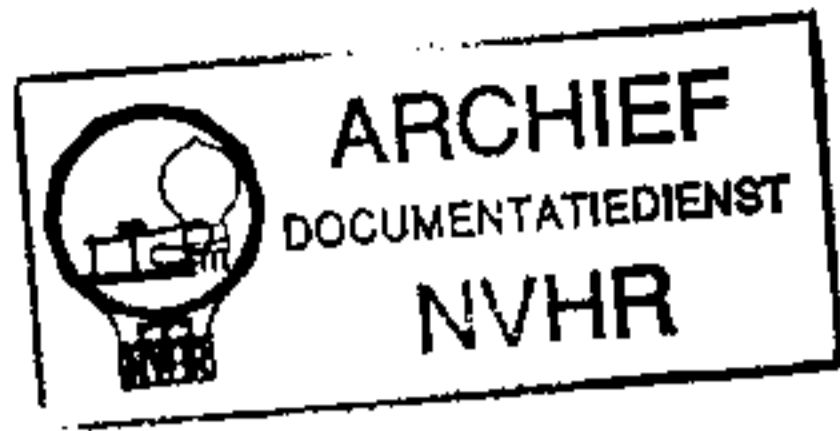


Compliments of Eckhard Kull
Ned. Ver. v. Historie v/d Radio

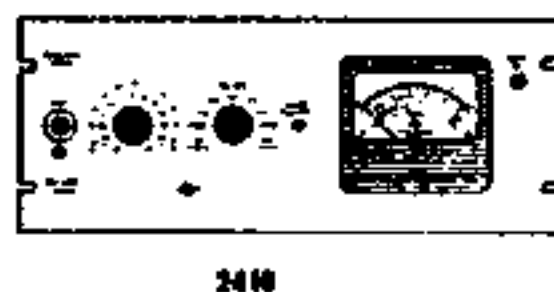


Electronic Voltmeter

Type 2409/16

Consisting of:

Meter Circuit	2409.1
Amplifier	2409.2
Positions of Components	2409.3
Parts List	2409.4
Circuit Diagram	2409.5



All the tolerances and the adjustment procedure are the same for type 2409 as well as for type 2416, which has the same electrical specifications but is equipped with a front plate for 19" rack mounting.

Removal of the Metal Case.

After removing the nuts at the back of the instrument, it is possible to slide the chassis and the front panel out of the case.

Trouble Shooting.

If the reason for a fault is not an obvious one such as a dead tube, broken down resistor, blown or disconnected fuse etc., then first test the voltages of all the tubes and compare them with the voltages shown in the circuit diagram in order to localize the defect. Should this method of finding the fault prove unsuccessful, then check the instrument by adopting the method described in the adjustment procedure. When the trouble has been found and remedied, the voltages and adjustments which are influenced by the remedy must be checked.

The tolerances stated in the instructions can only be used as a guide for adjustment and control, but any deviations must not be corrected without being sure that the tolerances of the instruments used for making the adjustment are so small as to have no influence on the measurements.

The instructions in this Manual are given purely as a guide to the service of equipment with minor faults. Some faults, as f. i. small deviations in tolerances require for their correction special control equipment and extensive experience, and in these cases it is necessary to send the instrument to the factory.

Note.

The three anticlockwise positions of the METER SWITCH give the smaller damping of the indicating meter designated either as LOW DAMPING or VU DAMPING.

The three clockwise positions give the higher damping of the indicating meter designated either as HIGH DAMPING or SLOW. In the following text the terms HIGH or LOW are used to express these METER SWITCH positions.

Instruments necessary for service and repair.

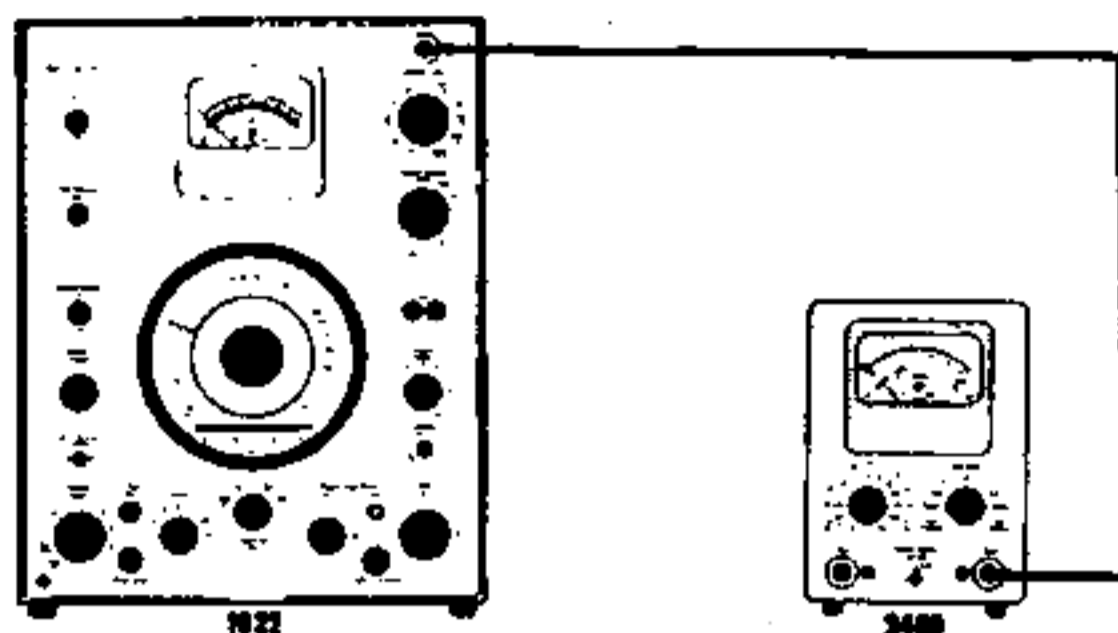
Multimeter (50 μ A)

Frequency Analyzer Type 2107.

Beat Frequency Oscillator Type 1022

(Beat Frequency Oscillator Type 1013)

valid from serial no. 144497



1.1. Mechanical Zero-point

METER RANGE: "Off"

Adjust for 0 with no power on.

1.2. Electrical Zero-point

METER RANGE: "10 V"
METER SWITCH: "RMS low"

Check that the pointer is still at 0. Tolerance: 1/2 pointer "width".

1.3. Dynamic Characteristics

METER SWITCH: "Average low"
METER RANGE: "Off"

Frequency: 1000 c/s. Adjust the input voltage for a 9 V deflection on type 2409. The input signal is switched off and on, and the overswing is checked.

Deflection on type 2409: 9.05-9.20 V.

If necessary change value of R 49.

1.4. Sensitivity

METER SWITCH: "RMS low"
METER RANGE: "Off"

Frequency: 1000 c/s. Adjust the input voltage for a 10 V deflection on type 2409. The input voltage should be within 8-11 V.

Possible reason for fault: defective diodes Q 4 - Q 7.

If cold cathode tube V 8 is dark change both V 8 and V 4

Whenever V 2 or V 4 is replaced P 4 should be adjusted to V_k (pin 2, V 4) is 110 V d.c.

1.5. Check of Meter Switch

a. METER SWITCH: "RMS low"
METER RANGE: "Off"

Frequency: 1000 c/s. Adjust the input voltage for a 15 dB deflection on type 2409.

b. METER SWITCH to "Average low"

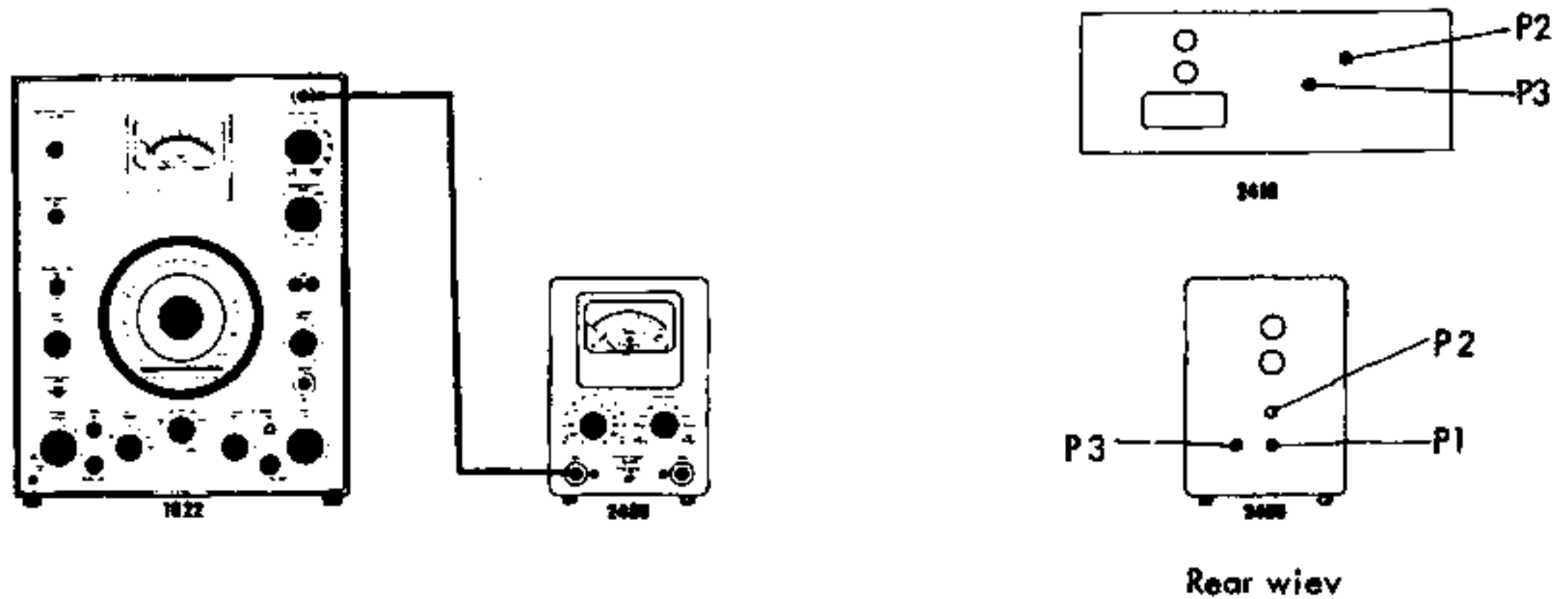
Deflection on type 2409: 14.9 - 15.3 dB.
If necessary adjust P 5.

c. METER SWITCH to "Peak low"

Deflection on type 2409: 18.5 - 19.5 dB.

If necessary adjust P 5 and repeat item b.

Also check a-b-c at 20 c/s in position "high".



2.1. Sensitivity.

METER RANGE: "10 mV"
METER SWITCH: "RMS low"

Input signal: 10 mV 1000 c/s.

Deflection on type 2409: 10 V.

If necessary adjust P 1. (Sen. Adj.)

If impossible to adjust to full scale deflection, check voltage on the OUTPUT socket: 8-11 V.

Possible reasons for fault: defective tubes V1 - V2 - V4

Whenever V 2 or V 4 is replaced P 4 should be adjusted to V_k (pin 2, V 4) is 110 V d.c.

2.2. Reference

- METER RANGE: "10 V"
METER SWITCH: "RMS low"
- METER RANGE to "Ref"

Input signal: 8 V 1000 c/s.

Deflection on type 2409 should be 8 V, if not check item 2.1.

Deflection on type 2409: 8 V (red line). If necessary adjust P 3.

2.3. Frequency Response 20-1000 c/s.

METER RANGE: "10 mV"
METER SWITCH: "RMS high"

Frequency: 1000 c/s. Adjust the input voltage for a 25 V deflection on type 2409 (on 0 - 30 V scale).

Vary the frequency from 20-1000 c/s.

Deflection on type 2409: 24.5-25.5 V (on 0 - 30 V scale).

If necessary adjust P 6

2.4. Frequency Response 1000 - 200.000 c/s

- METER RANGE: 10 mV.
METER SWITCH: "RMS low"

This can only be checked by means of a high frequency oscillator type 1013 connected to the INPUT socket.

Frequency: 1000 c/s. Adjust the input voltage for a 9.8 V deflection on type 2409.

Change frequency to 200000 c/s.

Deflection on type 2409: 9.6-10 V.

If necessary adjust C.31.

- METER RANGE to 100 V.

Frequency: 1000 c/s. Adjust the input voltage for a 9.8 V deflection on type 2409.

Change frequency to 50.000 c/s.

Deflection on type 2409: 9.6-10 V.

If necessary adjust C 32.

- METER RANGE to 1 V.

Frequency: 1000 c/s. Adjust the input voltage for a 9.8 V deflection on type 2409.

Change frequency to 50.000 c/s.

Deflection on type 2409: 9.6-10 V.

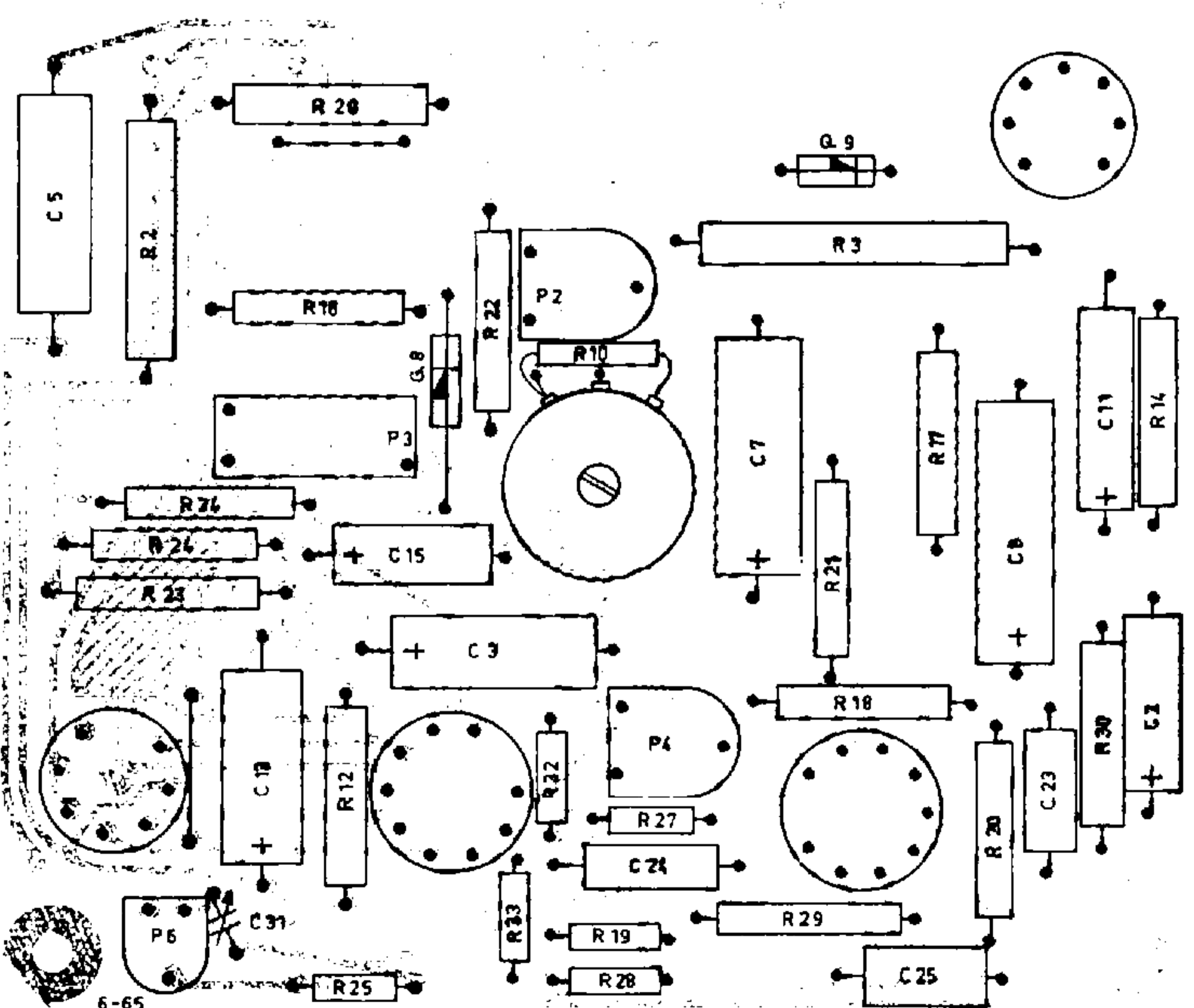
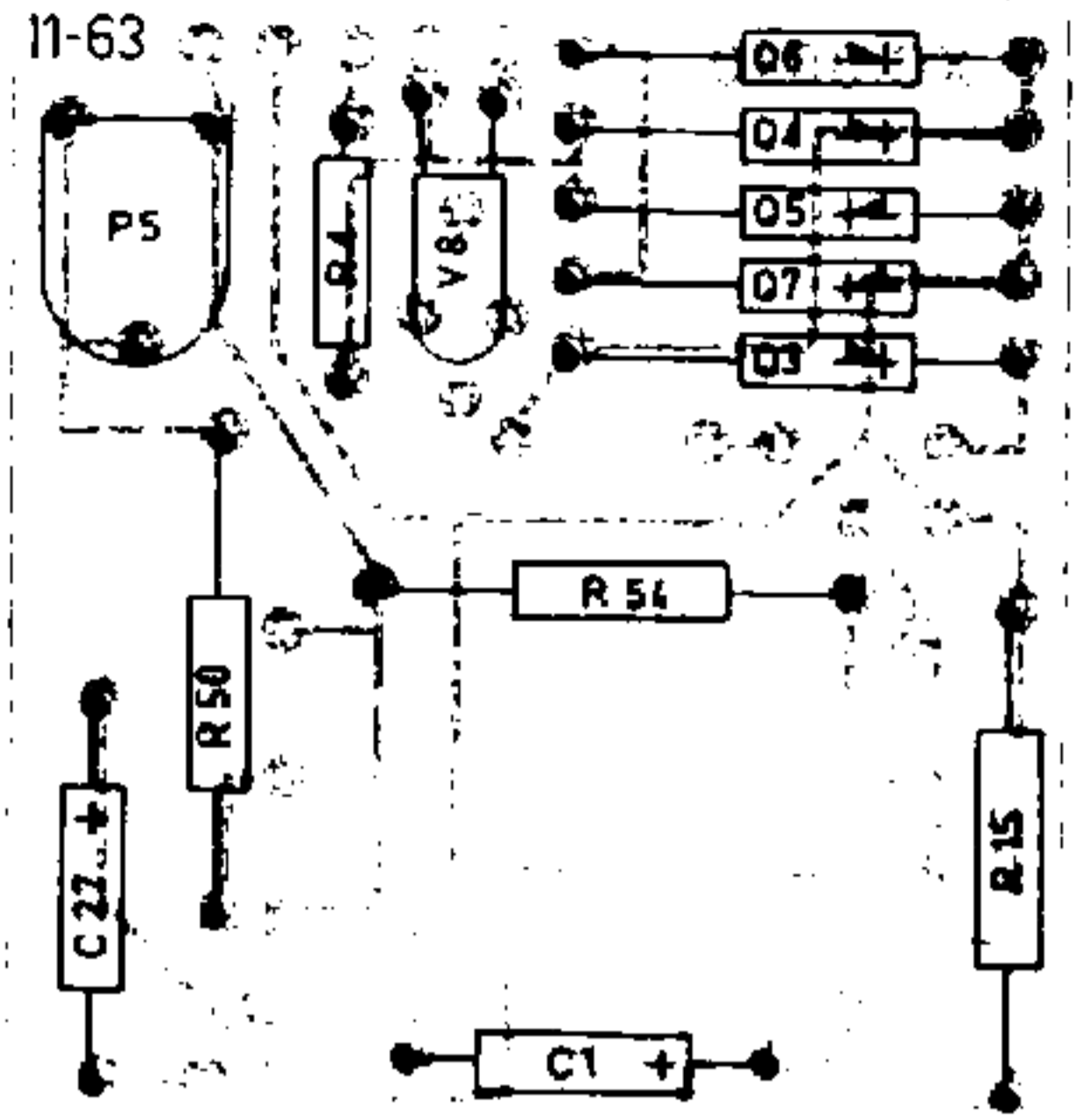
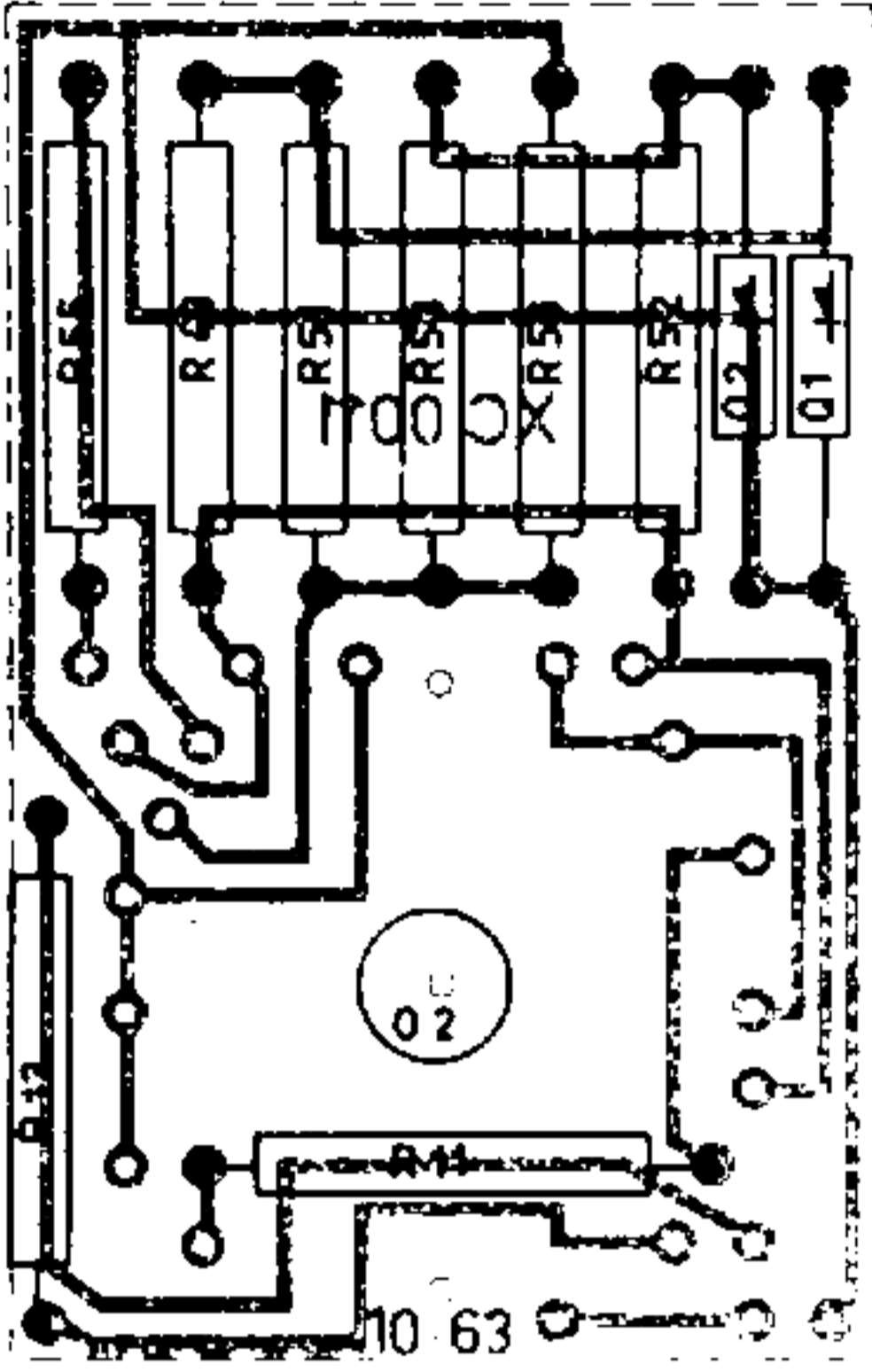
If necessary adjust C 33.

Change frequency to 200.000 c/s.

Deflection on type 2409: 9.6-10 V.

If necessary adjust the metal wire across R 41 and check item b and c again.

valid from serial no. 144497



2.5. Output Impedance

METER RANGE: "10 V"
METER SWITCH: "Peak low"

Frequency: 1000 c/s. Adjust the input voltage for a 18 dB deflection on type 2409. Load the OUTPUT socket with a resistor of 1000 Ω .

Deflection on type 2409: 17.6 - 18 dB

If necessary adjust P 4.

After adjustment check that the d.c. voltages on V_k , V 4 is within 100-120 V.

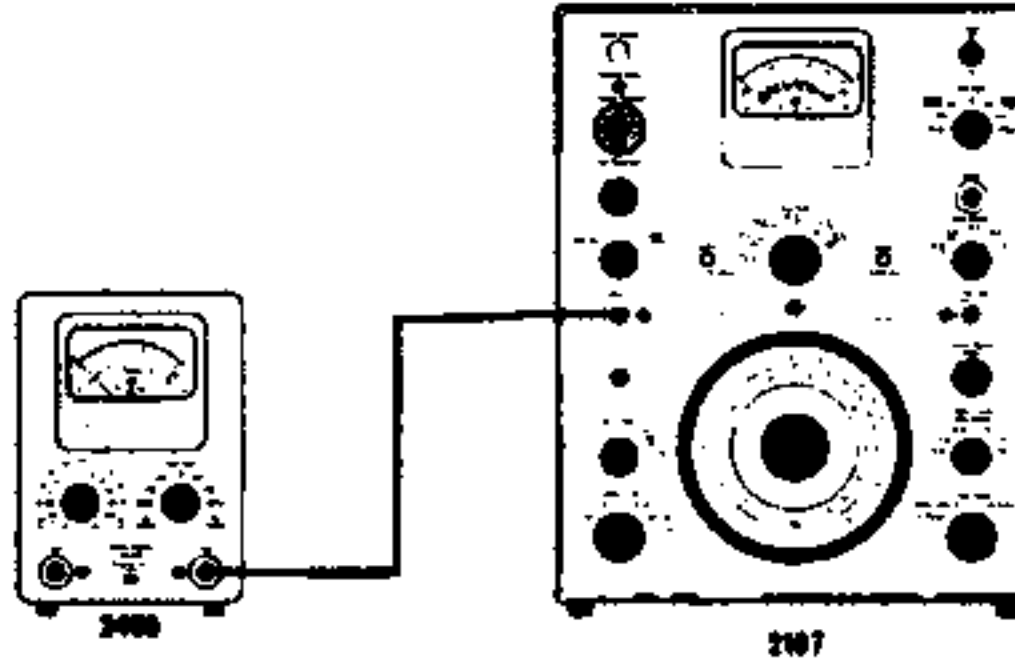
2.6. Input Impedance

METER RANGE: "300 mV"
METER SWITCH: "RMS low"

Frequency: 50 c/s. Adjust the input voltage for a 20 dB deflection on type 2409.

Insert a screened resistor of 10 M Ω in series with the generator.

Deflection on type 2409: 13-15 dB.



2.7. Noise - Hum

METER RANGE: "10 mV"
METER SWITCH: "RMS high"

The apparatus should be inserted into the cabinet and connected to ground.

a. Open input: adjust potentiometer P 2 for min. voltage on the OUTPUT socket. Tolerance: max. 100 mV.

Possible reasons for faults: defective tube V 1.

no electrical contact between the different parts of the instrument housing.

b. Short-circuited input: Tolerance max. 20 mV

Check all positions of METER RANGE switch.

2.8. Distortion

METER RANGE: "300 mV"
METER SWITCH: "RMS low"

Distortion down to around 0.5% can be measured with type 2107. Lower distortion measurement requires the use of a filter type 1607 connected between type 2409 and type 2107 for rejection of the fundamental frequency and a filter connected between type 1022 and type 2409 to ensure that the distortion of the input signal is lower than 0.01%. If these filters are available check limits:

Input signal:	300 mV	1000 c/s
Distortion max.	0.18% at	2000 c/s
" "	0.05% at	3000 c/s

2.9. Overdrive

a. Turn the METER RANGE slowly through all positions.

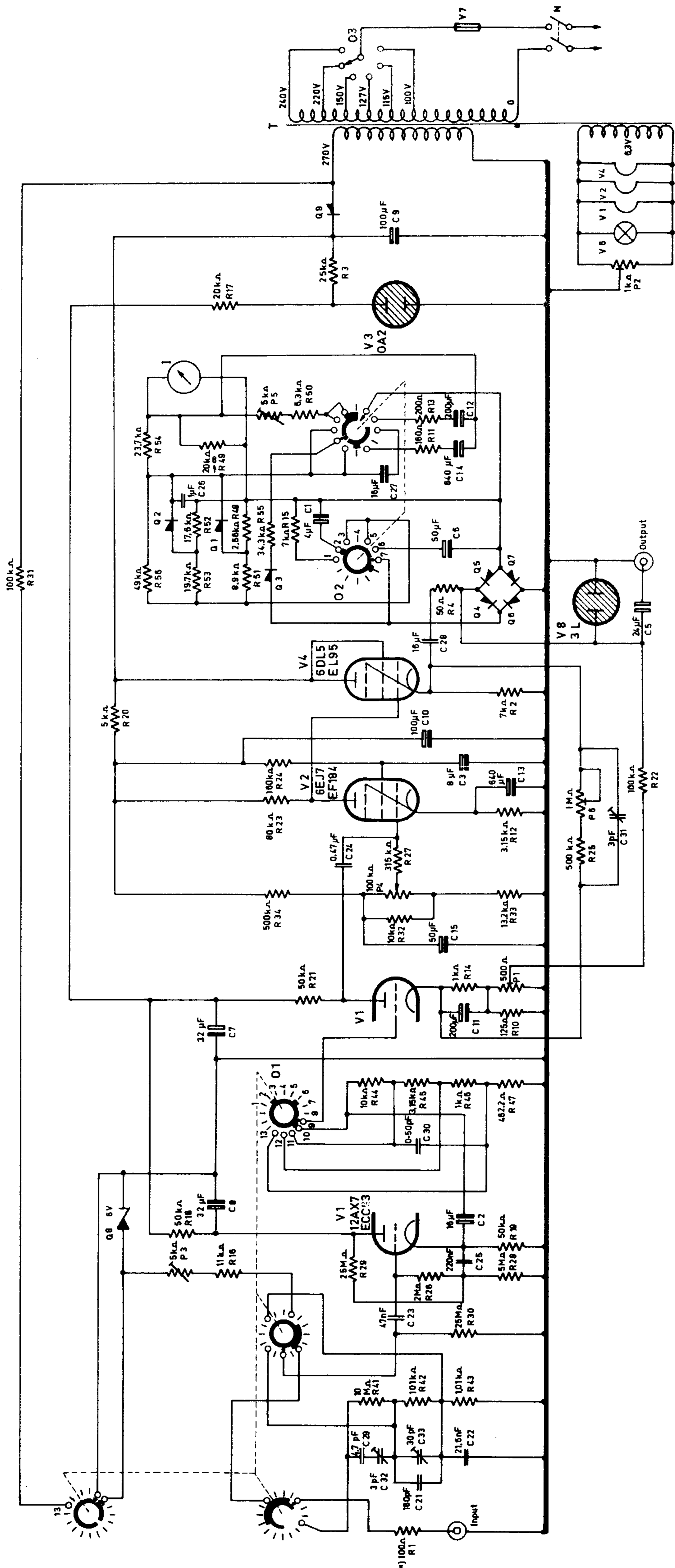
Open input: deflection on type 2409 must not exceed 1/3 scale deflection.

Possible reasons for fault: defective C 2

Leakage current in C2 max. 0.2 μ A at 20V d.c.

valid from serial no. 186456

COMPONENT TYPE	STOCK REFERENCE	CIRCUIT DIAGRAM REF.	COMPONENT TYPE	STOCK REFERENCE	CIRCUIT DIAGRAM REF.
CAPACITORS:			PRECISION RESISTORS:		
Electrolytic	4 µF/250 V	CE 2034	Carbon film	1/2 W ± 0.5%	RK 462.2 Ω R 47
"	40 µF/150 V	CE 2038	"	"	RK 1 kΩ R 46
"	bipolar 25 µF/ 35 V	CE 0412	"	"	RK 1.01 kΩ R 43
"	2 x 100 µF/350 V	CE 2989	"	"	RK 3.15 kΩ R 45
"	640 µF/ 16 V	CE 0209	"	"	RK 10 kΩ R 44
"	16 µF/ 63 V	CE 0504	"	"	RK 101 kΩ R 42
"	50 µF/ 50 V	CE 0503	"	± 1%	RK 2.66 kΩ R 48
"	50 µF/ 25 V	CE 8965	"	"	RK 8.9 kΩ R 51
"	200 µF/ 6 V	CE 8944	"	"	RK 17.6 kΩ R 52
"	8 µF/320 V	CE 0802	"	"	RK 19.7 kΩ R 53
Ceramic	4.7 pF/400 V	CK 0470	"	"	RK 23.7 kΩ R 54
"	27 pF/400 V	CK 1270	"	"	RK 34.3 kΩ R 55
Metallized paper	16 µF/160 V	CP 0005	"	1 W ± 0.5% 10 MΩ	RH 0100 R 41
Polyester	1 µF/250 V	CS 0025	TUBES:		
"	220 nF/250 V	CS 0017	Twintriode	ECC83/12AX7	VA 0012 V 1
"	470 nF/250 V	CS 0021	Pentode	EL95/6DL5	VA 0026 V 4
"	47 nF/400 V	CS 0109	Pentode	EF184/6EJ7	VA 0079 V 2
Polystyrene	180 pF/200 V	CT 0233	Stabilizer	OA2	VA 0037 V 3
"	21.6 nF/200 V	CT 3129	Cold cathode tube	90 V	VA 0072 V 8
Trimmer	0.7 - 3 pF/400 V	CV 0113	Fuse	1 Amp.	VF 0008 V 7
"	3 - 30 pF/400 V	CV 7864	Pilot lamp	6.3 V/0.25 A	VS 1273 V 6
POTENTIOMETERS:			PRINTED CIRCUIT:		
Pot.m. wire-wound	500 Ω/2 W	PQ 1501	Printed circuit		XC 0228
Pot.m. carbon	1 kΩ lin.	PG 2100	"		XC 0010
"	5 kΩ lin.	PG 2500	"		XC 0011
"	wire-wound 5 kΩ lin.	PG 2504	Printed circuit	XC 0228 with comp.	2409 bl. 805
"	carbon 100 kΩ lin.	PG 4102	"	XC 0010 "	2409 bl. 808
"	1MΩ lin.	PG 5102	"	XC 0011 "	2409 bl. 809
RECTIFIERS:			MISCELLANEOUS:		
Germanium diode	150 V	QV 0020	Power cord. EUR.		AN 0005
"	OA85	QV 0085	Power cord. USA		AN 0006
"	OA79	QV 0078	Rubber foot (only for 2409)		DF 7007
Zener diode	6.8 V ± 10%	QV 1106	Spring for tube		DL 0025
Silicon diode	1200 V/0.15A	QV 0025	Moving coil instrument 200 µA		IN 2409
RESISTORS:			Coaxial jack		JJ 0115
Wire-wound	2 W 7 kΩ	RO 0803	Coaxial plug		JP 0018
"	6 W 25 kΩ	RO 0900	Jack for grounding		JT 6204
"	1/3 W	RK 0.8 MΩ	Socket for V 1, V 2		JV 9012
Carbon film	1/3 W ± 10%	RK 100 Ω	Socket for V 3, V 4		JV 7505
"	1/2 W ± 5%	RK 125 Ω	Cabinet (only for 2409)		KQ 2409
"	" 10%	RK 160 Ω	Front plate (only for 2416)		FA 2416
"	"	RK 200 Ω	Attenuator switch (only for 2409)		OR 2409 O 1
"	"	RK 1 kΩ	Attenuator switch (only for 2416)		OR 2416 O 1
"	"	RK 3.15 kΩ	Meter switch (only for 2409)		OS 2409 O 2
"	"	RK 5 kΩ	Meter switch (only for 2416)		OS 2416 O 2
"	"	RK 6.3 kΩ	Power voltage selector		OA 0012 O 3
"	"	RK 20 kΩ	Bakelite knob (only for 2409)		SN 0807
"	"	RK 50 kΩ	Bakelite knob (only for 2416)		SN 0814
"	1 W	RK 80 kΩ	Power transformer		TN 8926 T
"	1/2 W	RK 160 kΩ			
"	"	RK 500 kΩ			
"	"	RK 2 MΩ			
"	"	RK 25 MΩ			
"	1 W	RK 100 kΩ			
"	1/2 W ± 5%	RK 7 kΩ			
"	"	RK 11 kΩ			
"	"	RK 20 kΩ → ∞			
"	"	RK 100 kΩ			
"	1/3 W ± 10%	RK 50 Ω			
"	"	RK 10 kΩ			
"	"	RK 13.2 kΩ			
"	"	RK 50 kΩ			
"	"	RK 315 kΩ			
"	"	RK 500 kΩ			
"	"	RK 5 MΩ			



For 2409 only

O1: Meter Range

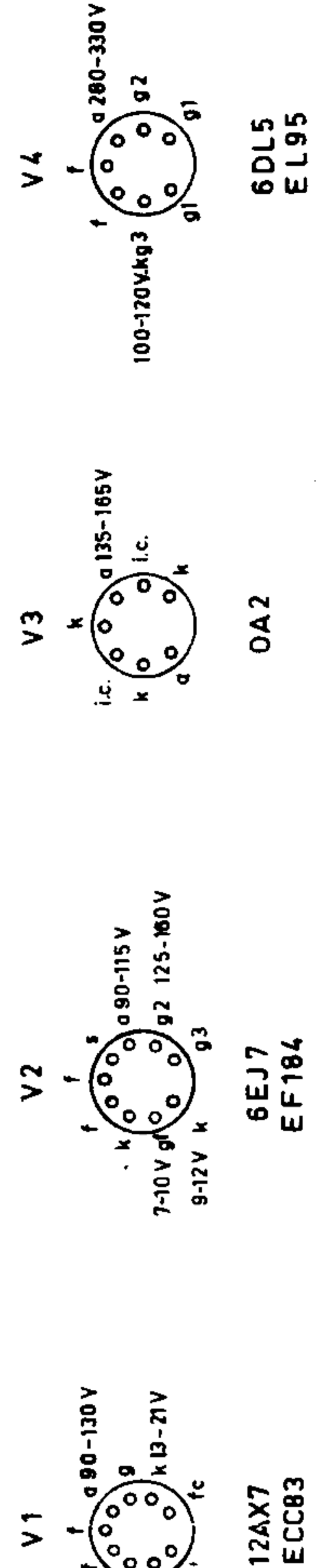
1: Off
2: 0.01 V
3: 0.03 "
4: 0.1 "
5: 0.3 "
6: 1 "
7: 3 "
8: 10 "
9: 30 "
10: 100 "
11: 300 "
12: 1000 "
13: Ref.

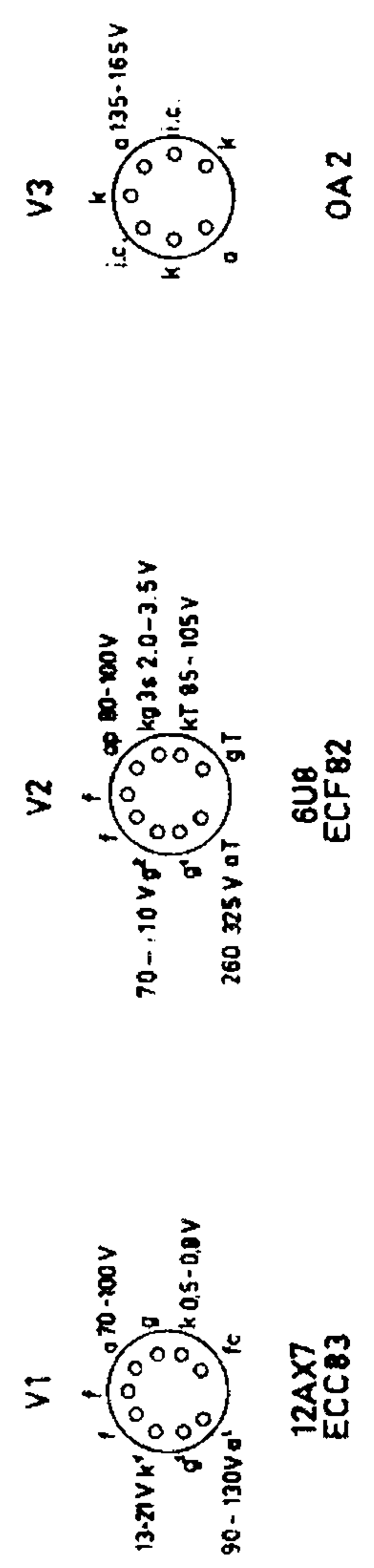
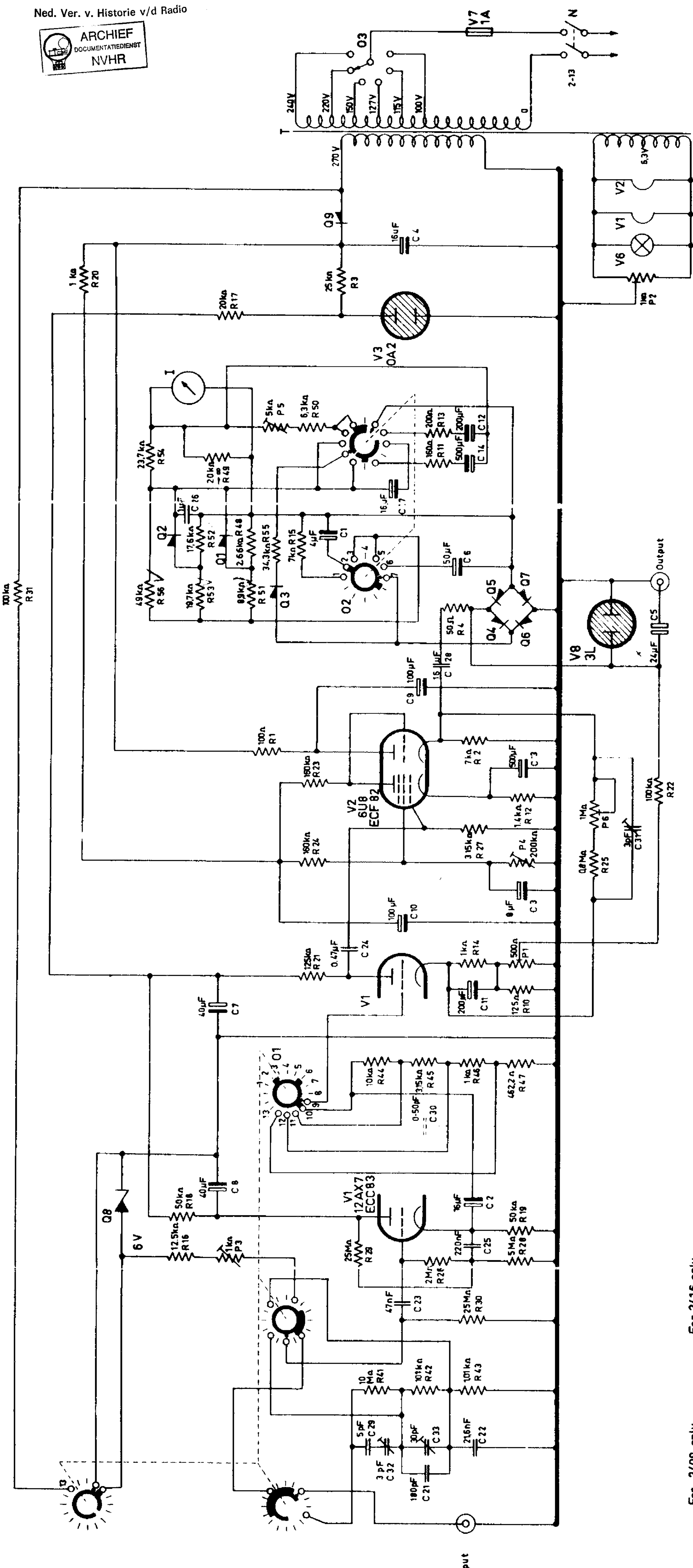
For 2416 only

O2: Meter Switch

1: Average	Low	Damping
2: Peak	"	"
3: RMS	"	"
4: Off	"	"
5: RMS	High	Damping
6: Peak	"	"
7: Average	"	"

Switch O1 is shown in position 0.01 V
 Switch O2 is shown in position Peak Low Damping.
 On type 2416 the front plate is insulated from the chassis.





For 2409 only		For 2416 only	
O1: Meter Range	O2: Meter Switch	1: Average	Low Damping
1: OFF	1: Average	2: Peak	2: Peak
2: 0.01V	2: Average	3: RMS	3: RMS
3: 0.03	3: Peak	4: Off	4: Off
4: 0.1	4: Peak	5: RMS	5: RMS
5: 0.3	5: Peak	6: Peak	6: Peak
6: 1	6: Average	7: Average	7: Average
7: 3	7: Average		
8: 10			
9: 30			
10: 100			
11: 300			
12: 1000			
13: Ref			

Switch O1 is shown in position 0.01V
 Switch O2 is shown in position peak low damping
 On type 2416 the front plate is insulated from the chassis.

COMPONENT TYPE	STOCK REFERENCE	CIRCUIT DIAGRAM REF.	COMPONENT	STOCK REFERENCE	CIRCUIT DIAGRAM REF.
CAPACITORS:					
Electrolytic	4 μ F/250 V	CE 2034	Carbon film	1/2 W \pm 1%	RK 23.7 k Ω R 54
"	40 μ F/150 V	CE 2038	"	" " "	RK 34.3 k Ω R 55
"	24 μ F/ 25 V	CE 3520	"	" " "	RK 49 k Ω R 56
"	2x100 μ F/350 V	CE 2989	"	1 W \pm 0.5% 10 M Ω	RH 0100 R 41
"	500 μ F/6-8 V	CE 0201	TUBES:		
"	16 μ F/450 V	CE 6846	Twintriode	12AX7(ECC83)	VA 0012 V 1
"	16 μ F/ 63 V	CE 0504	Triode-Pentode	6U8(ECF82)	VA 0014 V 2
"	50 μ F/ 50 V	CE 0503	Stabilizer	(OA2)	VA 0037 V 3
"	200 μ F/ 6 V	CE 8944	Cold cathode tube	(3L)	VA 0072 V 8
"	8 μ F/320 V	CE 0802	Fuse 1 A		VF 0008 V 7
Ceramic	4.7 pF	CK 0470	Pilot lamp		VS 1271 V 6
"	27 pF	CK 1270	PRINTED CIRCUIT:		
Metallized paper	16 μ F/160 V	CP 0005	Printed circuit		XC 0001
Polyester	1 μ F/250 V	CS 0025	" "		XC 0010
"	220 nF/ 250 V	CS 0017	" "		XC 0011
"	470 nF/250 V	CS 0021	Printed circuit XC 0001 with comp. 2409 bl.805		
"	47 nF/400 V	CS 0109	" " XC 0010 " "		2409 bl.808
Polystyrene	180 pF/200 V	CT 0233	" " XC 0011 " "		2409 bl.809
"	21.6 nF/200 V	CT 3129	MISCELLANEOUS:		
Trimmer	0.7-3 pF/400 V	CV 0113	Power cord. Eur.	AN 0005	
"	3-30 pF	CV 7864	Power cord. USA	AN 0006	
POTENTIOMETERS:					
Pot.m. wire-wound	500 Ω /2W	PQ 1501	Rubber foot (only for 2409)	DF 7007	
Pot.m. carbon	1 k Ω lin.	PG 2100	Spring for tube	DL 0025	
"	5 k Ω lin.	PG 2500	Meter	IN 2409	I
"	200 k Ω lin.	PG 4201	Coaxial jack	JJ 0013	
"	1 M Ω lin.	PG 5102	Coaxial plug	JP 0018	
RECTIFIERS:					
Germanium diode	150 V	QV 0020	Jack for grounding	JT 6204	
"	OA85	QV 0085	Socket for V 1, V2	JV 9012	
"	OA79	QV 0078	Socket for V3	JV 7505	
Zener diode	6.8V \pm 10%	QV 1106	Cabinet (only for 2409)	KQ 2409	
Silicon diode	1000V/o.15A	QV 0023	Front plate (only for 2416)	FA 2416	
RESISTORS:					
Wire-wound	3 W 7 k Ω	RO 0803	Attenuator switch (only for 2409)	OR 2409	O 1
"	6 W 25 k Ω	RO 0900	Attenuator switch (only for 2416)	OR 2416	O 1
"	1/3 W	RK 1.4 k Ω	Meter switch (only for 2409)	OS 2409	O 2
"	"	RK 0.8 M Ω	Meter switch (only for 2416)	OS 2416	O 2
Carbon film	1/2 W \pm 10%	RK 100 Ω	Power voltage selector	OA 0012	O 3
"	"	RK 125 Ω	Bakelite knob (only for 2409)	SN 0807	
"	"	RK 160 Ω	" (only for 2416)	SN 0814	
"	"	RK 200 Ω	Power transformer	TN 8926	
"	"	RK 1 k Ω			
"	"	RK 6.3 k Ω			
"	"	RK 20 k Ω			
"	"	RK 50 k Ω			
"	"	RK 100 k Ω			
"	"	RK 125 k Ω			
"	"	RK 160 k Ω			
"	"	RK 315 k Ω			
"	"	RK 2 M Ω			
"	"	RK 5 M Ω			
"	"	RK 25 M Ω			
"	1 W	RK 100 k Ω			
"	1/2 W \pm 5%	RK 7 k Ω			
"	"	RK 12.5 k Ω			
"	"	RK 20 k Ω			
"	1/3 W \pm 10%	RK 50 Ω			
PRECISION RESISTORS:					
Carbon film	1/2 W \pm 0.5%	RK 462.2 Ω			
"	"	RK 1 k Ω			
"	"	RK 1.01 k Ω			
"	"	RK 3.15 k Ω			
"	"	RK 10 k Ω			
"	"	RK 101 k Ω			
"	" \pm 1%	RK 2.66 k Ω			
"	"	RK 8.9 k Ω			
"	"	RK 17.6 k Ω			
"	"	RK 19.7 k Ω			