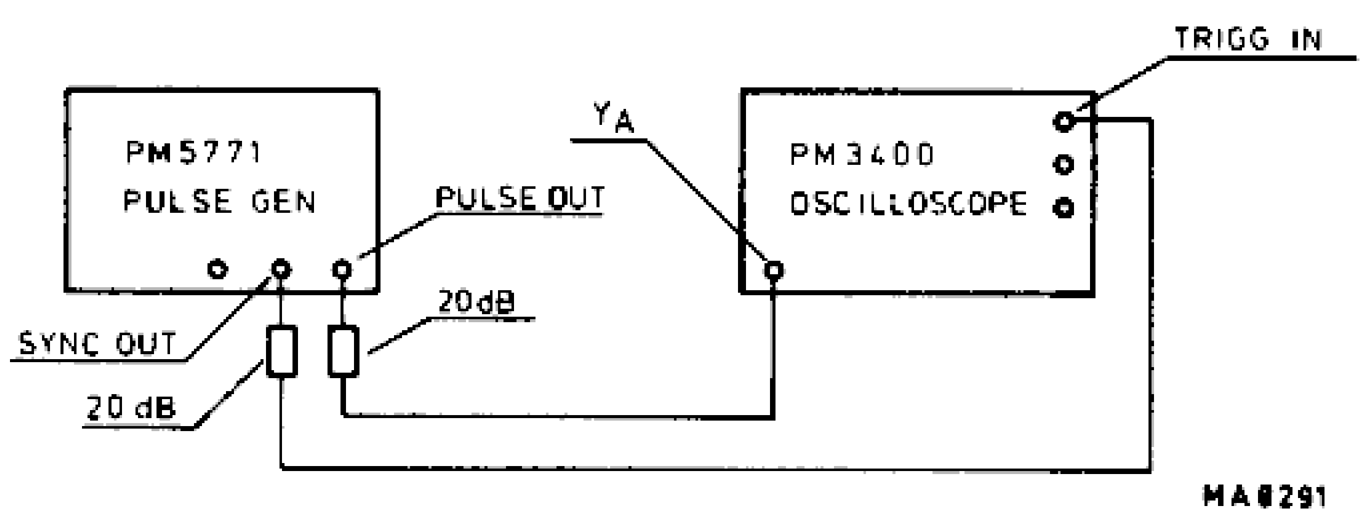


Fig. IX-14. Test set-up for checking pulse shape at low frequency

K. CHECK AMPLITUDE

– Test set-up Fig. IX-15

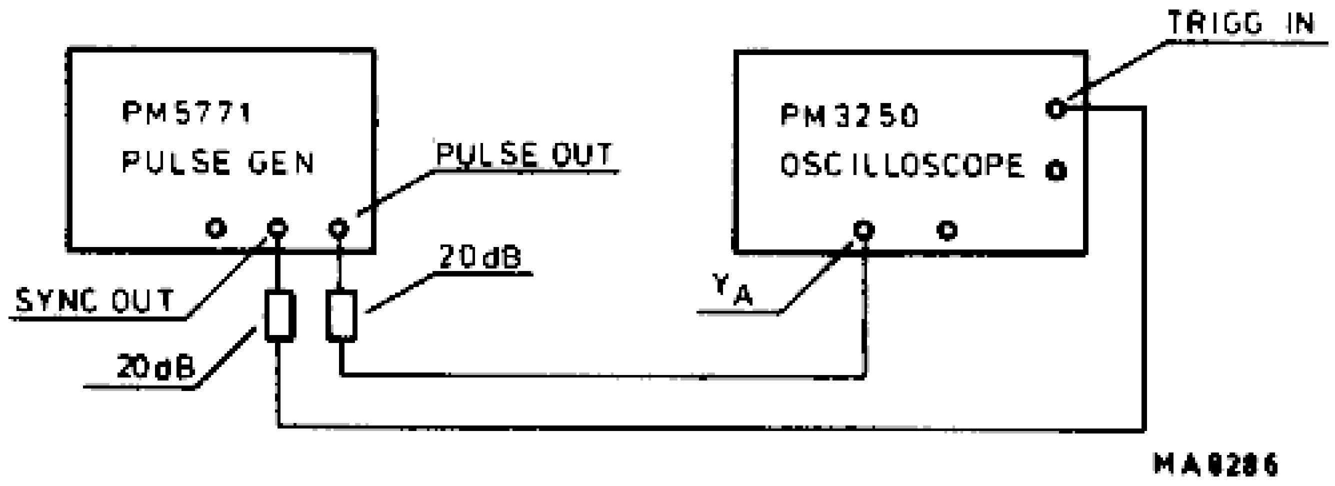


Fig. IX-15. Test set-up for checking amplitude

– Set the PM 5771 controls

RISE	R1	c.c.w.
RAMP RANGE	SK1	2.5 - 20
FALL	R2	c.c.w.
REPETITION TIME	SK2	10 ns
VERNIER	R4	c.c.w.
DELAY	SK3	5 ns
VERNIER	R5	c.c.w.
DURATION	SK4	5 ns
VERNIER	R6	c.c.w.
CONT. GATED	SK7	CONT
SINGLE DOUBLE	SK8	SINGLE
NORM INV	SK10	NORM
"+ –"	SK9	"+"

– Check that pulse duration and pulse spacing are equal.
If necessary, adjust with verniers.

– Set AMPLITUDE IN 50 Ω, SK5, and its vernier R7 to position 10 V.

– Check that the pulse amplitude is 8 to 10 V.

– Turn amplitude vernier R7 slowly c.c.w. and check that the relation between pulse duration and pulse spacing is maintained.

– Check that pulses are obtained and that overlap is provided at each step of the AMPLITUDE switch SK5.

L. CHECK DOUBLE PULSE MODE

– Test set-up Fig. IX-16

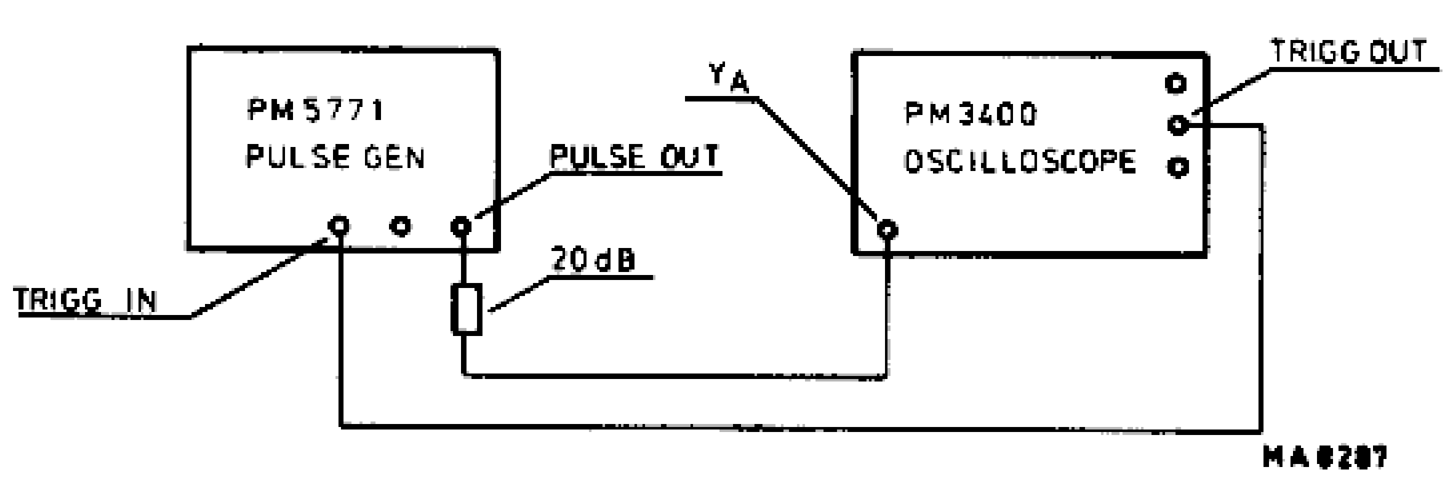


Fig. IX-16. Test set-up for checking double pulse mode

– Set the PM 5771 controls:

REPETITION TIME	SK2	TRIGG./SINGLE SHOT
DELAY	SK3	5 ns
DURATION	SK4	5 ns
VERNIER	R6	c.c.w.
AMPLITUDE IN 50 Ω	SK5	5 V
VERNIER	R7	c.c.w.
"+ –"	SK9	"+"
NORM. INV	SK10	NORM

– Shift the pulse on the oscilloscope 5 ns by means of DELAY VERNIER R5.

– Depress push-button SINGLE /DOUBLE to position DOUBLE.

– Check that the time difference between the pulses is 10 ns (refer to Fig. IX-17).

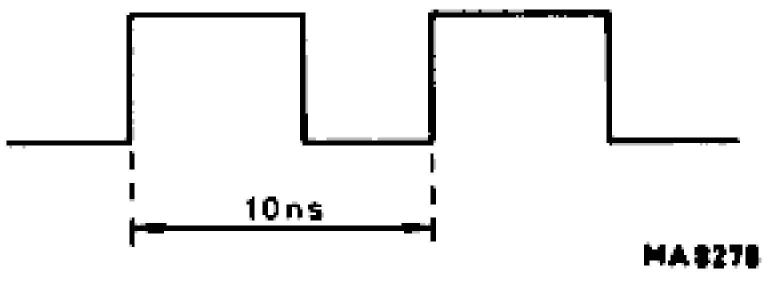


Fig. IX-17. Double pulse diagram

M. CHECK SINGLE SHOT MODE

– Test set-up Fig. IX-18

– Switch REPETITION TIME SK2 to position TRIGG. OR SINGLE SHOT

– Set the controls of the counter/timer:

FUNCTION	START
MEMORY	release button

– Depress push-button SINGLE SHOT, SK6.

– Check that only one pulse is counted.

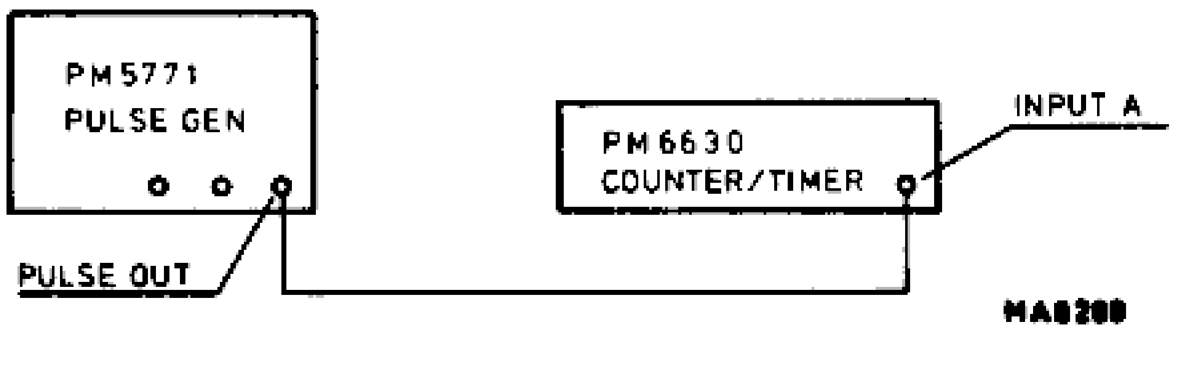


Fig. IX-18. Test set-up for checking single shot mode

X. Calibration

A. INTRODUCTION

The tolerances mentioned are factory tolerances; they apply when the instrument is readjusted completely and may differ from the data given in chapter II, Technical Data. It is recommended to perform the calibration in the sequence stated.

B. EQUIPMENT REQUIRED

Instrument	*Specification*	*Suggested type*
Digital multimeter	20 V d.c. range Accuracy ±0,1 % ±1 digit	PHILIPS PM 2421 or PM 2422
Pulse generator	> 60 MHz	PHILIPS PM 5770 or PM 5771
Counter timer	0 - 110 MHz resolution 10 μs - 1 s	PHILIPS PM 6630A, E
Sampling oscilloscope	Dual channel Bandwidth 1 GHz	PHILIPS PM 3400
LF oscilloscope	Sensitivity 2 mV	PHILIPS PM 3200
Active probe		PHILIPS PM 9345 or PM 9354
Termination	50 Ω, 1 W	PHILIPS PM 9585
Attenuator	20 dB, 1 W	Texscan FP 50 BNC outline A

C. SURVEY OF CALIBRATION POINTS

Calibrate	*Calibration element*	*Section of chapter X*
Power supply		
+20 V	R120	D
–20 V	R121	D
Output circuit		
Reference level adjustment, negative pulse	R332	E
Clipping zero level adjustment, negative pulse	R387, R372	E
Clipping level adjustment, negative pulse	R364	E
Zero level adjustment, clipping circuit	R387	E
Zero level adjustment, positive pulse	R3102	E
Max. amplitude adjustment	R350	E
Timing circuit		
Repetition time	R286, R287, R288, R289, R290	F
Delay	R291, R292, R293	F
Duration and double pulse	R294, R295, R296	F

D. POWER SUPPLY

Adjustments should be carried out after a warming up period of approx. 30 minutes.

- Check by means of a digital multimeter the +20 V and the −20 V d.c. voltages, points 10 and 13 respectively on the printed wiring board 1, at nominal mains voltage.
  Permissible tolerance ±0.1 V.
  If necessary adjust R120 and R121 respectively.
- Check that the +5 V at point 11 of printed wiring board 1 is between 4.7 and 5.4 V.
- Check by means of an LF oscilloscope that the ripple does not exceed 2 mV_{p-p} with load and the mains voltage set to 190 - 250 V.

E. OUTPUT CIRCUIT

- Required test units:
  Sampling oscilloscope PM 3400
  20 dB attenuators (2 required)
  1 active probe
- Set the PM 5771 controls:

RISE and FALL time	R1, R2	Fully c.c.w.
RAMP RANGE	SK1	2.4 - 20 ns
DC OFFSET IN 50 Ω	R3	0 V
REPETITION TIME	SK2, R4	30 μs
DELAY	SK3, R5	5 ns
DURATION	SK4, R6	100 ns
AMPLITUDE IN 50 Ω	SK5, R7	5 V
"+ −"	SK9	"−"
CONT GATED	SK7	CONT
SINGLE DOUBLE	SK8	SINGLE
NORM INVERTED	SK10	NORM

1. Reference level, negative pulse

- Connect the sampling oscilloscope to the anode of diode GR302 on printed wiring board 3 via an active probe.
- Position the pulse to the middle of the screen using the oscilloscope controls.
- Connect the oscilloscope to the slider contact of R332.
- Set d.c. level with R332 until it coinsides with centre line of oscilloscope graticule. (refer to Fig. X-1).

2. Clipping zero level, negative pulse

- Set R387 until pulse is not clipped.
- Turn control RISE from fully c.c.w. to fully c.w.
- Refer to Fig. X-2 and check td_1 is 5 to 10 ns.
- If necessary, adjust R372.

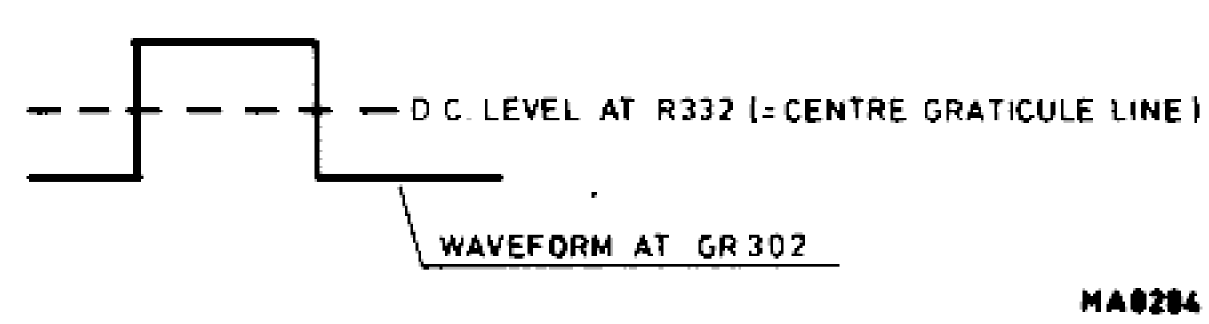


Fig. X-1. Reference level, negative pulse

3. Clipping level, negative pulse

- Decrease the amplitude to −2 V using switch AMPLITUDE and its vernier.
- Turn control FALL time fully c.w. and back to c.c.w. position again.
- Refer to fig. X-3 and check that td_2 is 5 to 10 ns.
- If necessary, adjust R364.

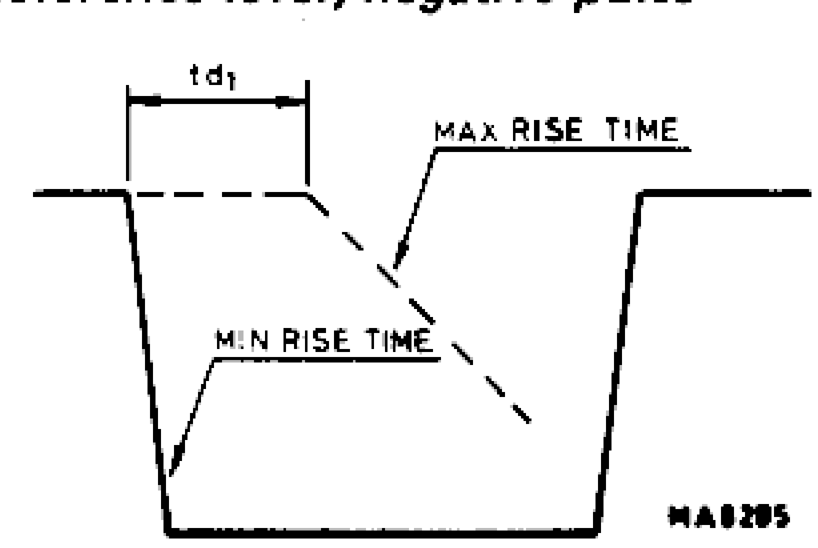


Fig. X-2. Clipping zero level, negative pulse

4. Zero level, clipping circuit

- Adjust R387 to that point, that one further slight adjustment makes the pulse top leave 0 V.

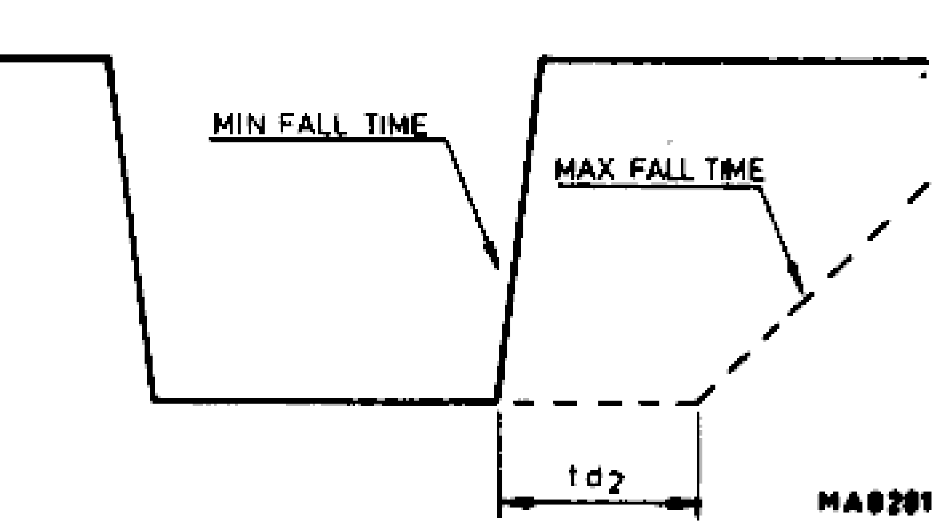


Fig. X-3. Clipping level, negative pulse

5. Zero level, positive pulse

- Set control "+ –", SK9, to position "+".
- Turn control RISE from fully c.c.w. to fully c.w.
- Refer to fig. X-4 and check that td_2 is 5 to 10 ns.
- If necessary, adjust R3102.

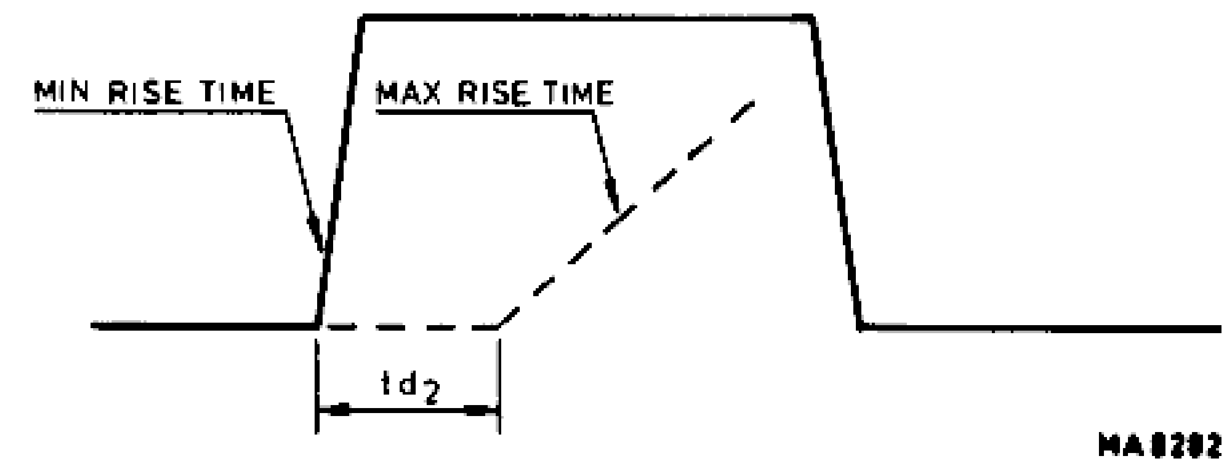


Fig. X-4. Zero level, positive pulse

6. Max. amplitude adjustment

- Connect sampling oscilloscope to PULSE OUT via 20 dB attenuator.
- Set R350 as shown in table.

Set PM 5771 controls		Set R350 to read
AMPLITUDE IN 50 Ω NORMAL/INV.	AMPLITUDE VERNIER	
–5 V, INV.	MAX	–5.2 ±0.1 V
–5 V, INV.	MIN	> –2.0 V
+5 V, NORM.	MAX	+5.2 ±0.1 V
+5 V, NORM.	MIN	< +2.0 V

F. TIMING CIRCUIT

Required test units:

Sampling oscilloscope PM 3400
Counter/timer PM 6630
Pulse generator PM 5771
20 dB attenuator
50 Ω termination

1. Repetition time

Preliminary setting of the controls

RISE and FALL time	SK1, R1, R2	2.4 ns
DC OFFSET	R3	0 V
REPETITION TIME	SK2	10 ns
REPETITION TIME VERNIER	R4	Fully c.c.w.
DELAY	SK3, R5	5 ns
DURATION	SK4, R6	5 ns
AMPLITUDE	SK5, R7	1 V
CONT. GATED	SK7	CONT
SINGLE DOUBLE	SK8	SINGLE
NORM INV	SK10	NORM
"+ –"	SK9	"+"

- Connect SYNC OUT to the oscilloscope via a 20 dB attenuator
- Set R288 until duty factor is 0.5
- Turn repetition time VERNIER fully clockwise
- Set R290 until duty factor is 0.5
- Check amplitude and pulse shape of SYNC OUT pulse (refer to chapter IX, section 3).
- Set CONT. GATED to position GATED
- Turn repetition time VERNIER fully counter-clockwise

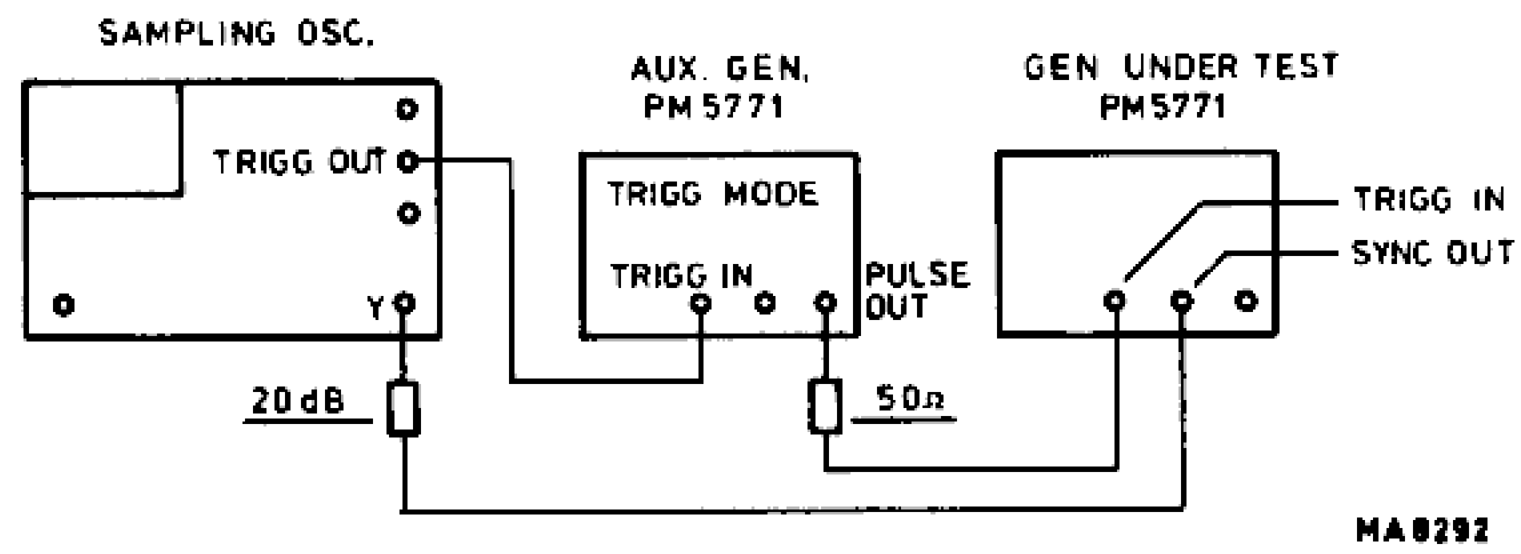


Fig. X-5. Set-up for calibration of repetition time

- Connect pulse generators and oscilloscope as shown in figure X-5
- Set auxiliary generator to repetition time 50 ns and 1.2 V.
- Set R289 until first pulse of displayed pulse train is identical to remaining pulses.
- Set auxiliary generator to 60 MHz, +1.2 V and duty factor 0.5.
- Set REPETITION TIME switch of generator under test to position TRIGG. OR SINGLE SHOT.
- Check that 60 MHz is obtained at socket SYNC. OUT.
- Remove auxiliary generator.
- Connect SYNC OUT to the counter/timer, mode PERIOD, 10 ns.

1.1. – Set REPETITION TIME to position 10 μs.
– Turn repetition time vernier fully counter-clockwise
– Check if the repetition time is 9 μs ±3 %
– If necessary adjust R287.

1.2. – Turn repetition time vernier fully clockwise.
– Check if the repetition time is 110 μs ±3 %.
– If necessary adjust R286.

1.3. Repeat point 1.1. and 1.2.

2. Delay

– Set the PM 5771 controls:

REPETITION TIME	SK2	100 ms
REPETITION TIME VERNIER	R4	fully c.w.
DELAY	SK3	10 μs
DELAY VERNIER	R5	fully c.c.w.
DURATION	SK4, R6	15 ns
CONT GATED	SK7	CONT
SINGLE DOUBLE	SK8	DOUBLE
NORM INV	SK10	NORM
"+ –"	SK9	"+"

2.1. – Set counter/timer to PERIOD, 10 ns
– Connect PULSE OUT to counter.
– If necessary adjust R292 to 9 μs ±3 %.

2.2. – Turn delay VERNIER fully clockwise.
– If necessary adjust R291 to 110 μs ±3 %.

2.3. – Repeat point 2.1. and 2.2.

3. Duration and double pulse

– Set the PM 5771 controls:

DELAY	SK3, R5	5 ns
DURATION	SK4	10 μs
DURATION VERNIER	R6	Fully c.c.w.
CONT. GATED	SK7	CONT
SINGLE DOUBLE	SK8	SINGLE

3.1. – Set counter to WIDTH, 10 ns.
– If necessary, adjust R295 to 9 μs ±3 %.

3.2. – Turn duration VERNIER fully clockwise.
– If necessary, adjust R294 to 110 μs ±3 %.

3.3. – Repeat point 3.1. and 3.2.

3.4. – Change control settings:

DELAY	SK3, R5	5 ns
REPETITION TIME	SK2	TRIGG. OR SINGLE SHOT
DURATION	SK4	5 ns
AMPLITUDE	SK5, R7	5 V
"+ –"	SK9	"–"

3.5. – Connect pulse generator to oscilloscope as shown in Fig. X-6.
– Shift the pulse 5 ns by means of delay vernier.
– Depress push-button SINGLE DOUBLE to position DOUBLE.
– Adjust R293 until the pulses are spaced 10 ns (refer to Fig. X-7).

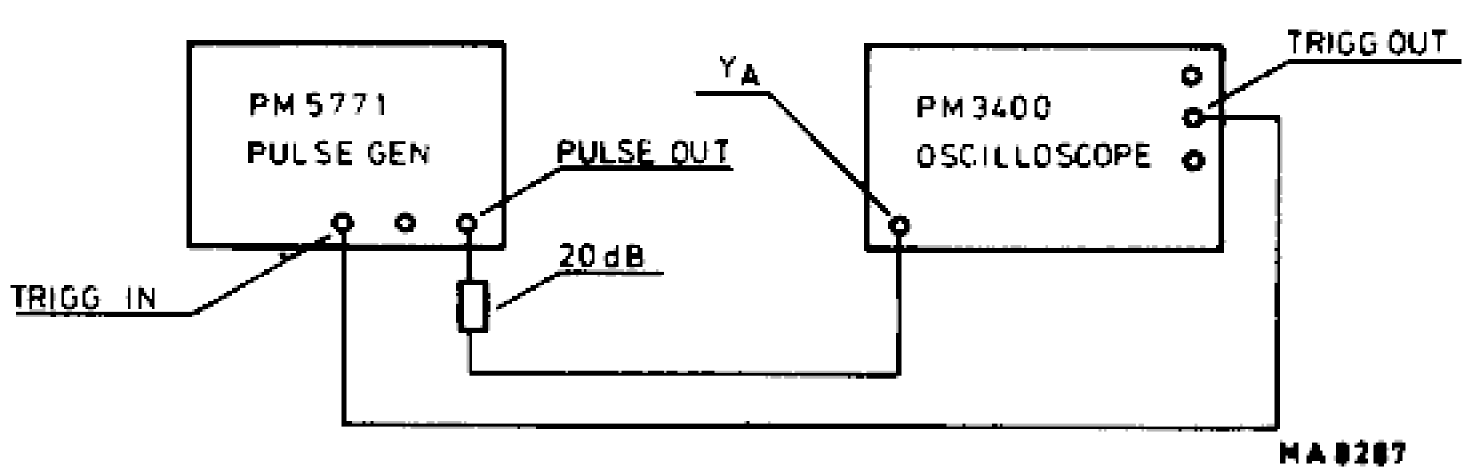


Fig. X-6. Set-up for calibration of delay time

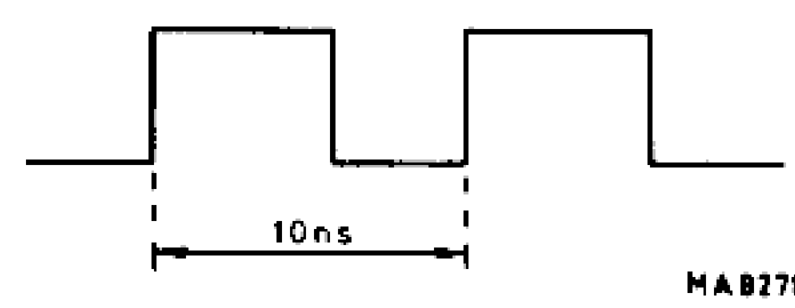


Fig. X-7. Correct delay adjustment

3.6. – Set push-button SINGLE DOUBLE to position SINGLE.
– Set DELAY to position 5 ns.
– Turn delay vernier fully counter-clockwise.
– Set DURATION and its vernier as shown in the table.
– If necessary adjust by means of R296.

DURATION	DURATION VERNIER MIN.	DURATION VERNIER MAX.
5 ns	3 - 5 ns	> 15 ns
15 ns	10 - 15 ns	> 100 ns
100 ns	80 - 100 ns	> 0.95 μs

XI. Adjustment to mains voltage ranges 85...115 V and 170...230 V

1. Unsolder wires from tags 1 and 3 of the mains transformer and solder them to tags A and B respectively (see Fig. XIII-2).

XII. Parts lists

A. MECHANICAL

Fig.	*Item*	*Qty*	*Ordering number*	*Description*
XII-1	1	2	5322 460 60014	Ornamental profile
XII-1, XII-3	2	2	5322 460 60017	Ornamental profile (6 module length)
XII-2	3	4	5322 462 40157	Rubber foot
XII-1	4	1	5322 498 50098	Handle sleeve
XII-1	5	2	5322 310 10044	Handle bracket
XII-1	6	2		Handle screw
XII-1	7	2		Washer for handle screw
XII-1	8	2		Screw for handle bar
XII-1	9	1	5322 267 14004	BNC connector KINGS KC-19-161, BU3
XII-1	10	2	5322 267 10004	BNC connector, UG 1094-U, BU1, 2
XII-2	11	1	5322 265 30066	Mains input connector, CS1
XII-2	12	1	5322 290 40012	Earth terminal
XII-1	13	1	5322 414 34079	Switch knob
XII-1	14	4	5322 414 34081	Switch knob
XII-1	15	3	5322 414 34082	Control knob
XII-1	16	4	5322 414 34083	Control knob
XII-1	17	4	5322 414 74014	Knob cover
XII-1	18	4	5322 414 74016	Knob cover
XII-1	19	1	5322 273 34028	Rotary switch, SK1
XII-4	20	1	5322 273 50092	Rotary switch, SK2
XII-4	21	2	5322 273 40207	Rotary switch, SK3, 4
XII-1	22	1	5322 276 14039	Push-button switch, SK6
XII-5	23	4	5322 276 14041	Push-button switch, SK7 ... 10
XII-5	24	1	5322 276 14024	Mains switch SK11
XII-2	25	1	5322 277 20014	Mains voltage selector
XII-2	26	2	5322 255 40091	Protection cap for power transistors
–	27	4	5322 255 40072	Mica washer (PHILIPS 56201D) + bushing (PHILIPS 56201C) for transistors TS1-TS2
–	28	2	5322 255 40085	Transistor holder for TS1, TS2
–	29	54	5322 255 40089	Transistor holder T018
–	30	12	5322 255 40038	Transistor holder T05
–	31	1	5322 255 40053	Transistor cooler T018
XII-6	32	5	5322 255 40054	Transistor cooler T05
XII-3	33	2	5322 462 70366	Slide piece
XII-3	34	2	5322 520 10182	Bracket pivot
XII-1	35	1	5322 455 74017	Text plate
XIII-6	36	3	5322 267 14011	Coaxial connector (301...303, mounted on soldering side)
XIII-6	37	1	5322 267 14003	Coaxial connector (304, mounted on the soldering side)
XII-6	38	1	5322 267 50096	Printed wiring board connector, 10 pole (BU7)
XII-7	39	1	5322 278 74004	Index mechanism
XII-7	40	1	5322 278 34001	Slide contact
XII-7	41	1	5322 278 64002	Rotor
XII-7	42	2	5322 492 54142	Compression spring
XII-7	43	4	5322 532 64132	Coupling piece for potentiometers R4...7

Fig.	*Item*	*Qty*	*Ordering number*	*Description*
XII-7	44	1	4822 530 70125	Locking washer
–	45	1	5322 532 24341	Plastic locking ring on R3
–	46	1	5322 492 64367	Leaf spring for ring on R3
–	47	6	5322 268 24026	Lead spring socket for TS247, 248
XII-5	48	52	5322 268 10072	Lug
XII-4	49	2	5322 320 10003	Delay line/meter (required 90 cm for each delay line)
XII-6	50	1	5322 492 64341	Leaf spring for TS347, 348
XII-5	51	1	5322 320 14022	Coaxial cable assy
–	52	2	5322 532 54225	Washer for RE303
–	53	tube (contents 4 oz)	5322 390 20019	Silicone heat sink compound
–	54	100 gr	5322 390 84001	Soldering tin, 62 % tin, 36 % lead, 2 % silver

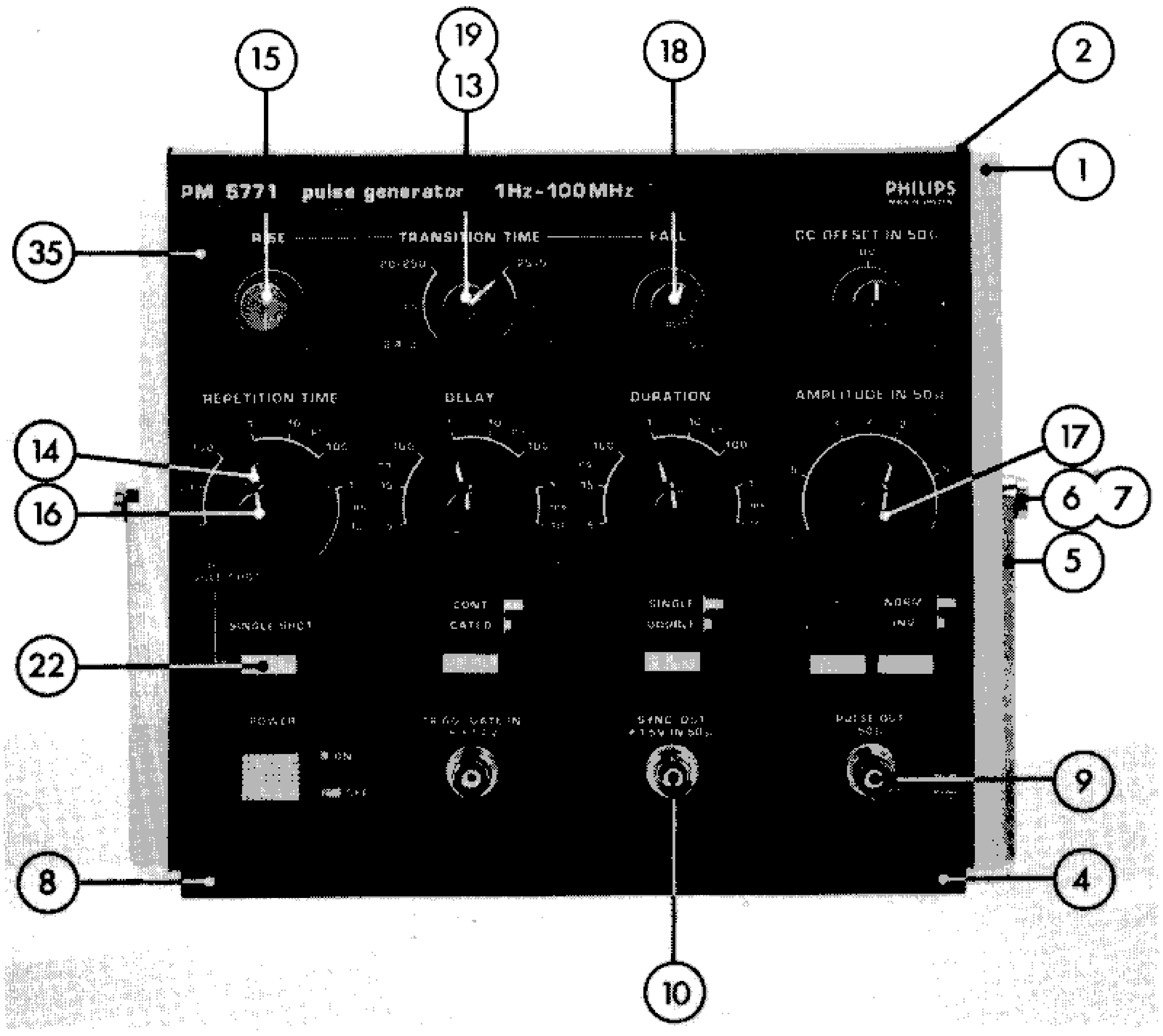


Fig. XII-1. Location of components (front)

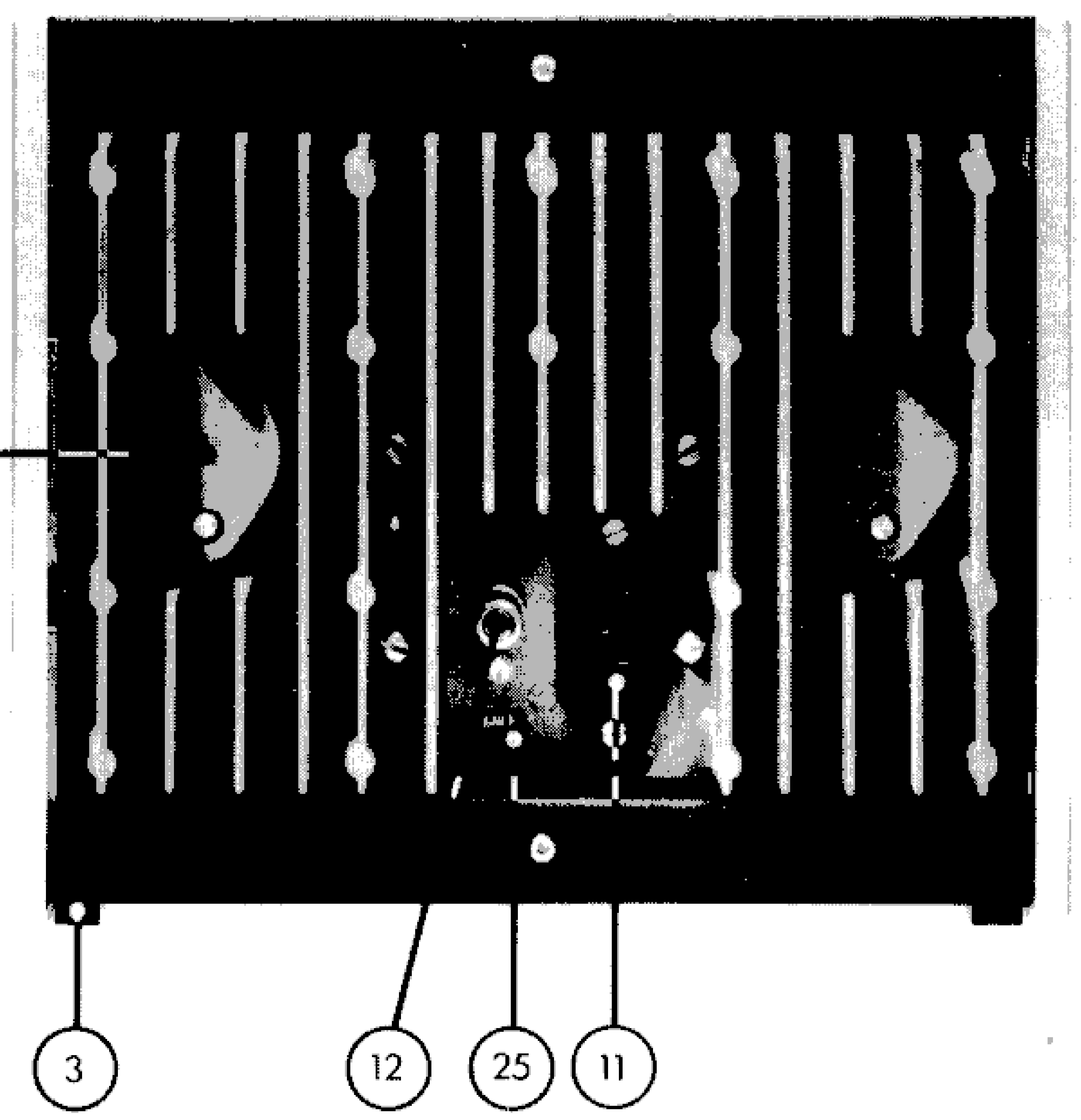


Fig. XII-2. Location of components (rear)

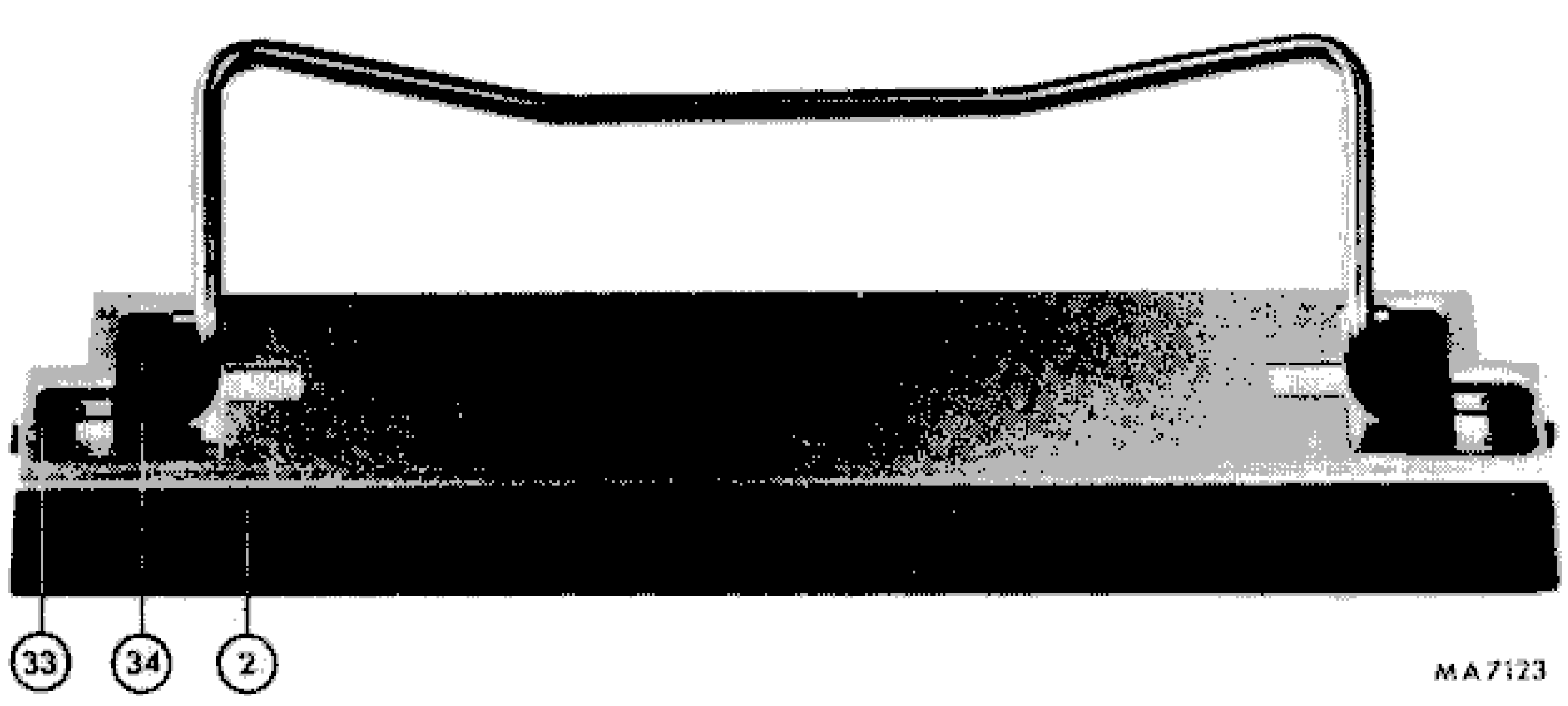


Fig. XII-3. Location of components of the tilting assy

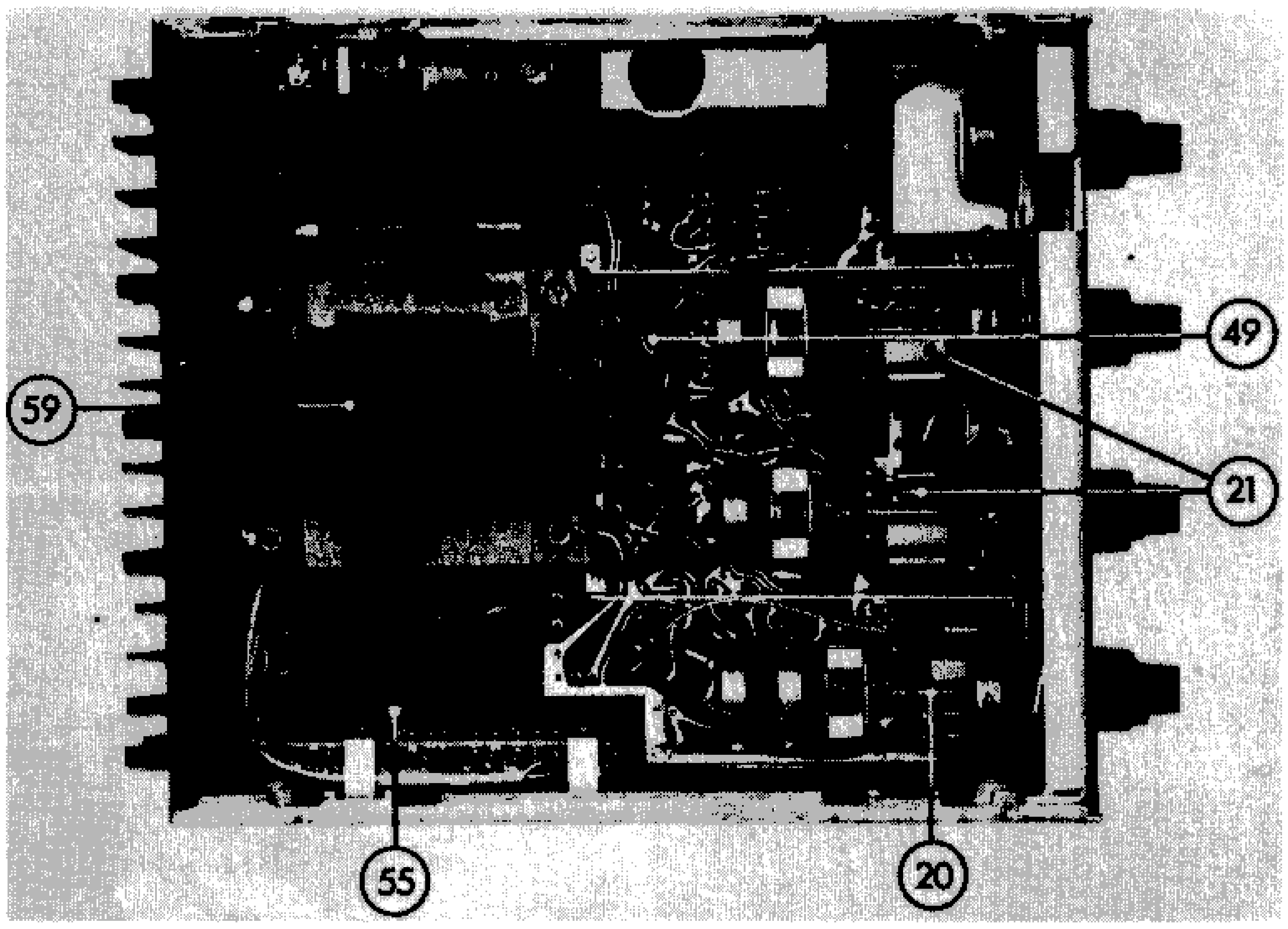


Fig. XII-4. Location of components (interior)

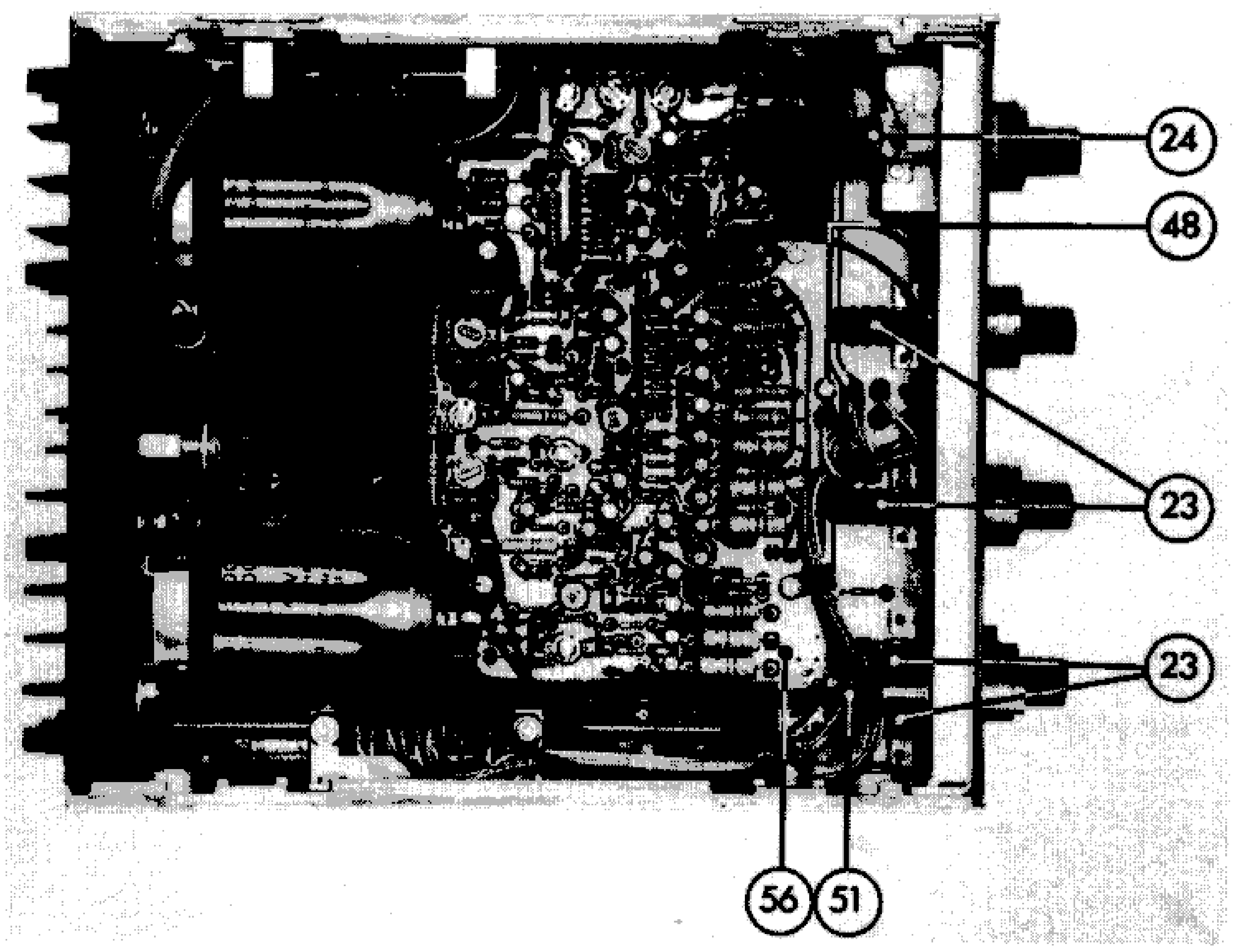


Fig. XII-5. Location of components (interior)

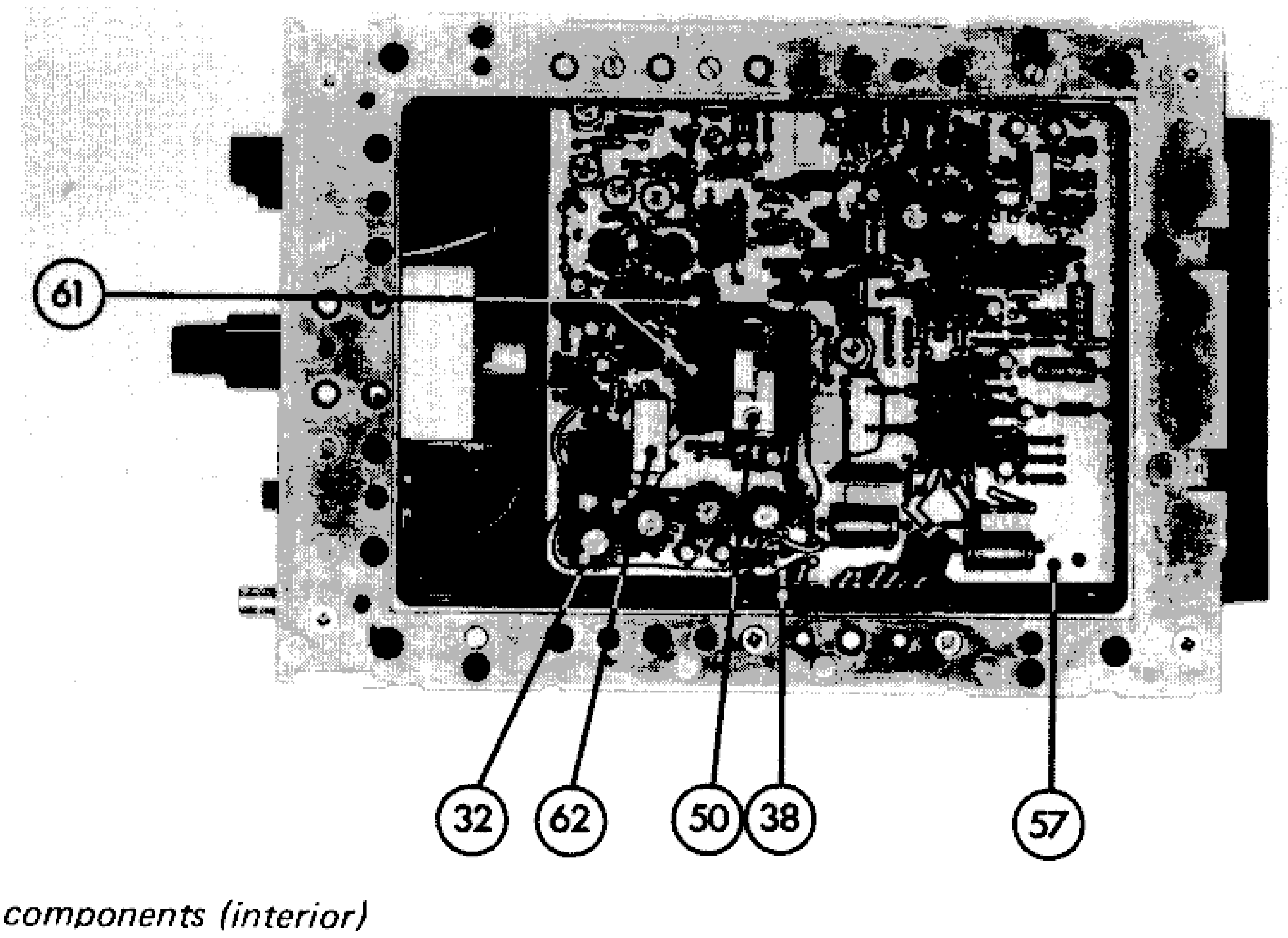


Fig. XII-6. Location of components (interior)

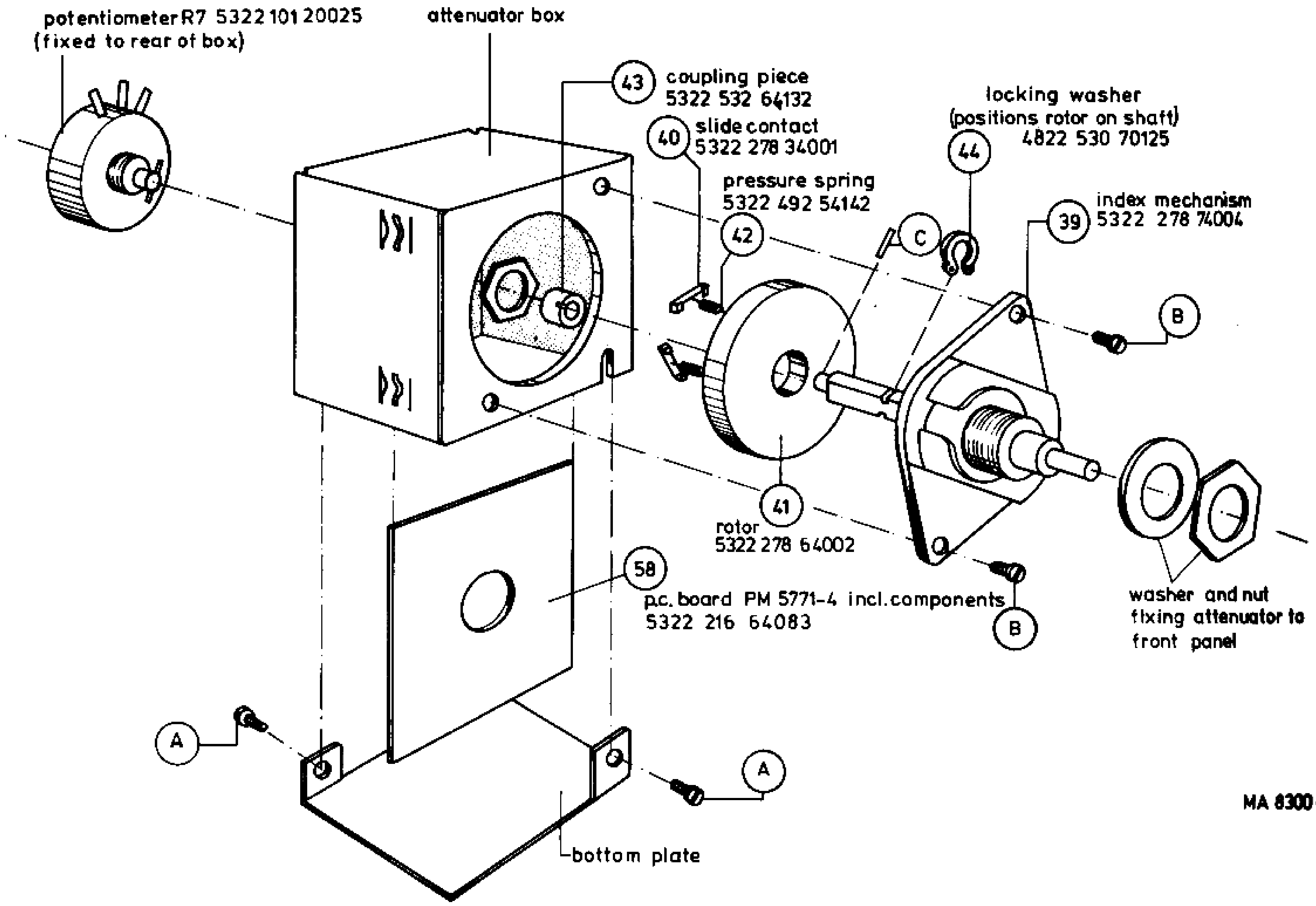


Fig. XII-7. Exploded view of the attenuator

MODIFICATIONS OF VERSIONS –/02 AND –/03 WITH RESPECT TO VERSION –/01

Added

Resistor R3163 (820 ohm) connected in series with L313 (2.2 mH), is mounted between pin 7 of relay RE302, POLARITY SWITCH, and 0 V.
Service code no. for L313: 5322 158 10272

Deleted

L313, FXC bead.

Changed

No.	Old value	New value	Tolerance (%)	Power (W)	Service code no.
R3104	120 Ω	82 Ω	5	CR16	4822 111 30352
R3116	120 Ω	150 Ω	5	CR16	4822 111 30325
R3119	120 Ω	220 Ω	5	CR16	4822 111 30327
R3140	866 Ω	825 Ω	1	MR25	5322 116 54541
R3145	100 Ω	120 Ω	5	–	4822 110 23083
R3149	140 Ω	130 Ω	1	MR25	5322 116 54481
R3151	2.2 kΩ	6.8 kΩ		CR25	4822 110 63129
C314	33 nF	39 nF		–	5322 122 34037
L312	100 μH	1 mH		–	5322 158 14052

CAPACITORS

No.	*Ordering number*	*Value (F)*		*Tol (%)*	*Voltage (V)*	*Description*
C1	4822 120 60078	82	p	2	100	Mica
C2	4822 120 60103	680	p	2	500	Mica
C3	5322 121 54005	6.8	n	1	63	Polyester
C4	5322 121 50401	68	n	1	63	Polyester
C5	4822 121 40219	680	n		100	Polyester
C6	5322 124 14051	6.8	μ	10	6	Tantal
C7	5322 124 10073	68	μ	10	15	Tantal
C8	5322 124 10081	330	μ	10	6	Tantal
C9	5322 124 10081	330	μ	10	6	Tantal
C12	4822 120 60069	39	p	2	500	Mica
C13	4822 120 60097	430	p	2	500	Mica
C14	5322 121 50512	4.7	n	1	63	Polyester
C15	5322 121 50375	47	n	1	63	Polyester
C16	5322 121 40218	470	n		100	Polyester
C17	5322 124 10157	4.7	μ	10	10	Tantal
C18	5322 124 10013	47	μ	10	6	Tantal
C22	4822 120 60069	39	p	2	500	Mica
C23	4822 120 60097	430	p	2	500	Mica
C24	5322 121 50512	4.7	n	1	63	Polyester
C25	5322 121 50375	47	n	1	63	Polyester
C26	5322 121 40218	470	n		100	Polyester
C27	5322 124 10157	4.7	μ	10	10	Tantal
C28	5322 124 10013	47	μ	10	6	Tantal
C31	4822 121 20067	5	n		250	Paper
C32	4822 121 20067	5	n		250	Paper
C41	4822 124 70235	2x5000	μ		40	Electrolytic
C42	4822 124 70235	2x5000	μ		40	Electrolytic
C101	4822 124 20398	220	μ		25	Electrolytic
C102	4822 122 31081	100	p		100	Ceramic
C103	4822 122 31175	1	n		100	Ceramic
C104	4822 124 20575	100	μ		25	Electrolytic
C105	4822 124 20398	220	μ		25	Electrolytic
C106	4822 124 20398	220	μ		25	Electrolytic
C107	4822 122 31081	100	p		100	Ceramic
C108	4822 124 20386	150	μ		63	Electrolytic
C109	4822 124 20362	22	μ		25	Electrolytic
C201	4822 122 30043	10	n		40	Ceramic
C202	4822 124 20362	22	μ		25	Electrolytic
C203	4822 124 20362	22	μ		25	Electrolytic
C204	4822 124 20362	22	μ		25	Electrolytic
C205	4822 122 30043	10	n		40	Ceramic
C206	4822 122 31054	10	p		100	Ceramic
C208	4822 122 30043	10	n		40	Ceramic
C209	4822 122 31063	22	p		100	Ceramic
C210	4822 122 30043	10	n		40	Ceramic
C212...224	4822 122 30043	10	n		40	Ceramic
C225	4822 124 20362	22	μ		25	Electrolytic
C226	4822 122 30043	10	n		40	Ceramic
C227	4822 122 30043	10	n		40	Ceramic
C228	4822 122 31054	10	p		100	Ceramic

No.	*Ordering number*	*Value (F)*	*Tol (%)*	*Voltage (V)*	*Description*
C229	4822 122 31054	10 p		100	Ceramic
C301	4822 124 20575	100 µ		25	Electrolytic
C302	4822 121 40232	0.22 µ		100	Ceramic
C303	4822 124 20575	100 µ		25	Electrolytic
C304	4822 121 40232	0.22 µ		100	Ceramic
C305	5322 122 34006	10 n			Ceramic
C306	5322 122 34006	10 n		40	Ceramic
C307	4822 122 30043	10 n		40	Ceramic
C308	4822 122 30043	10 n		40	Ceramic
C310	5322 122 34006	10 n			Ceramic
C311	5322 122 34006	10 n			Ceramic
C312	5322 122 34034	100 p			Ceramic
C313	4822 122 30043	10 n		40	Ceramic
C314	5322 122 34036	33 n			Ceramic
C315	4822 122 30043	10 n		40	Ceramic
C316	5322 122 34035	2.2 n			Ceramic
C317	4822 122 30043	10 n		40	Ceramic
C318	4822 121 40232	0.22 µ		100	Polyester
C319	4822 121 40232	0.22 µ		100	Polyester
C320	4822 122 30043	10 n		40	Ceramic
C321	5322 122 34006	10 n			Ceramic
C322	4822 122 30043	10 n		40	Ceramic
C323	4822 121 40232	0.22 µ		100	Polyester
C324	4822 124 20368	33 µ		16	Electrolytic
C325	5322 122 34006	10 n			Ceramic
C326	4822 124 20362	22 µ		25	Electrolytic
C327	5322 122 34006	10 n			Ceramic
C328	4822 122 31072	47 p		100	Ceramic
C329	4822 122 30103	22 n		40	Ceramic
C330	4822 122 30043	10 n		40	Ceramic
C331	4822 122 30043	10 n		40	Ceramic
C332	4822 121 40232	0.22 µ		100	Polyester
C333	4822 122 30043	10 n		40	Ceramic
C334	4822 122 30026	0.1 µ		6	Ceramic
C335	4822 122 31177	470 p		100	Ceramic
C336	4822 122 31063	22 p		100	Ceramic
C337	4822 122 30103	22 n		40	Ceramic
C338	4822 122 31058	15 p		100	Ceramic
C339	5322 122 34006	10 n			Ceramic
C340	5322 122 34006	10 n			Ceramic
C341	5322 122 34006	10 n			Ceramic
C342	4822 122 31067	33 p		100	Ceramic
C343	5322 121 40197	1 µ		100	Polyester
C344		0.68 µ			
C345	4822 122 30043	10 n		40	Ceramic
C346	4822 122 30043	10 n		40	Ceramic
C347	5322 122 34006	10 n			Ceramic
C348	5322 122 34006	10 n			Ceramic
C349	4822 122 30043	10 n		40	Ceramic
C350	4822 122 30026	0.1 µ		6	Ceramic
C351	4822 121 40232	0.22 µ		100	Polyester
C352	4822 122 30043	10 n		40	Ceramic
C353	4822 122 30043	10 n		40	Ceramic

POTENTIOMETERS

No	*Ordering number*	*Value (Ω)*	*Tol (%)*	*Description*
R1	5322 101 24042	5 k	20	Carbon potentiometer, lin.
R2	5322 101 24042	5 k	20	Carbon potentiometer, lin.
R3	5322 101 24042	5 k	20	Carbon potentiometer, lin.
R4	5322 273 50092	500+1.5 k	10	Carbon twin-potentiometer
R5	5322 273 40207	22 k	20	Carbon potentiometer
R6	5322 273 40207	22 k	20	Carbon potentiometer
R7	5322 101 20025	5 k	20	Carbon potentiometer
R120	5322 101 14047	470	20	Ceramic trim potentiometer
R121	5322 101 14047	470	20	Ceramic trim potentiometer
R286	5322 100 10113	10 k	20	Ceramic trim potentiometer
R287	5322 101 14004	47	20	Ceramic trim potentiometer
R288	5322 101 14008	2.2 k	20	Ceramic trim potentiometer
R289	5322 101 14047	470	20	Ceramic trim potentiometer
R290	5322 100 10112	1 k	20	Ceramic trim potentiometer
R291	5322 101 14048	47 k	20	Ceramic trim potentiometer
R292	5322 101 14047	470	20	Ceramic trim potentiometer
R293	5322 101 14009	220	20	Ceramic trim potentiometer
R294	5322 101 14048	47 k	20	Ceramic trim potentiometer
R295	5322 101 14047	470	20	Ceramic trim potentiometer
R296	5322 101 14009	220	20	Ceramic trim potentiometer
R332	5322 101 14049	470	20	Ceramic trim potentiometer
R350	5322 100 10115	1 k	20	Ceramic trim potentiometer
R364	5322 101 14072	100	20	Ceramic trim potentiometer
R372	5322 100 10117	2.2 k	20	Ceramic trim potentiometer
R387	5322 101 14049	470	20	Ceramic trim potentiometer
R3102	5322 100 10115	1 k	20	Ceramic trim potentiometer

FIXED RESISTORS

CR16 : Carbon film resistor
$T_{max.}$ hot spot = 155 °C
Typical dissipation at $T_{amb.}$ (70 °C) = 0.2 W

MR25 : Metal film resistor
$T_{max.}$ hot spot = 175 °C
Typical dissipation at $T_{amb.}$ (70 °C) = 0.4 W

No.	*Ordering number*	*Value (Ω)*	*Power (W)*	*Tol (%)*	*Description*
R303	5322 116 50636	2.74 k	MR25	1	
R304	5322 116 54012	6.81 k	MR25	1	
R305	4822 111 30352	82	CR16	5	
R306	5322 116 54572	2.00 k	MR25	1	
R307	5322 116 54572	2.00 k	MR25	1	
R308	5322 116 54486	150	MR25	1	
R309	5322 116 54536	750	MR25	1	
R310	4822 111 30352	82	CR16	5	
R313	5322 116 54564	1.50 k	MR25	1	
R314	5322 116 54564	1.50 k	MR25	1	
R315	5322 116 54486	150	MR25	1	
R317	5322 116 54006	392	MR25	1	
R318	4822 111 30067	33	CR16	5	
R319	4822 111 30067	33	CR16	5	
R321	4822 111 30067	33	CR16	5	
R322	4822 111 30067	33	CR16	5	
R323	5322 116 54009	562	MR25	1	
R324	5322 116 54564	1.50 k	MR25	1	
R325	5322 111 30074	56	CR16	5	
R326	5322 111 30074	56	CR16	5	
R327	5322 116 54513	332	MR25	1	
R328	4822 111 30347	10	CR16	5	
R329	5322 116 54486	150	MR25	1	
R330	4822 111 30271	820	CR16	5	
R334	4822 111 30324	100	CR16	5	
R336	4822 111 30265	220	CR16	5	
R337	5322 111 44153	15	CR16	5	
R338	4822 111 30265	220	CR16	6	
R339	5322 111 44153	15	CR16	5	
R343	5322 111 44153	15	CR16	5	
R344	5322 111 30298	120	CR16	5	
R345	5322 116 54513	332	MR25	1	
R346	4822 111 30277	22 k	CR16	5	
R348	5322 111 30396	22	CR16	5	
R356	4822 111 30269	1.0 k	CR16	5	
R358	4822 111 30269	1.0 k	CR16	5	
R361	4822 111 30269	1 k	CR16	5	
R362	5322 116 54541	825	MR25	1	
R363	4822 111 30245	47	CR16	5	
R368	4822 111 30265	220	CR16	5	
R375	4822 111 30265	220	CR16	5	
R376	4822 111 30265	220	CR16	5	
R378	4822 111 30325	150	CR16	5	
R381	5322 116 54392	100		5	Metal power

No.	Ordering number	Value (Ω)	Power (W)	Tol (%)	Description
R383	5322 116 54591	3.92 k	MR25	1	
R385	5322 116 54574	2.21 k	MR25	1	
R386	4822 111 30326	180	CR16	5	
R391	5322 116 54006	392	MR25	1	
R392	5322 116 54469	100	MR25	1	
R393	5322 116 54513	332	MR25	1	
R394	5322 116 54462	82.5	MR25	1	
R395	5322 111 30298	120	CR16	5	
R398	5322 111 30298	120	CR16	5	
R399	4822 111 30328	330	CR16	5	
R3100	4822 111 30265	220	CR16	5	
R3103	5322 116 54503	267	MR25	1	
R3104	5322 111 30298	120	CR16	5	
R3105	5322 116 54549	1.0 k	MR25	1	
R3106	5322 111 30396	22	CR16	5	
R3107	5322 116 54503	267	MR25	1	
R3108	5322 111 30396	22	CR16	5	
R3109	5322 111 30074	56	CR16	5	
R3110	5322 111 30074	56	CR16	5	
R3111	5322 116 50437	243	MR25	1	
R3112	5322 116 54002	221	MR25	1	
R3113	5322 116 50952	47.5	MR25	1	
R3114	5322 116 50952	47.5	MR25	1	
R3115	4822 111 30323	270	CR16	5	
R3116	5322 111 30298	120	CR16	5	
R3117	5322 116 50952	47.5	MR25	1	
R3118	5322 116 50952	47.5	MR25	1	
R3119	5322 111 30298	120	CR16	5	
R3120	4822 111 30245	47	CR16	5	
R3121	5322 116 54459	75.0	MR25	1	
R3122	5322 116 54455	68.1	MR25	1	
R3123	4822 111 30267	1.5 k	CR16	5	
R3124	5322 116 54459	75.0	MR25	1	
R3125	5322 116 54455	68.1	MR25	1	
R3126		22..150	CR16	5	
R3127	5322 116 54504	274	MR25	1	
R3128	4822 111 30269	1.0 k	CR16	5	
R3129	5322 116 54572	2.00 k	MR25	1	
R3130	4822 111 30325	150	CR16	5	
R3131	5322 116 54499	249	MR25	1	
R3132	4822 111 30267	1.5 k	CR16	5	
R3133	5322 116 54549	1.0 k	MR25	1	
R3134	5322 116 54503	267	MR25	1	
R3135	5322 116 54552	1.05 k	MR25	1	
R3140	5322 116 54543	866	MR25	1	
R3141	5322 116 54503	267	MR25	1	
R3142	5322 116 54549	1.0 k	MR25	1	
R3143	5322 116 50526	1.30 k	MR25	1	
R3146	5322 116 54395	330		5	Metal power
R3148	5322 116 54484	140	MR25	1	
R3149	5322 116 54484	140	MR25	1	
R3150	5322 116 54564	1.50 k	MR25	1	
R3151	4822 111 30265	2.2 k	CR16	5	
R3152	4822 111 30265	2.2 k	CR16	5	
R3153	5322 116 54484	140	MR25	1	

No.	Ordering number	Value (Ω)	Power (W)	Tol (%)	Description
R3154	5322 116 54484	140	MR25	1	
R3155	5322 116 54464	1.50 k	MR25	1	
R3156	5322 116 54009	562	MR25	1	
R3157	5322 116 54572	2.00 k	MR25	1	
R3158	5322 116 54012	6.81 k	MR25	1	
R3159	5322 116 54549	1.0 k	MR25	1	
R3160	5322 116 54549	1.0 k	MR25	1	
R3162	5322 111 30396	22	CR16	5	
R401	5322 116 54536	750	MR25	1	
R402	5322 116 54586	3.57 k	MR25	1	
R403	5322 116 50904	30.1	MR25	1	
R404	5322 116 54469	100	MR25	1	
R405	5322 116 50679	237	MR25	1	
R406	5322 116 54505	280	MR25	1	
R407	5322 116 54462	82.5	MR25	1	
R408	5322 116 54469	100	MR25	1	
R409	5322 116 54493	182	MR25	1	
R410	5322 116 54493	182	MR25	1	
R411	5322 116 54462	82.5	MR25	1	
R412	5322 116 54469	100	MR25	1	
R413	5322 116 54481	130	MR25	1	
R414	5322 116 54496	200	MR25	1	
R415	5322 116 54455	68.1	MR25	1	
R416	5322 116 54545	909	MR25	1	
R417	5322 116 54776	84.5	MR25	1	
R418	5322 116 54776	84.5	MR25	1	
R419	5322 116 54448	59	MR25	1	
R420	5322 116 54449	60.4	MR25	1	
R421	5322 116 54449	60.4	MR25	1	

COILS

No.	Ordering no.	Description
L1	5322 526 10083	
L3	4822 526 10025	FXC-bead, 4B
L4	4822 526 10011	FXC-bead, 3B
L5...7	4822 526 10011	FXC-bead, 3B
L8	4822 526 10025	FXC-bead, 4B
L10	4822 526 10025	FXC-bead, 4B
L201	4822 526 10011	FXC-bead, 3B
L202	4822 526 10025	FXC-bead, 4B
L203...205	4822 526 10011	FXC-bead, 3B
L207	4822 526 10011	FXC-bead, 3B
L209	4822 526 10025	FXC-bead, 4B
L301	5322 158 10052	H.F. Choke
L302	5322 158 10052	H.F. Choke
L303...306	4822 526 10025	FXC-lead, 4B
L307	5322 158 10307	Choke, 330 μH
L308	5322 158 10307	Choke, 330 μH
L309	5322 158 14049	Choke, 0.15 μH
L310	4822 526 10025	FXC-bead, 4B
L311	5322 158 10243	Choke, 100 μH
L312	5322 158 10243	Choke, 100 μH
L313	4822 526 10025	FXC-bead, 4B

TRANSISTORS

Type	*Ordering no.*	*No's*	*Remarks*
BC107B	5322 130 40332	TS303, 306, 309, 312, 322, 324, 355	
BC108B	5322 130 40343	TS109, 111	
BC177	4822 130 40522	TS320, 325, 331, 349, 352, 358	
BCY70	5322 130 40324	TS108, 221, 231, 242, 252	
BF180	5322 130 40492	TS207, 214, 259	
BFR64	5322 130 44193	TS344	
BFR91	5322 130 44181	TS327	
BFX49	5322 130 44079	TS340, 341	
BFX89	5322 130 40542	TS203, 204, 217, 220, 224, 235, 236, 240, 241, 243, 245, 256, 257	
BFW16	5322 130 44381	TS234, 255	
BFW16A	5322 130 44015	TS336, 337, 339, 342, 343	
BFW30	5322 130 40379	TS206, 208, 326, 345, 346	
BFW92	5322 130 40745	TS301, 302, 304, 305, 307, 308, 319, 321, 323, 335	
BFW93	5322 130 44262	TS310, 311, 316, 317, 318, 328, 329, 333, 334, 338	
BFY50	5322 130 40294	TS356, 357	
MPSL08	5322 130 44215	TS313, 314, 315	
2N1613	5322 130 40127	TS101, 106	
2N2219	5322 130 44034	TS112, 330, 350, 351	
2N2369	5322 130 40407	TS332	
2N3055	5322 130 40132	TS1, 2	
2N3905	5322 130 40171	TS215, 218	Manufacturer Motorola
2N4037	5322 130 40433	TS353, 354	Manufacturer RCA
2N5583	5322 130 44033	TS347, 348	Manufacturer Motorola
2N709	5322 130 40495	TS211, 222, 225, 229, 238, 244, 246, 250	
2N709 SELECTED	5322 130 40183	TS223, 230, 251	

DIODES

Type	*Ordering no.*	*No's*	*Remarks*
BAX13	5322 130 40182	GR201, 202, 212, 213, 226 239, 247, 305, 306, 307, 315, 316	
BAV10	5322 130 30594	GR317, 319	
BZX79-B15	5322 130 34281	GR301, 302	
BZX79-B6V2	5322 130 34167	GR310, 311	
BZX79-C4V7	5322 130 30773	GR314	
BZX79-C5V1	5322 130 30767	GR205, 216, 219, 258	
BZX79-C6V8	5322 130 30768	GR107, 110	Zener diodes
BZX79-C7V5	5322 130 30666	GR233, 313	
BZX79-C9V1	5322 130 30667	GR254	
BZY88-C3V3	5322 130 30392	GR237	
BZY88-C4V3	5322 130 30509	GR119	
FD777	5322 130 34045	GR228, 232, 248, 249 253	Manufacturer Fairchild
HP5082-2800	5322 130 30635	GR210	Manufacturer Hewlett Packard
HP5082-2833	5322 130 34282	GR303, 304	Manufacturer Hewlett Packard
HP5082-2835	5322 130 34283	GR308, 309, 312	
VH248	5322 130 34042	GR1	Rectifier bridge Varo inc.
IN5349	5322 130 34284	GR318, 320	Rectifier bridge Motorola

MISCELLANEOUS

Fig.	*Item*	*Qty.*	*Ordering no.*	*Description*
XII-4	55	1	5322 216 64084	Printed wiring board incl. components PM 5771-1 (power supply)
XII-5	56	1	5322 216 64085	Printed wiring board incl. components PM 5771-2 (timing circuit)
XII-6	57	1	5322 216 64086	Printed wiring board incl. components PM 5771-3 (output circuit)
XII-7	58	1	5322 216 64083	Printed wiring board incl. components PM 5771-4 (attenuator)
XII-4	59	1	5322 146 24044	Mains transformer, T1
–	60	1	5322 134 44016	Lamp for SK11, LA1
XII-6	61	2	5322 280 24048	Reed relay, RE301, 302
XII-6	62	1	5322 280 24049	Reed relay, RE303

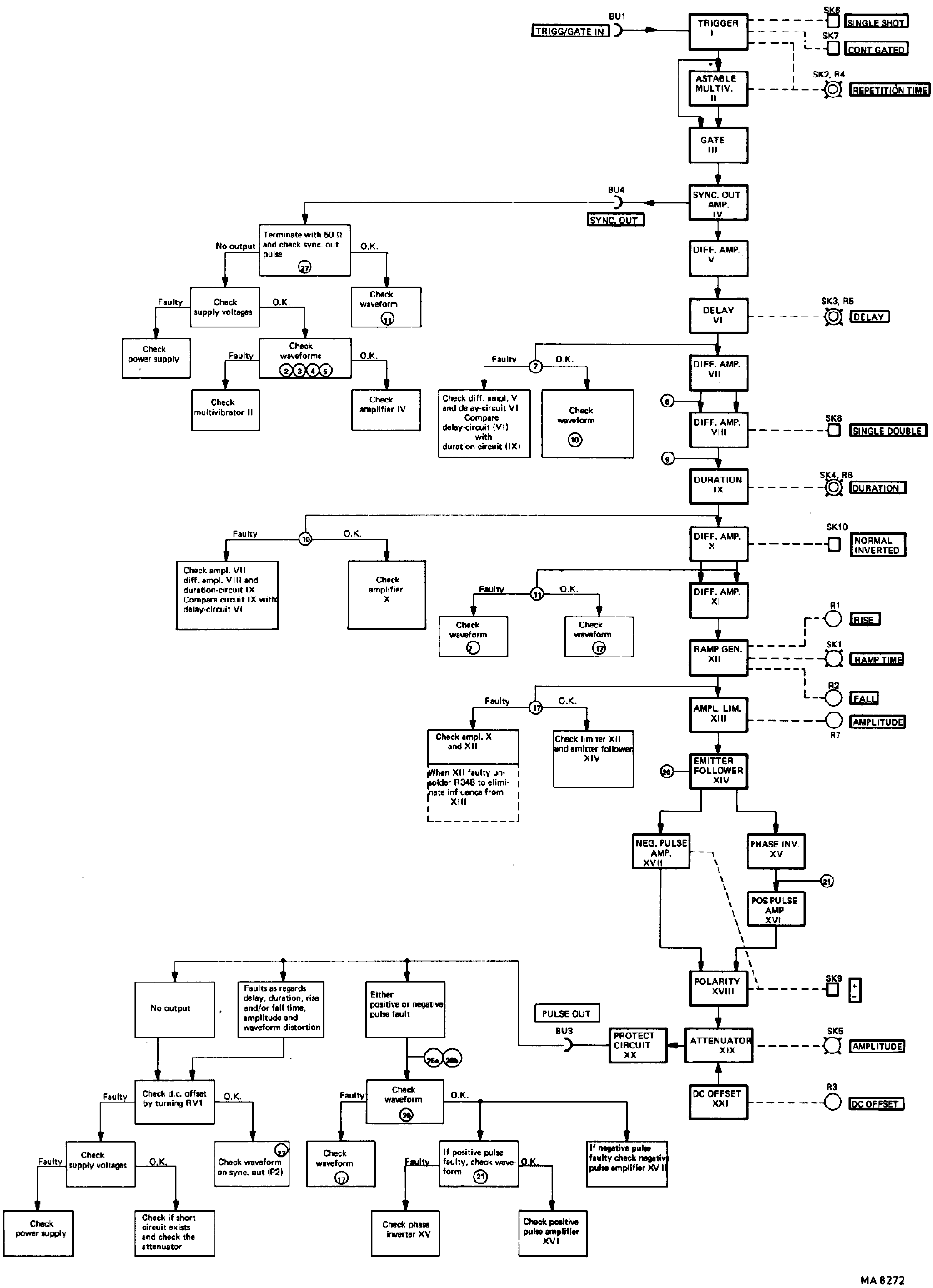


Fig. XIII-1. Block diagram with fault finding procedure

XIII. Fault finding procedure

TEST CONDITIONS

Test instruments used

Voltage measurements	: Voltmeter 40,000 Ω/V or digital voltmeter	e.g. PHILIPS PM 2411 or PHILIPS PM 2421
Waveforms	: Sampling oscilloscope, cathode follower probe and attenuator heads	e.g. PHILIPS PM 3400, PM 9345, PM 9341

When checking the timing-circuit, the oscilloscope is triggered by means of the sync. output pulse of the generator.

Oscilloscope trigg. control: EXT +

Settings of the controls

DC OFFSET	R3	0 V
RISE	R1	Minimum (fully anti-clockwise)
FALL	R2	Minimum (fully anti-clockwise)
RAMP TIME	SK1	2.4 ns - 20 ns
AMPLITUDE	SK5	1 V
AMPLITUDE	R7	Maximum (fully anti-clockwise)
REPETITION TIME	SK2	1 μs, R4 on the black dot
DELAY	SK3	5 ns, R5 on the black dot *)
DURATION	SK4	15 ns, R6 on the black dot
PULSE MODE	SK7	CONT.
	SK8	SINGLE *)
POLARITY	SK10	NORM.
	SK9	+

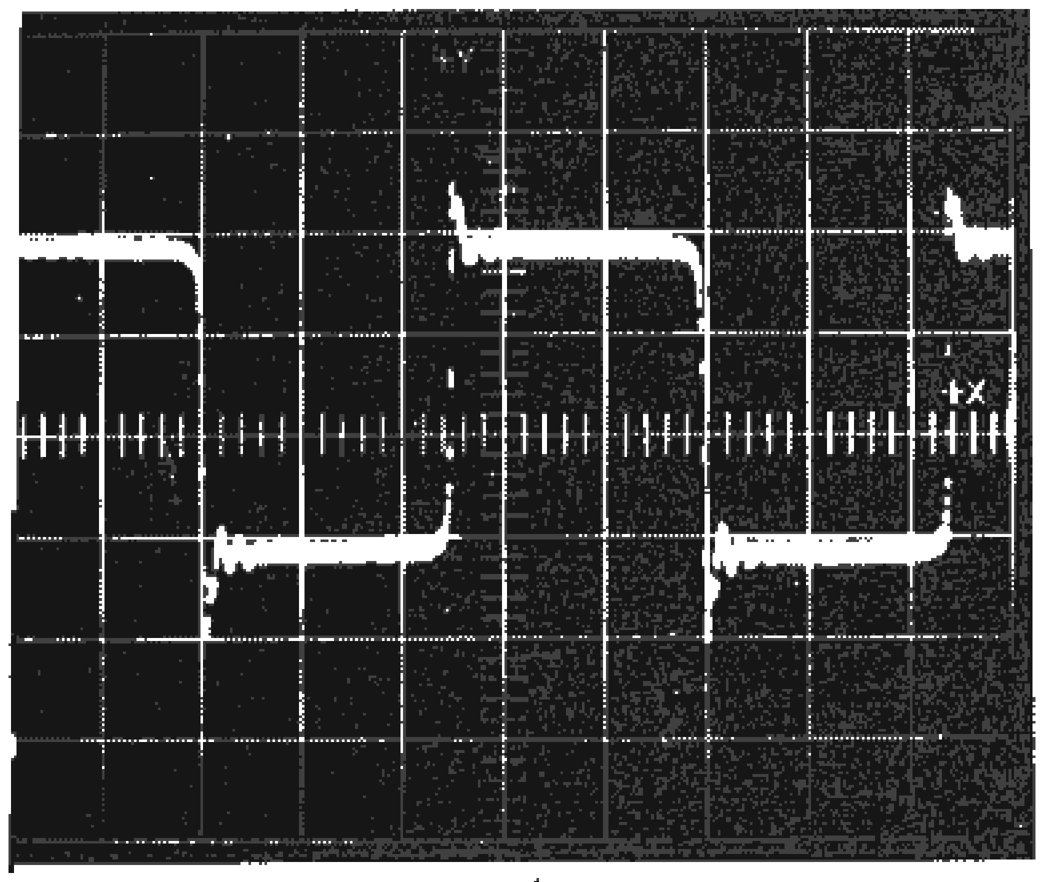
*) Waveform photographs 8′ and 10′ are obtained at a DELAY adjustment of approximately 50 ns and with switch PULSE MODE (SK8) in position DOUBLE.

Checking the output circuit

The pulse generator is triggered externally by means of the CAL pulse of the oscilloscope.

VOLTAGES AND WAVEFORMS ARE TYPICAL AND MAY VARY BETWEEN INSTRUMENTS.

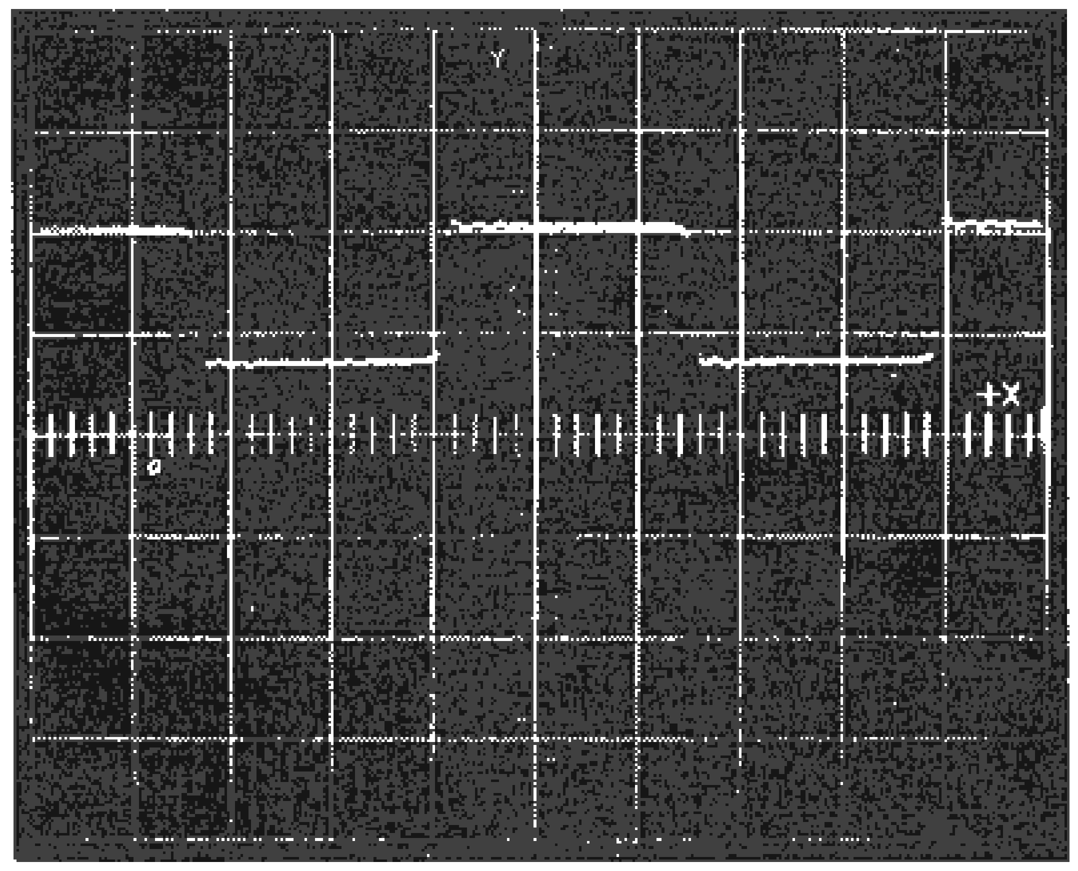
Fig. XIII-3. Circuit diagram, power supply PM 5771-1



0
250 mV/cm
0,2 µs/cm

ollector TS206

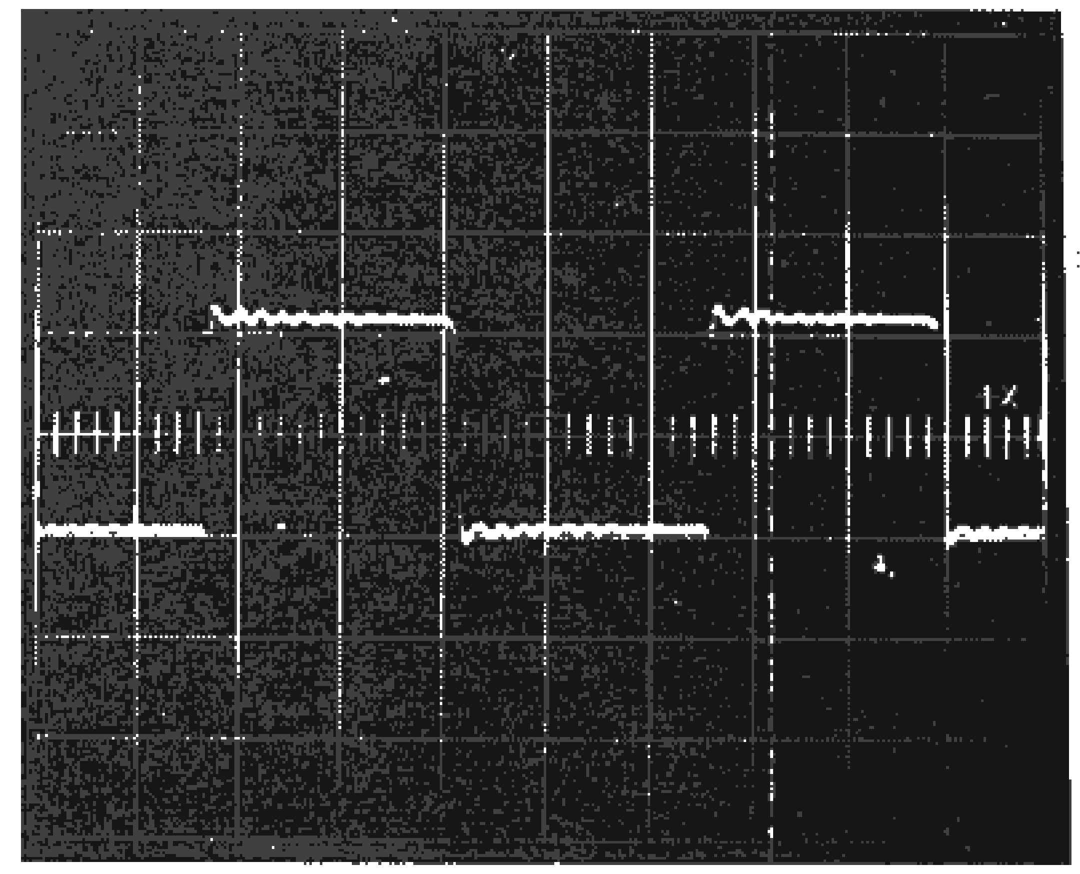
2



2,5 V/cm
0
0,2 µs/cm

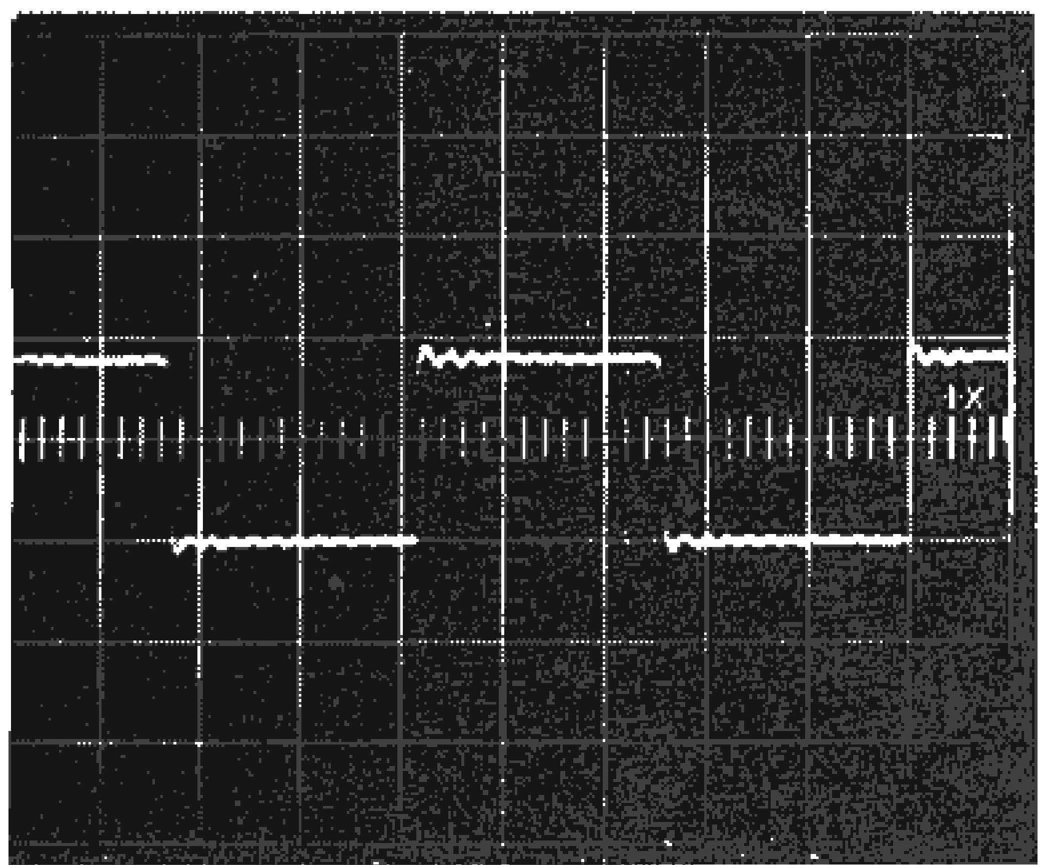
Cathode GR213

3



1 V/cm
0
0.2 µs/cm

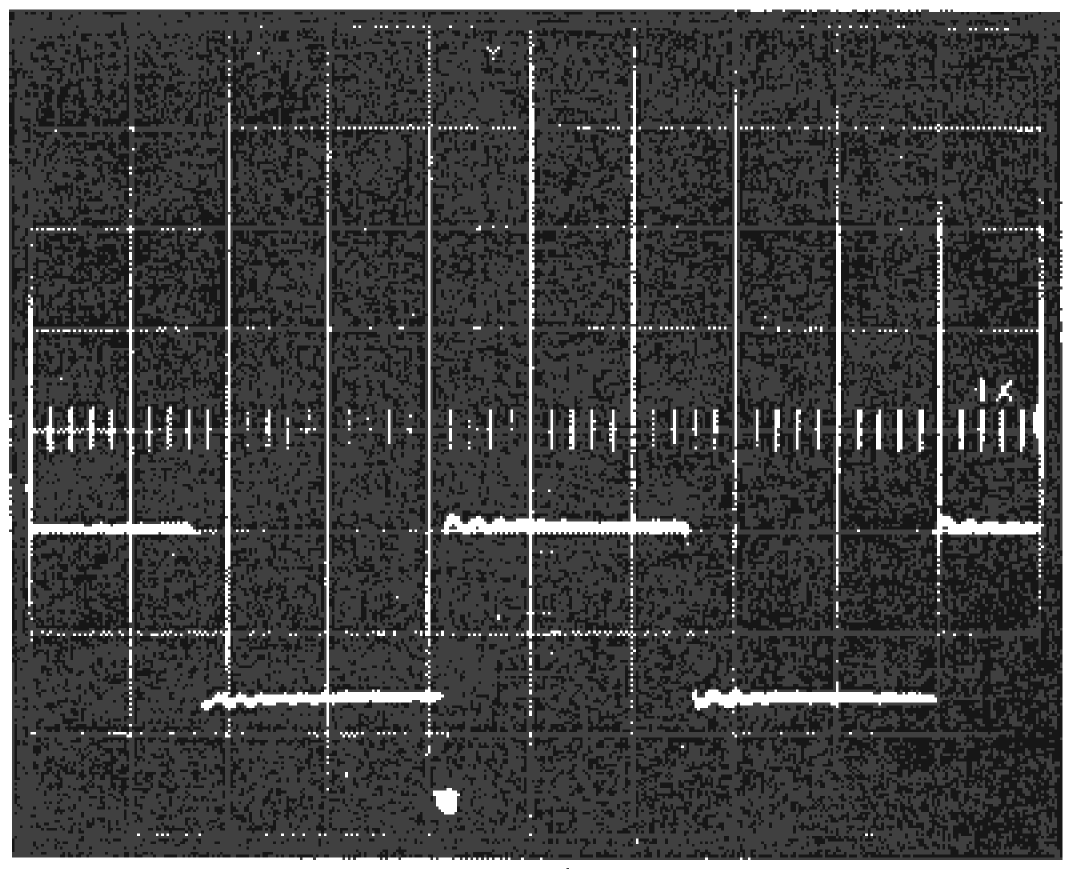
Cathode GR216



1 V/cm
0
0,2 µs/cm

athode GR219

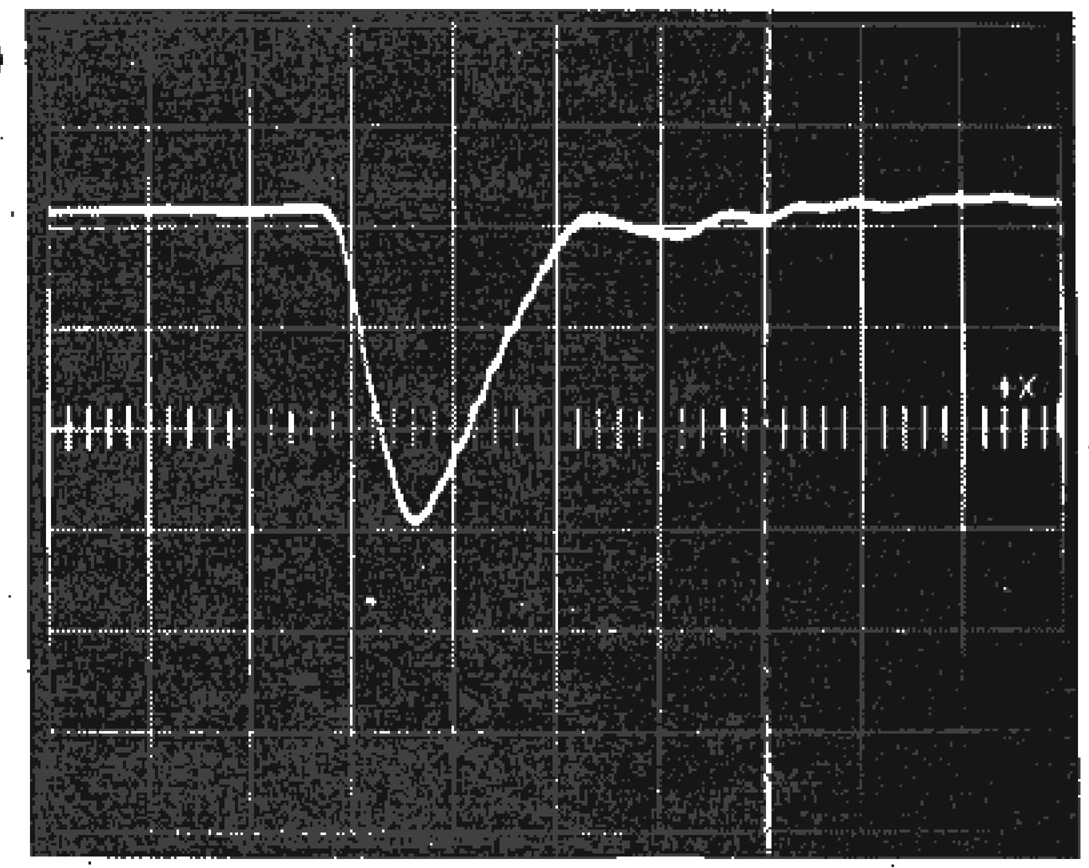
5



0
1 V/cm
0,2 µs/cm

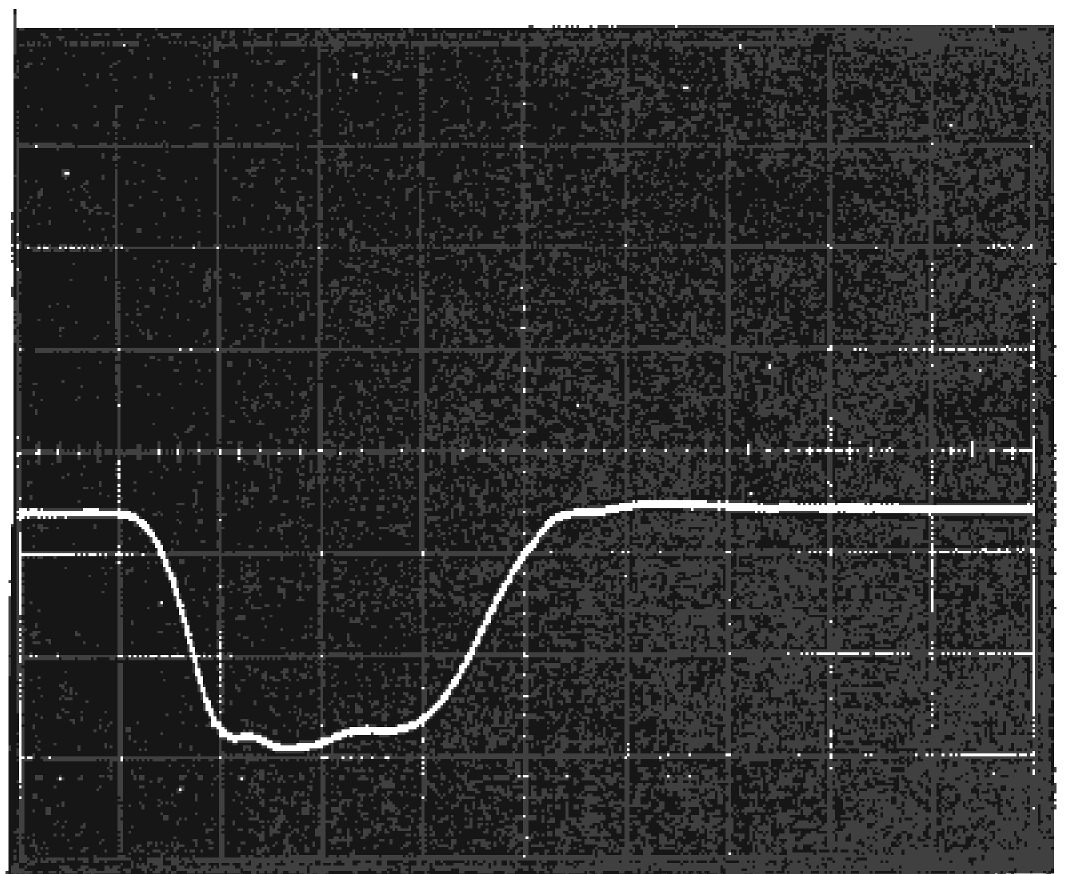
Base TS220

6



2 V/cm
0
5 ns/cm

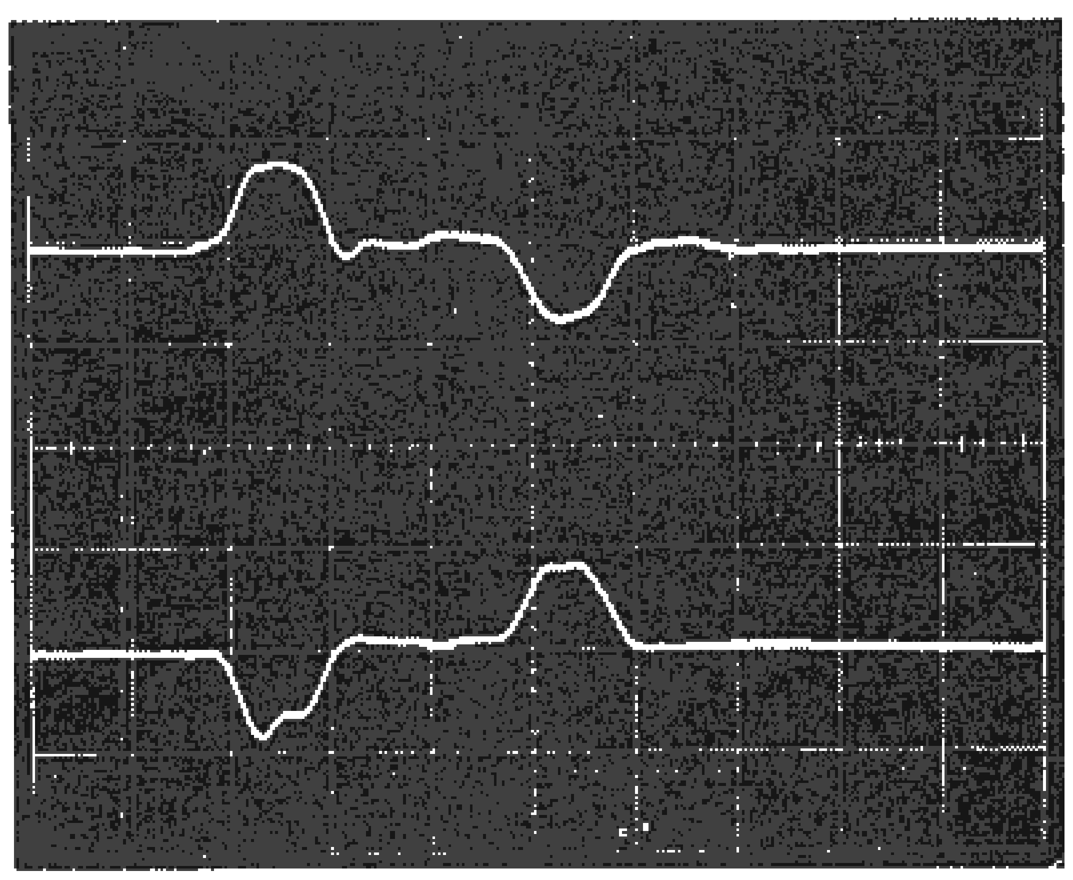
Anode GR227



0
2 V/cm
5 ns/cm

Emitter TS234

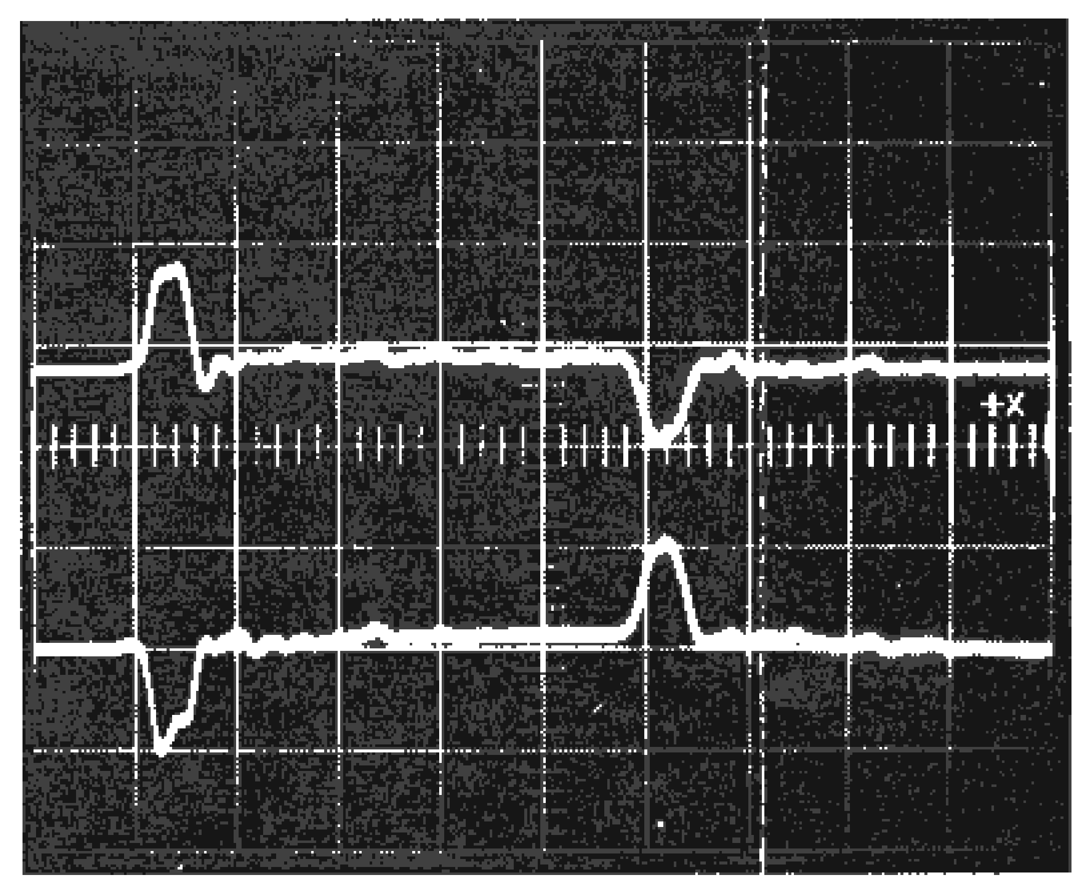
8



A
B
0
1 V/cm
0
5 ns/cm

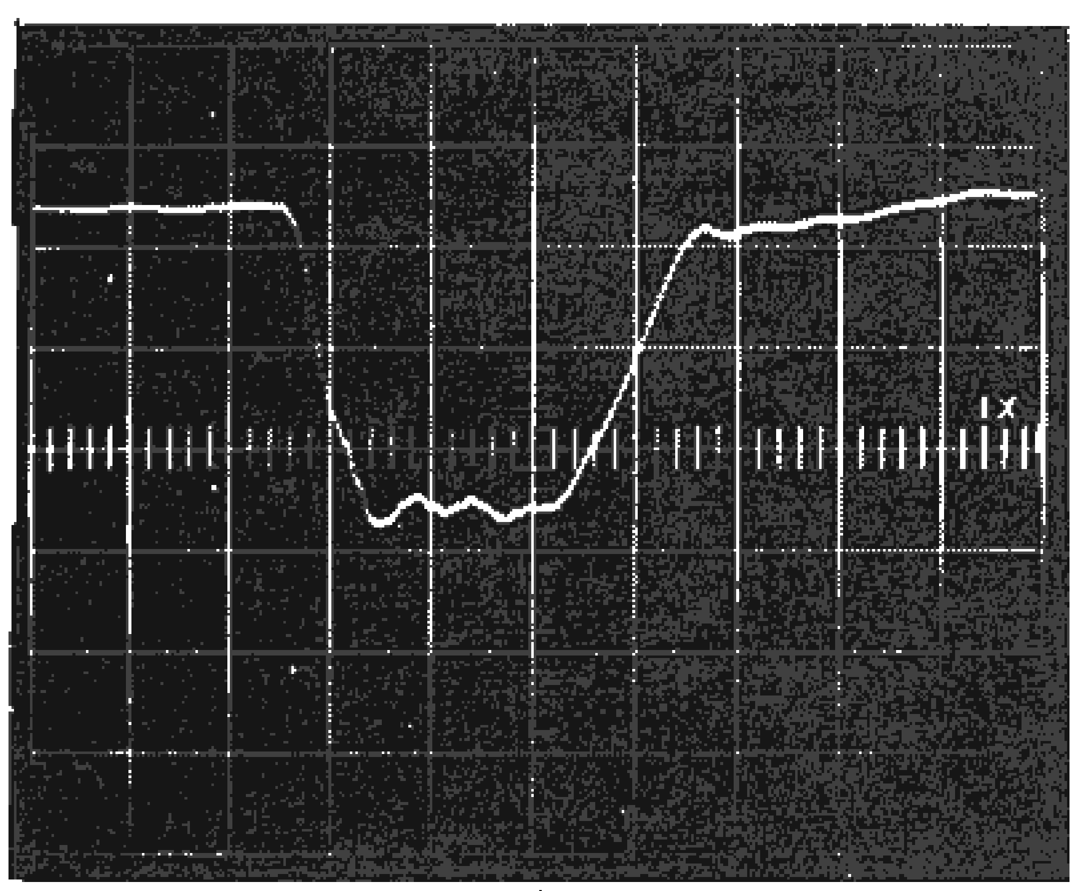
A. Base TS238
B. Base TS246

8'



A
B
0
1 V/cm
0
10 ns/cm

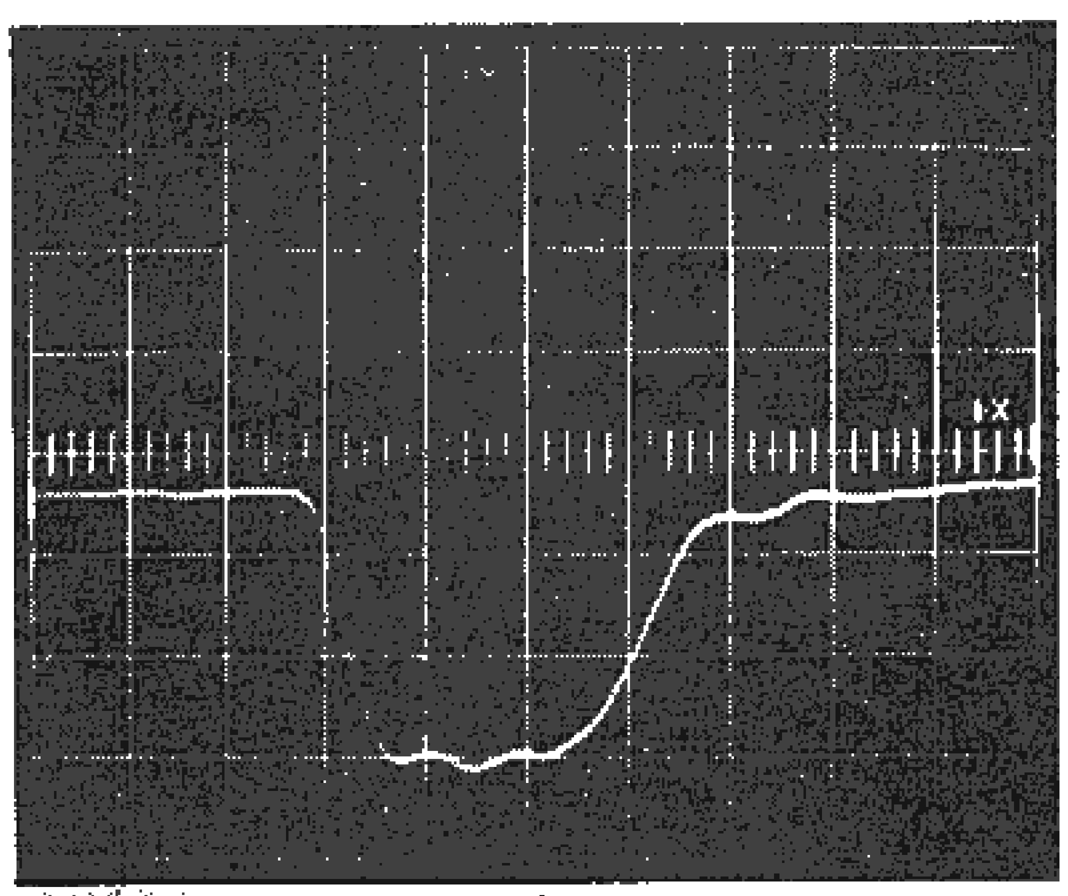
Double pulse mode
Delay time adjusted to 50 ns
A. Base TS238
B. Base TS246



2 V/cm
0
5 ns/cm

Anode CR248

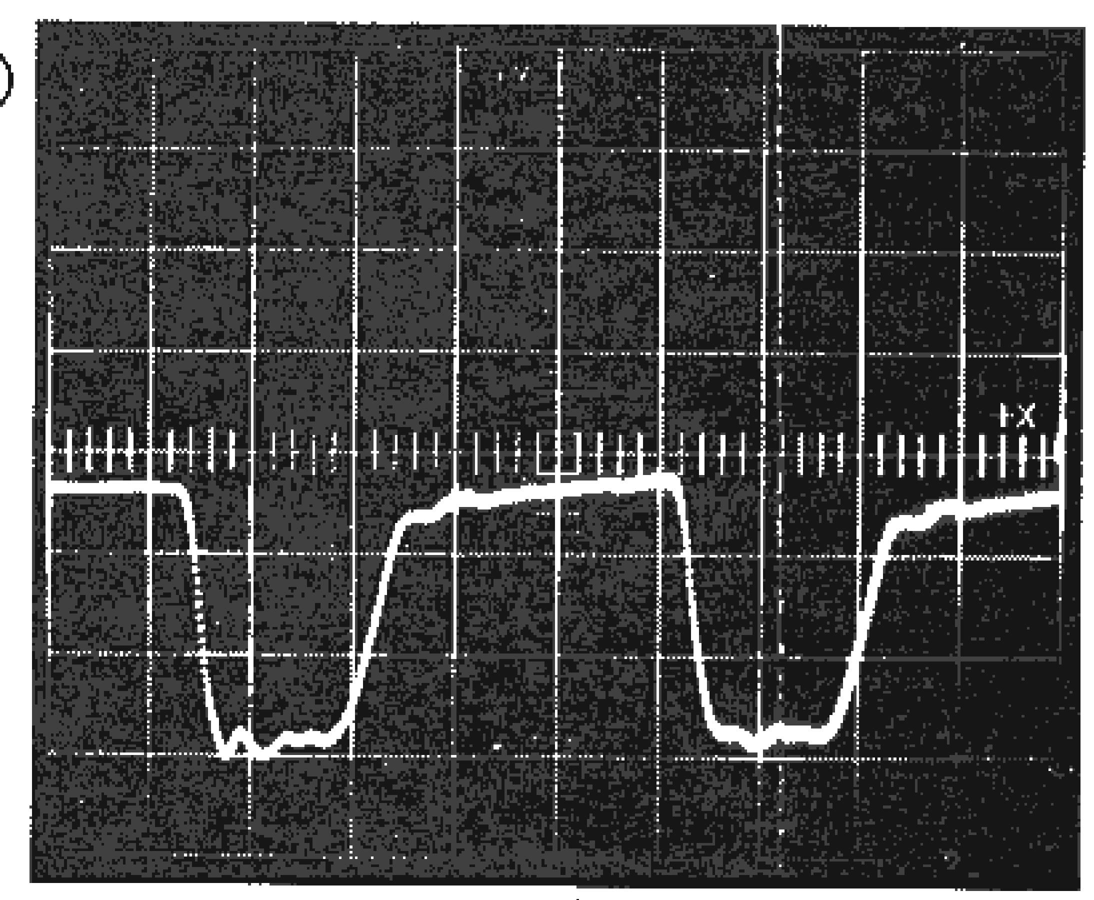
10



0
2 V/cm
5 ns/cm

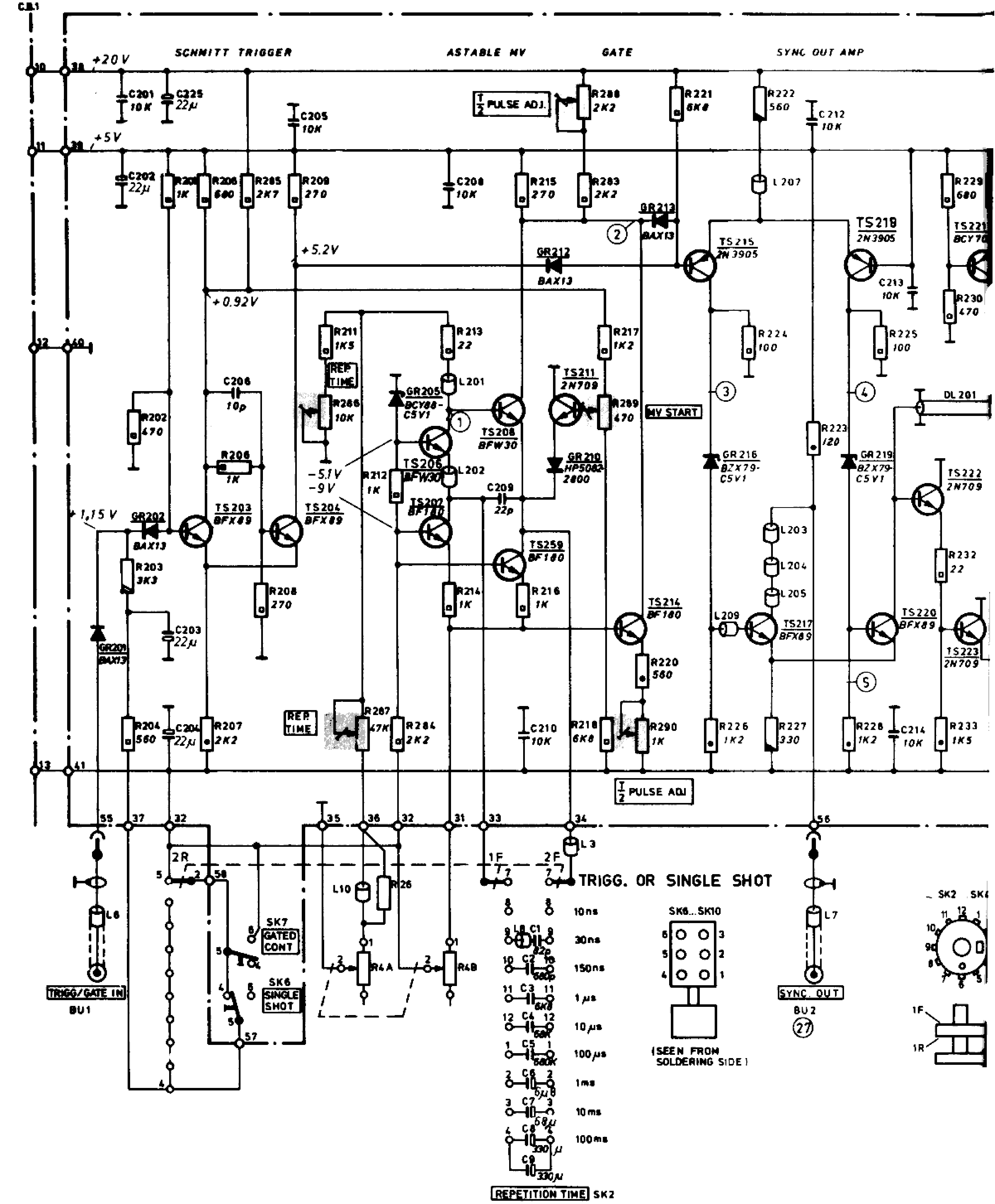
Emitter TS255

10'

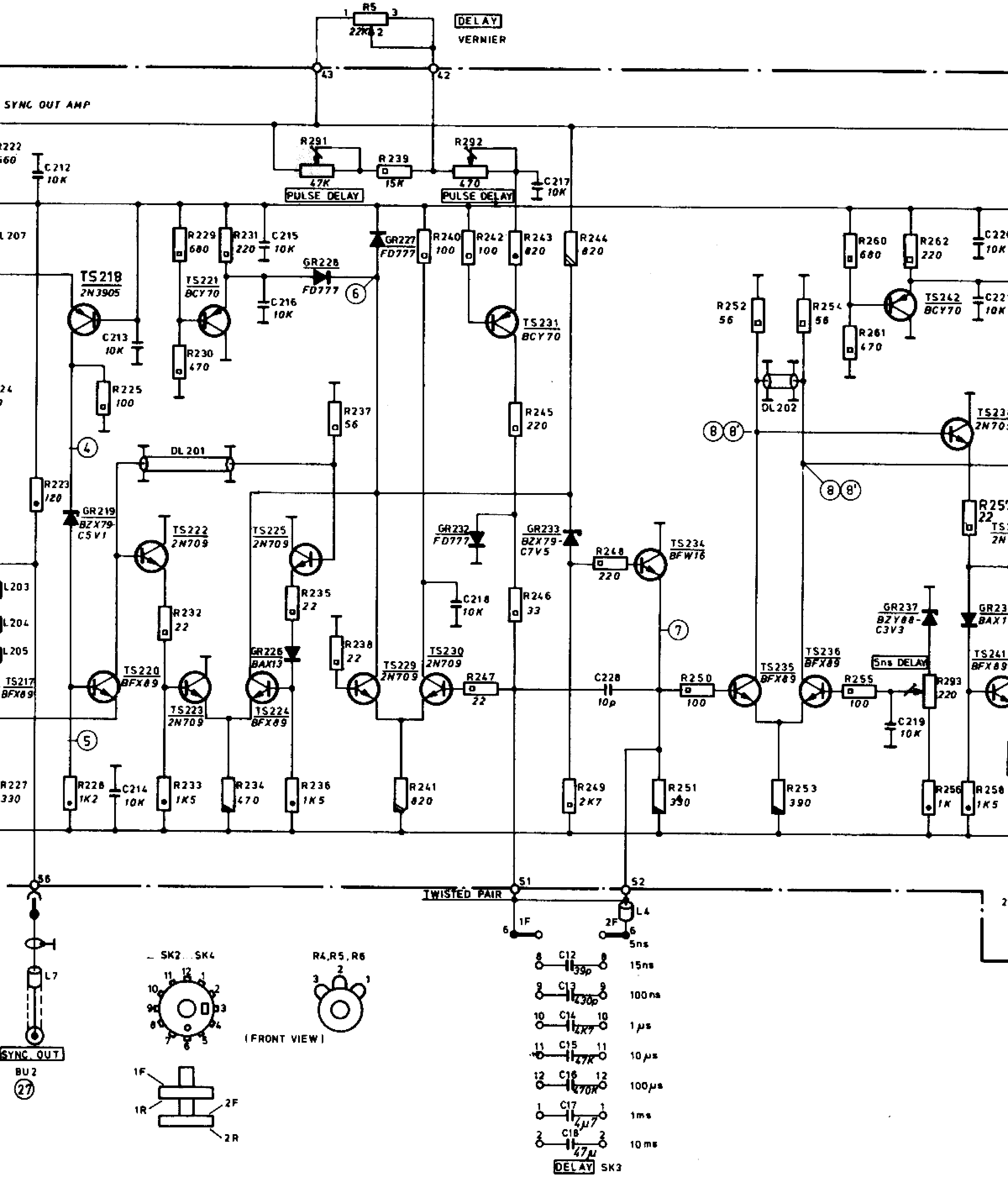


0
2 V/cm
10 ns/cm

Double pulse mode
Delay time adjusted to 50 ns
Emitter TS255



C.B.1
SCHMITT TRIGGER
ASTABLE MV
GATE
SYNC OUT AMP
+20V
+5V
+5.2V
+0.92V
+1,15V
-5.1V
-9V
T/2 PULSE ADJ.
REP. TIME
MV START
TRIGG. OR SINGLE SHOT
SK7 GATED CONT
SK6 SINGLE SHOT
TRIGG/GATE IN
BU1
SYNC. OUT
BU2
SK6...SK10
(SEEN FROM SOLDERING SIDE)
REPETITION TIME SK2
10ns
30ns
150ns
1 µs
10 µs
100 µs
1ms
10ms
100ms
TS203 BFX89
TS204 BFX89
TS205 BFW30
TS202 BF180
TS208 BFW30
TS211 2N709
TS259 BF180
TS214 BF180
TS215 2N3905
TS217 BFX89
TS218 2N3905
TS220 BFX89
TS222 2N709
TS223 2N709
TS221 BCY70
GR201 BAX13
GR202 BAX13
GR205 BCY88-C5V1
GR210 HP5082-2800
GR212 BAX13
GR213 BAX13
GR216 BZX79-C5V1
GR219 BZX79-C5V1
DL 201



DELAY
VERNIER
SYNC OUT AMP
PULSE DELAY
PULSE DELAY
TS218 2N3905
TS221 BCY70
TS231 BCY70
TS242 BCY70
TS222 2N709
TS225 2N709
TS234 BFW16
TS220 BFX89
TS223 2N709
TS224 BFX89
TS229 2N709
TS230 2N709
TS235 BFX89
TS236 BFX89
DL201
DL202
5ns DELAY
TWISTED PAIR
SYNC. OUT
BU2
SK2...SK4
R4,R5,R6
(FRONT VIEW)
15ns
100ns
1 μs
10 μs
100μs
1ms
10 ms
DELAY SK3

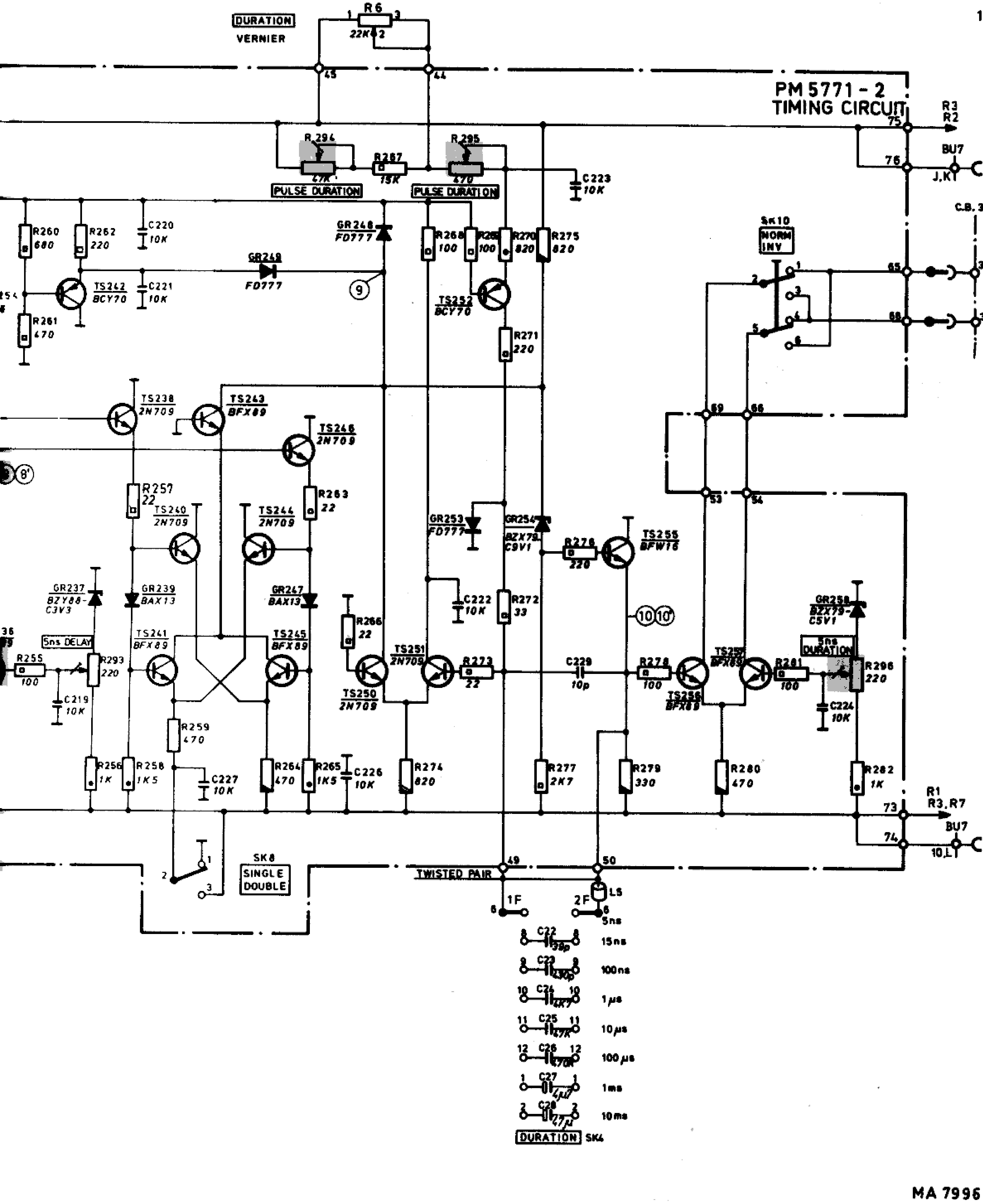
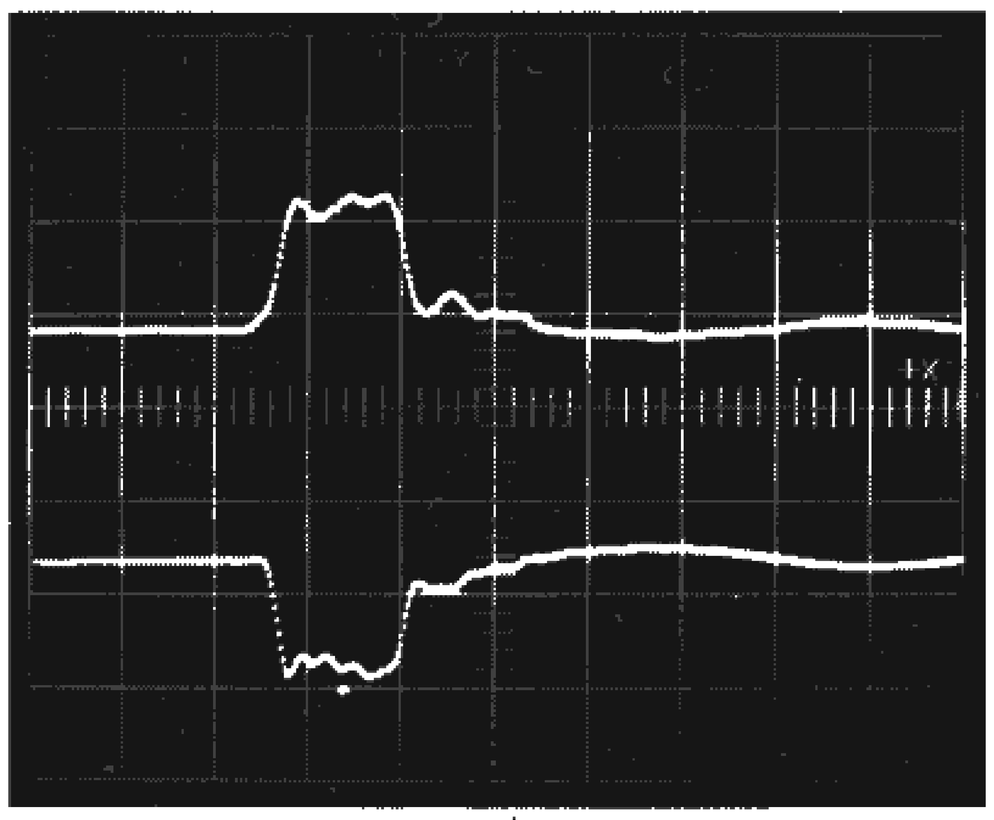


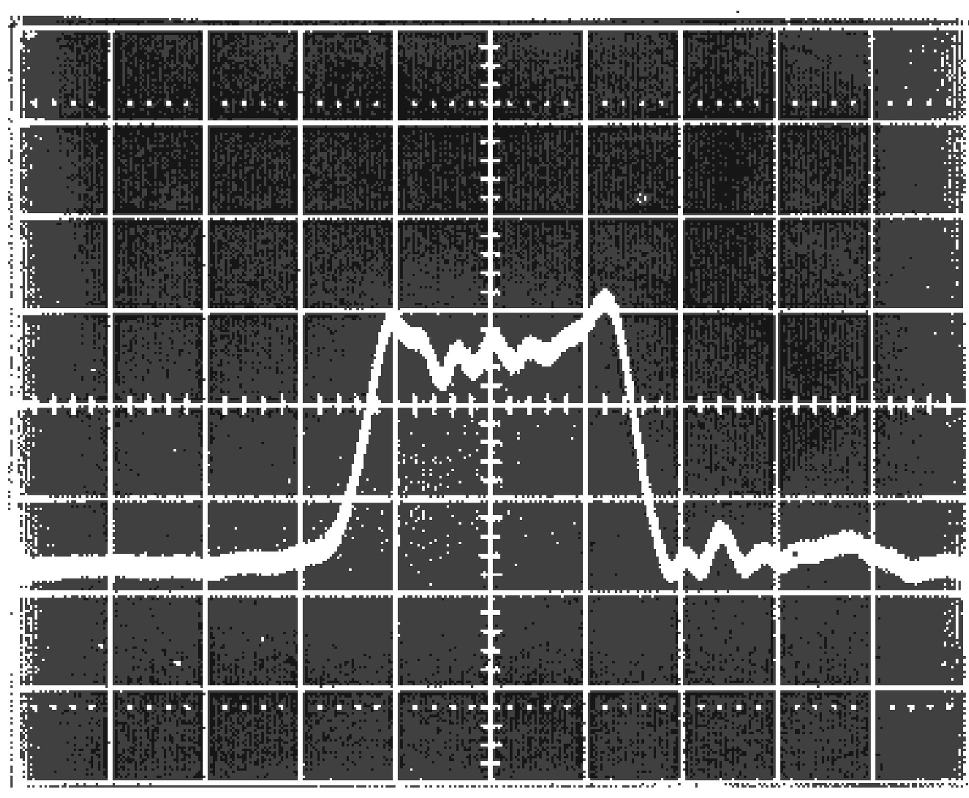
Fig. XIII-5. Circuit diagram, timing circuit PM 5771-2

(11)



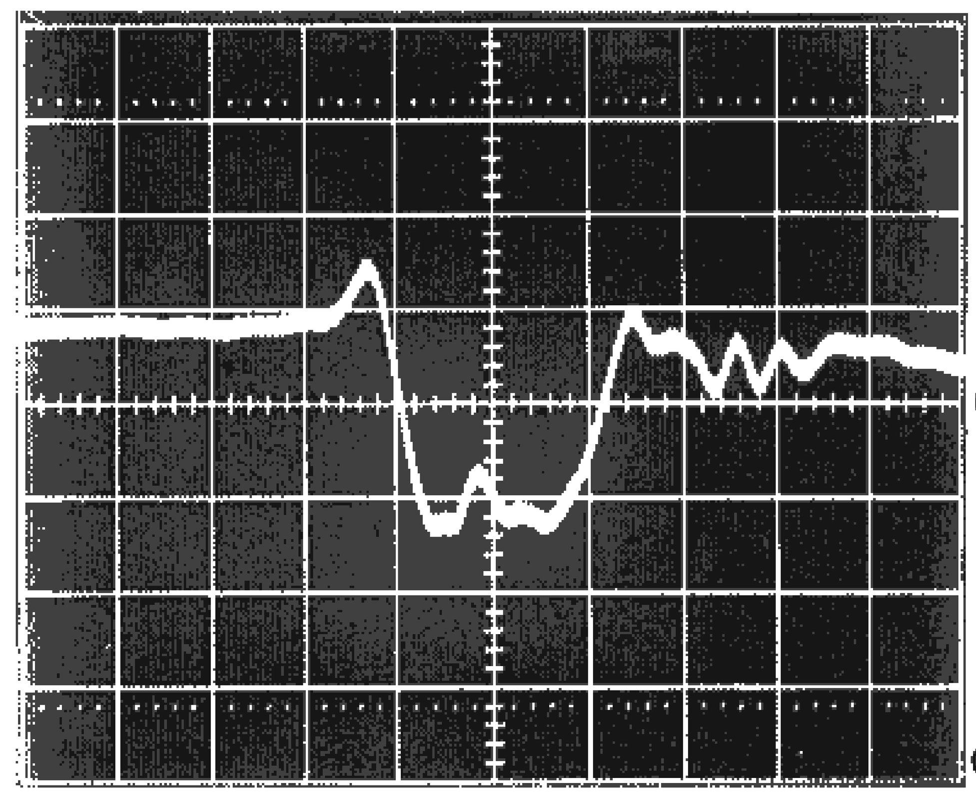
A. Collector TS256 (pin 301)
B. Collector TS257 (pin 302)

(12)



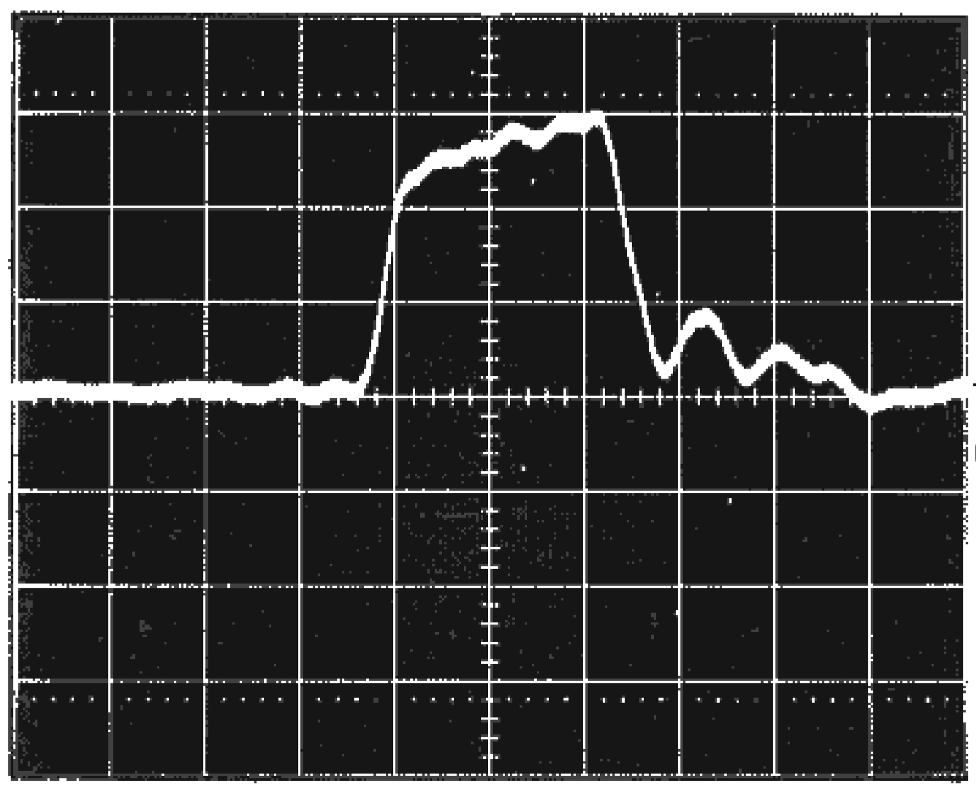
Collector TS301

(13)



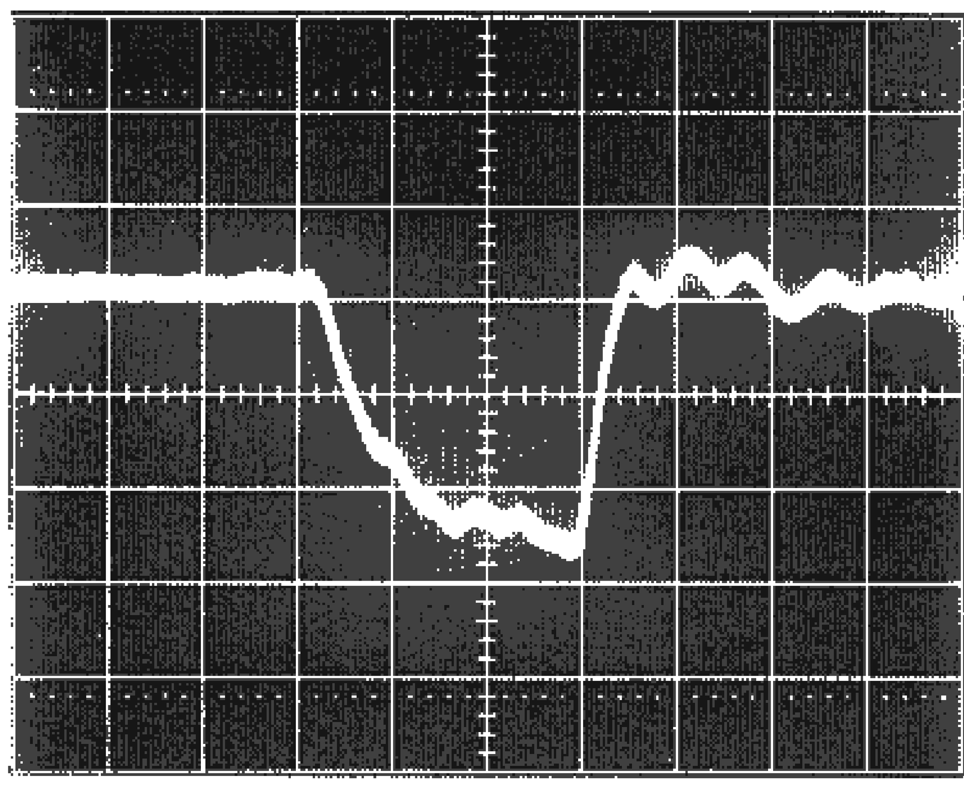
Collector TS302

(15)



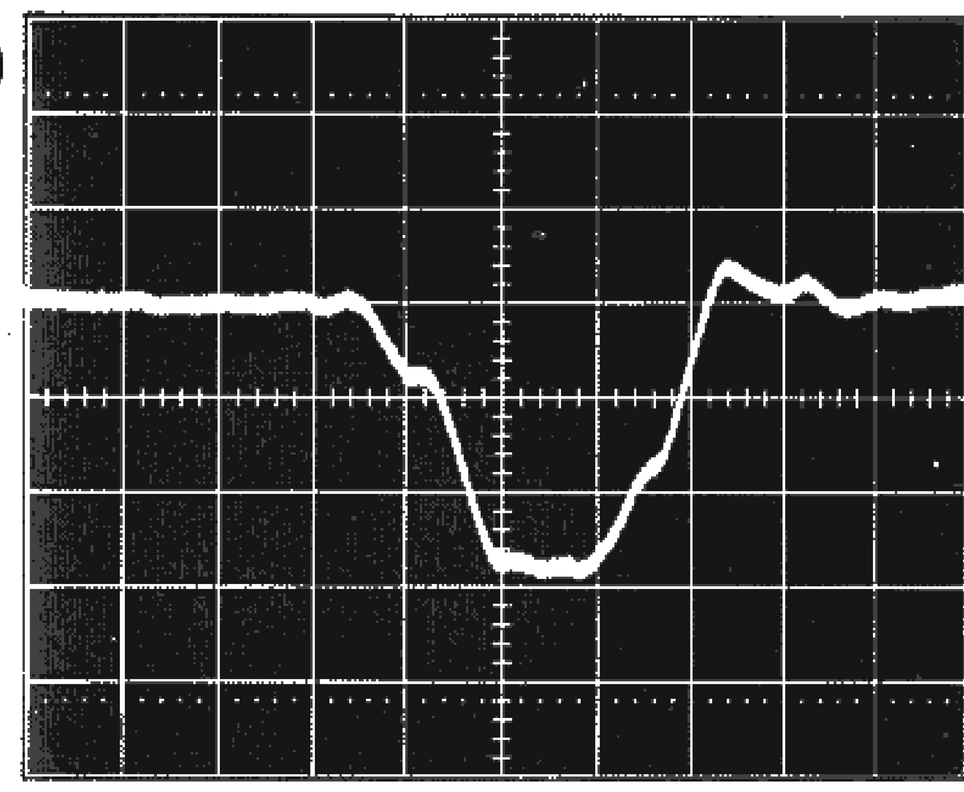
Collector TS310

(16)



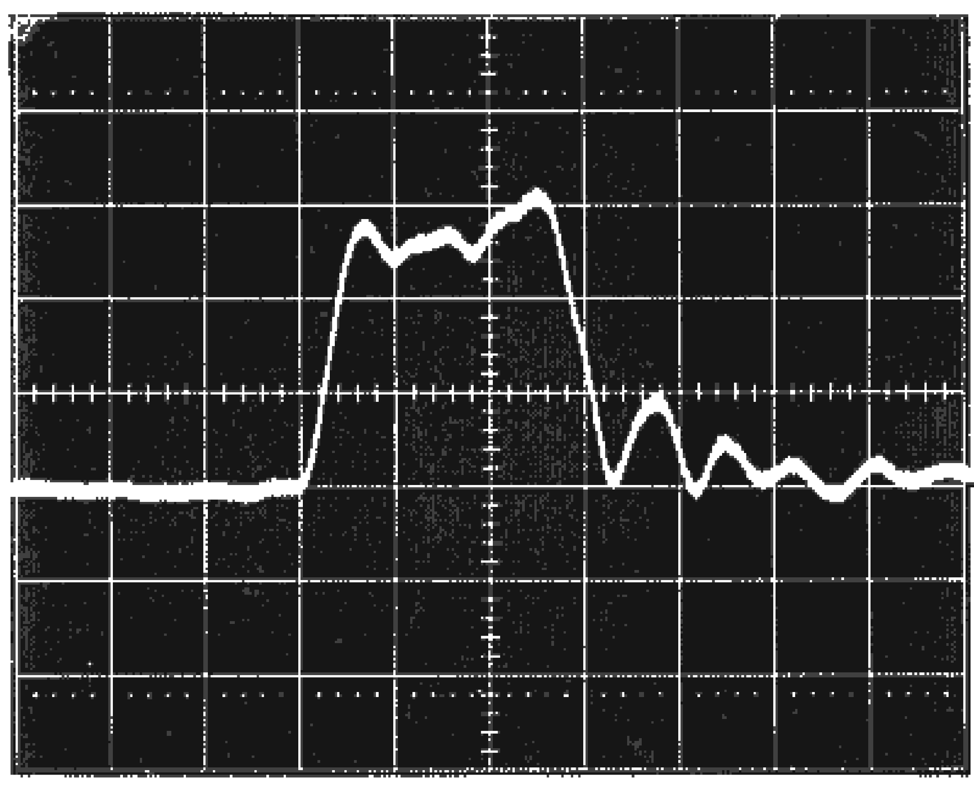
Collector TS314

(17)



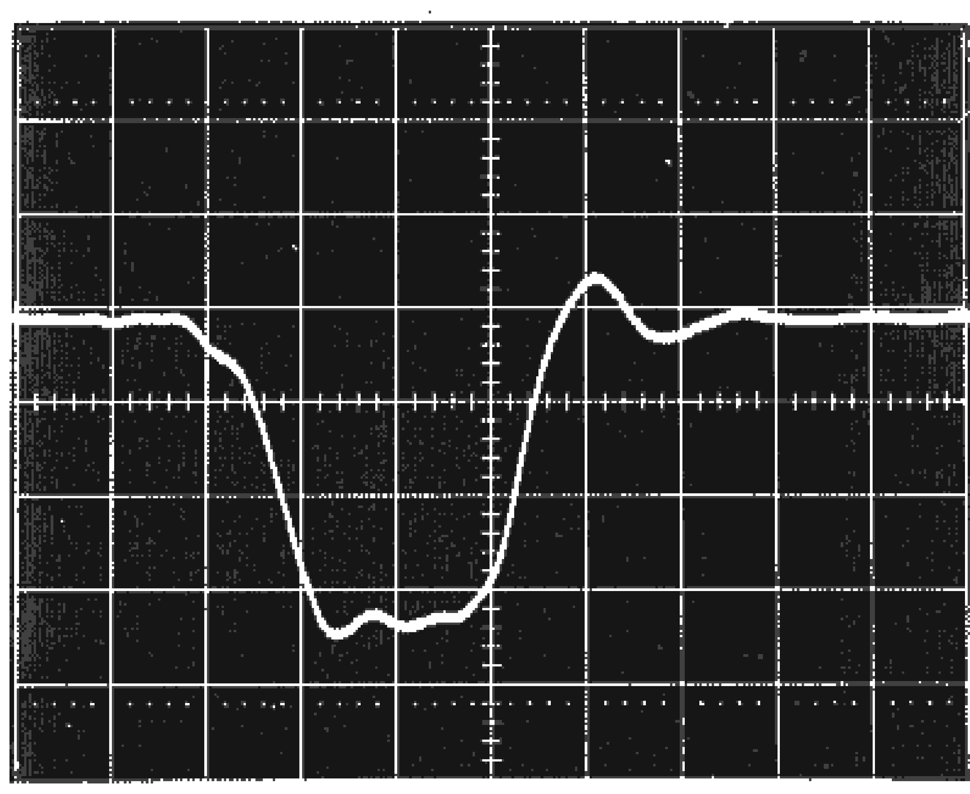
Collectors TS315/316

(19)



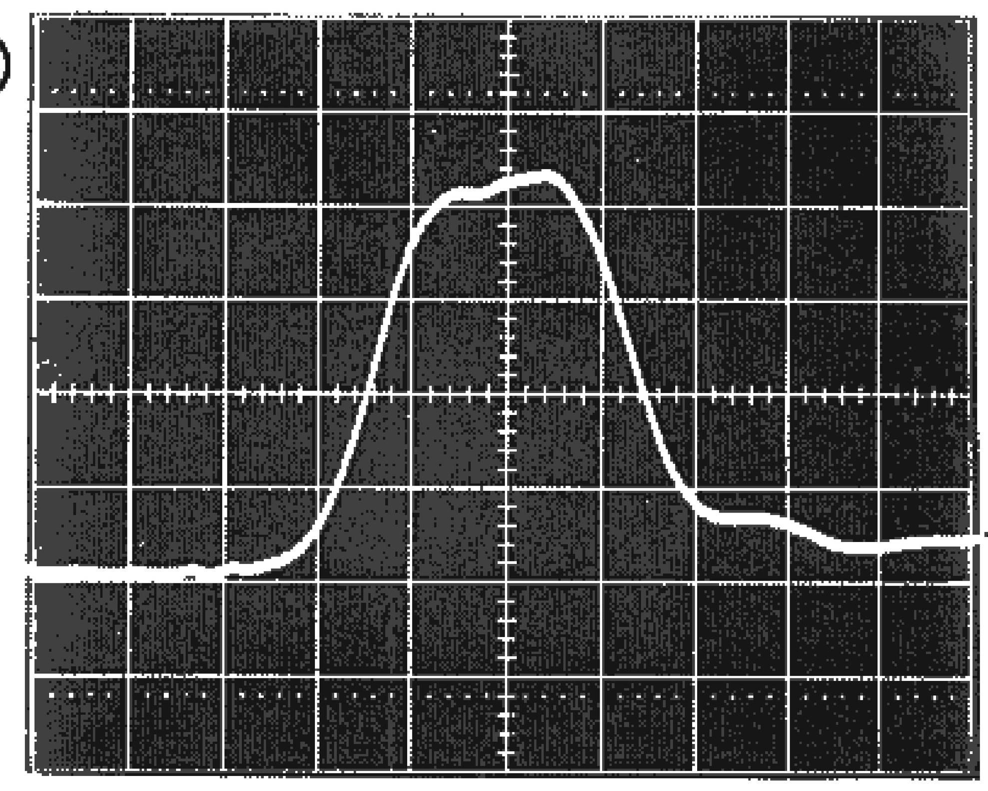
Anode GR302

(20)



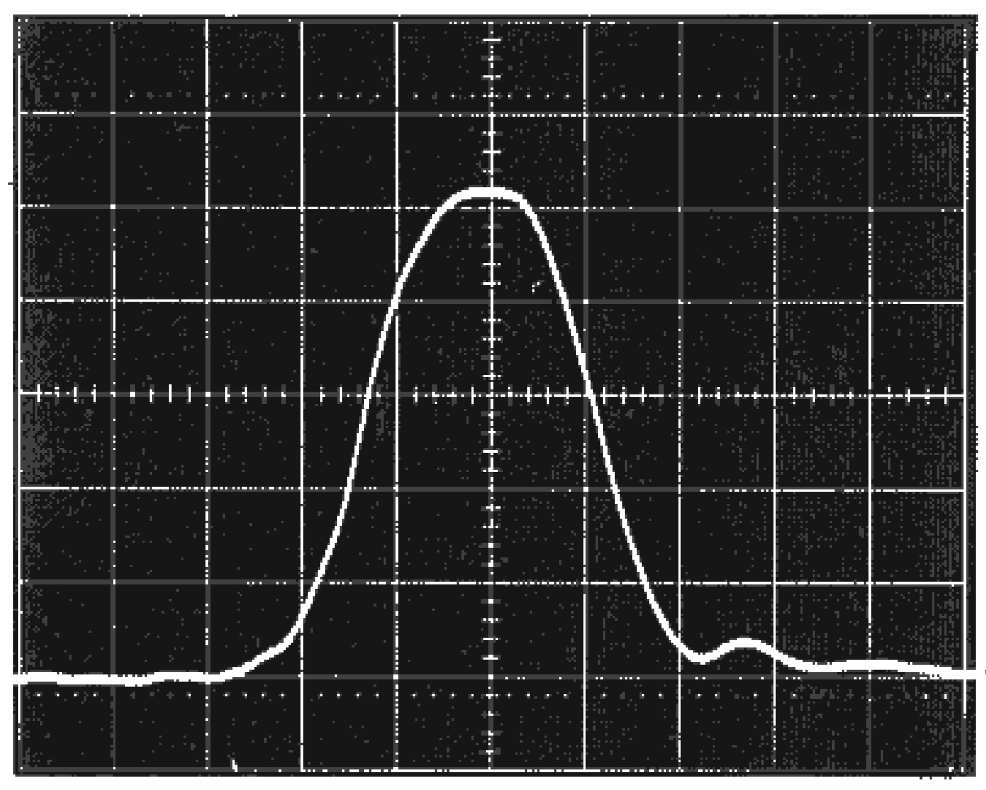
Cathode GR309

(21)



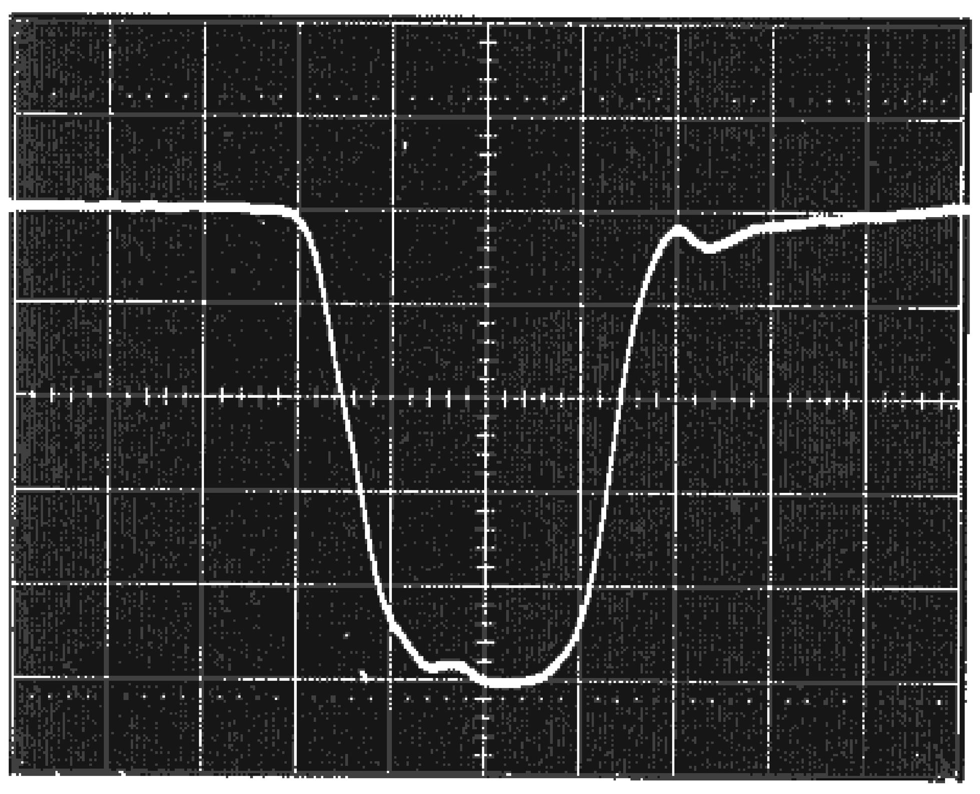
Collector TS333

(23)



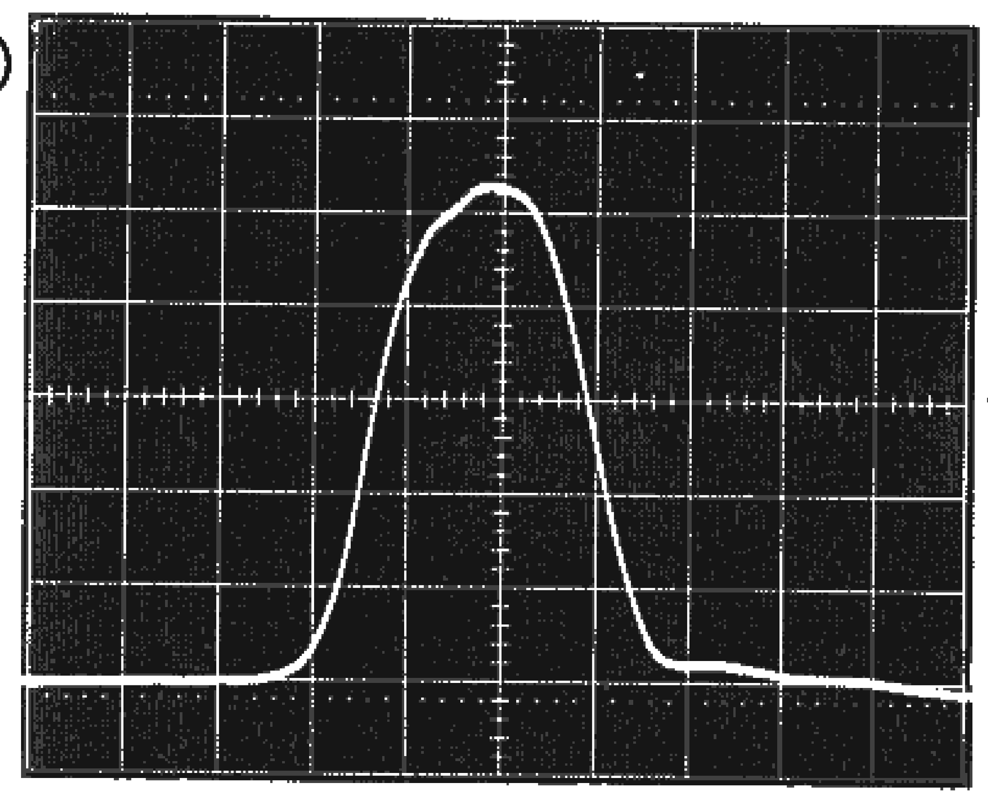
Base TS343

(24)



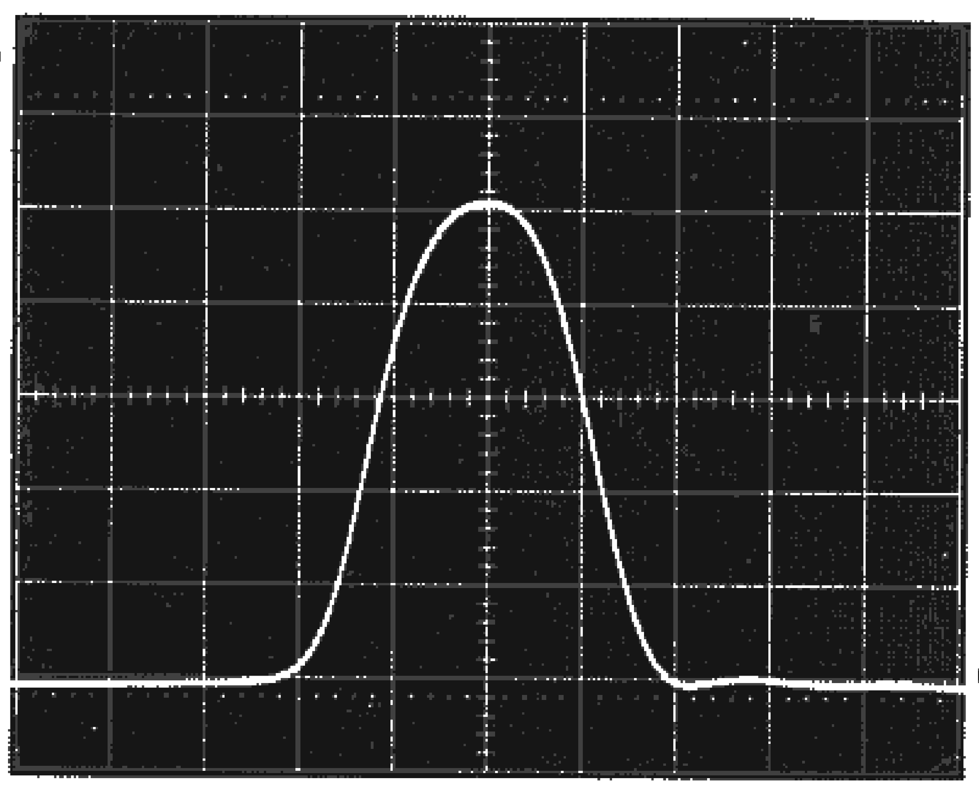
Collector TS344

(25)



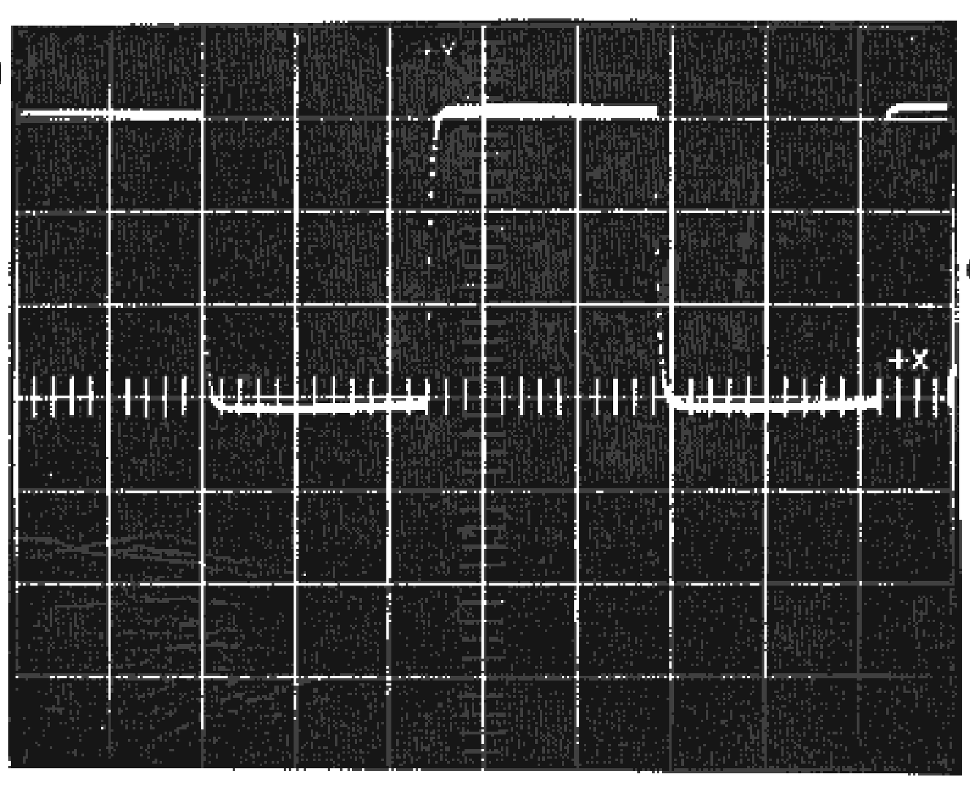
Collector TS348

(26)



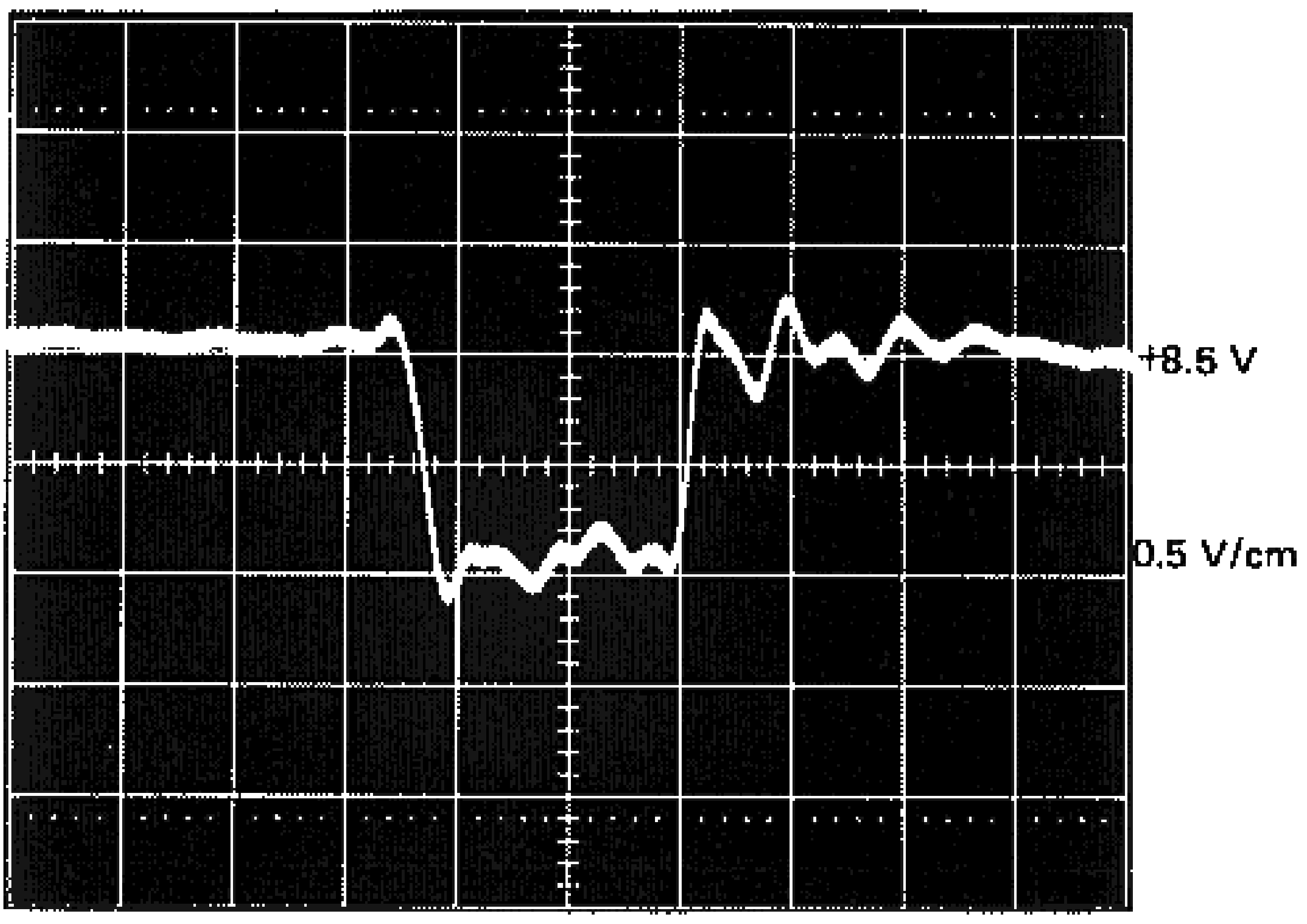
PULSE OUT, BU3 positive pulse

(27)



Sync. output pulse at socket SYNC. OUT (P2)

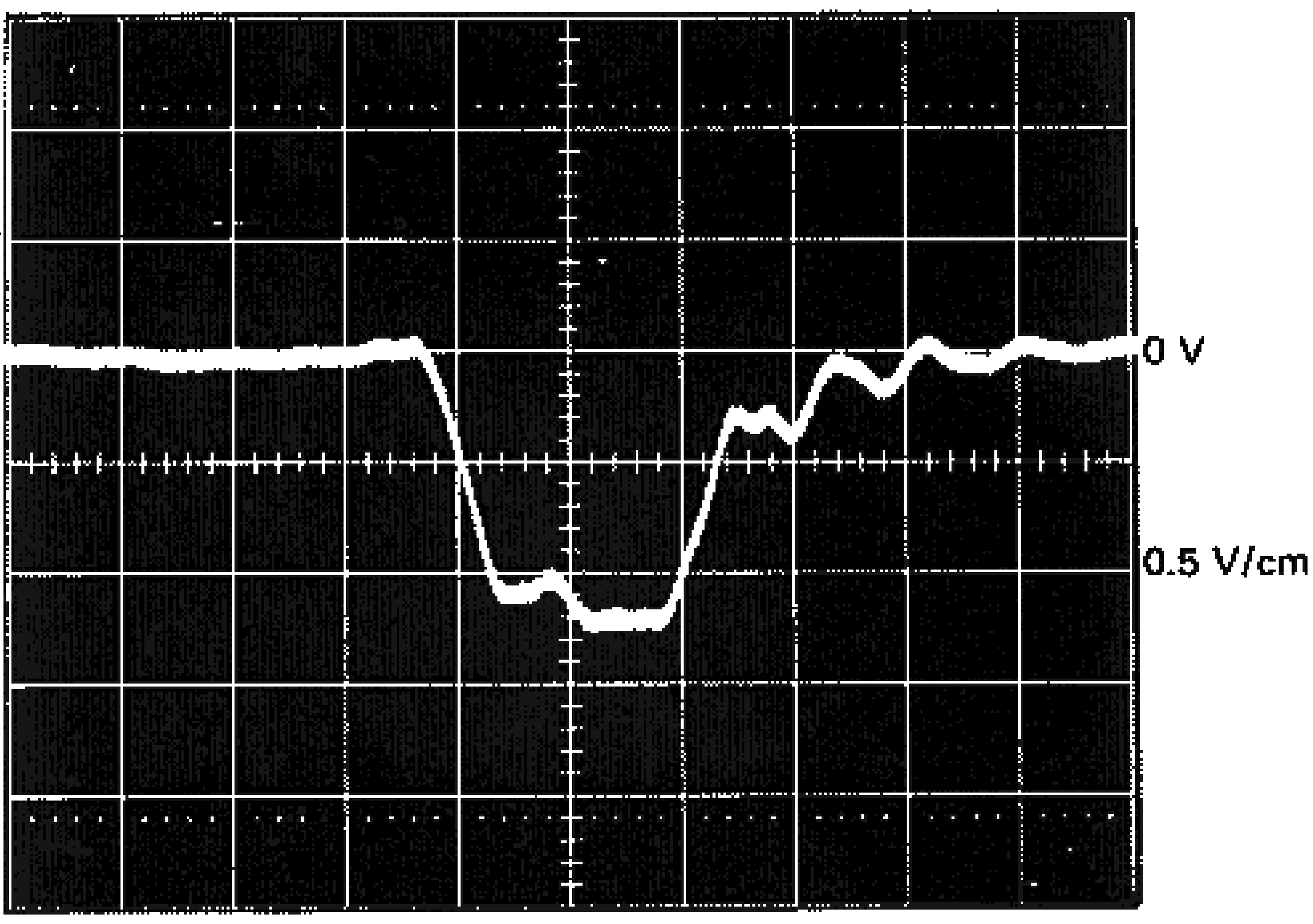
⑭



2 ns/cm

Collector TS308

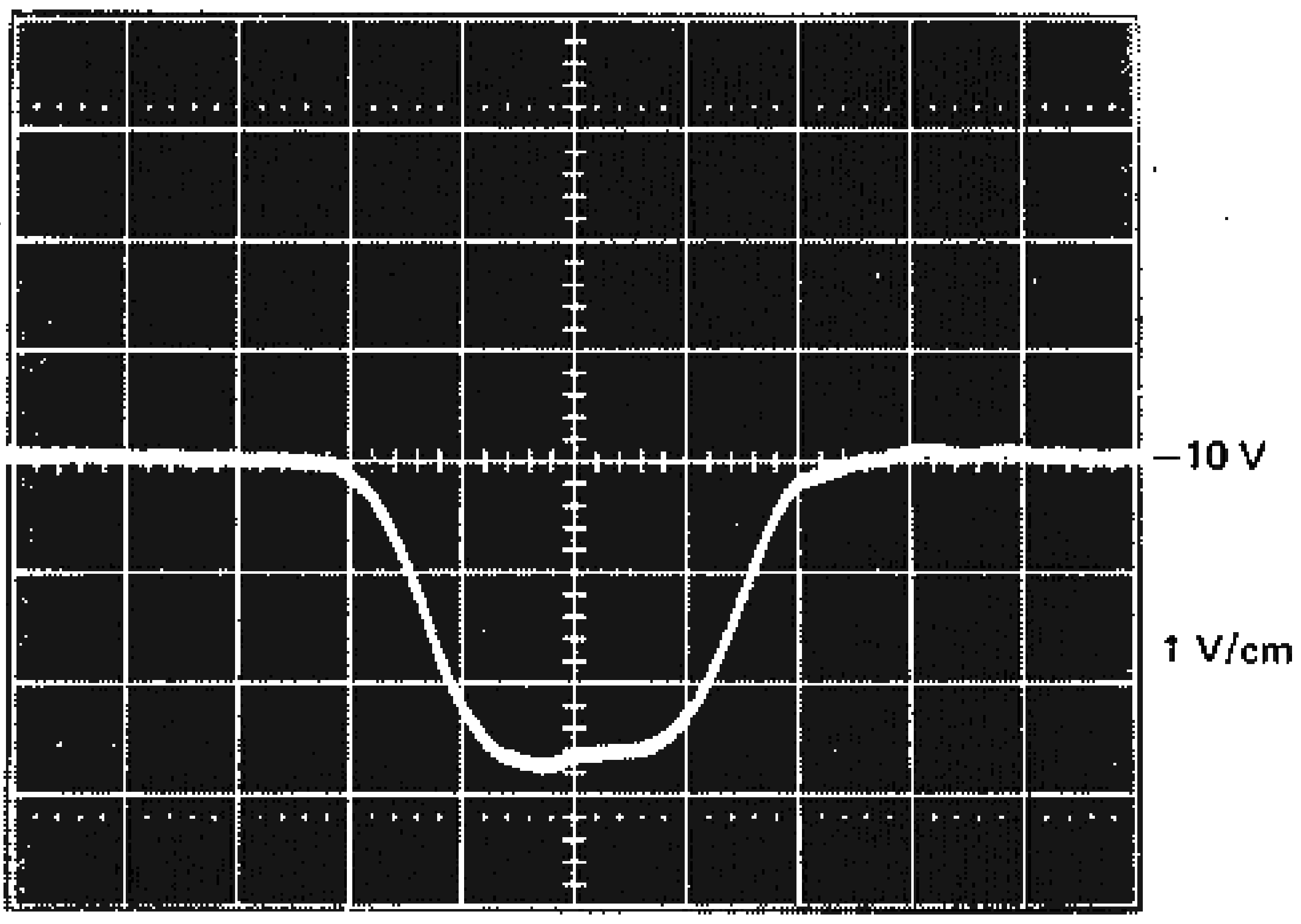
⑱



2 ns/cm

Collector TS318

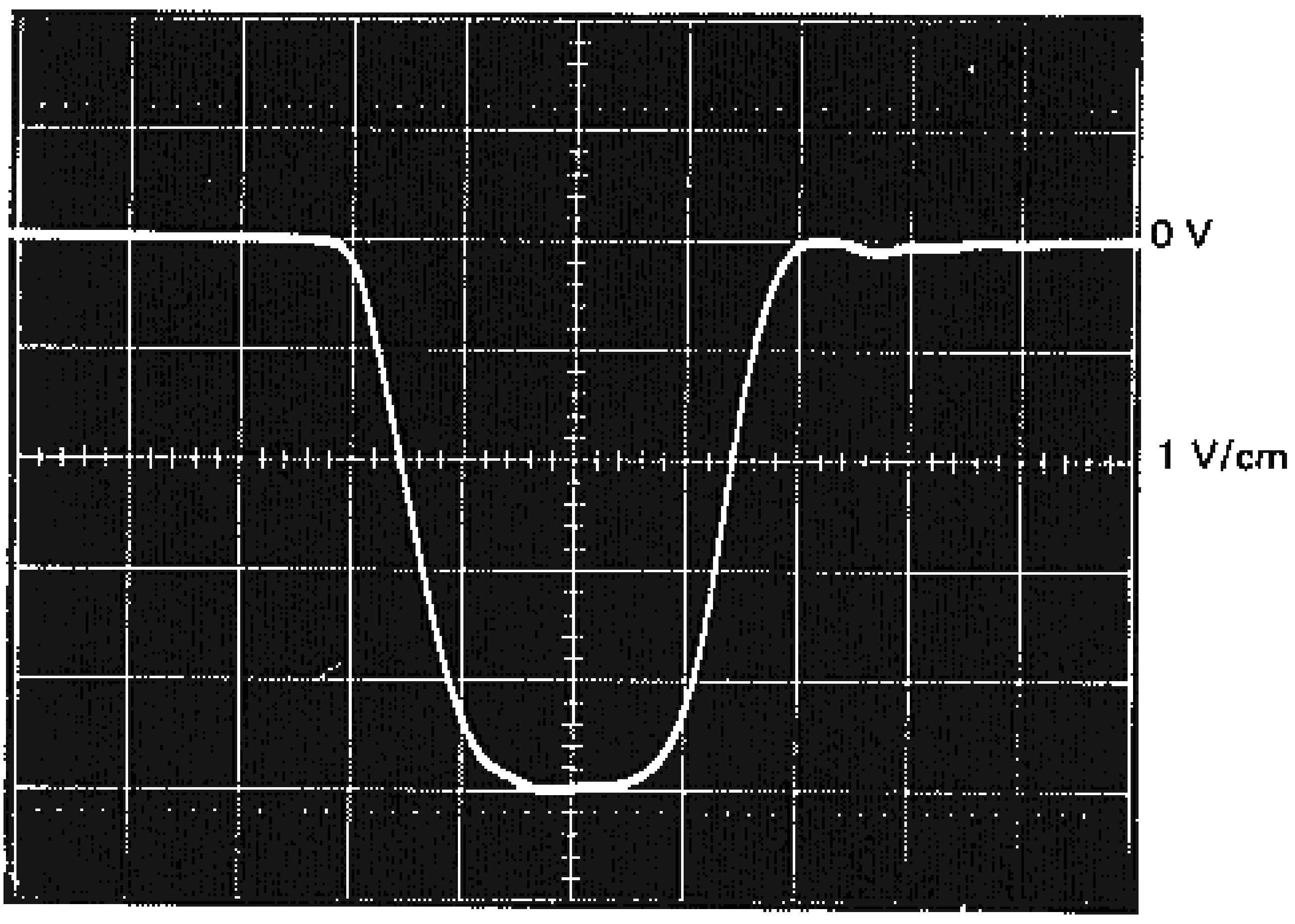
㉒



2 ns/cm

Base TS336

26a



2 ns/cm

PULSE OUT, BU3 negative pulse

DIFFERENTIAL AMPLIFIERS
RAMP. GENERATOR
FALL
RISE
+20V C.B.2 p.75
-20V C.B.2 p.73
BU 7
C.B.2
+20V
-20V
0V
R301 2K2
R302 56
R303 2K74
R304 6K81
R305 82
R306 2K00
R307 2K00
R308 150
R309 750
R310 82
R311 56
R312 2K2
R313 1K50
R314 1K50
R315 150
R316 1K0
R317 392
R318 33
R319 33
R320 680
R321 33
R322 33
R323 562
R324 1K50
R325 56
R326 56
R327 332
R328 10
R329 150
R330 820
R331 470
R332 470 REF LEVEL ADJ
R333 560
R334 100
R335 270
R336 220
R337 15
R338 220
R339 15
R340 470
R343 15
R344 120
R345 332
R346 22K
R347 1K8
R3162 22
C301 100µF
C302 0.22µF
C303 100µF
C304 0.22µF
C305 0.01µF
C306 0.01µF
C307 0.01µF
C308 0.01µF
C310 0.01µF
C311 0.01µF
L301
L302
L303 4B
L304 4B
L305 4B
L306 4B
L307 330µH
L308 330µH
TS301 BFW92
TS302 BFW92
TS303 BC107B
TS304 BFW92
TS305 BFW92
TS306 BC107B
TS307 BFW92
TS308 BFW92
TS309 BC107B
TS310 BFW93
TS311 BFW93
TS312 BC107B
TS313 MPSL08
TS314 MPSL08
TS315 MPSL08
TS316 BFW93
TS317 BFW93
TS318 BFW93
GR301 BZX79-B15
GR302 BZX79-B15
-1.2V
+2V
+5.1V
+7.8V
+8V
R10*
R11*
R1
RZ
REAR VIEW
R1, R3, R7
* Selected

PM5771-3
RAMP TIME
SK1
5 μs - 100 μs
250 ns - 5 μs
20 ns - 250 ns
2.4 ns - 20 ns
BU7
RAMP. GENERATOR
AMPL. LIMITER
+20V
C.B.2 p75
FROM VERSION-/02: 39nF
CLIPPING ZERO LEVEL ADJ
CLIPPING LEVEL ADJ.
MAX. AMPL ADJ
AMPLITUDE
+8V
0V
R386
b TS334
VIEW FROM SOLDERING SIDE
SK9
PM5771-2
-20V
C.B.2 p73

PHASE INVERTER
POS. PULSE AMPLIFIER
NEG PULSE AMPLIFIER
+20V
0V
-20V
-20V ("-") 0V ("+")
e TS329
R378
R392 100
R386 180
R3161 1K5
C328 47p
R387 470
ZERO LEVEL ADJ. CLIPPING CIRCUIT
R388 680E
GR312 5082-2835
TS332 BFW30
-9V
C327 0.01μ
R389 1K0
R390 1K5
R391 392
R393 332
R394 82.5
GR313 BZX79-C7V5
GR314 BZX79-C4V7
TS333 BFW93
TS334 BFW93
R395 120
C329 0.022μ
R3100 220
R399 330
TS335 BFW92
R396 1K2
R397 180
ZERO LEVEL ADJ. POS PULSE
C330 0.01μ
R3102 1K0
+1.5V
R3101 5K6
TS336 BFW16A
R398 120
TS337 BFW16A
R3103 267
TS338 BFW93
R3104 120
TS339 BFW16 A
R3105 1K00
R3106 22
R3107 267
R3108 22
C331 0.01μ
R3109 56
R3110 56
R3111 243
R3112 221
C332 0.22μ
C333 0.01μ
TS340 BFX49
TS341 BFX49
TS342 BFW16A
TS343 BFW16A
R3113 47.5
R3114 47.5
R3115 270
R3116 120
C334 0.1μ
C335 470p
R3117 47.5
R3118 47.5
R3119 120
C336 22p
R3121 75.0
R3122 68.1
R3123 1K5
C337 0.022μ
C342 33p
R3124 75.0
R3125 68.1
R3126
C338 15p
22...150 (VERSION -/01)
56...330 (FROM VERSION -/02)
TS344 BFR64
-13V
C339 0.01μ
C340 0.01μ
R3120 47
-13.5V
C341 0.01μ
L310 4B
L311 100μH
R3132 1K5
R3127 274
R3128 1K0
R3129 2K00
R3130 150
C346 0.01μ
TS346 BFW30
TS345 BFW30
-12.4V
R3131 249
R3135 1K05
GR315 BAX13
GR316 BAX13
R3133 1K0
R3134 267
TS347 2N5583
TS348 2N5583
TS349 BC177
C343 1.0 u
C344 0.68μF
C345 001μ.
C347 0.01μ
C348 0.01μ
+12V
R3138 1K0
TS352 BC177
R3139 270
R3140 866
-14V
-15.5V
TS350 2N2219
TS351 2N2219
R3136 33
R3137 33
R3141 267
C350 0.1μ
C349 0.01μ
R3143 1K30
R3142 1K00
+11.3V
R3144 100
C351 0.22μ
REAR VIEW
R3
TOP VIEW
RE 301
RE 302
✱ IN VERSION -/01 ONLY
FUNCTION OF REED SWITCH
NO CURRENT
CURRENT FLOWS
C.B.2


PM5771-3
OUTPUT CIRCUIT
DC-OFFSET
PROTECTION CIRCUIT
PM5771-4
FROM VERSION -/02
RE302 PIN 7-8
"INTERNAL 50Ω" SWITCH
POLARITY SWITCH
ATTENUATOR SWITCH
RE301
RE302
RE303
BU3 PULSE OUT
BU7 DC OFFSET
C.B.2-75 +20V
-20V C.B.2-73
+20V SK9-3
SK9-4
+11,3V
-15,5V
C.B.2 +20V ("–") p.78
0.2V
0.5V
1V
2V
5V
10V
MA8001
DIAGRAM DRAWN IN SWITCH POSITIONS
"±", SK9:"–"

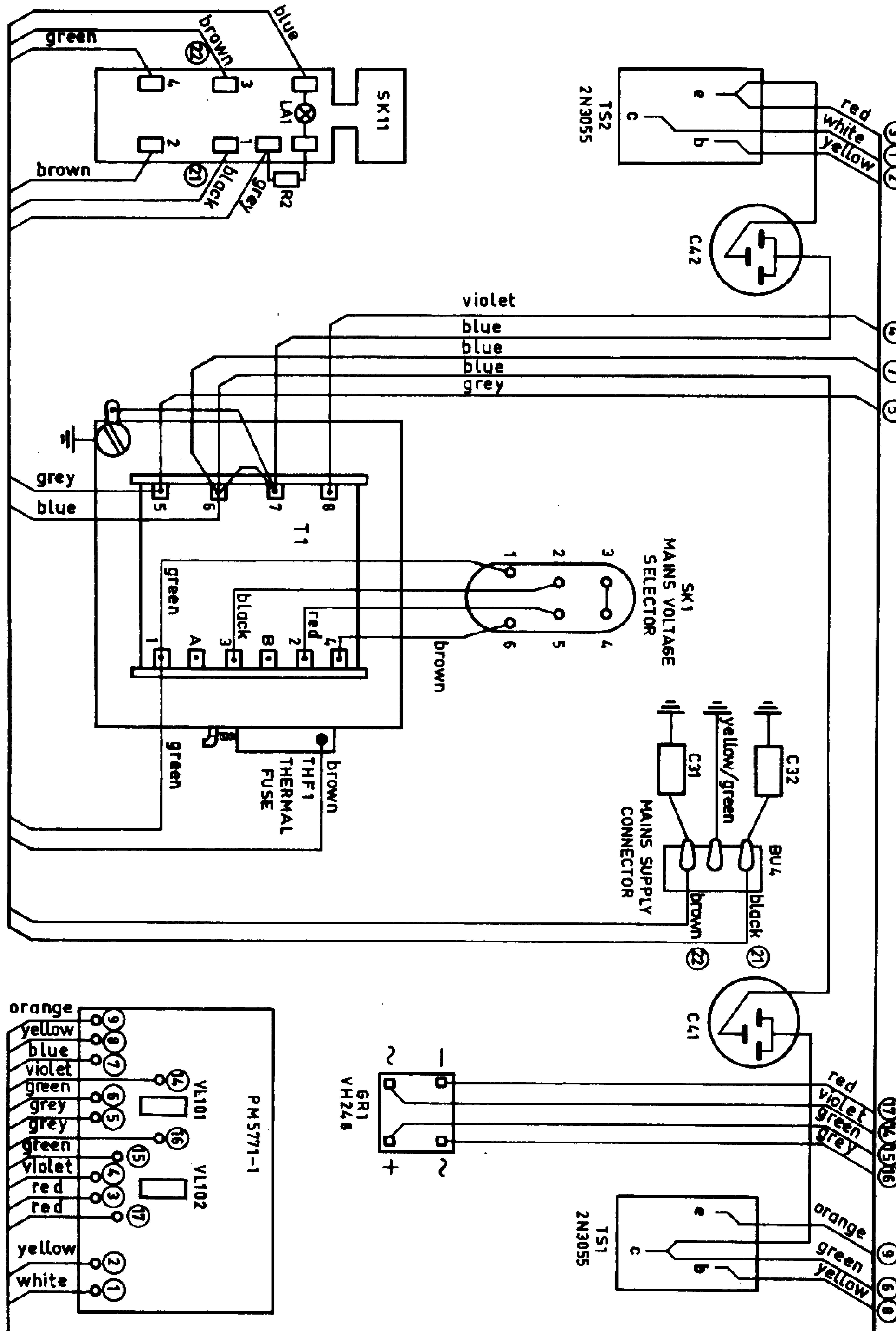


Fig. XIII-10. Wiring diagram of rear panel