

# PHILIPS

## SERVICE NOTES

for the  
Cathode-ray oscilloscope

### GM3156-01



1953

#### GENERAL DATA

##### VERTICAL DEFLECTION AMPLIFIER

Frequency range : 0.1 c/s - 40 kc/s (70%)  
10 Mohm (R8 fully anti-clockwise)

Input impedance : 0.5 Mohm - 2 Mohm (dependent on pos.  
SK5)

Sensitivity : 1 mV r.m.s./cm image height

Cathode-ray tube B1 : Type DR10-5

##### Tubes

B2 : 6F6N  
B3 : 6F6N  
B4 : 6F6N  
B5 : 6F6N  
B6 : 1876  
B7 : AZ1  
B8 : ECH21  
B9 : 6C50  
La1 : 85A1  
La2 : 85A1

##### TIME BASE

Frequency range : Adjustable from 0.25 c/s - 9 kc/s in 10  
steps, as well as continuously.

##### Mains voltage :

Adaptable for :  
110V, 125V, 145V, 200V,  
220V and 245V (40-100c/s)

##### Consumption

approx. 65 W  
Weight :  
approx. 23 kg

##### Dimensions

Height : 35 cm } handgrip  
Width : 25 cm } and knobs  
Length : 46.5 cm } included

##### Amplitude control

Directly indicated in mV r.m.s./cm image height with an error of  $\pm 15\%$ .

##### Connection available for

- The 5000 V power-supply unit GM 4188 or GM 4198 (Bu19)
- The large screen apparatus GM 4590 (Bu8)

LIST OF ILLUSTRATIONS

- Fig. 1 Circuit diagram  
 Fig. 2 View right-hand side chassis  
 Fig. 3 View left-hand side chassis  
 Fig. 4 Bottom view chassis  
 Fig. 5 Front view of the apparatus  
 Fig. 6 Rear view of the apparatus  
 Fig. 7 Frequency response curve of vertical amplifier  
 Fig. 8 Simplified diagrams of the 6 positions of SK3  
 Fig. 9 Power transformer  
 Fig. 10 Switch segments

B. APPLICATION

Owing to its extensive frequency range, from 0.1 c/s - 40,000 c/s this oscilloscope can be used for examining vibrations of very low frequencies (up to 0.5 c/s), as well as of high-frequency vibrations.

C. CIRCUIT DESCRIPTION

The oscilloscope consists of the following components :

- |     |  |
|-----|--|
| I   | Cathode-ray tube   |
| II  | Time-base generator  |
| III | Push-pull amplifier for vertical deflection                                    |
| IV  | Power supply for cathode-ray tube, time-base generator and vertical amplifier. |

C I Cathode-ray tube (B1)

This tube is provided with a post acceleration anode for photographic- and projection purposes. A voltage of max. 5000 V can be applied to this anode by connecting the power-supply unit GM 4188 or GM 4198 to socket Bu19, so that a considerably brighter image can be produced. Bu8 is used for the connection of the large screen apparatus GM 4590.

C II Time-base generator

The time-base generator supplies an asymmetrical saw-tooth voltage and consists of a charging tube (B8) and a gas-filled discharge tube (B9).

The frequency can be adjusted :

- In steps, by means of SK4, which switches one or several of the charging capacitors C20-C29 into the circuit.
- For intermediate values, by means of R7, which controls the screen-grid voltage of B8.

The amplitude of the saw-tooth voltage is adjusted by means of R6, which controls the grid voltage of B9.

Synchronization (fig. 8)

The synchronizing voltage is applied to R5. The triode part of B8 functions as a synchronization amplifier and supplies the amplified

voltage to the control grid of B9. Three synchronization possibilities can be applied by means of SK3 :

Position 1 (Internal synchronization)

R5 is connected to a part of the vertical deflection voltage, viz. via the voltage divider R36, R37.

Position 2 (External synchronization)

R5 is connected to Bu4, to which the synchronizing voltage is applied.

Position 3 (Synchronization with the mains frequency)

R5 is connected to part of the alternating voltage across S2', viz. via the voltage divider R47, R48.

In position 5 external synchronization of low-frequency phenomena can be obtained by connecting a contact device, operated by the object under test, to the socket Bu3 and Bu4. Synchronization is then obtained by the periodically breaking contact.

In position 6 the light spot on the screen will disappear towards the left and re-appear at the left after a few seconds. The light spot can be adjusted at the left-hand side by means of R1. When sockets Bu3 and Bu4 are short-circuited, the time base becomes effective. When the short-circuit is removed, the light spot jumps back to the left.

C III Push-pull amplifier for vertical deflection

Attenuator

R11-R19, combined with SK5, can vary the input sensitivity of the vertical amplifier in a number of steps. A continuous adjustment of the sensitivity can be effected by means of R8. For maximum sensitivity R8 should be turned fully anti-clockwise. Via C1 and R21, Bu6 is then directly connected to the control grid of B2.

Amplifier

The vertical deflection is symmetrical, whereas the alternating voltage supplied to the control grid of B2, is asymmetrical. As a result of the unbypassed cathode resistor R22 and the grounded grid circuit of B3, the anodes of B2 and B3 are supplied with alternating voltages of opposite phase.

Bu4 and Bu5 constitute a normal push-pull output stage. The signal is applied to the vertical-deflection plates in B1, via C7 and C16.

C IV Supply part

The high tension for the cathode-ray tube is obtained from a rectification of the alternating voltage across S2' and S3 of T1, by means of B6. The alternating voltage across S2 and S2' of T1, after being rectified by B7, serves for supplying the vertical amplifier. La1 and La2 stabilize the screen-grid voltages of B2, B3, B4 and B5. The ignition of La2 is promoted by R69. The post-acceleration anode of B1 is connected to the supply voltage +1 via R65. In normal use there is a post-acceleration voltage of approx. 1300 V with respect to the cathode. Image brightness and focussing are adjusted by means of R3 and R4 respectively.

C V Image shift

Horizontal image shift is effected asymmetrically by means of R1. A symmetrical vertical image shift is possible by means of R2, R2'. In the middle position of R1 and R2-R2', their moving contacts have a zero potential with respect to the last anode of B1.

D. CHECKINGD I Time basea. Line length

In all positions of SK4, R6 being turned fully clockwise, the length of the horizontal line on the screen should be greater than 80 mm.

b. Frequency

Set SK3 in position 1. Connect an A.F.-generator (e.g. GM 2307) to the sockets Bu5 and Bu7 and adjust SK5 and R8 for a sufficiently large image. Then check the time-base frequencies in the positions 1 - 10 of SK4 with a line length of 80 mm on the screen.

Position SK4	Line length 80 mm	
1	0.25 -	2.0 c/s
2	0.5 -	4.0 c/s
3	1.0 -	8 c/s
4	2.5 -	20 c/s
5	6 -	50 c/s
6	20 -	160 c/s
7	50 -	400 c/s
8	150 -	1200 c/s
9	450 -	3500 c/s
10	1200 -	9000 c/s

If the lower limit of one or more time-base ranges cannot be obtained, then adjust R9 (in pos. 7, R7 turned fully anti-clockwise), for a frequency of approx. 45 c/s. After this, check the other position of SK4 again and, if necessary, slightly adjust R9.

The lowest frequencies up to 5 c/s, can be determined by means of a stopwatch.

c. Centring

Set SK3 to pos. 4, SK5 to pos. 1 and R8 fully anti-clockwise. It should now be possible to adjust the position of the light spot at least 5 cm from the centre of the screen, in a horizontal direction by means of R1, in a vertical direction by means of R2-R2'.

Adjusting the potentiometer R2-R2'

1. Connect a meter between the moving contact of R2 (at the front) and the chassis.
2. Loosen the set screw in the adjusting ring of R2'.
3. Adjust R2 for zero reading on the meter.

4. Remove the meter connection from the moving contact and connect the meter to the moving contact of R2'.
5. Adjust R2' for zero reading on the meter (retain knob in that position).
6. Tighten the set screw.

#### D II Amplifier

##### a. Frequency-response curve

The frequency-response curve is represented in fig. 7. R8 should be turned fully clockwise and SK5 set to pos. 1 mV/cm. At 40 kc/s the amplification should not be reduced by more than 30 % of the amplification at 100 c/s.

##### b. Sensitivity

Turn R8 fully clockwise, so that SK2 switches to a higher impedance. Apply a signal of 3 mV, 50 c/s, to sockets Bu5 and Bu6. The image height should be at least 30 mm.

##### c. Attenuator

In the various positions of SK5 the actually measured sensitivities should not differ more than  $\pm 15$  % from the sensitivities stated on the text plate.

##### d. Hum

With SK5 in pos. 1 and R8 turned fully anti-clockwise, no hum may be visible on the line, at a time-base frequency between 2 and 3 c/s.

##### e. Stability

1. At rapid mains-voltage fluctuations between 200 and 245 V, the image line may not fluctuate more than 5 mm up and down.
2. Lower the mains voltage from 220 V to 200 V. The stabilizer tubes La1 and La2 should remain burning. Switch off the apparatus. After switching on, the tubes should re-ignite.

#### D III Synchronization

##### Pos. 1 of SK3

Time base : internal  
Synchr. : internal

At a 50 c/s-signal and a 25 c/s-time-base frequency and a image height of 2 cm, it should be possible to obtain a stationary image by means of R5.

##### Pos. 2 of SK3

Time base : internal  
Synchr. : external

See pos. 1, this time, however, connect a voltage of 15 V, 50 c/s to sockets Bu3 and Bu4. The image should likewise be stationary.

Pos. 3 of SK3

Time base : internal  
Synchr. : mains frequency

In this position, the time-base generator is synchronized by the mains frequency. The synchronization voltage is adjustable by means of R5.

D IV Cathode-ray tube

1. With a sinusoidal image of 3 complete cycles and a height of 4 cm, no perceptible astigmatism should occur.
2. The horizontal and vertical deflection should deviate no more than  $2^{\circ}$  from  $90^{\circ}$ .

D V Voltages and currents

These have been indicated in the circuit diagram and have been measured by means of the valve voltmeter GM 7635. Max. permissible error 20 %. When measuring, turn the knobs fully anti-clockwise with the exception of R1 and R2-R2', which must be adjusted to zero and of SK4, which should be turned fully anti-clockwise.

The no.load voltages of the supply transformer are indicated in fig. 9.

E. REPLACEMENT OF PARTS

E I Taking the chassis out of its case

After removal of the 3 screws and the earth connection at the rear of the apparatus, the chassis can be slid out of its case.

E II Front panel

For the replacement of one or more potentiometers, the front panel must be removed.

1. Remove the knobs
2. Unscrew the fixing rings of sockets Bu1-Bu7.
3. Remove the following 8 screws :
  - a. 4 around the cathode-ray tube
  - b. 2 on either side of the cathode-ray tube
  - c. 2 at the sides of the chassis

E III Cathode-ray tube

1. Remove the H.T.-connection and the tube holder
2. Loosen the 2 knurled screws, which fasten the upper bracket round the tube base and remove this bracket.
3. Slide the lower bracket backwards, after the 2 fastening screws on the chassis have been loosened.
4. The metal screening of the cathode-ray tube is likewise connected to the chassis by means of 2 screws, which are now easily accessible and can be loosened.
5. The tube with screening can now be removed, after the 2 supporting brackets along the tube have been bent away.

**E4 IV Power-supply transformer**

1. Remove the cathode-ray tube (see E3)
2. Unscrew the mounting plate for the voltage adaptor and fuses, at the rear of the apparatus (4 screws).
3. On the cap, covering the transformers, is a clamping plate, relieving the stress of the 2 screened connections. Remove this plate after unsoldering the 2 connections which lead to the sockets at the rear of the apparatus. Do not unsolder the screened connections!
4. Remove the 2 rectifying-stabilizer tubes
5. Unsolder the grey connection to the tube holder of La2
6. Unscrew the 2 screws, fastening the cover to the supporting brackets.
7. Remove the 4 screws, fastening the cover to the chassis.
8. The cover can now be tilted sideways and the transformer can be exchanged.

LIST OF MECHANICAL PARTS

When ordering always state :

1. Code number
2. Description and colour
3. Type number of the apparatus

Pos.	Fig.	Description	Code number
1	2	H.T.-cable	34 008 12/1
2	2	Tube holder B1	49 231 26.1
3	2	Tube holder	49 231 67.0
4	2	Spring	89 312 14.3
5	2	Rubber pad	NA 908 59.0
6	2	Knob without arrow	E2 440 67.0
7	2	Cap	23 653 38.0
8	2	Countersunk screw	07 810 06.1
9	2	Arrow (short)	23 680 53.0
10	2	Knob with arrow	E2 440 54.0
11	2	Cap	23 653 40.0
12	2	Text plate	M7 184 10.0
13	2	Rubberring	E2 475 44.0
14	2	Window with lattic	M7 748 11.0
17	3	Tube holder	B1 505 13.1
		H.F.-cable	34 090 08/134Z
18	3	Hexagonal nut	07 093 02.0
19	3	Insulating ring	49 654 45.0
20	3	Soldering tag	M7 315 51.0
21	4	Inlet pin socket	E2 555 65.0
22	5	Spindle	E3 870 19.0
23	6	Voltage adaptor	A1 138 14.1
24	6	Fuse holder	B1 505 06.0
25	6	Plug socket	E2 555 57.0
26	6	Socket	A3 186 07.0
27	6	Switch	M7 429 75.0
28	6	Hexagonal nut	07 094 02.0
		Mounting support	E2 544 21.0
		Mounting support	E2 544 31.0
		Mounting support	E2 544 41.0
		Bracket for these supports	E2 003 00.0



## GM3156-01

R1		
R2		
R2'	310 Ω	
R3	690 Ω	
R4	<1 Ω	A1 056 29.4
R5	<1 Ω	
R6	<1 Ω	
R7	<1 Ω	
R8	<1 Ω	
C1	0.39 μF	48 106 10/B390K
C2	25 μF	} 48 317 00/25+25
C3	25 μF	
C4	0.39 μF	48 106 10/B390K
C5	0.39 μF	48 106 10/B390K
C6	18 μF	48 211 10/18B
C7	0.39 μF	48 106 10/B390K
C8	0.47 μF	48 106 10/D470K
C9	1.6 μF	48 113 10/K1M6
C10	1.6 μF	48 106 10/V220K
C11	0.22 μF	48 105 10/0220K
C12	0.22 μF	48 106 10/D470K
C13	0.47 μF	48 105 10/V33K
C14	33000 pF	48 106 10/D470K
C15	0.47 μF	48 106 10/B390K
C16	0.39 μF	48 106 10/D470K
C17	0.47 μF	48 106 10/D470K
R1	0.5 MΩ	49 472 26.0
R2	1 MΩ	49 472 34.0
R12	1 MΩ	49 472 34.0
R3	50000 Ω	49 501 06.0
R4	0.5 MΩ	49 472 26.0
R5	0.5 MΩ	49 472 26.0
R6	0.2 MΩ	49 472 31.0
R7	0.2 MΩ	49 472 31.0
R8	0.5 MΩ	49 500 21.1
R9	1000 Ω	49 472 41.0
R10	2000 Ω	49 472 25.0
R11	2x360 Ω	49 999 01/360K ■
R12	820 Ω	49 999 01/820K ■
	750 Ω	49 999 01/750K ■
R13	2x3000 Ω	49 999 01/3K ■
R14	2400 Ω	49 999 01/24K ■
	1300 Ω	49 999 01/13K ■
R15	2x30000 Ω	49 999 01/30K ■
R16	36000 Ω	49 999 01/36K ■
	20000 Ω	49 999 01/20K ■
R17	110000 Ω	49 999 01/110K ■
	160000 Ω	49 999 01/160K ■
R18	1.8 MΩ	49 999 01/18M ■
	2.2 MΩ	49 999 01/22M ■
R19	0.68 MΩ	49 999 01/680K ■
R20	10 MΩ	49 999 00/10M ■
R21	47 Ω	49 999 00/47R ■
R22	330 Ω	49 999 00/330R ■
R23	47 Ω	49 999 00/47R ■
R24	47000 Ω	49 999 00/47K ■
R25	56000 Ω	49 999 00/56K ■
R26	15000 Ω	48 766 05/15K ■
R27	56000 Ω	49 999 00/56K ■
R28	56000 Ω	49 999 00/56K ■
R29	10 MΩ	49 999 00/10M ■
R30	10 MΩ	49 999 00/10M ■
R31	47 Ω	49 999 00/47R ■
R32	270 Ω	49 999 00/270R ■
R33	47 Ω	49 999 00/47R ■
R34	3x0.1 MΩ	49 999 00/100K ■
R35	3x0.1 MΩ	49 999 00/100K ■
R36	0.47 MΩ	49 999 00/470K ■
R37	0.22 MΩ	49 999 00/220K ■
R38	39000 Ω	49 999 00/39K ■

R9		R1 300 30.0
VL1	125°	08 100 97.0
VL2	2.5 A	08 140 48.0
VL3	2.5 A	08 140 48.0
C18	25 μF	} 48 317 11/25+25
C19	25 μF	
C20	4 μF	48 110 10/4M
C21	2 μF	48 110 10/2M
C22	1.2 μF	48 110 10/1M2
C23	0.47 μF	48 106 10/D470K
C24	0.22 μF	48 106 10/R220K
C25	68000 pF	48 106 10/680K
C26	27000 pF	48 106 10/270K
C27	8200 pF	48 104 10/82K2
C28	2700 pF	48 104 10/27K2
C29	1500 pF	48 104 10/15K5
C30	0.47 μF	48 106 10/D470K
C31	0.1 μF	48 105 10/100K
C32	0.47 μF	48 106 10/D470K
C33	0.47 μF	48 106 10/D470K
C34	0.1 μF	48 105 10/100K
R39	56000 Ω	49 999 00/56K
R40	0.47 MΩ	49 999 00/470K
R41	0.12 MΩ	49 999 00/120K
R42	0.27 MΩ	49 999 00/270K
R43	0.47 MΩ	49 999 00/470K
R44	10000 Ω	49 999 00/10K
R45	10 MΩ	49 999 00/10M
R46	10 MΩ	49 999 00/10M
R47	4.7 MΩ	49 999 00/47M
R48	33000 Ω	49 999 00/33K
R49	68000 Ω	49 999 00/68K
	82000 Ω	49 999 00/82K
R50	4700 Ω	49 999 00/47K
R51	0.15 MΩ	49 999 00/150K
R52	1 MΩ	49 999 00/1M
R53	47 Ω	49 999 00/47R
R54	10000 Ω	49 999 00/10K
R55	9.18 MΩ	49 999 00/918K
R56	1000 Ω	49 999 00/1K
R57	0.27 MΩ	49 999 00/270K
R58	0.22 MΩ	49 999 00/220K
R59	0.68 MΩ	49 999 00/680K
R60	82000 Ω	49 999 00/82K
R61	0.22 MΩ	49 999 00/220K
R62	10000 Ω	49 999 00/10K
R63	4700 Ω	49 999 00/47K
R64	0.33 MΩ	49 999 00/330K
R65	1 MΩ	49 999 00/1M
R66	10 MΩ	49 999 00/10M
R69	0.68 MΩ	49 999 00/680K

- - Parallel geschakeld.
- - Parallel connected.
- - Connectées en parallèle.
- - Parallel geschaltet.
- - Conectadas en paralelo.

- - In serie geschakeld.
- - Series connected.
- - Couplées en série.
- - In Reihe geschaltet.
- - Conectadas en serie.

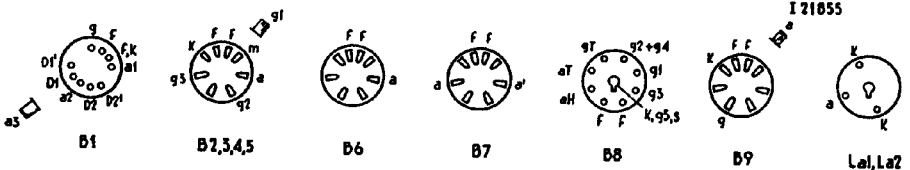
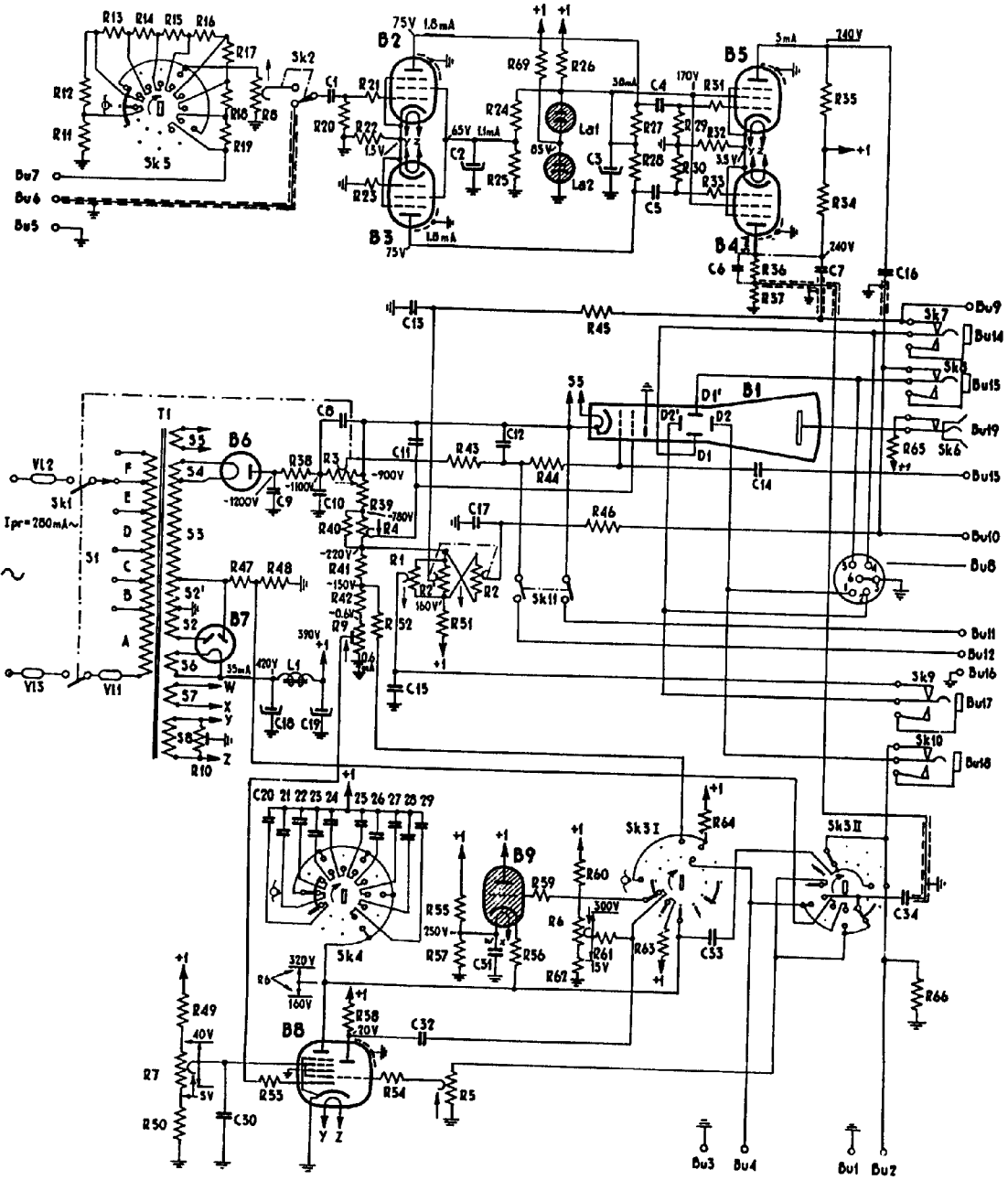


Fig.1

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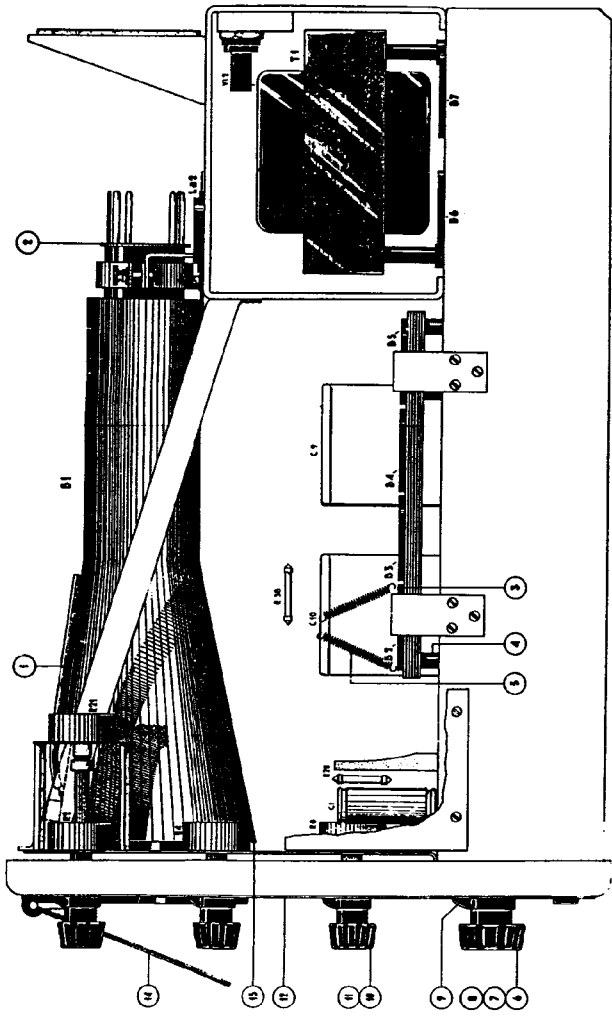


Fig 2

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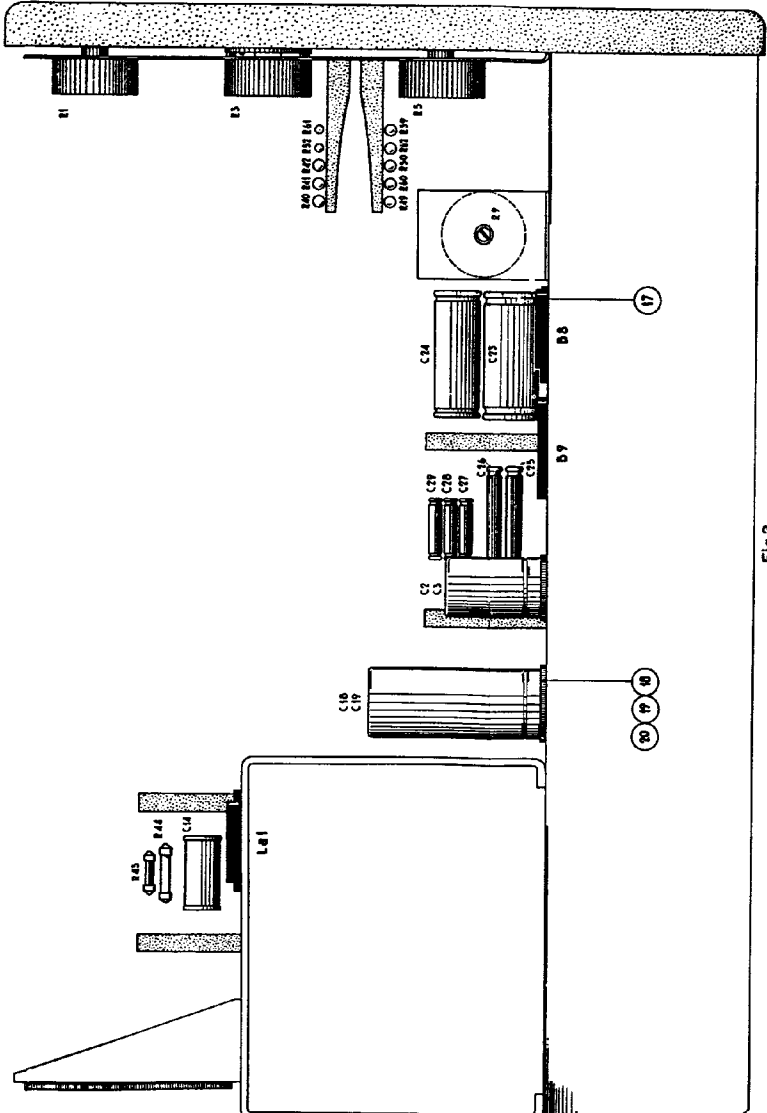


Fig.3

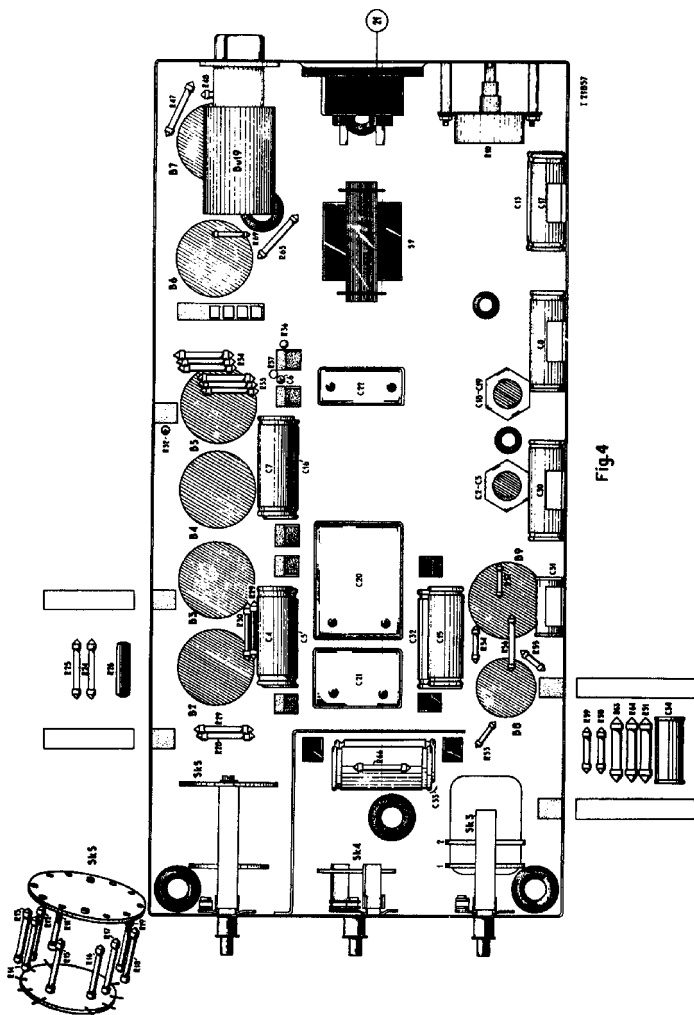
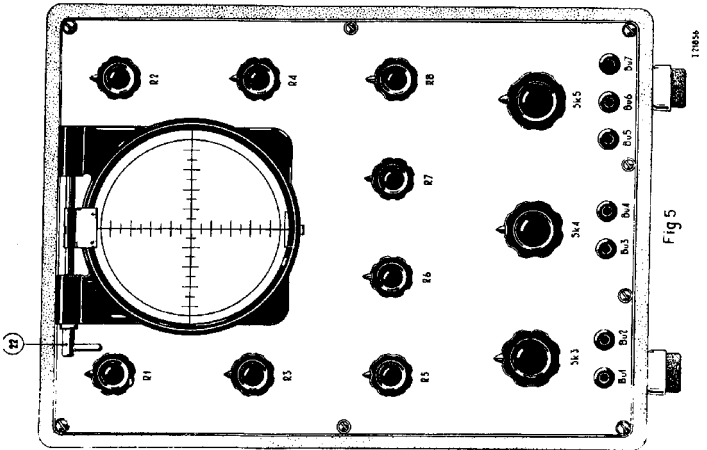
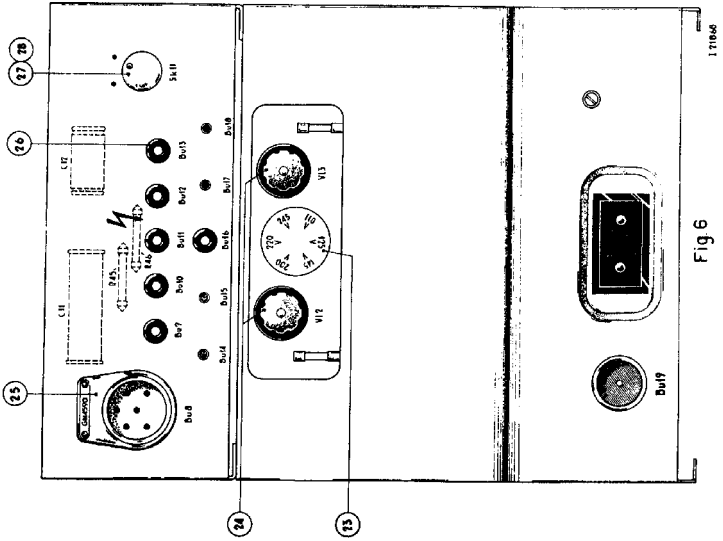


Fig. 4

V

GM3156-01



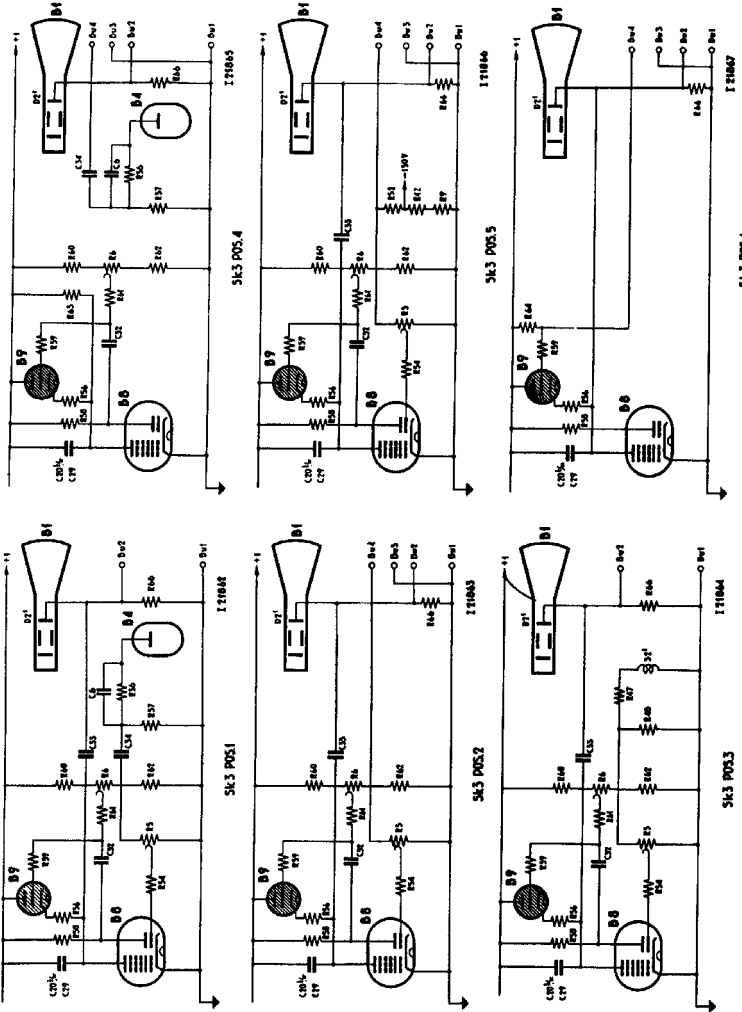


Fig. 6

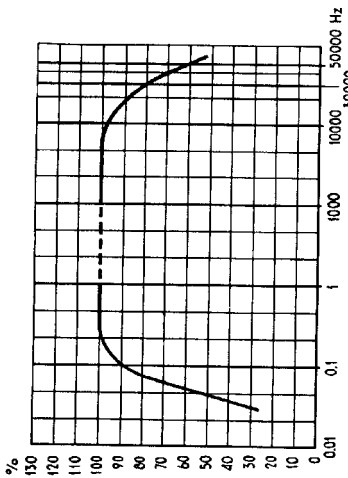


Fig.7

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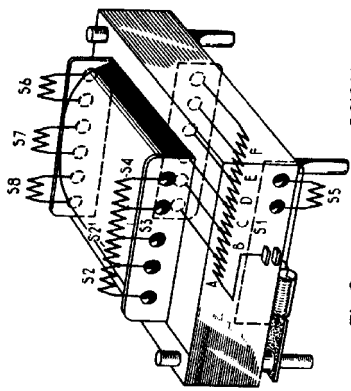
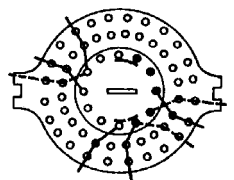
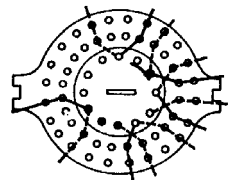


Fig.9

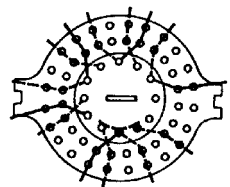
I 21861



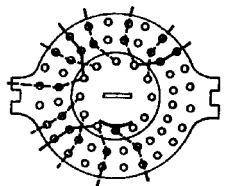
Sk3I



Sk3II



Sk4



Sk5

Fig.10

I 21869



SERVICE

22-6-53

Teneinde de kans op kraken te verminderen is de as van potentiometer R8 van een extra aarding voorzien, zie figuur. Voor deze verbinding worden 80 mm soepel snoer en 2 kabelschoenen gebruikt.

In order to reduce the possibility of noise an additional earth connection for the spindle of potentiometer R8 has been added, see figure. For this connection 80 mm of flexible wire and 2 cable terminals are used.

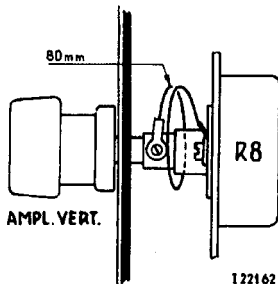
Afin de réduire la possibilité de craquements l'axe du potentiomètre R8 est muni d'une connexion de terre supplémentaire: voir figure. Pour cette connexion on utilise 80 mm de fil de câblage souple et deux souliers de cable.

Um die Möglichkeit von Krachen zu vermeiden, ist die Achse des Potentiometers R8 mit einer Extra-Erdung versehen: siehe Abbildung. Für diese Verbindung werden 80 mm schmiegsame Leitungsschnur und zwei Kabelschuhe benutzt.

Para evitar la posibilidad de carraspeo, el eje del potenciómetro R8 se ha provisto de un circuito de puesta a tierra suplementario: véase la figura. Para este circuito se utilizan 80 mm de cordón flexible y 2 terminales para cable.

CENTRAL SERVICE DEPT.

*[Signature]*  
A. Salverda.



N.V. PHILIPS'  
GLOEILAMPENFABRIEKEN  
EINDHOVEN

GM 3156/01

M177

SERVICE

7-1-1954.

Seriennummers 2105-2600

Tengevolge van statische ladingen op met Podur geïsoleerde verbindingsdraden kunnen kraakstoringen ontstaan, die in ongunstige gevallen op de beeldbuis zichtbaar worden.

Dit geldt speciaal voor de twee draden, die van de potentiometer R2' langs R4 en SK2/R8 naar de onderzijde van het chassis lopen; zie figuur. Door deze draden via de tule A en langs de kathodestraalbuis B1 naar R2' te leiden, worden deze moeilijkheden voorkomen; draad 1 is geel, draad 2 is rood.

Serial numbers 2105-2600

Owing to static charges on Podur insulated connecting wires, interferences through crackling may be produced which in unfavourable cases become visual on the picture tube.

This applies specially to the two wires which run from the potentiometer R2' along R4 and SK2/R8 to the lower part of the chassis; see figure. By leading these wires via the grommet A and along the cathode ray tube B1 to R2', such difficulties will be prevented; wire 1 is yellow, wire 2 is red.

Numéros de série 2105-2600

Par suite de charges statiques sur les fils de connexion isolés avec du Podur, des craquements peuvent se produire qui dans des cas défavorables deviennent visibles sur le tube d'image.

Ceci s'applique spécialement aux deux fils qui vont du potentiomètre R2' lelong R4 et SK2/R8 à la partie inférieure du châssis; voir la figure. Pour éviter ces difficultés mener ces fils à travers le manchon A et lelong du tube à rayons cathodiques à R2'; le fil 1 est jaune, le fil 2 est rouge.

Seriennummern 2105-2600

Infolge statischer Ladungen auf mit Podur isolierten Verbindungsdrähten können Knackstörungen entstehen, die in ungünstigen Fällen auf der Bildröhre sichtbar werden.

Dies gilt besonders für die zwei Drähte, die vom Potentiometer R2' längs R4 und SK2/R8 nach der Unterseite des Chassis laufen, siehe Abbildung. Indem man diese Drähte über die Tülle A und längs der Kathodenstrahlröhre nach R2' führt, werden diese Schwierigkeiten vermieden. Draht 1 ist gelb, Draht 2 ist rot.

Números de serie 2105-2600

A causa de cargas estáticas en hilos de conexión aislados con Podur, carraspeos pueden producirse que en casos desfavorables se hacen visibles en el tube de imagen.

Esto se aplica especialmente a los dos hilos que corren del potenciómetro R2' a lo largo de R4 y SK2/R8 a la parte inferior del chasis, véase figura. Estas dificultades pueden evitarse conduciendo estos hilos a través del manguito A y a lo largo del tubo de rayos catódicos B1 a R2'. Hilo 1 es amarillo, hilo 2 es rojo.

N.V. PHILIPS'  
GLOEILAMPENFABRIEKEN  
EINDHOVEN

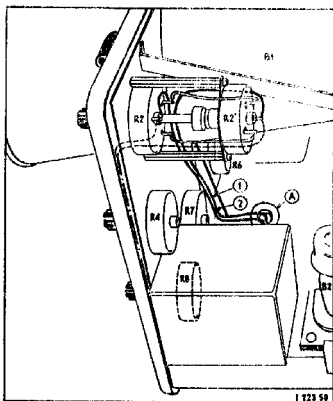
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SERVICE

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CENTRALE SERVICE AFDELING

*[Handwritten signature]*  
Ph. Saiverda.

JM/MZ

N.V. PHILIPS  
GLOEILAMPEN  
FABRIEKEN  
EINDHOVEN

# Service Information

No. Cd46

DATE 26-4-55

CENTRAL  
SERVICE  
DIVISION

GROUP: P.I.T. - E.M.A.  
ARTICLE: Cathode ray oscilloscope  
TYPE: GN3156-01

GD/TV

RE: Delivery check.

## A) MECHANICAL

Check the apparatus on the following points:

1. Damages.
2. Well closing of the cabinet.
3. Contact of ornamental window and front plate against the cabinet.
4. Fixing of the knobs.
5. Easy turning of the hinged rear cover.
6. Availability of directions for use, mains cord, screen cover and frame.

## B) ELECTRICAL

### 1. Mounting of the tube

Make a time base line visible and check whether it stands horizontally

### 2. Hum

SK5 in the position 1.

R8 to the left.

Time base frequency about 10 c/s.

No perceptible hum should be visible on the line (line thickness 0.5 mm max.).

### 3. Horizontal and vertical shift

SK3 in position 4.

SK5 in position 1.

R8 entirely to the left.

A light spot develops on the screen which should be adjustable with R1 in horizontal, with R2 - R2' in vertical direction at least 5 cm from the centre.

### 4. Sensitivity of the amplifier

SK3 in position 4.

R8 entirely to the left, until SK2 switches over.

The attenuator is now disconnected.

Apply a sinusoidal voltage of exactly 6 mm eff at 1000 c/s to Bu5 - Bu6.

Measure this voltage for instance with the GM6015 or GM6017. A vertical line of at least 6 cm should now develop.

### 5. Check of the attenuator

SK3 in position 4.

R8 entirely to the right.

SK5 in position 9.

Apply a sinusoidal voltage of 6 mm eff at 1000 c/s to Bu5 - Bu7.

The vertical line should now have a length of approx. 6 cm. Now put SK5 in position 8, 7, 6 etc. Whereby the voltage applied to Bu5 - Bu7 is taken 6 x greater every time than the indication on the scale of SK5. The line length should then always be about 6 cm.

### 6. Frequency response curve

SK3 in position 4.

R8 entirely to the right.

SK5 in position 9.

If possible, check the frequency response curve on the following points:

(adjust the length of the vertical line at 1000 c/s to 50 mm; keep the input voltage on Bu5 - Bu6 constant).

Frequency	min.	max.
0.1 c/s	35	46
1 c/s	46	53
10 c/s	48	53
50 c/s	49	52
1 kc/s	50	50
10 kc/s	48	51
30 kc/s	40	52
40 kc/s	35	52
50 kc/s	30	51

### 7. Time base amplitude

SK3 in position 1.

R6 entirely to the right.

In all positions of SK4, the time base line should be greater than the screen diameter of the cathode ray tube.

### 8. Time base frequencies

Check the time base frequencies with R7 at minimum and then with R7 at maximum.

Adjust the line length with R6 to 8 cm.

The low frequencies can be determined with the aid of a chronometer.

The other ones with an A.F. generator connected to Bu5 - Bu7.

The frequency ranges should overlap each other.

Check in each range the flyback suppression.

### 9. Linearity of the time base voltage

Apply a sinusoidal signal of about 5 kc/s to Bu5 - Bu7.

Focus a picture of about 10 periods.

Picture width 6 - 7 cm.

The mutual distances between the peaks should now be equal.

### 10. Single time base

SK3 in position 6.

Adjust the light spot with R1 at the left side of the screen.

When short circuiting Bu3 - Bu4, the time base enters into operation. When breaking the contact, the spot jumps back again to the left.

11. Ray modulation

Apply a voltage of 30 V, 500 c/s to Bu13 - Bu16.  
Connect a sinusoidal voltage of 50 c/s to Bu5 - Bu7 and make  
a picture visible of 3 periods. Now a well visible ray modulation  
should be obtained.

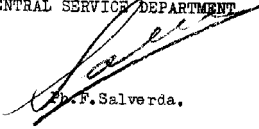
12. Operation SK11

SK11 in position "red".  
Make a time base line visible and short circuit Bu11 and Bu12  
during about 1 second. The luminous intensity of the picture  
should increase in this case.

13. Dependence on the mains voltage

Make a time base line visible and vary the mains voltage with  
pulses, between 200 V and 245 V. Now the line should  
not move more than 5 mm upward or downward.

CENTRAL SERVICE DEPARTMENT

  
P. F. Salverda.