CARRIER FREQUENCY SIGNAL GENERATOR

TFPS-42

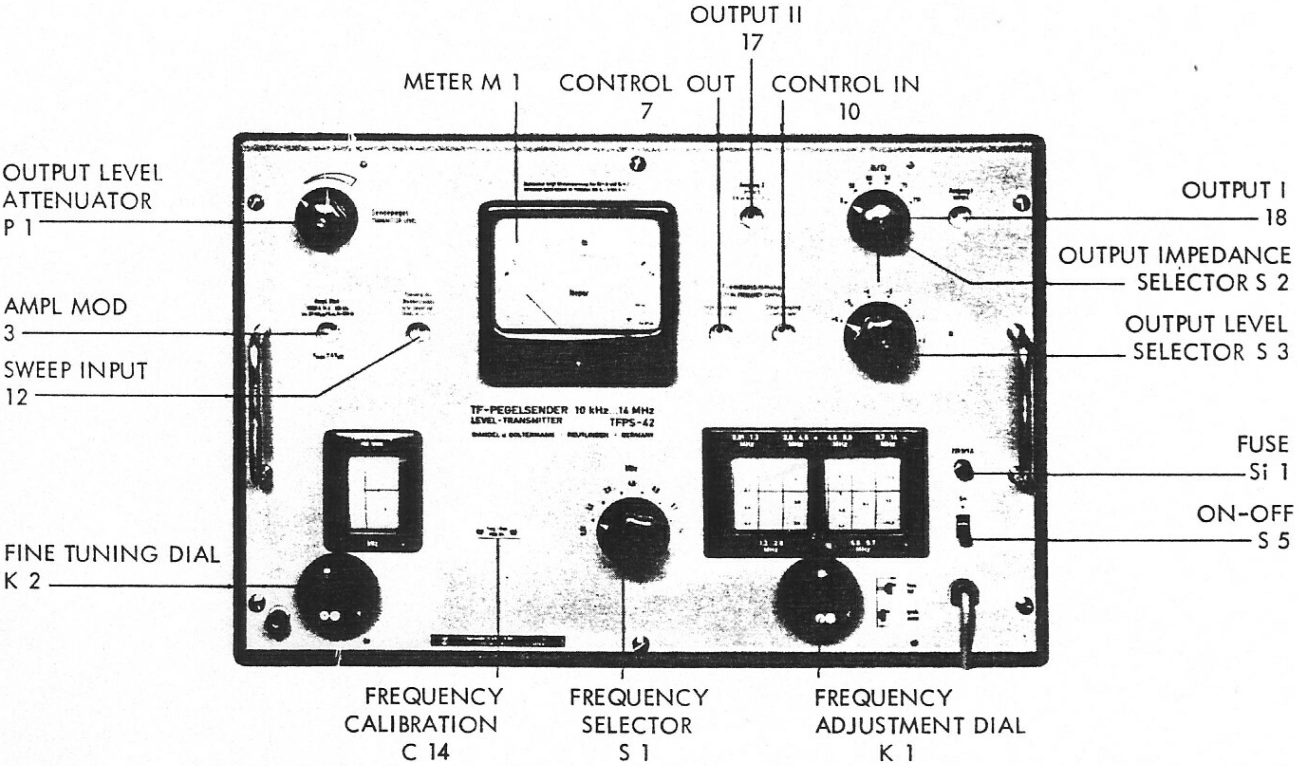
10 kHz to 14 MHz

Description and
Operating Manual 84 X

I. 6.61
0. 2. 7.69 1820 UN v. 1741
Printed in Western Germany

Subject to change without notice

Wandel u. Goltermann · 7410 Reutlingen


OUTPUT II
17
METER M 1
CONTROL OUT
7
CONTROL IN
10
OUTPUT LEVEL
ATTENUATOR
P 1
OUTPUT I
18
OUTPUT IMPEDANCE
SELECTOR S 2
AMPL MOD
3
OUTPUT LEVEL
SELECTOR S 3
SWEEP INPUT
12
TF-PEGELSENDER 10 kHz ..14 MHz
LEVEL-TRANSMITTER
TFPS-42
FUSE
Si 1
ON-OFF
S 5
FINE TUNING DIAL
K 2
FREQUENCY
CALIBRATION
C 14
FREQUENCY
SELECTOR
S 1
FREQUENCY
ADJUSTMENT DIAL
K 1

SPECIFICATIONS

dB/V - Version BN 84/1
Np - Version BN 84/0 (compare data in parenthesis)

Frequency range	10 kHz to 14 MHz
6 bands	10 kHz to 1.28 MHz, 1.28 to 2.8 MHz, 2.8 to 4.7 MHz, 4.7 to 7 MHz, 7 to 10 MHz, 10 MHz to 14 MHz
Frequency accuracy (after 2 hours warm-up-time)	≦ ± 0.2 % ± 3 kHz
Frequency drift (after 2 hours warm-up-time)	≦ ± 10^{-4} ± 500 Hz/hour
Effect of ± 10 % mains voltage fluctuation upon frequency deviation	≦ ± 1 x 10^{-5} ± 50 Hz
Fine-tuning range	± 25 kHz
Fine-tuning accuracy	≦ ± 200 Hz
Output level (when R_i = 0 and R_L ≧ 50 Ω, ref. to 0 dB (0 Np)- deflection	-60, -50, ..., +10 dB (-6, -5, ..., +1 Np) 0,8 mV to 2.5 V
Lowest level adjustable	-80 dB (-8 Np)
Output impedance, switchable	approx. 0, 50, 60, 70, 75, 150 Ω
Output level accuracy at 100 kHz matched to 75 Ω at f.s.d., in range +10 dB (+1 Np)	± 2 % or better
Attenuator accuracy (full scale, in ranges -60 dB(-6 Np) through 0 dB (0 Np) ref. to +10 dB (+1 Np) and f = 100 kHz when R_i = R_L = 75 Ω)	0.1 dB (0.01 Np) or better
Frequency-response accuracy (in all ranges, ref. to 100 kHz matched to 75 Ω	0.2 dB (0.02 Np) or better
additionally (when matched to 50, 60, 70, 150 Ω)	0.1 dB (0.01 Np) or better
Frequency response of level reading (at constant control position for all combinations of level and R_i switches, referred to f = 100 kHz	
for f = 10 kHz to 5 MHz	0.5 dB (0.05 Np) or better
for f = 14 MHz	approx. 1 dB (0.1 Np)
Attenuation of 2nd and 3rd harmonics (ref. to level +10 dB (+ 1Np) and matched to 75 Ω	
for f = 10 kHz to 2 MHz	≧ 43 dB (5 Np)
for f = 14 MHz	approx. 35 dB (4 Np)

Amplitude modulation . . . . 0 to 100 %

Modulating-frequency range . . . . d.c. to 100 kHz

Frequency response (d.c. to 20 kHz) . . . . 0.1 dB (0.01 Np) or better

Voltage required in 300 Ω . . . . approx. 26 mV per %

Distortion coefficient (for m ≦ 30 %, modulating frequencies ≦ 20 kHz output levels ≦ + 5 dB (+0.5 Np) . . . . ≦ 1 %

External control
Generator may be controlled from Level Meter TFPM-43 or from WO-1 or MMO-3. Conversely, the generator may be used to control the Level Meter TFPM-43.

Tube complement . . . . . 4 x E 88 CC, 5 x E 180 F, 2 EL 86, 85 A 2, 150 B 2

Mains voltage required . . . . 110/ 115/ 220 V, 40 to 60 Hz

Power consumption, ... 190 VA

Overall dimensions . . . . 565 x 381 x 278 mm (23 x 15 x 11 in.)

Weight . . . . 33 kg (66 lbs)

Subject to change without notice

CONTENTS

2.2 Modulator and Lowpass Filter Network

The following stage is a ring modulator comprising four germanium diodes. The modulator is primarily controlled by the frequency f_I and, to a lesser degree, by f_{II}. Possible harmonics of the latter frequency are filtered out by a preceding bandpass filter network. The modulator output contains the desired difference frequency $f = f_I - f_{II}$ and also the sum frequency $f_I + f_{II}$ and the combinations $2\ f_I \pm f_{II}$, $3\ f_I \pm f_{II}$ etc., all above the output frequency f. These and the oscillator frequencies are filtered out by a lowpass filter network (LPFL) having high attenuation above 14 MHz. The output frequency having an extremely low harmonics content is available at the LPFL output.

The modulator output voltage is in wide limits independent of the no. 1 control voltage and remains practically stable in the oscillator II full tuning range although the oscillator voltage undergoes some change. The linear relation between the output voltage and the input voltage II from oscillator II (which is highly stable in its narrow detuning range) enables the generator voltage to be modulated in buffer stage II. The advantage of this arrangement as compared with a modulation in the amplifier stage of the set is that the output voltage does not contain additional harmonics of the output frequency nor the modulating frequency itself.

2,3 Amplifier

This wideband amplifier covers the range 10 kHz to 14 MHz. The first two and the last three tubes each have negative feedback, resulting in a flat frequency response characteristic and extremely low distortion. The two last tubes, series-connected in the DC circuit, have a special feature. They are controlled in opposite phase so that their alternating currents add up in the output transformer. Second-harmonic distortion is very low. The overall gain across the output transformer amounts to 50, the maximum output level being +10 dB (2.5 V) or + 1 Np in 75 Ω.

2.4 Output attenuator and meter circuit

A voltage step-down transformer arrangement 10 or 20 dB (1 or 2 Np) is provided between amplifier and output socket. The transformers may be switched on in succession so that the voltage can be divided in steps of 10 dB up to 70 dB (1 Np to 7 Np). The resistance of the transformers is so low that the divider ratio is independent of the load.

The meter circuit comprises a full-wave rectifier crystal-diode circuit and a high-precision moving-coil instrument, calibrated in r.m.s. voltage levels. This arrangement permits output level adjustment between +10 dB and -80 dB (+1 Np and -8 Np).

The meter scale is calibrated to give readings of the voltage level across the attenuator output. When switched to zero output impedance (selector S 2), the attenuator output is connected to the output sockets. When R_i = 50 to 150 Ω, suitable resistors are inserted electrically between the attenuator output and the output socket resulting in a voltage division between the load and output impedances R_L and R_i, the voltage is divided at a ratio 2 : 1 giving an attenuation of 6 dB (0.7 Np). This has been taken into consideration in the calibration of the black meter scale which gives direct readings of the voltage level across the load impedance R_L for the matched condition.

2.5 External tuning facility

Since the instrument is tuned by means of the oscillator I control frequency, a number of instruments having identical oscillators can be sync. tuned from a single set.

The control signal required for this purpose can be derived from socket Bu 7. Conversely socket Bu 10 is provided for the control signal input, whereby the internal oscillator is automatically rendered inoperative.
This external tuning facility is especially useful in the carrier frequency test setup incorporating TFPS-42 and TFPM-43, whereby the frequency adjustment of the one instrument automatically effects an identical adjustment to the tuning frequency of the other.
When incorporated in the Sweep Measuring Set WM-1 or WM-3, the signal generator TFPS-42 is tuned by means of a swept control signal derived from either the Sweep Accessory WZ-1 or the Sweep Generator WG-1.

3 INSTRUCTIONS FOR OPERATION

3.1 Connecting the Signal Generator

The signal generator is designed for 40 to 60 Hz mains operation. The mains voltage required is usually 220 V and is engraved on the front panel. For operation from 110 V mains, the primary windings of the power transformer should be connected in parallel, the fuse should be changed and the inscription altered. This is best done by the instrument supplier.

3.2 Frequency Adjustment

The desired output frequency is selected with the aid of the frequency selector and the frequency dial K 1, leaving the fine-tuning dial K 2 in position 0. The output frequency accuracy is within the range of adjustment accuracy and amounts to ± 0.2 % ± 3 kHz.

The fine-tuning dial K 2 permits adjustment of the output frequency setting by ± 25 kHz at an accuracy of ± 200 Hz or better. Accurate measurements from highly selective circuits such as resonant circuits and filters are thus provided. In addition high-accuracy frequencies may be generated which will differ from a frequency standard by not more than 25 or 50 kHz respectively. To do this, establish an identity of frequencies and then detune the generator frequency by the value desired. In the same way, a much higher reliability of frequency adjustment can be achieved in the range 10 to 25 kHz or 10 to 50 kHz respectively, than would be possible with the coarse scale. Start from the frequency 0 (zero beat) that is readily identified on the meter, and use the fine-tuning dial only to adjust the frequency. If zero beat is adjusted when S 1 is in position +25 kHz and K 2 dial is adjusted to -25 kHz than a range of 50 kHz will be covered at an accuracy of about ± 200 Hz.

Checking for zero beat is an effective means of testing output frequency accuracy. When the fine-tuning dial K 2 is set to zero, no meter needle deflection should be visible when the coarse setting is again positioned to zero with selector S 1. A closer check of the zero beat is obtained by connecting a headphone to the generator output. If, after prolonged operation, the zero beat no longer coincides with the zero mark of the frequency scale, recalibrate the set. To do this, remove the cover plate marked "FREQ. CAL" and adjust the trimmer capacitor of oscillator II so that zero beat occurs with the frequency scale division 0.

3.3 Level Adjustment

Before switching on, check the mechanical zero of the meter needle.

Coarse adjustment of the output level is achieved with switch S 3 and fine adjustment with the control P 1. The true generator level is the sum of the level values indicated by switch S 3 and by the meter. Example: Switch S 3 in position -3 Np and meter reading -0.4 Np result in a generator level -3.4 Np. Example for the dB-version: Switch S 3 in position -30 dB, meter reading -4 dB mean that the generator level is -34 dB. When the output impedance is between 50 Ω and 50 Ω, a corresponding output impedance is series connected between meter and output. The output voltage then depends on R_L, corresponding tc a voltage division between R_L and R_i. Only in the no-load condition ($R_L = \infty$) is the voltage level connected to the output. In the matching condition ($R_L = R_i$), the output voltage is halved, i.e. the output level is decreased by about 6 dB.

Generally the signal generator is connected to the load by a cable. This cable, when it is long and when the output frequency is high, should be terminated for freedom from reflections, otherwise a voltage transformation can take place between generator output and load. Hence, the characteristic impedance Z_o of the cable should correspond to the load impedance R_L and the output impedance R_i or at least to one of them. The most favorable condition is matching ($R_L = R_i = Z_o$) where unavoidable VSWR have the least effect. The meter accuracy is approx. ± 2 % f.s.d. at 100 kHz output and in switch position 0 dB (0 Np). In all other positions of S 3, the attenuator accuracy 0.1 dB (0.01 Np) becomes effective. The frequency response of the meter and the attenuator is about 0.2 dB (0.02 Np). An additional accuracy range is presented by the distortion coefficient of the amplifier which may rise to as much as 1.5 % for highest generator level and highest frequency. Depending on whether the comparing meter gives a reading of the peak, rms or (selectively) the fundamental frequency value, an additional error may be introduced and have the magnitude of the distortion coefficient.

3.4 Connecting the Load

The voltage transformation on the mismatched cable may assume substantial values at 10 MHz even when the cable is short. The characteristic impedance of the cable should therefore be matched to the load. Coaxial cables are available with characteristic impedances between 50 and 150 Ω. If this requirement cannot be met in certain cases, the cable must be maintained as short as possible. In case of doubt measure the voltage across the load, using a separate level meter.

3.5 Attenuation of Distortion and Interference

The voltage across the amplifier input has a very low harmonic content. The harmonics are 60 to 70 dB (7 to 8 Np) down compared with the fundamental-wave component. The voltage also contains oscillator frequency components, the magnitude which somewhat depends on the amplitude of the oscillator and generator frequencies, respectively. Generally they are attenuated by at least 60 dB (7 Np). The percentage of other combination oscillations and of white noise is still less.
The non-linearity of the amplifier neccessarily introduces an additional distortion of the voltage available across the signal output. The attenuation of this distortion depends on the voltage level adjusted, on the load impedance and on the frequency. The harmonics attenuation vs. frequency characteristic is shown in Fig. 2 for the highest output signal level, i.e. +10 dB (1 Np) in 75 Ω. It amounts to approx. 50 dB (5.8 Np) at medium frequencies and is somewhat less at higher and lower frequencies. When a moderate control voltage is applied to the amplifier, the harmonics attenuation will increase, this control voltage is reduced by tuning the control P_1 in counter-clockwise direction, but not if the stepping switch S 3 is operated. Fig. 3 shows the harmonics attenuation distortion as a function of the position of control P_1 (switch S 3 in pos. +10 dB (+ 1 Np).

3.6 Amplitude Modulation

Using an external voltage source, the output signal amplitude may be modulated by frequencies from d.c. to greater than 100 kHz.26 mV are required for each one per cent of the depth of modulation. When the modulating voltage is constant, the depth of modulation will remain constant from d.c. to 20 kHz increasing somewhat towards 100 kHz and decreasing at higher frequencies. The modulating characteristic may be plotted statically, that is, with a direct voltage across the modulator input, it is also possible to modulate by square-wave keying, i.e. to operate the generator under control of the quantity applied to the modulation jack.

The carrier-voltage component of the output is not affected by a change in the depth of modulation. Proper indication by the built-in meter, however, occurs only when the depth of modulation is zero (m = 0).

The distortion coefficient of the modulation (higher-order sidebands) is in most cases less than 3 % when m = 30 % and may increase to about 10 % when m = 80 %. For a large depth of modulation it is recommended to turn control P_1 counter-clockwise so that the amplifier can pass the modulating peaks at low distortion.

3.7 Operation with external tuning

To tune the Signal Generator TFPS-42 by means of the Level Meter TFPM-43, the control signal output socket Bu 16 is connected to the TFPS-42 control signal input Bu 10. Oscillator I of the level meter then assumes the function of the signal generator oscillator I (see block circuit diagram). Prior to commencing measurement, the signal generator output is connected to the input of the level meter. Maximum needle deflection of the TFPM-43 meter is then achieved by adjustment to the fine tuning dial K 2. The test object can then be inserted between generator and level meter. The fine tuning setting must not be changed during the measurement. The sync. condition must be checked from time to time during prolonged measurements or a series of tests.

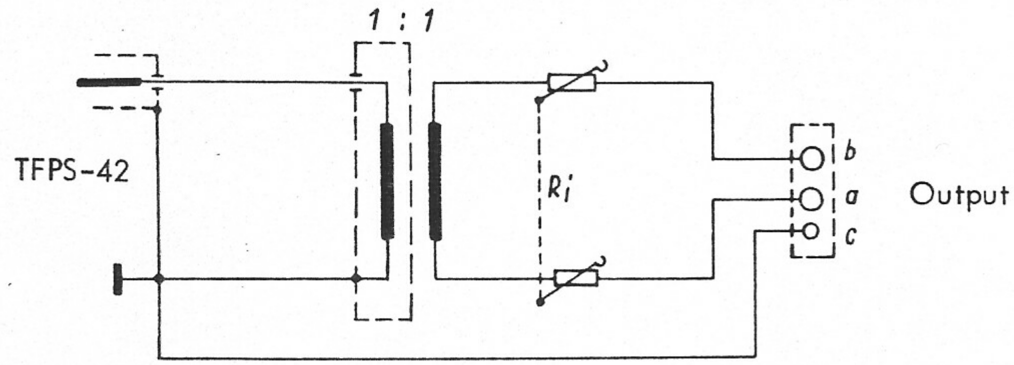
To provide synchronous tuning of the Level Meter TFPM-43 by the Signal Generator TFPS-42, the control signal output at socket Bu 7 of the TFPS-42 is connected to the socket input Bu 18 of TFPM-43. Fine tuning, as described above, is also to be undertaken in this case.

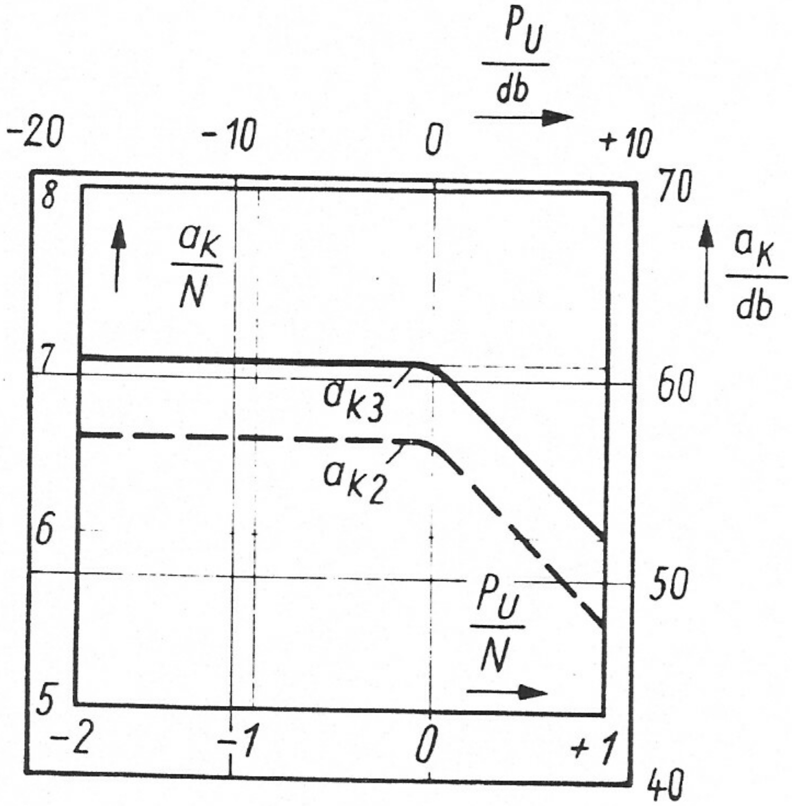
Additional ground leaks are not introduced between the generator and level meter when external tuning is made use of. This is of special importance when testing objects having elevated attenuation figures. Care must thus be taken with such high loss test objects (e.g. in excess of 70 dB (8 Np) that additional ground leaks are not introduced. In critical cases, operation with protective ground or instrument stacking must be avoided. Under extreme conditions the signal generator and the level meter (receiver unit) must be located separately, whereby provision should be made to enable the use of short connecting leads between the receiver unit and the object under test.

3.8 Unbalanced-to-balanced output transformer SÜ-7031

This device finds application for the provision of a balanced output and for this purpose is inserted into the output socket of the TFPS-42. The output impedance selector S 2 on the generator front panel is then set to zero and the desired output impedance selected with the step switch of the SÜ-7031 transformer.

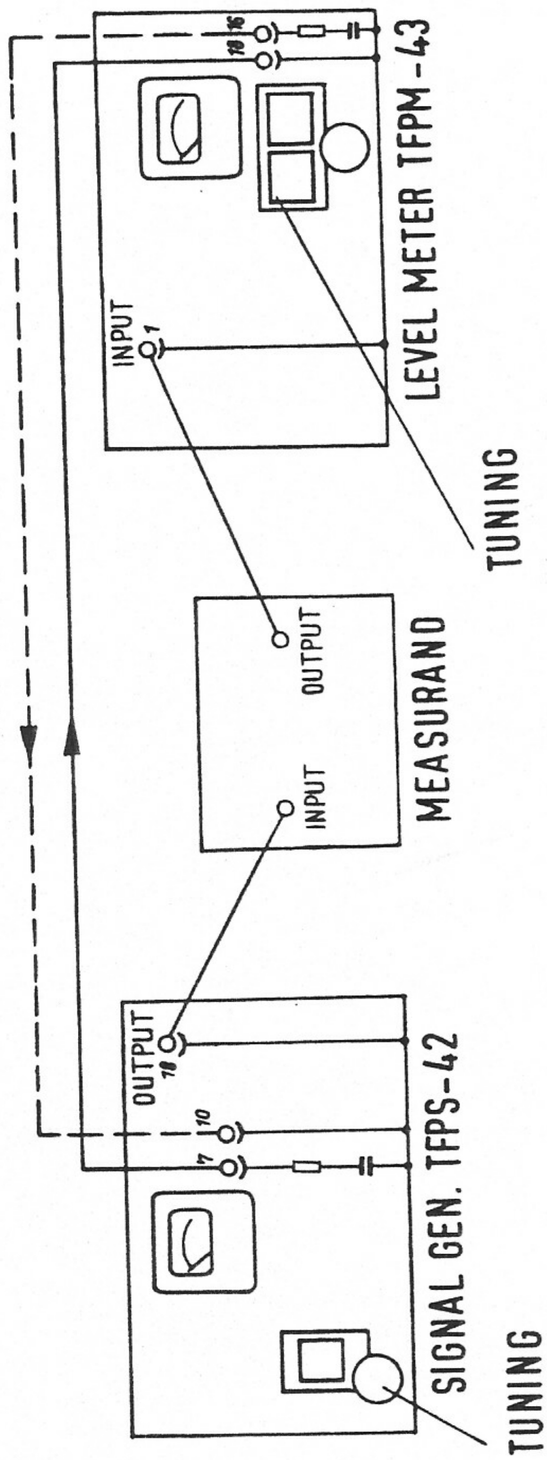
Frequency range	10 kHz to 600 kHz
Transformer ratio	1 : 1
Output impedance, balanced	0, 50, 60, 75 and 150
Frequency response	within ± 2 %
Balance attenuation	min. 40 dB(5 Np)
Dimensions	40 x 70 x 135 mm
Order No.	BN 84/6





ATTENUATION OF DISTORTION VS. GENERATOR LEVEL P_U FOR $R_i = R_A = 75\Omega$ AND f = 2 MC

Fig. 3



EXTERNAL CONTROL

Fig. 4

No.	a + feed to ● measure at	b Rated voltage + open ● parallel	c Frequency	d R_i of test voltage or R_{in} of level meter	e Switch positions S 1	 S 2	 S 3	f P 1	g Test procedure	h Testing of:
1	● Bu 8	+ ≧ 0,9 V	20–34Mc	150 Ω	1–6	–	–	–	Diode voltmeter with probe head and parallel	no. I osc. w/buffer
2	● Bu 7	● ≧ 0,5 V	"	75 Ω	"	–	–	–	resistor.	
3	● Bu 2	+ ≧ 1,1 V	20 Mc	"	–	–	–	–		no. II osc. w/buffer
4	● P 1	● ≧ 22 mV (≧ – 3.55 N)	100 Kc	≧ 10 kΩ	1	–	–		Adjust generator frequency to 100 kc by no. I osc. Voltage across P1 should disappear when cable is plugged in jack 12 or 10. Voltage should be present when jack 7 is connected to jack 10.	Amplitude modulator, main modulator, switch buffer
5	+ Bu 12 P 1	250 mV ● ≧ 20 mV (≧ – 3,65 N)	20 Mc 100 kc	50 Ω ≧ 10 kΩ	1	–	–	–	Adjust generator frequency to 100 kc by no. I osc.	
6	● R 83	● ≧ 67 mV (≧ – 2,45 N)	100 kc	≧ 10 kΩ	1	–	–	turned on	"	Amplifier I
7	● R 101	● ≧ 1.2 V (≧ + 0,42 N)	"	"	1	–	–	"	"	
8	● Bu 18	● ≧ 2.57 V (≧ + 1.2 N)	"	≧ 75 Ω	1	0	+ 1 N + 10 db	"	"	Amplifier II / Output I
9	● Bu 18	+1N±0.02N +10db±0.2db	"	75 Ω ± 0,2 %	1	75 Ω	+ 1 N + 10 db	Adjust P 1 to 0 N / 0 db of meter		Level reading
10	● Bu 17	0N±0.02N (0db ±0.2db)	"	"	1	–	–	Adjust P 1 to 0 N / 0 db of meter		Output II

Aligning component	Aligning problem	Aligning procedure
R 123	Output-level accuracy + 1 N/+ 10 db, R_i = 75 Ω	Generator frequency 100 kc, switch S 2 = 75 Ω, Switch S 3 = + 1 N/+ 10 db, connect calibrating level meter of R_i = 75 Ω ± 0.2 % to no.1 OUTPUT, adjust reading of cal. level meter to exactly + 1 N/+ 10 db by control P 1. Adjust by R 123 generator-level reading on meter M 1 to zero reading (exact 0).
L 13	No. 1 oscillator frequency	Demount no. 1 osc. Remove cover plate, no. 1 osc. Is mounted on front panel. S 1 = range 0.01 to 1.3 Mc. Adjust C 50 to scale reading 0 c/s. Test oscillator frequency at CONTROL OUT and adjust to exactly 20 Mc by L 13.
C 14 Frequency calibration	No. 2 oscillator frequency	Adjust generator frequency to 0 c/s by no. 1 osc. (C 50). Fully turn on generator level at P 1. Adjust no. 2 osc. to 0 c/s by FINE TUNING scale. Adjust by C 14 to minimum generator-level reading.

VOLTAGE CHART AND DIRECTIONS FOR ALIGNMENT

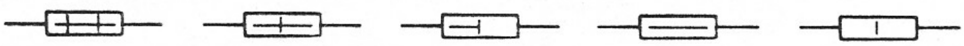
PEFER TO BLOCK DIAGRAM

Anmerkungen zu den Stromlaufplänen (Circuit Diagram Details)

Alle angegebenen Spannungen sind mit einem Instrument 100 kΩ/V gegen 0 V gemessen
(All voltage ratings measured with respect to 0 V with 100 kΩ/V meter)

Relais in Ruhestellung
(Relays shown non-excited)

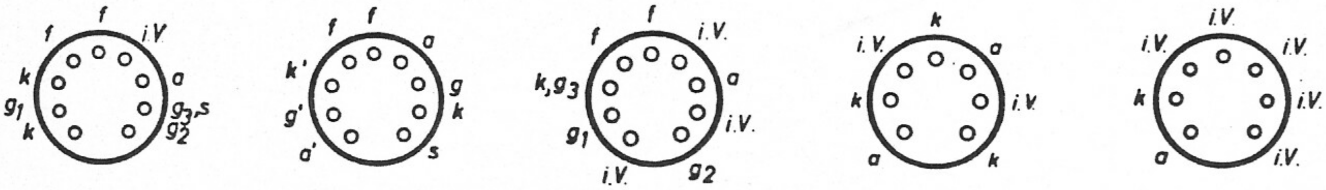
Belastbarkeit der Widerstände (Resistor Ratings)

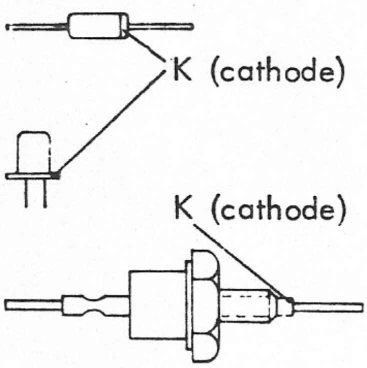


1/10 W   1/4 W   1/3 W   1/2 W   1 Strich (mark) = 1 W

Anschlußschemas (Connection Details)

E 180 F   E 88 CC   EL 86 u. E 84 L   85 A 2   150 B 2

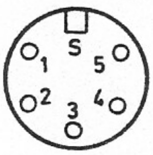




1 N 82, OA 126/14, OA 150, OA 159, OA 160

Z 8, Z 10, FD 7

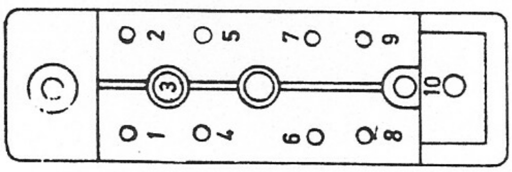
OY 5063

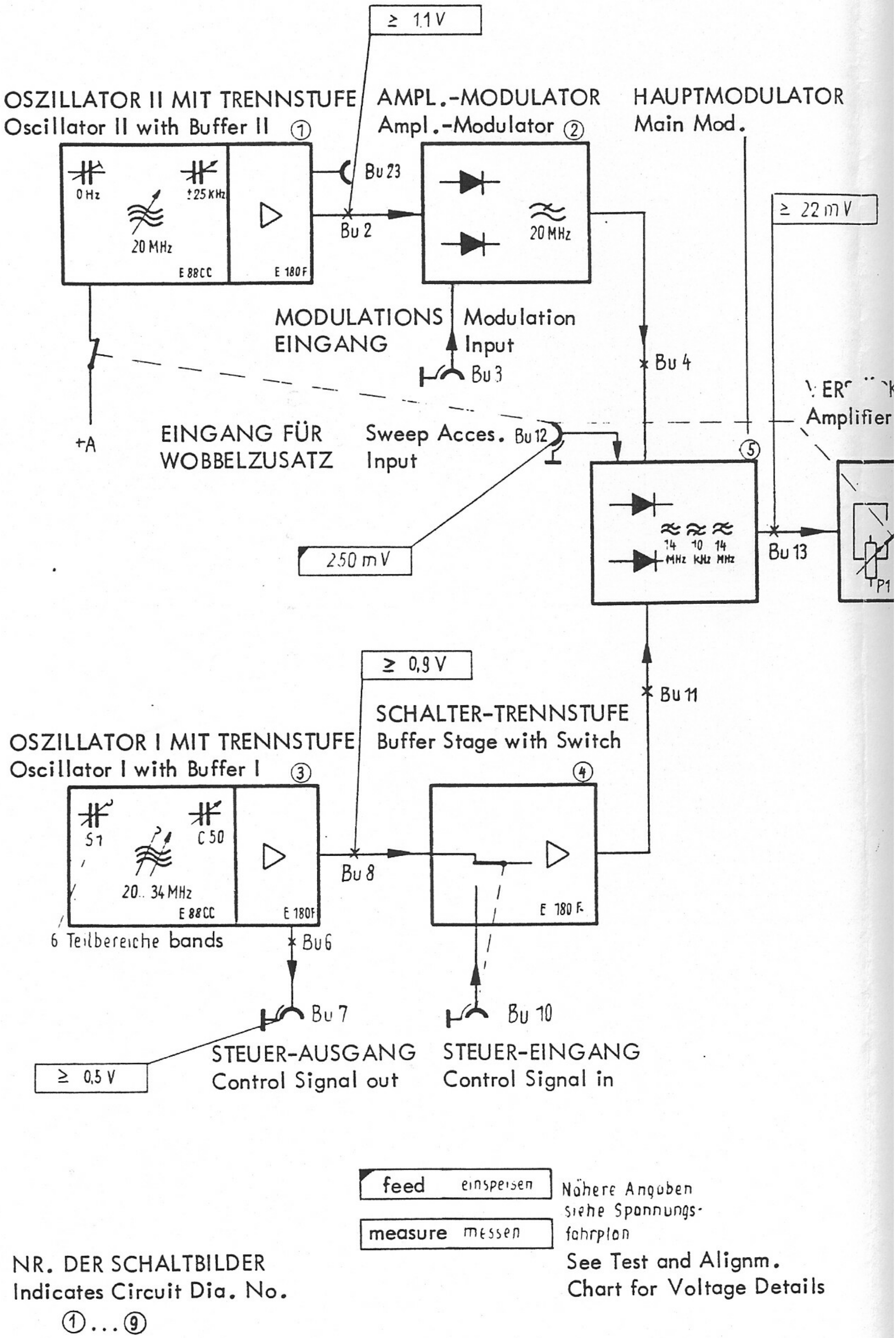


Speisespannungen (Supply voltages)

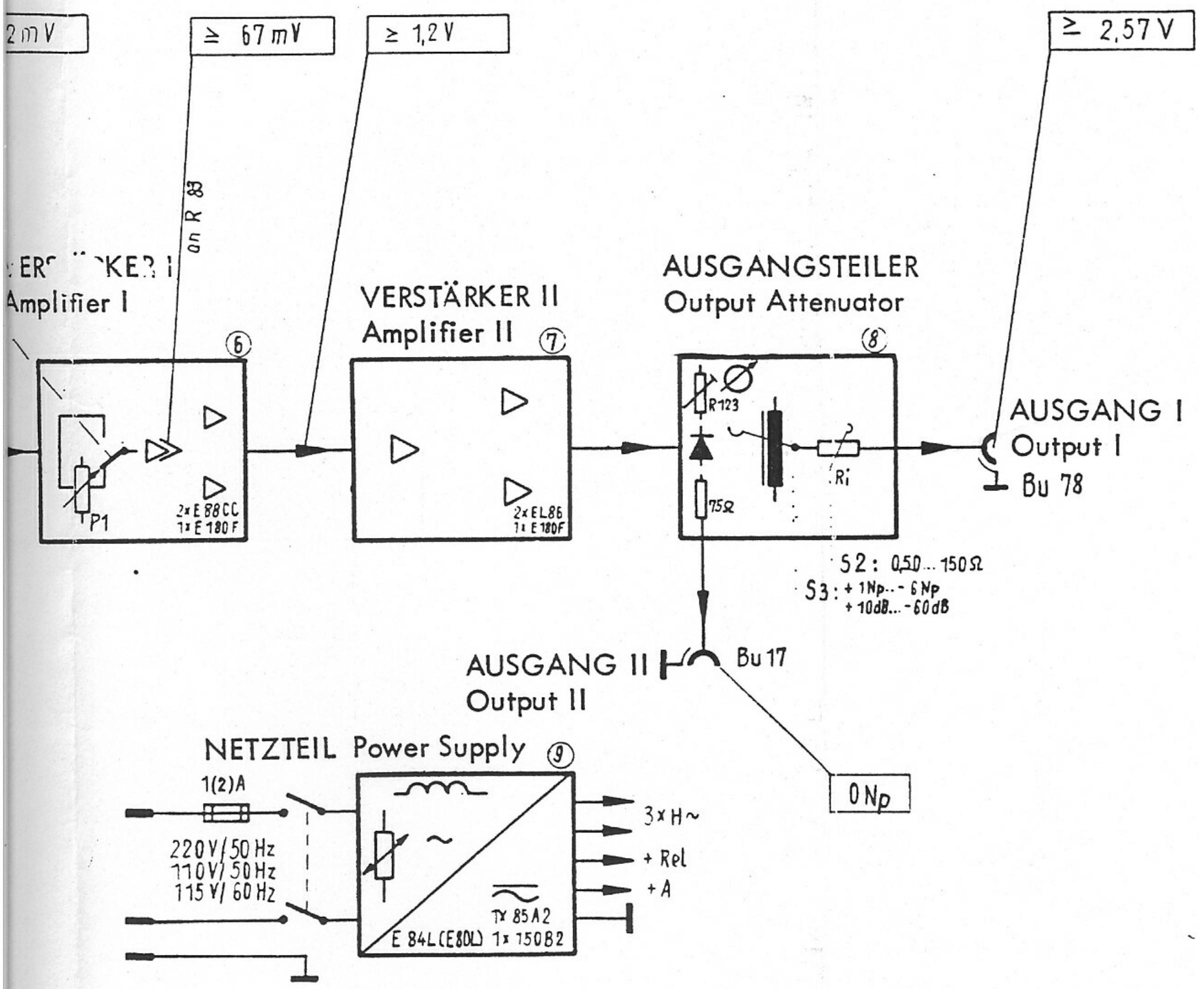
Bu 14 (Buchsenleiste) auf Lötseite gesehen

Connector Bu 14 showing solder tags




≥ 1,1 V
OSZILLATOR II MIT TRENNSTUFE
Oscillator II with Buffer II ①
AMPL.-MODULATOR
Ampl.-Modulator ②
HAUPTMODULATOR
Main Mod.
0 Hz
±25 KHz
20 MHz
E 88CC
E 180F
Bu 23
Bu 2
20 MHz
≥ 22 mV
MODULATIONS
EINGANG
Modulation
Input
Bu 3
Bu 4
Amplifier
+A
EINGANG FÜR
WOBBELZUSATZ
Sweep Acces.
Input
Bu 12
⑤
14 MHz
10 KHz
14 MHz
Bu 13
P1
250 mV
≥ 0,9 V
Bu 11
SCHALTER-TRENNSTUFE
Buffer Stage with Switch
OSZILLATOR I MIT TRENNSTUFE
Oscillator I with Buffer I ③
④
S1
C 50
20...34 MHz
E 88CC
E 180F
Bu 8
E 180 F
6 Teilbereiche bands
Bu 6
Bu 7
Bu 10
STEUER-AUSGANG
Control Signal out
STEUER-EINGANG
Control Signal in
≥ 0,5 V
feed einspeisen
measure messen
Nähere Angaben siehe Spannungsfahrplan
See Test and Alignm. Chart for Voltage Details
NR. DER SCHALTBILDER
Indicates Circuit Dia. No.
①...⑨

'OR



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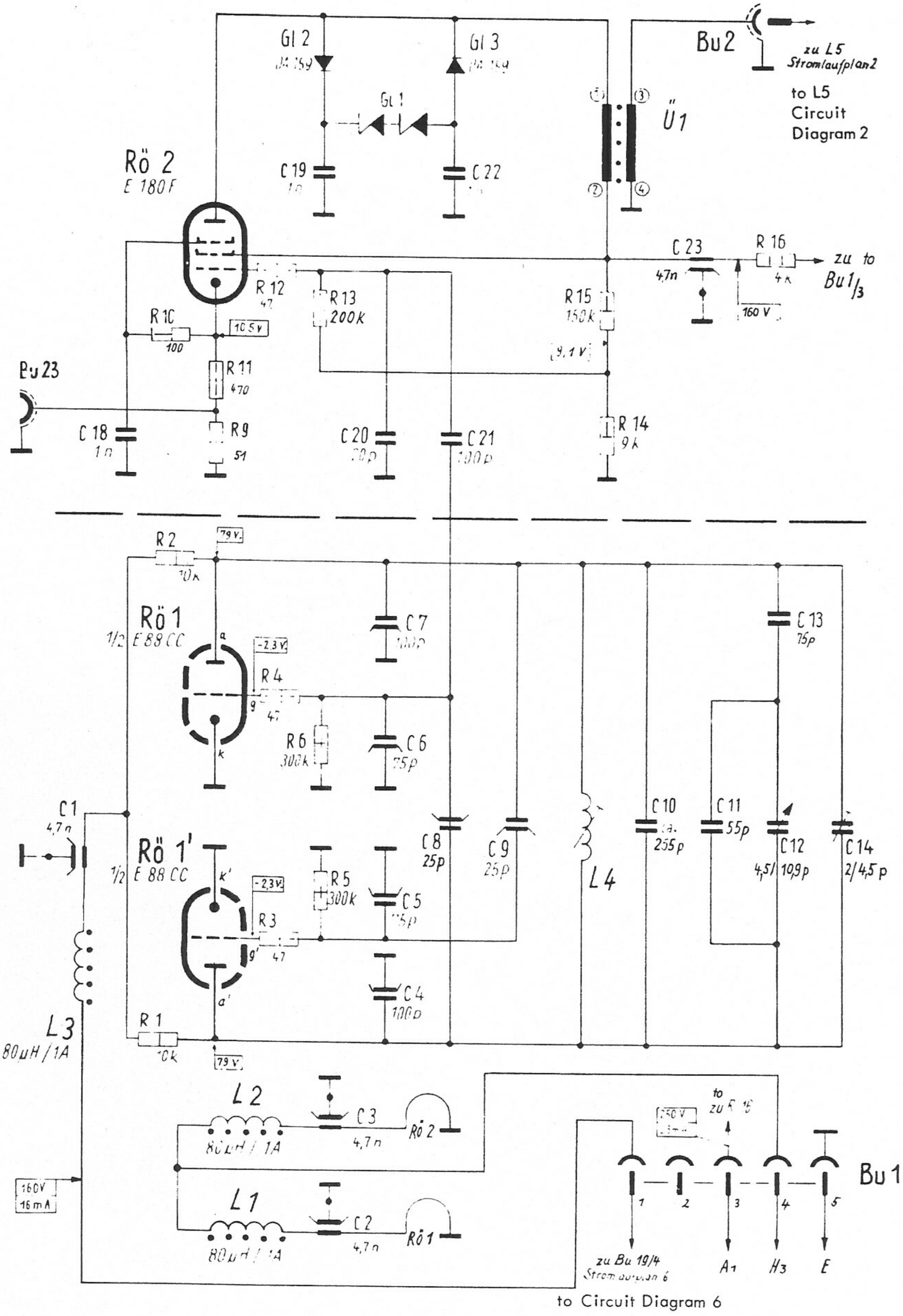
TFPS - 42 / BN 84

Blockschaltplan

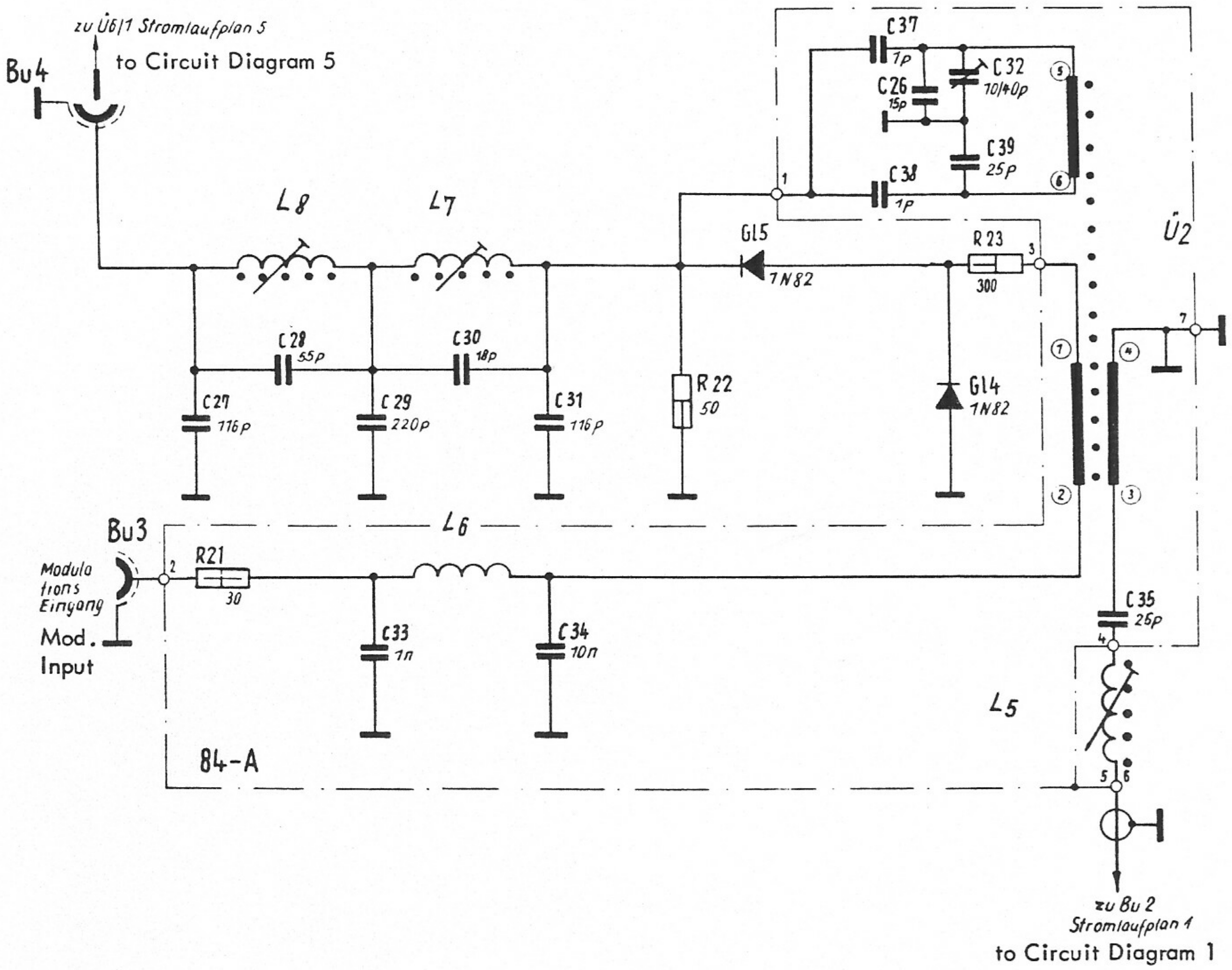
Block Circuit Diagram



TFPS - 42 / BN 84

Oszillator II mit Trennstufe II (1)

Oscillator II eith Buffer-stage II



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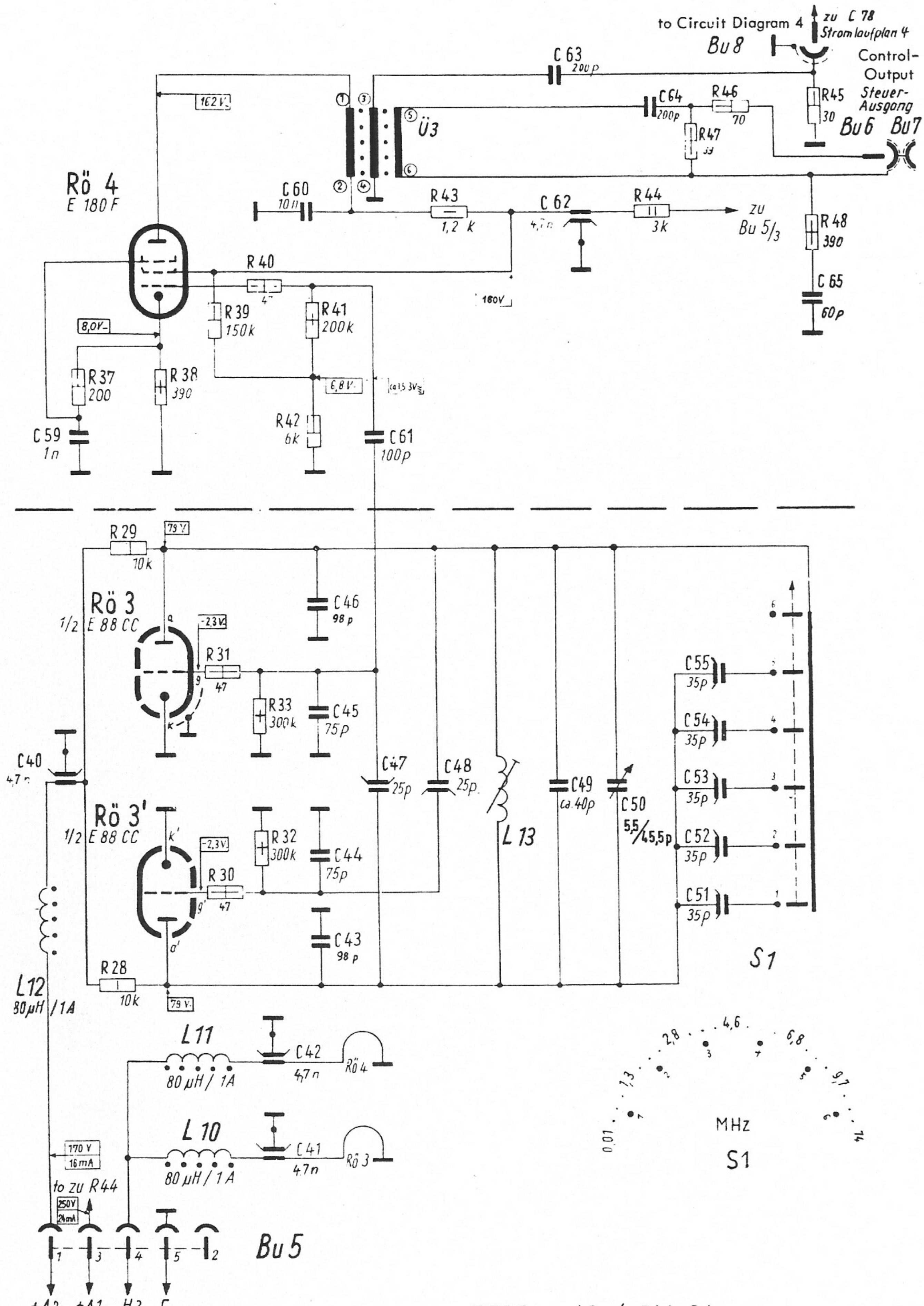
Amplituden-Modulator (2)

Amplitude - Modulator



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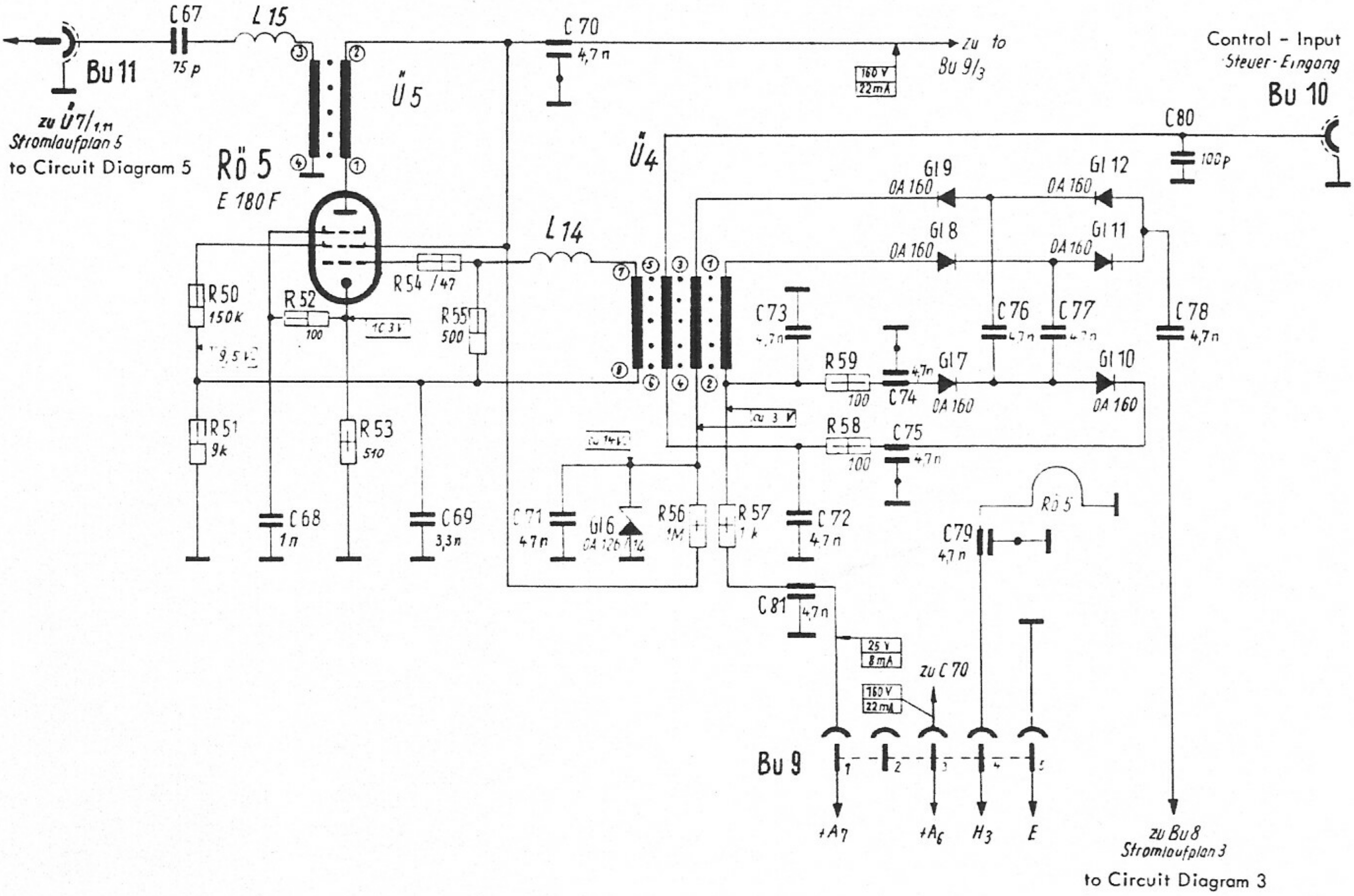
Oszillator I mit Trennstufe I (3)

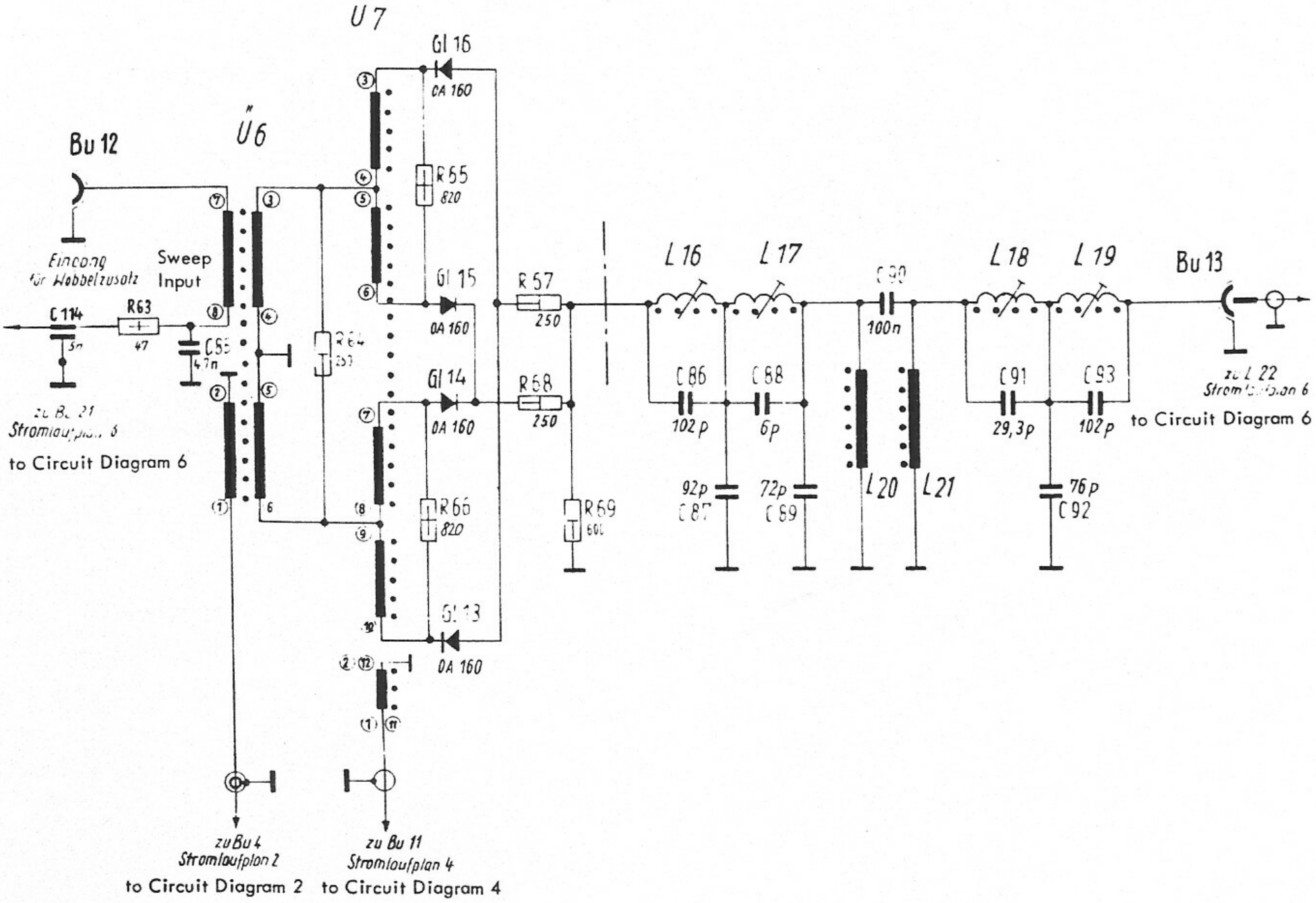
Oscillator I with Buffer-stage I



TFPS - 42 / BN 84

Schaltertrennstufe 20 MHz bis 34 MHz (4)

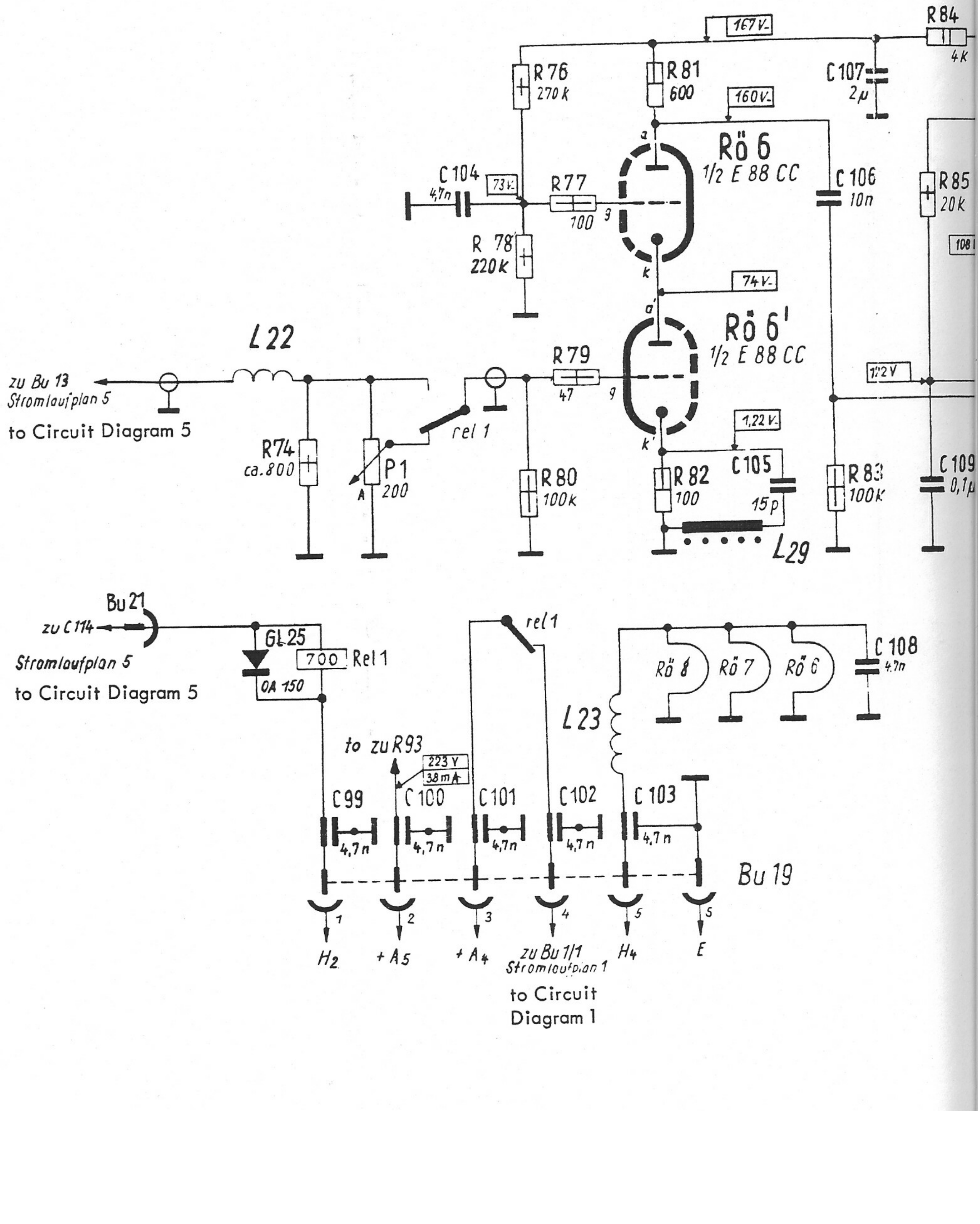
Buffer Stage with Switch 20 MHz to 34 MHz



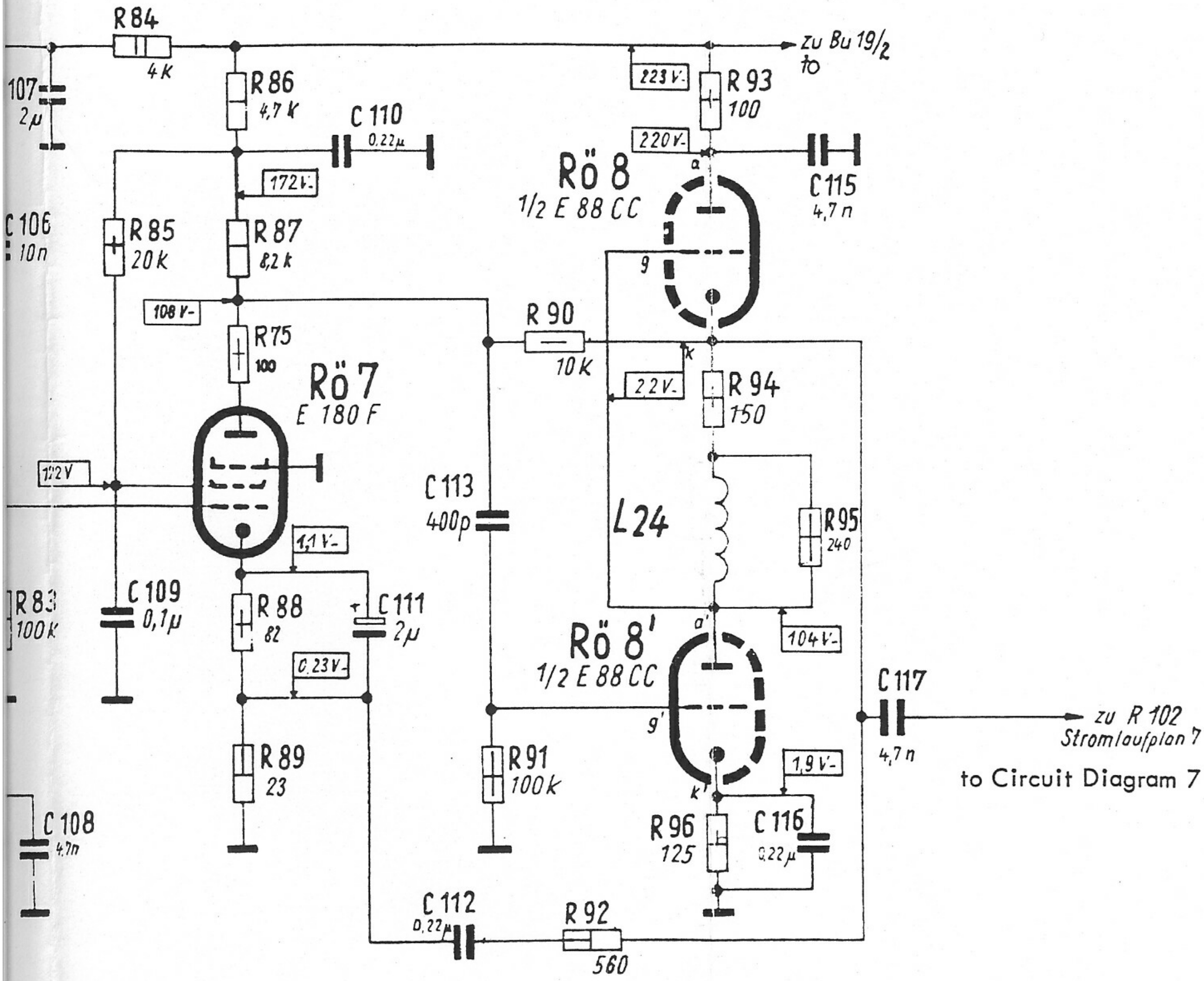
TFPS - 42 / BN 84

Hauptmodulator (5)

Main Modulator



R 84
4K
167 V.
R 76
270 K
R 81
600
C 107
2μ
160 V.
Rö 6
1/2 E 88 CC
C 104
4,7n
73 V.
R 77
100
C 106
10n
R 85
20K
R 78
220K
74 V.
L 22
Rö 6'
1/2 E 88 CC
R 79
47
zu Bu 13
Stromlaufplan 5
to Circuit Diagram 5
172 V
rel 1
1,22 V.
R74
ca. 800
P 1
200
R 80
100 K
R 82
100
C 105
15 p
R 83
100K
C 109
0,1μ
L29
Bu 21
zu C 114
Stromlaufplan 5
to Circuit Diagram 5
GL 25
700
Rel 1
OA 150
rel 1
Rö 8
Rö 7
Rö 6
C 108
4,7n
L 23
to zu R 93
223 V
38 mA
C 99
C 100
C 101
C 102
C 103
4,7 n
Bu 19
H2
+ A5
+ A4
zu Bu 1/1
Stromlaufplan 1
to Circuit Diagram 1
H4
E



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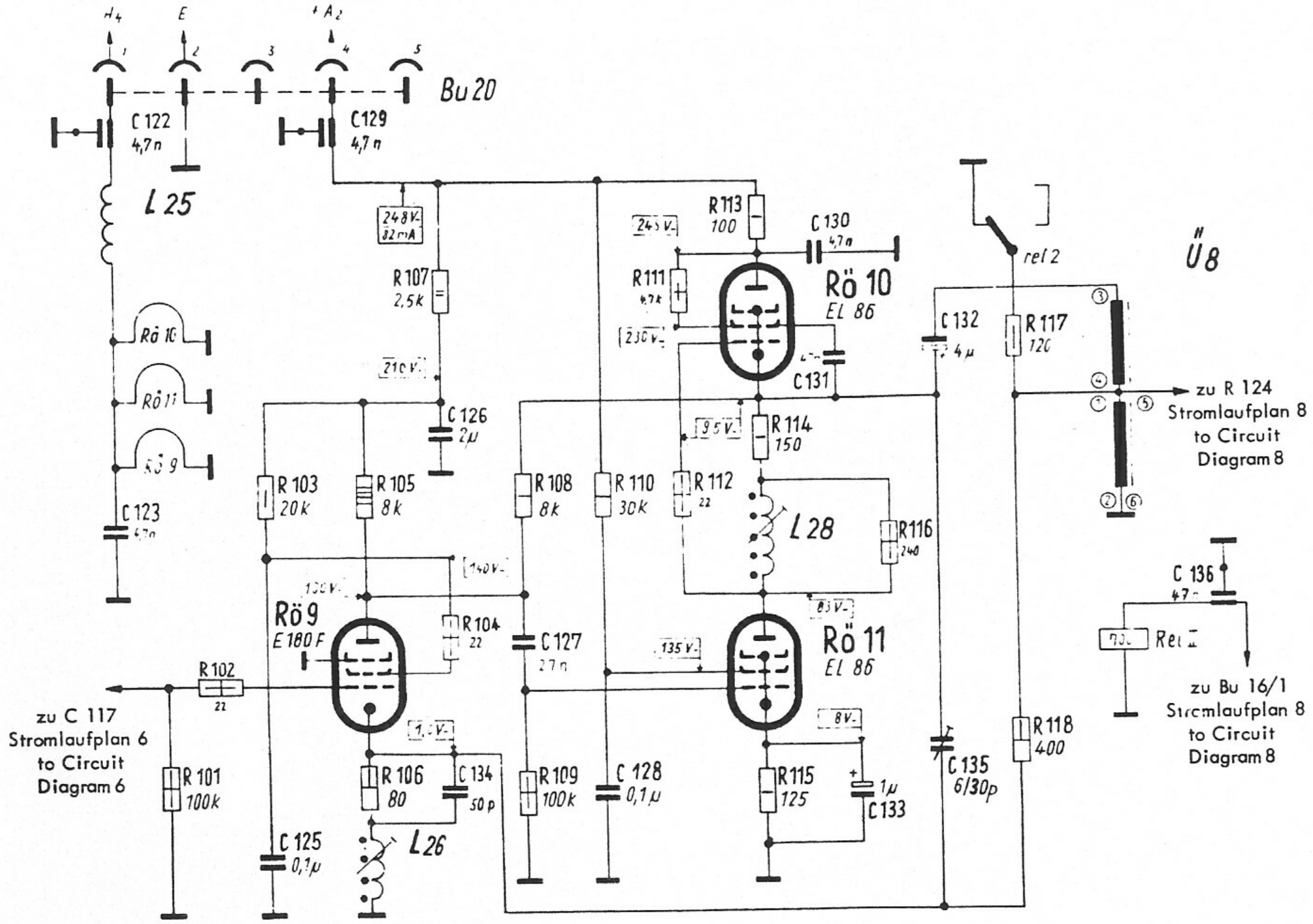
Verstärker I (6)

Amplifier I



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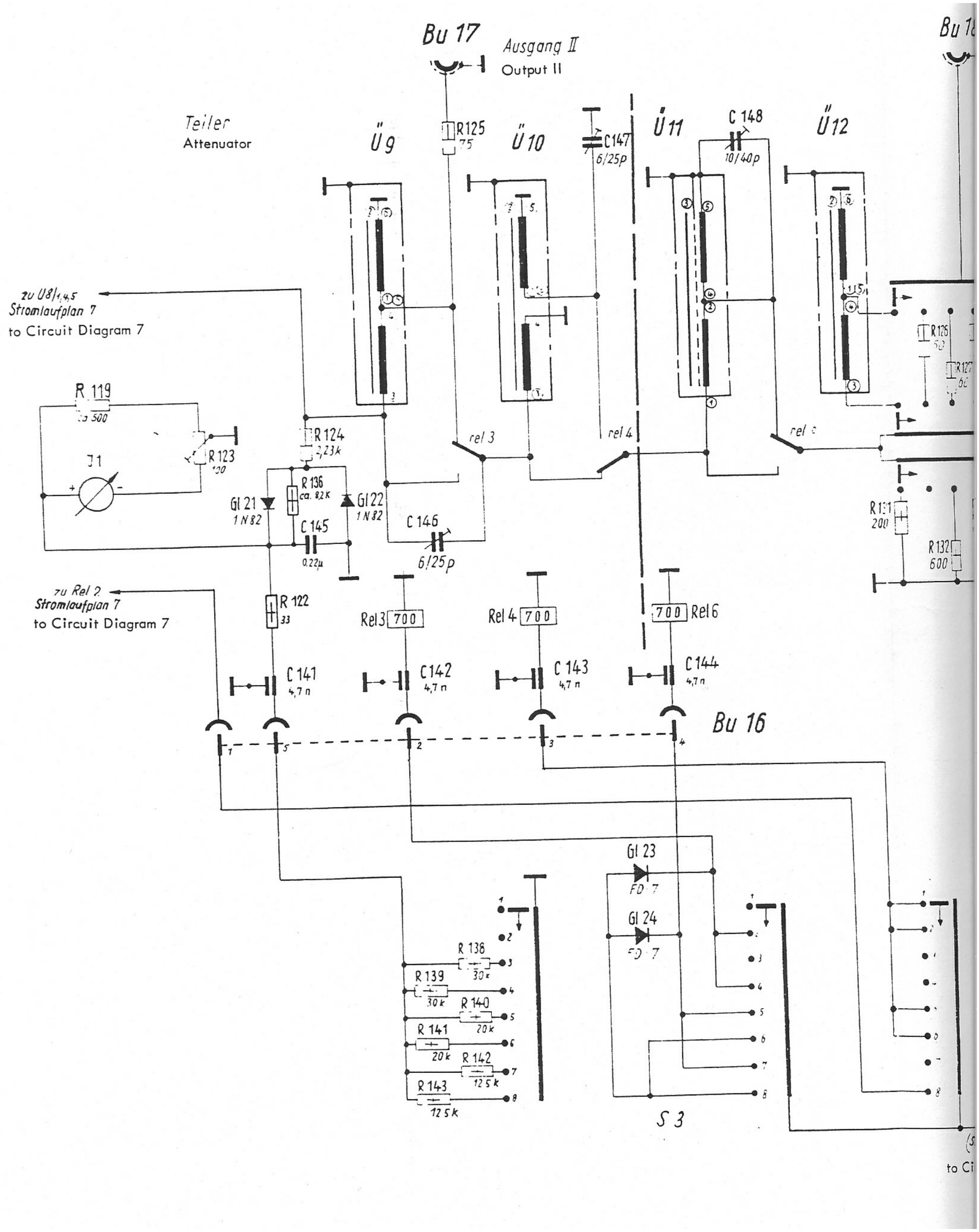
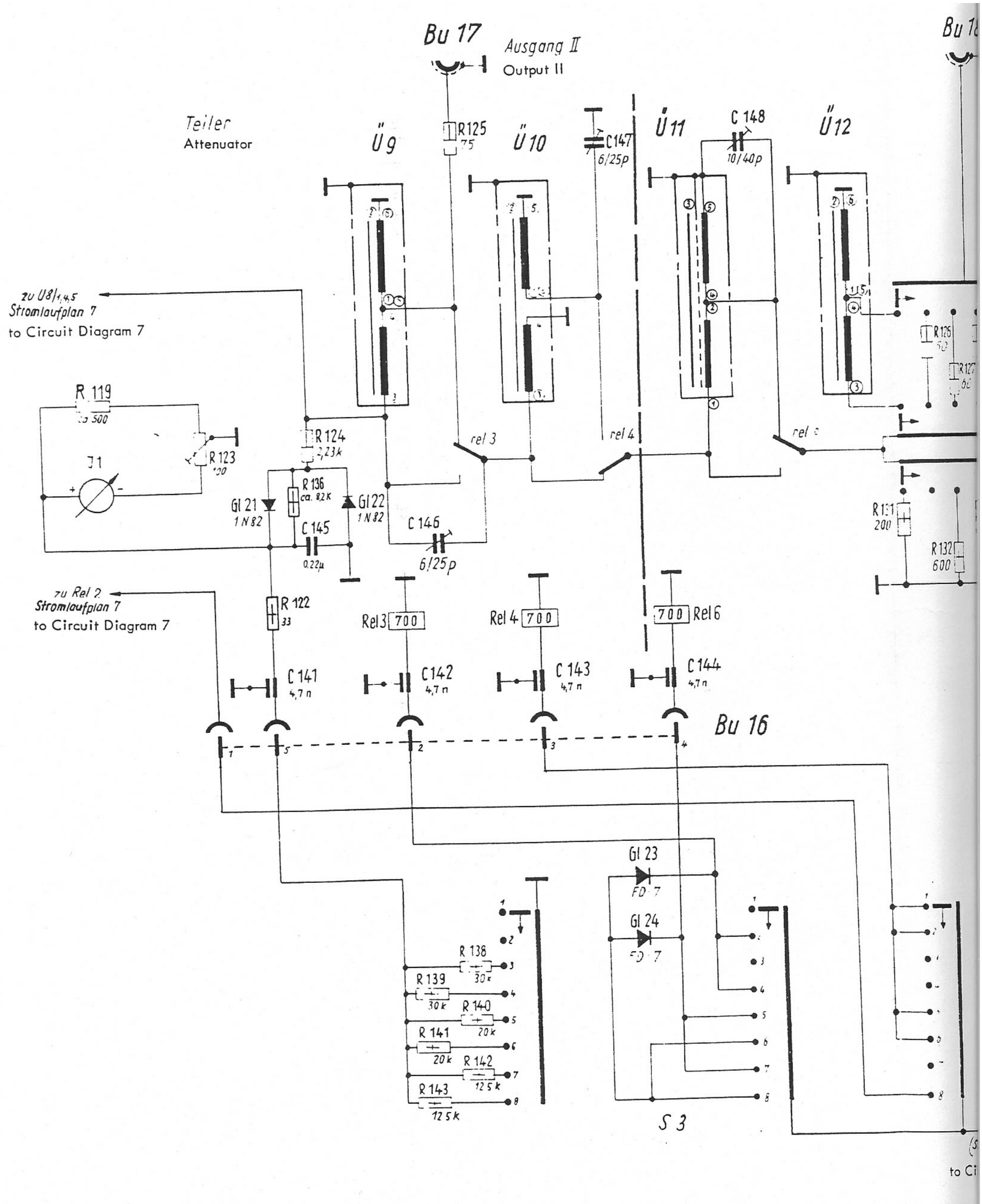
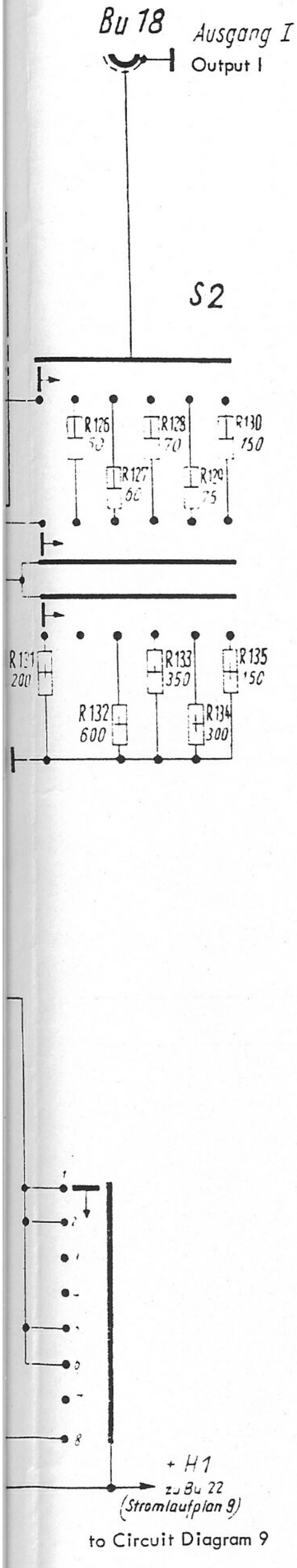
Verstärker II (7)

Amplifier II

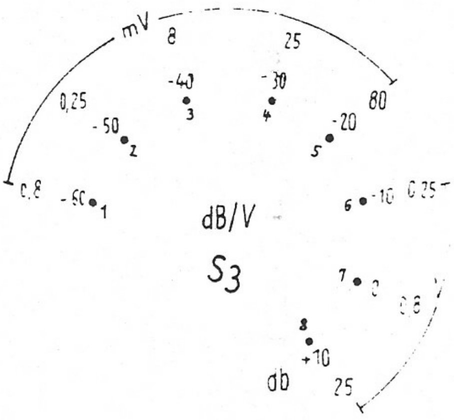

Bu 17
Ausgang II
Output II
Teiler
Attenuator
Ü 9
R 125
75
Ü 10
C 147
6/25p
Ü 11
C 148
10/40p
Ü 12
zu U8/1,4,5
Stromlaufplan 7
to Circuit Diagram 7
R 119
500
R 123
100
J 1
R 124
2,23k
R 136
ca. 8,2K
Gl 21
1 N 82
Gl 22
1 N 82
C 145
0,22µ
C 146
6/25p
rel 3
rel 4
R 126
R 132
600
R 131
200
zu Rel 2
Stromlaufplan 7
to Circuit Diagram 7
R 122
33
Rel 3
700
Rel 4
700
700
Rel 6
C 141
4,7 n
C 142
4,7 n
C 143
4,7 n
C 144
4,7 n
Bu 16
Gl 23
FD 7
Gl 24
FD 7
R 138
30 k
R 139
30 k
R 140
20 k
R 141
20 k
R 142
12,5 k
R 143
12,5 k
S 3
to Ci

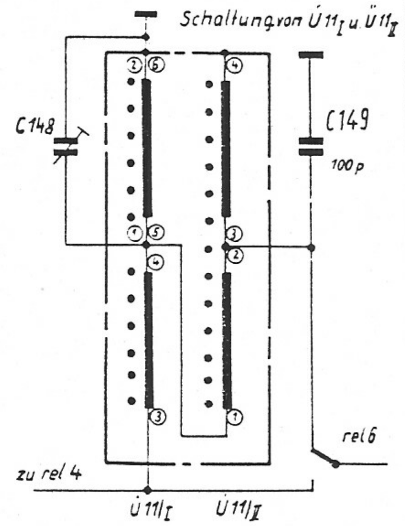

Bu 17
Ausgang II
Output II
Teiler
Attenuator
Ü9
Ü10
Ü11
Ü12
R125
75
C147
6/25p
C148
10/40p
zu U8/1,4,5
Stromlaufplan 7
to Circuit Diagram 7
R 119
R 123
100
R124
2,23k
R 136
ca. 8,2K
Gl 21
1N82
Gl 22
1N82
C 145
0,22μ
C 146
6/25p
rel 3
rel 4
R126
R127
R131
200
R132
600
zu Rel 2
Stromlaufplan 7
to Circuit Diagram 7
R 122
33
Rel3 700
Rel 4 700
700 Rel6
C 141
4,7 n
C142
4,7 n
C 143
4,7 n
C144
4,7 n
Bu 16
Gl 23
FD 7
Gl 24
FD 7
R 138
30k
R139
30k
R 140
20k
R 141
20k
R 142
12,5 k
R 143
12,5k
S 3
to Ci

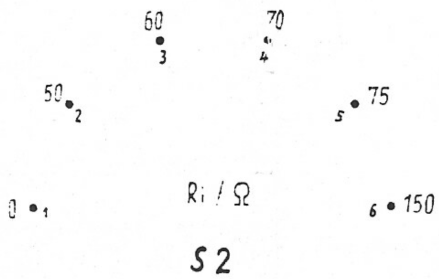


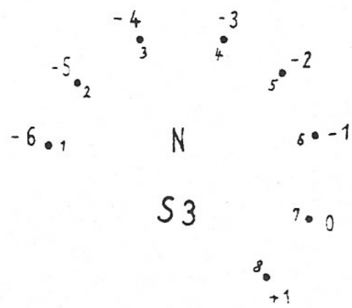
Änderungen bei dB/V-Ausführung:
Modifications for dB/V version

1) R 138, 139, . . . , 143 entfallen (deleted)
2) R 124 : 2,4 kΩ / 0,33 W / 1 %
3) Trimmer C 146 : 3/12 pF
4) Trimmer C 147 : 10/40 pF
5) C 149 : 100 pF / 500 V / 2%









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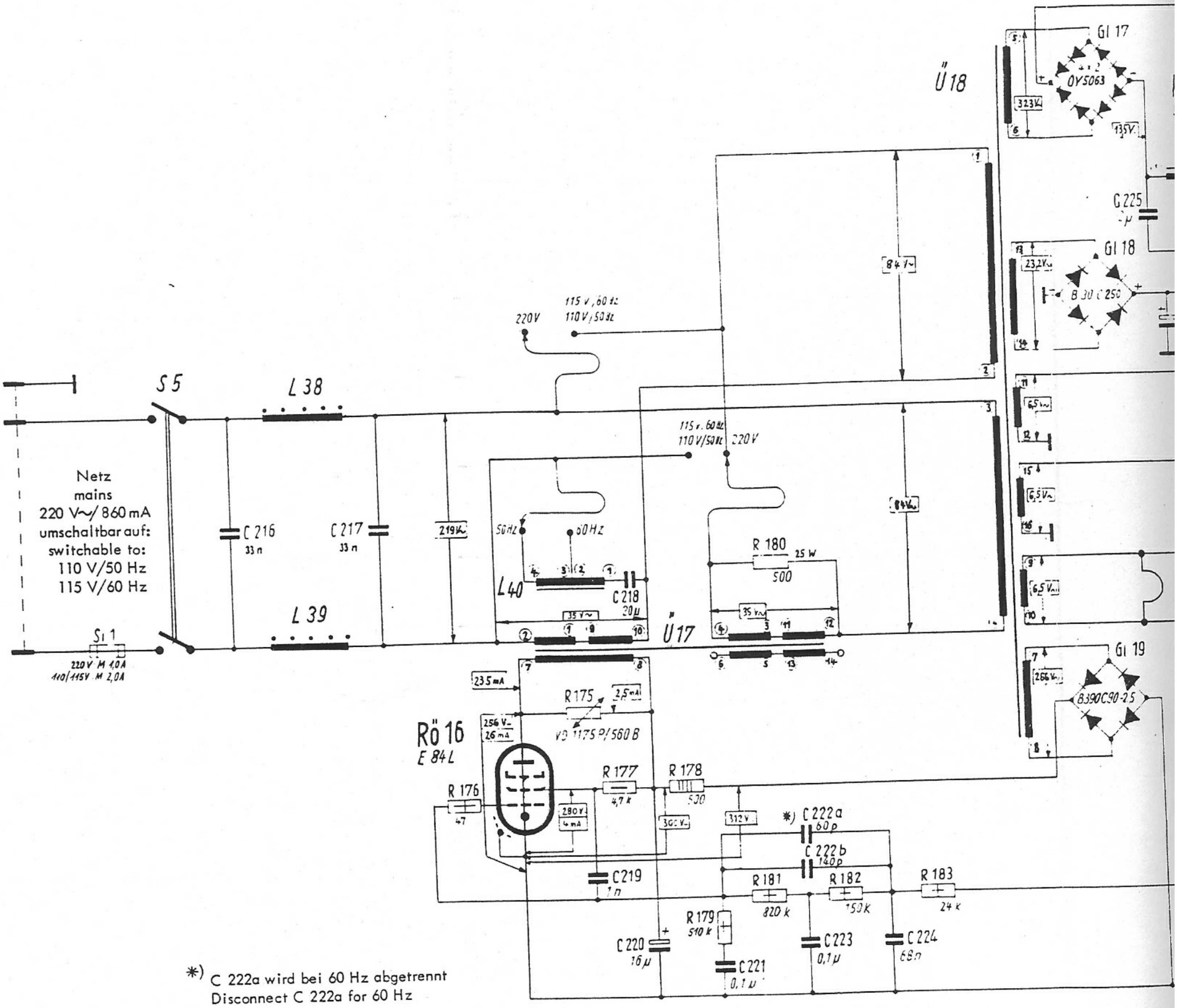
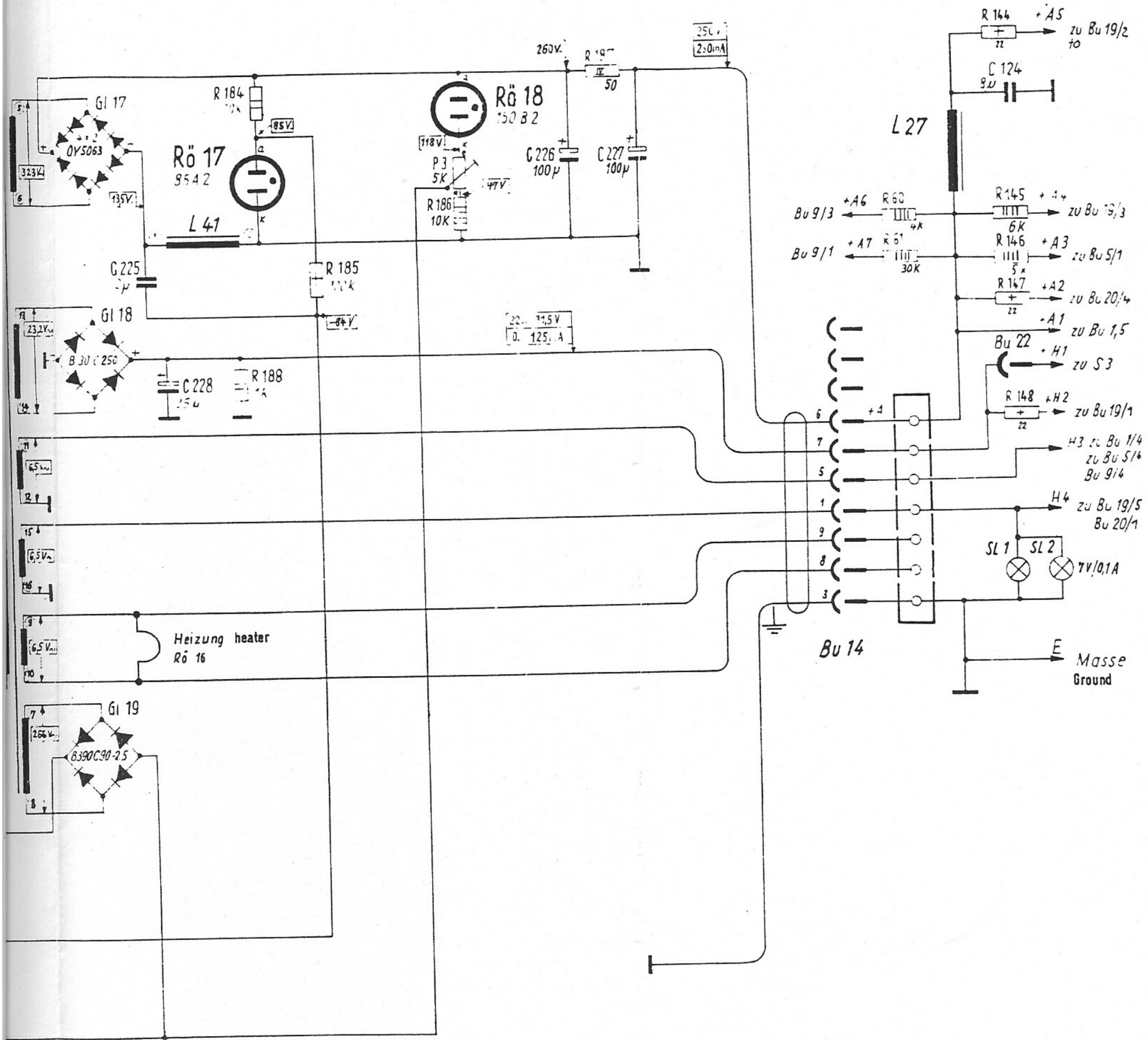
Teiler (Np und dB Ausführung) (8)

Attenuator (Np and dB version)



*) C 222a wird bei 60 Hz abgetrennt
Disconnect C 222a for 60 Hz



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Netzteil (9)

Power Supply