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SIEMENS

SUPERHETERODYNE RECEIVER

30 c/s to 1 mc/s · Type Rel 3 U 420c

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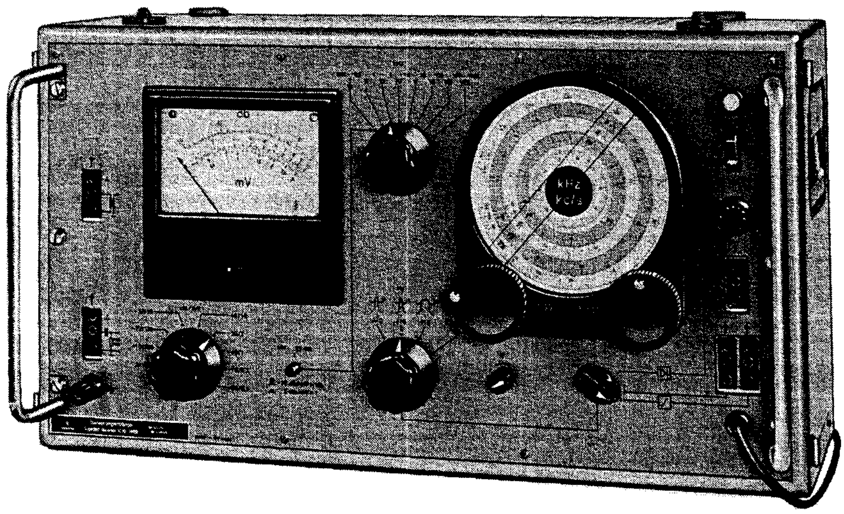
WERNERWERK FÜR WEITVERKEHRS- UND KABELTECHNIK · MÜNCHEN

I. APPLICATION

The superheterodyne receiver Type Rel 3 U 420 is a selective voltmeter for low voltages in the frequency range 30 c/s to 1 mc/s. It serves chiefly as a detector for measurements according to the null method or comparison methods, e.g. measurements of coupling, impedance, and crosstalk on telephone cables.



Superheterodyne Receiver Type Rel 3 U 420c

The device can also be used for measuring individual voltage components of complex-frequency waves, e.g. harmonics of a fundamental frequency, and hence for determining distortion factors.

For measuring very low voltages the preamplifier Type Rel 3 U 42 or the wideband voltmeter Type Rel 3 U 133 can be connected in tandem with the superheterodyne receiver. They extend the voltmeter range of the superheterodyne receiver in both directions so that it comprises 0.3 µv to 30 v or 100 v (in the case of model Rel 3 U 133). With the model Rel 3 U 42 the frequency range encompasses 100 c/s to 1 mc/s.

The operational voltages are supplied via the incorporated power supply unit by AC mains with the nominal voltages of 110, 130, 220, or 240 v.

II. ELECTRICAL DATA

Frequency range . . . . 30 c/s to 1 mc/s
covered in eight bands . . . . 30 to 300 c/s; 0.3 to 1 kc/s; 1 to 3 kc/s; 3 to 10 kc/s; 10 to 30 kc/s; 30 to 100 kc/s; 100 to 300 kc/s; 0.3 to 1 mc/s

Frequency calibration error . . . . $\pm 3\%$ ± 5 c/s

Voltmeter ranges (full-scale deflection)
of the volt scale . . . . 0.1; 0.3; 1; etc.; 300; 1000 mv
of the decibel scale . . -80 db; -70 db; -60 db; etc.; -10 db; 0 db

Minimum readable voltage (level) . . . . 10 µv (-100 db)
Minimum voltage perceivable with headphones . . . . approx. 1 µv
In frequency band I (30 to 300 c/s) the tenfold values apply.

Mid-band voltage error (20 kc/s)
as referred to full-scale deflection . . . . $\pm 3\%$

Frequency response of the voltage indication
between 300 c/s and 1 mc/s . . . . $\pm 3\%$
between 30 c/s and 300 c/s . . . . +3/-10%

With mains voltage variations of $\pm 10\%$
the indications vary by . . . . $\leqq 3\%$

Output frequency . . . . approx. 910 (870) c/s

Bandwidth (between the 3-db-down points;
for the curves see the annexed Figs. 6 to 8)
Narrow band: ∩ 910 c/s, can be switched to 870 c/s . approx. 10 c/s
Wide band: ∩ 910 c/s . . . . .approx. 300 c/s

Input impedance (for the curve see the annexed Fig. 5)
floating circuit, f < 30 kc/s . . . . $\geqq$ 100 kΩ shunted by 15 h in parallel to 500 pf
f > 30 kc/s . . . . . . $\geqq$ 5 kΩ in parallel to 160 pf
Balance ratio (common mode suppression) . . . . $\geqq$ 60 db
single-ended circuit . . . . $\geqq$ 300 kΩ shunted by 100 pf

Residual distortion (f > 300 c/s) . . . . $\geqq$ 60 db
(when in the case of the fundamental frequency the sensitivity is increased by 40 db with respect to full-scale deflection)

Gain (with calibrated device, S1 to 0.1 mv)
between the single-ended input ("2" in the annexed Fig. 2) and the IF output ("4" in the annexed Fig. 2), Z = 600 Ω . . . . approx. 1:5000 (74 db)

External instrument, full-scale deflection . . . . 150 µa
Terminal resistance . . . . 5 kΩ

Power supply . . . . 110/130/220/240 v $\pm 10\%$;47to 60 c/s;65 va

III. FUNCTION AND LAYOUT

1. Basic Circuit (annexed Fig. 3)

The unknown voltage of the frequency f_m is amplified by two input stages and heterodyned with a carrier of the frequency f_s in a ring modulator. Of the modulation products the voltage of the frequency f_a (lower sideband), which is proportional to the voltage under test, is applied via a selective two-stage amplifier of switched bandwidth to one of the two outputs "AC" (4 and 5), or via rectifiers, to the moving-coil instrument J and the terminal jack (3) for an external instrument.

The gain, and hence the sensitivity, can be set to the nominal value with a stabilized calibrating voltage taken from the power supply unit.

2. Input and Wideband Amplifier

The input jacks "1" (annexed Fig. 2) serve to establish the connection to balanced circuits. When a cord is plugged on these jacks, the built-in break contact is actuated. This causes relay A to operate and, with its contact a, connect the transformer groups Ü1 and Ü2 to the voltage divider S1 (see the circuit diagram). In the lower frequency bands (positions I to V of S2) the transformer Ü1 is connected via the relay contacts b, c. In the positions VI to VIII (frequencies in excess of 30 kc/s), the relays B and C are energized to transfer the circuit from transformer Ü1 to Ü2. Depending upon the measuring frequency and the frequency band, the input impedance varies between 1 and over 100 kΩ. The annexed Fig. 5 shows a typical impedance curve.

For special applications, e.g. for measuring high crosstalk values, there is available the highly balanced plug-in transformer Type Rel 3 B 214 (0.1 to 1 mc/s). Its transformation ratio of 2:1 additionally increases the input impedance of the superheterodyne receiver.

The jacks "Unbal. Input" ("2" in the annexed Fig. 2) are intended for measurements on single-ended circuits. In such case the voltage under test is directly applied to the calibrated flat voltage divider S1, where the voltage for the grid of the first tube is tapped and the sensitivity set.

The wideband amplifier following the voltage divider S1 comprises two stages (tubes 1 and 2; 2 tubes C3g) and is stabilized by degeneration.

3. Control Oscillator

Below 10 kc/s (frequency bands I to IV) the control oscillator (tube 5; C3g) works as an R-C generator and above 10 kc/s (frequency bands V to VIII) as an L-C generator, the eight frequency bands being set by switching with S2 the resistors and capacitors or the resonant circuit transformers Ü10, Ü7, Ü8, Ü9. The variable capacitor C40 with coarse drive (4:1) and fine drive (1000:1) serves for tuning within the individual frequency bands. Its frequency scale is marked with the measuring frequency $f_m = f_s - f_a$. For the output frequency $f_a \sim 910$ c/s, the following values of f_m and f_s result in the eight frequency bands:

Frequency Range	Measuring Frequency f_m (to be read on the frequency scale of C40)	Carrier Frequency f_s
I	30 to 300 c/s	940 to 1210 c/s
II	300 to 1000 c/s	1210 to 1910 c/s
III	1 to 3 kc/s	1.91 to 3.91 kc/s
IV	3 to 10 kc/s	3.91 to 10.91 kc/s
V	10 to 30 kc/s	10.91 to 30.91 kc/s
VI	30 to 100 kc/s	30.91 to 100.91 kc/s
VII	100 to 300 kc/s	100.91 to 300.91 kc/s
VIII	300 to 1000 kc/s	300.91 to 1000.91 kc/s

The carrier reaches the modulator Gl 2 via the transformer Ü3 or Ü4, which are also switched when the frequency band is selected with S2 (spring set S2b I, II).

4. Modulator

The circuit is so designed as to suppress the carrier signal f_s at the output of the balanced modulator. At low frequencies, particularly high demands are placed on circuit balance, since the carrier signal f_s is near the output frequency f_a. The input voltages of the frequencies f_m to $n \times f_m$ are so efficiently suppressed at the output of the modulator that residual voltages passing the modulator without translation will not falsify the measuring result. The modulation products after the modulator chiefly contain voltages of the sum and difference frequencies $n \times f_s \pm f_m$, out of which $f_s - f_m = f_a$ is selected.

5. Output Amplifier

With switch S3 the two-stage selective amplifier (tubes 3 and 4; 2 tubes C3g) can be switched to the difference frequency $f_s - f_m = f_a$ = 910 c/s or 870 c/s and to any of two bandwidths. Normally, the frequency f_a = 910 c/s shall be used. Switching to 870 c/s is provided to avoid interference of the output voltages in the form of pulsation. This switch (S3) has four positions:

In position 1 "Л 870 c/s" a band-pass filter (Type Rel 35 U 150) tuned to 870 c/s is interposed before tube 4. The width of the band-pass filter is 10 c/s. Since the variable capacitor C40 of the control oscillator is marked with the measuring frequency with the normal output frequency of 910 c/s, the resonance point is by 40 c/s lower in position 1 of S3 than what is indicated by the lettering. The correct frequency f_m is thus obtained in such case by adding 40 c/s to the reading.

In position 2 "Л 910 c/s" the pass band frequency is 910 c/s by varying the two shunt-arm capacitances and the series-arm capacitance (disconnection of the capacitors C22, C26, and C24). The bandwidth is again 10 c/s.

In position 3 "⎍ 910 c/s" the pass band width is predominantly determined by the first resonant circuit of the filter, which is additionally damped in this case (R34, R35, and R38; C27). The following two circuits are disconnected. The pass band frequency is 910 c/s in the bandwidth setting of about 300 c/s.

Position 4 " ▼ " serves to calibrate the device (section 6). The pass band width and the band width correspond to those of position 2.

The annexed Figs. 6 to 8 show the filter curves. The reduced width is required at the low frequencies for suppressing the residual carrier voltages and the intermodulation products that arise as a result of harmonics of the input voltage. In addition, the narrow band is used to decrease the noise voltage in measuring extremely low voltages (< 30 µv) and high attenuation values in connection with the preamplifier Type Rel 3 U 42.

The output of the selective amplifier is connected via transformer Ü6 to switch S4, which has three positions:

a. In the first position the incorporated moving-coil instrument (mv and db), which is calibrated in RMS values for RMS measurements, is connected via rectifier Gl 3. An external instrument (with 150 μa full-scale deflection and with a resistance of 5 kΩ) can be connected via the jacks "⦸" ("3" in the annexed Fig.2). When the connecting cord to the external instrument is plugged, the incorporated instrument is disconnected.

b. In the mid-position part of the output voltage is connected to the jack pair "•→—" ("4" in the annexed Fig. 2). With termination into 600 Ω the gain of the calibrated device between the jacks "2" (single-ended input) and the jacks "4" (IF output) is about 74 db.

c. In the third position this part of the output voltage is applied via a limiter circuit (crystal diode Gl 7) to jack pair "⊐" ("5"). This causes the output power in the headphones to follow the measuring voltage approximately logarithmically. This is especially expedient for null balancing, e.g. in bridge measurements, since repeated switching of the sensitivity with S1 is largely avoided, the ear being simultaneously protected from clicks and excessive volume.

6. Calibrating

For absolute voltage measurements the device can be calibrated. The power supply unit furnishes the required calibrating voltage via an incandescent-lamp bridge. With the grid short-circuited (position "▼" of S1), part of the voltage is applied via switch S3 (position "▼") to the cathode of the input tube and measured in frequency band I (S2 to "I, ▼") with tuning to the mains frequency. The gain must be adjusted with potentiometer R30 "⌒, ▼" so that the pointer of the instrument reaches the red mark.

7. Power Supply Unit

The power supply unit furnishes from the AC mains all required operational voltages (heater, tube DC, calibrating, and relay voltages).

The tubes 1 and 2 are heated with DC. The heater voltage for the tubes 3 to 5 is balanced by a hum compensator (R71). The screen grid voltage for the tubes 3 to 5 is made constant by the stabilizer tube 100/60 II.

8. Layout

The device is incorporated into a rugged casing. The annexed Fig. 1 shows the internal layout. The controls are accommodated at the front panel in accordance with the annexed Fig. 2.

IV. INSTRUCTIONS FOR USE

A. At the factory the superheterodyne receiver is adjusted for connection to 220-v mains. When the available mains voltage (110, 130, or 240 v) is different, the voltage adjuster S6 must be relocated: withdraw the device from the casing after loosening the nickeled fixing screws on the front panel and set the voltage adjuster S6 (annexed Fig. 1) to the available AC voltage. Then reinsert the chassis. The 0.4-amp fuse in the fuse element on the front panel must be exchanged for an 0.6-amp fuse when the mains voltage is 110 or 130 v.

In accordance with the safety regulations of the "Verein Deutscher Elektrotechniker (VDE)" (Association of German Electrical Engineers), mains-powered appliances whose touch voltage may exceed 65 v with respect to ground in the case of a failure, must be equipped with a terminal for a protective grounding lead.

For this reason the device is provided with a three-wire power cord with protective lead and a three-wire safety plug (Schuko plug) for insertion into an outlet with protective ground connection (Schuko outlet). The connecting facility and the cross-section of the non-current carrying protective lead must be equivalent to those for the current carrying conductors.

If the Schuko plug must be exchanged for another (locally used) plug with protective terminal, the three leads (red, gray, and black) of the power cord should be connected as follows:

In the case of non-polarized connector systems:

red lead to protective terminal,
gray and black leads to the current carrying terminals.

In the case of polarized connector systems in mains with phase and neutral wire:

red lead to protective terminal,
gray lead to neutral terminal,
black lead to "phase" terminal.

If the mains has no protective ground connection, there should be established an interference-free ground connection, e.g. to the terminal

(" ⏚ " on the front panel) provided for this purpose before placing the device into operation. When the Schuko plug is exchanged for a locally used two-prong plug, leave the red lead of the power cord unconnected, insulate it and connect the gray and black leads to the current carrying terminals.

When establishing or modifying a measuring setup, avoid the interruption of ground connections as long as the device is connected to the mains. Avoid multiple grounding, if possible.

For connecting the voltage under test the balanced and shielded cords Type Rel ltg 546 with two three-pole plugs as well as the cords Type Rel ltg 703 with three individual banana plugs at one end or Type Rel ltg 701 with a two-pole plug at the other can be used.

The device is ready for operation about 20 minutes after energization with S5.

B. Calibrating

Operate switch S4 to " -⊠- ", and the switches S3 and S1 to " ▼ ". Coarsely tune to the mains frequency (Band I, 50-c/s mark) with the band switch S2 and the variable capacitor C40. Then maximize the deflection of the instrument with the fine drive of C40. Finally adjust the pointer to the red calibrating mark with the control R30.

It is advisable to check the calibration in the first hours of operation and prior to exact measurements.

C. Measuring

Apply the voltage under test via a shielded connecting cord, e.g. Type Rel ltg 546, to the corresponding jacks "Input Bal." ("1" in the annexed Fig. 2) or "Input Unbal." ("2" in the annexed Fig. 2).

Adjust the required sensitivity with switch S1. In frequency band I (30 to 300 c/s) the sensitivity is reduced by a factor of ten to achieve a satisfactory S/N ratio, because of the particularly high interfering voltages in this frequency band. For this reason the voltage readings taken in frequency band I must be multiplied by ten. Relay M drops out upon actuation of key T. In this case, frequency band I, has also full sensitivity, i.e. no multiplication by ten is any longer necessary.

The selection of the bandwidth depends on measuring frequency and type of the measurement.

> With frequencies below 3 kc/s the position Λ 910 c/s (10 c/s bandwidth) must be used for suppressing the residual carrier.

Interfering voltages near the output frequency can mostly be eliminated by switching S3 to the pass band " Λ 870 c/s" and changing the oscillator tuning by -40 c/s.

In the case of medium frequencies either the narrow or the wide band can be used, depending upon the type of measurement. Tuning is easier in the position " ⊓ 910". All that is required is some retuning when switching to " Λ 910 or Λ 870". The demands placed on tuning accuracy, frequency stability of the measuring current source and control oscillator increase as the frequency becomes higher. For this reason the wide band will be used as a rule with frequencies over 100 kc/s.

Set the measuring frequency with the band switch S2 and the variable capacitor C40 and bring the audible signal in the headphones to maximum volume or the instrument pointer to maximum deflection by fine tuning of C40. The built-in instrument is disconnected when an external instrument is plugged.

With unknown frequencies it is advisable to tune the receiver first by reference to the headphones, followed by operating switch S4 to "–▷|–" and retuning the receiver, if necessary.

The damping of the movement of the built-in instrument depends on the deflection. In the upper part of the scale overshoot of the pointer can be observed. It is recommended for this reason to work in the middle part of scale when comparison measurements are made. Otherwise, the instrument must be damped by bridging a capacitor (approx. 100 µf) across it, using the jacks " ⊘ " ("3" in the annexed Fig. 2).

Use the balanced plug-in transformer Type Rel 3 B 214 (0.1 to 1 mc/s) for measuring high crosstalk values (i.e. in excess of 70 db). It is plugged into the output jacks of the attenuation measuring equipment (e.g. Type Rel 3 D 23). From its output jacks the shielded connecting cord leads to the jacks "Bal. Input" ("1") of the superheterodyne receiver. This arrangement minimizes the influence of the connecting cord on input imepdance and circuit balance.

When measuring very low voltages (below 30 µv), interpose the preamplifier Type Rel 3 U 42 or the wideband voltmeter Type Rel 3 U 133 in front of the superheterodyne receiver (with S3 at "Ω 870 or Ω 910"). In such case the gain of the interposed amplifier should be fully utilized before the gain (switch S1) of the superheterodyne receiver is increased.

D. Measuring Distortion Factors

There is a limit to the measurement of low distortion factors (below 0.1%) on account of the residual distortion of the wideband amplifier at the input, the residual distortion depending on the voltage of the fundamental wave at the grid of the input tube. Since the sensitivity switch S1 precedes the first tube, the grid AC voltage at the measuring frequency for which the set is tuned is proportional to the pointer deflection and amounts to 100 µv with full-scale deflection. When the sensitivity is increased with S1 for measuring the harmonic, the voltage of the fundamental wave also increases by the ratio of the sensitivity increase. The residual distortion of the wideband amplifier is e.g. 0.1% for the first harmonic for a grid AC voltage of 30 mv, and about 0.3% for 100 mv. For the second harmonic 1/3 of these values can be assumed.

The following rules allow harmonics to be measured with an error of approx. 0.1% (in band I, where the grid AC voltage has the tenfold value, the error is 1%).

First measure the voltage of the fundamental wave. Then, with increased sensitivity, tune for the respective harmonic and measure the voltage. When the instrument gives about full-scale deflection when the fundamental wave is measured, the sensitivity should be increased not more than hundred times (40 db) with S1 for the measurement of the harmonic. With half-scale or even lower deflection on the fundamental it may be increased by a factor of 300 (50 db). In band I only 1/10 of these values applies, i.e. 10 (20 db) and 30 (30 db). With greater amplitude ratios or for better accuracy with a low distortion factor the fundamental wave must be correspondingly damped by interposing a high-pass filter (e.g. Type Rel 3 F 51). The measuring accuracy is best when the harmonic is measured at low pointer deflections, because in this case the input stage is loaded correspondingly less. Overloading of the input stage can be recognized by the fact that, when the sensitivity is increased with S1, the deflection will suddenly become greater than what corresponds to the division step.

The distortion factor being a relative magnitude, an exact absolute voltage measurement can be dispensed with and the control R30 can be turned fully clockwise. With this increased sensitivity of the IF amplifier section, the residual distortion of the input and the modulating stages is decreased, since e.g. the grid AC voltage of the input tube corresponding to the full-scale deflection of the instrument is lower than what would correspond when the control R30 is in mid-position or at the CCW stop.

After the measurement of the individual amplitudes E_1, E_2, E_3, etc. the distortion factors k_2', k_3', etc. can be computed from the equation

$$k_2' = \frac{E_2}{E_1} \times 100 \text{ in percent,}$$

$$k_3' = \frac{E_3}{E_1} \times 100 \text{ in percent, etc.}$$

The total distortion factor K' or K results as

$$K' = \sqrt{\frac{E_2^2 + E_3^2 + E_4^2 + \ldots}{E_1^2}} \times 100 \text{ in percent}$$

or

$$K = \sqrt{\frac{E_2^2 + E_3^2 + E_4^2 + \ldots}{E_1^2 + E_2^2 + E_3^2 + \ldots}} \times 100 \text{ in percent}$$

K' and K are interrelated by

$$K' = K \times \sqrt{1 + K'^2}$$

For small values of K ($K \leqq 10\%$) applies practically

$$K = K'$$

(For instance, if K' = 10%, the deviation from K is only 0.5%.)

E. Higher-Order Intermodulation Products

At the output of the modulator there appear, as a result of the heterodyning process, besides the desired output frequency $f_a = f_s - f_m$ both the so-called image frequency $f_{sp} = f_m - f_a$ and a spectrum of higher-order intermodulation products formed from integral multiples of f_s and f_m according to $f = n \times f_s \pm f_m$. However, these frequencies are suppressed by the selectivity of the amplifier in normal operation. But there is in each case a heterodyne whistle when one of these intermodulation products falls within the pass band of the amplifier, i.e. has the value f_a, when the pilot frequency or the measuring frequency is changed or when several measuring frequencies are simultaneously present.

For an explanation we give the following example:

Let us assume that a signal at the measuring frequency f_m = 6 kc/s is applied to the input. When the frequency of the superheterodyne receiver is set to 6 kc/s, the control oscillator operates at 6.91 kc/s, causing a deflection of the meter or a heterodyne whistle in the headphones of the frequency

$$f_a = f_s - f_m = 6.91 - 6 = 0.91 \text{ kc/s}.$$

If now the measuring frequency is held stable and the carrier frequency is varied by turning the frequency control of the receiver, there will be deflections according to the following scheme:

Set Frequency f_e	Corresponding to	Carrier frequency f_s	Corresponding to	Deflection is Proportional to
6000	$(f_m+f_a)-f_a$	6910	f_m+f_a	Fundamental frequency
4180	$(f_m-f_a)-f_a$	5090	f_m-f_a	Image frequency
2545	$(f_m+f_a)1/2-f_a$	3455	$(f_m+f_a)1/2$	
1635	$(f_m-f_a)1/2-f_a$	2545	$(f_m-f_a)1/2$	
1393	$(f_m+f_a)1/3-f_a$	2303	$(f_m+f_a)1/3$	
786	$(f_m-f_a)1/3-f_a$	1696	$(f_m-f_a)1/3$	

From this follows that heterodyne whistles will be encountered at the frequency settings

$$f_e = \frac{f_m + f_a}{n} - f_a \quad (f_a = 910 \text{ or } 870 \text{ c/s}),$$

whose amplitude depends on the ordinal number n:

n	1	2	3	4	5	6	7	8	9
Guiding values for the amplitude in %	100	5	30	4	16	5	10	4	6

A corresponding scheme for a fixed carrier frequency and variation of the measuring frequency is obtained according to the formula

$$f_m = n \times (f_e + f_a) \pm f_a.$$

For n, the same amplitude values apply.

V. NOTES ON MAINTENANCE

No special maintenance is required for the device when it is expertly handled and operated. Under no circumstances must the contact areas of the switches be treated with grease-dissolving or greasy means. Their normal operation assures self-cleaning. Careful dusting of the device at extended intervals of time will be sufficient.

For further details, e.g. on tube replacement, refer to section VI (on Fault Locating and Fault Eliminating).

VI. FAULT LOCATING AND FAULT ELIMINATING

Malfunction of the superheterodyne receiver can be recognized by jitter of the instrument deflection (with $f < 3$ kc/s and S3 to "Ω") or absence of any deflection or by the fact that the device can no longer be calibrated. Locating the trouble will often be possible by the following simple examination of the chassis withdrawn from the casing: broken wires, burned or overloaded resistors are in evidence and voltage flashovers in inductors and transformers can be heard.

A failure may also be due to a worn-out or damaged tube, or to a faulted regulating lamp. For this purpose examine the individual tubes with a tube tester and replace them, if necessary. No special alignment work is necessary after the replacement of a tube,

If no tube tester is available, a µa-v-Ω-Multizet meter should be used for checking the following voltages at a mains voltage of 220 v ±4%.

AC voltages

Heater voltages of the tubes 3, 4, 5 . . . . approx. 6.3 v each
Voltage of the anode winding as measured on the
transformer between 3b and 6b . . . . 260 to 290 v

DC voltages

Guiding values (± 10%)	Tube 1 Tube 2	Tube 3	Tube 4	Tube 5
E_b^+ v	95	250	260	90
E_{c2}^+ v	150	100	100	100
E_k^+ v	2.0	0.9	0.8	0.7

$^+$The voltages E_b and E_{c2} must be measured in the 600-v range of the Multizet meter.

Voltage at C35 with respect to chassis approx. 12.6 v DC

Input current

with 220 v mains voltage . . . . $\leqq$ 280 ma
with 110 v . . . . $\leqq$ 560 ma

The ballast resistor must glow dimly. The firing and steady glow of the stabilizer tube are clearly visible through the opening in the metal cap. When the stabilizer tube is faulted, one will nearly always observe firing trouble which leads to fluctuating mostly excessive DC voltage.

The regulating lamp Lp2, which stabilizes the calibrating voltage, is operated with undervoltage and hence has a long service life. If, however, the filament should be broken and thus the calibrating voltage rise to several times the normal value, the regulating lamp must be replaced and the bridge re-aligned.

For re-aligning the lamp bridge, one requires an AC voltmeter indicating about 1 v at full-scale deflection and with a source impedance in excess of 10 kΩ, e.g. Type Rel 3 U 122, and a variable transformer for regulating the mains voltage and varying it by ±10%. The voltmeter must be connected between the star point Lp-R48-R51 and chassis for measuring the voltage of about 0.55 v occurring there. The spindle resistor R48 is so adjusted not earlier than 20 minutes after energization that the reading of the voltmeter decreases by not more than 1% when the mains voltage is varied by ±10% as referred to 220 v (110 v). In no case must the voltage increase, i.e. when the mains voltage is varied from +10% via 0% to -10% a flat maximum is passed.

For adjusting the calibrating voltage, apply an AC voltage of 100 µv ±0.5%, approx. 800 c/s, to the unbalanced input, then operate switch S1 to the position "0.1 mv" and switch S2 to the position II "0.3 to 1 kc/s". Subsequently adjust the variable capacitor C40 for the applied frequency and for a maximum deflection of the instrument pointer. Re-adjust potentiometer R30 for a maximum. Now operate switch S1 to "▼" and switch S2 to the position I "0.03 to 0.3 kc/s" and tune for 50 c/s. Then set the pointer to the red calibrating mark with the spindle resistor R51 without varying R30.

The modulator balance is checked with the inputs open:
Set the sensitivity switch S1 to "0.1 mv", the band switch S2 to "0.03 to 0.3 kc/s" and switch S4 to the position "IF Output". Connect a voltmeter. e.g. Type Rel 3 U 122, to the jacks "IF Output". Adjust now the variable capacitor C40 for maximum deflection of the connected voltmeter. The voltmeter must not indicate more than 20 mv when switch S3 is operated to "⊓ (910) c/s", and not more than 200 mv when it is set to "⊓⊓ (910) c/s". Otherwise, adjust the potentiometers R23a and R24a (at the lower left of the device; screwdriver control) for a minimum.

Note: When aligning see to it that no voltages are compensated for that are due to extraneous fields.

The locating and eliminating of faults is facilitated by the circuit and wiring diagrams (see the annexed figures) and the parts list.

For checking the oscillator, connect an oscilloscope or, if this is not possible, a voltmeter to the contacts 1 and 2 of modulator Gl 2 (approx. 0.25 v in the R-C ranges, and 2 v in the L-C ranges; f > 10 kc/s). Subsequently tune the oscillator slowly through the various bands.

The output amplifier can be checked by reference to the annexed Fig. 4. For this purpose connect a voltmeter, e.g. a "kc/s-Multizet" meter, to the jacks "•→—" and rotate switch S4 to its mid-position. Connect a measuring oscillator set to 910 c/s, e.g. Type Rel 3 W 38, to a variable attenuator whose output is first also connected to the voltmeter via an 0.1-µf capacitor. Set the variable attenuator to 26 db and adjust the output voltage to 0.25 v by varying the oscillator voltage. Now connect the lines coming from the output of the variable attenuator to the feed-in points listed in the table (see page 17) and adjust the output voltage to the same value with the aid of the variable attenuator. If the nominal levels are not attained, but the tubes are in order, the circuit must be checked by reference to the circuit diagrams and the parts list.

Feeding in at:		Adjust the Variable Attenuator for 0.25 v to:	Note
a	Voltage measurement input	26 db	
b	Tube 4 g1 ⟶ ⊥	≧ 60 db	The setting of the variable attenuator shall not be changed when switch S3 is operated from ⎍ 910 to ⎍ 910 (S3) and when the frequency is changed to 870 c/s (S3 : ⎍ 870).
c	Tube 3 a ⟶ ⊥	≧ 58 db	
d	Tube 3 g1 ⟶ ⊥	≧ 95 db	
e	Ü5 2 ⟶ ⊥	≧ 95 db	R30 must be operated to the CW stop (max)

For examining the relays (A, B, C, and M) the following operations must be effected:

Operate switch S2 from band I to another band; depress key T	Relay M must drop out in each case+
Put a banana plug into the jacks "Balanced" (jacks "1" in the annexed Fig. 2)	Relay A must operate+
Advance switch S2 from band V to band VI	The relays B and C must operate+

+The operation and the dropping out of these coupled relays is distinctly heard.

VII. ACCESSORIES, DIMENSIONS, AND WEIGHTS

Description	Type	Dimensions in ft./in. (mm)	Approx. weight in lb(kg)
Superheterodyne receiver . (30 c/s to 1 mc/s)	Rel 3 U 420c	1'9^7/8"x1'^{3}/4"x11^7/8" (558x324x300)	66 (30)
Accessories			
5 tubes	C3g	-	-
1 stabilizer tube	100/60z II	-	-
1 ballast resistor	Osram 2,5...7,5 V 1,2 A; E 14	-	-
1 indicating lamp 6 v/1 w	9 T lp 2b	-	-
3 fuses (2 as spares)			
0.4 amp for 220, 240 v	0,4 C DIN 41571	-	-
0.6 amp for 110, 130 v	0,6 C DIN 41571	-	-
Optional			
1 connecting cord, e.g. .	Rel ltg 546a to d	1'8" to 6'7" (500 to 2000)	0.33 (0.15
or . .	Rel ltg 703a to e	1' to 4'11" (300 to 1500)	0.33 (0.15
or . .	Rel ltg 701a to d	1' to 3'3" (300 to 1000)	0.33 (0.15
1 preamplifier	Rel 3 U 42	1'9^5/8"x9^1/8"x11" (550x232x280)	33 (15)
or			
1 wideband voltmeter . . .	Rel 3 U 133	6^3/8"x10^1/8"x1'1^7/8" (163x256x352)	14.3 (6.5)
1 measuring oscillator,e.g.	Rel 3 W 38	1'9^5/8"x11^7/8"x11" (550x300x280)	70.4 (32)
1 balanced plug-in transformer (0.1 to 1 mc/s)	Rel 3 B 214	2^5/8"x2"x^3/4" (66x50x20)	0.33 (0.15

P A R T S   L I S T

To the Circuit Diagram of the Superheterodyne Receiver

Type Rel 3 U 420c

This parts list essentially contains the electrical components stating, in addition to their ordering data, their main characteristics. The individual parts for the device and its subassemblies have here been arranged alphabetically according to their designations on the circuit diagrams. But the relays have been indicated at the respective ends.

Introductory remarks

In the column headed Symbol the designations used in the circuit diagrams are listed in an alphabetical and, as far as possible, numerical order. Under the heading Qty. the number of equal components within a subassembly is given. The column Description contains, in addition to the description of the component , its main data.

The value of components marked "as mounted" is determined by alignment in the test room and can therefore be gathered from these parts themselves.

There denote, for instance,

with a layer-type resistor:	1000 pF ±20% 125 V
1000 pF	nominal value of the capacitance (1 pf = 1 μμf = 10^{-12} f)
±20%	tolerance of the nominal capacitance
125 V	permissible DC operating voltage
with a capacitor:	1000 pF ±20% 125 V
1000 pF	nominal value of the capacitance (1 pF = 1 μμf = 10^{-12} f)
±20%	tolerance of the nominal capacitance
125 v	permissible DC operating voltage
with a semi-conductor:	I_D>4 mA, U_{Sp}>50 V
I_D	forward current at +1 v
U_{Sp}	maximum inverse voltage
with a transformer or a coil:	Wicklg.I (1a,2a) 725 Wdg 0,3 CuL 25 Ω — Wicklg.II (4b,5b,6b) 165 Wdg 0,5 Cu2L 2,7 Ω Abgriff(5b): 138 Wdg
Wicklg.I, 725 Wdg (1a,2a)	725 turns, start at soldering lug 1a, end at 2a
0,3 CuL	of copper wire (Cu); 0.3 mm dia enamel insulation (L)
25 Ω	DC resistance of winding I
Wicklg.II, 165 Wdg (4b,5b,6b)	165 turns, start at soldering lug 4b, end at 6b
0,5 Cu2L	of copper wire (Cu); 0.5 mm dia.; double enamel insulation (2L)
2,7 Ω	DC resistance of winding II
Abgriff (5b): 138 Wdg	tap at soldering lug 5b at the 138th turn

The Ordering Data designate clearly the component by an abbreviation code or a component specification.

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA

<u>Überlagerungsempfänger Rel 3 U 420c</u> (Ausg. VII)

<u>SUPERHETERODYNE RECEIVER</u> (ISSUE VII)

-	1	Eingangsspannungsteiler INPUT VOLTAGE DIVIDER	Rel 35 U 217 (Seite/PAGE L4)
-	1	Eingangsteil INPUT SECTION	Rel 35 U 147 (Seite/PAGE L5)
-	1	Abstimmteil TUNING SECTION	Rel 35 U 257 (Seite/PAGE L7)
-	1	Schwingteil OSCILLATOR SECTION	Rel 35 U 148 (Seite/PAGE L7)
-	1	Verstärkerteil AMPLIFIER SECTION	Rel 35 U 149 (Seite/PAGE L10)
-	1	Filter FILTER	Rel 35 U 150 (Seite/PAGE L13)
-	1	Netzteil POWER SUPPLY UNIT	Rel 35 U 151 (Seite/PAGE L14)
C 10	1	MP-Kondensator METALLIZED-PAPER CAPACITOR 0,5 µF ±10% 500 V-	D 0,5/500 "k" B 25210
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 42	1	400 Ω ±2% 0,5 W	B 51265 A 400 2/2
R 99	1	5 kΩ ±5% 0,5 W	B 51265 A 5 K 5/2
S 4	1	Drehschalter ROTARY SWITCH 2polig, 6stufig, 1 Ebene 2-POLE, 6-POSITION, 1-DECK	Rel sch 176a, Form A
T	1	Drucktaste PUSHKEY	Fg sch 290b Fg kfs 369 ac/370u
-	1	DQr-Instrument DQr INSTRUMENT 150 µA, Ri = 5 kΩ, Ra 40 kΩ	Ms sdr 517 Bv 68
-	1	Buchsenplatte mit Federsatz JACK PLATE WITH SPRING SET	Rel Bv 654 B 32 9 Rel kli 6be

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Eingangsspannungsteiler Rel Bv 35 U 217 INPUT VOLTAGE DIVIDER	(Ausg. V) (ISSUE V)
C 1, 3a, 4, 6a	4	Trimmerkondensator TRIMMER CAPACITOR 10 - 60 pF 350 V	16 K Triko 10/60 D 90
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 2	1	5000 pF ±5 % 250 V-	B 31142 F 5000 J 250
C 3b	1	16 pF ±10 % 500 V-	B 31141 E 16 K 500
C 5	1	70 pF ±10 % 500 V-	B 31141 E 70 K 500
C 7	1	350 pF ±10 % 500 V-	B 31142 F 350 K 500
C 8	1	1320 pF ±1 % 500 V-	FN 1320/1/500 B 31070
C 9	1	3000 pF ±1 % 500 V-	FN 3000/1/500 B 31070
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 1	1	300 kΩ ±0,5 % 0,25 W	B 51265 A 300 K 0,5/0,5
R 2	1	3,05 kΩ ±0,2 % 0,25 W	B 51265 A 3,05 K 0,2/0,5
R 3	1	365,1 kΩ ±0,5 % 0,25 W	B 51265 A 365,1 K 0,5/0,5
R 4	1	169,3 kΩ ±0,2 % 0,25 W	B 51265 A 169,3 K 0,2/0,5
R 5	1	46,78 kΩ ±0,2 % 0,25 W	B 51265 A 46,78 K 0,2/0,5
R 6	1	13,6 kΩ ±0,2 % 0,25 W	B 51265 A 13,6 K 0,2/0,5
R 7	1	6 kΩ ±0,2 % 0,25 W	B 51265 A 6 K 0,2/0,5
R 21	1	600 kΩ ±1 % 0,25 W	B 51265 A 600 K 1/0,5

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Eingangsteil Rel Bv 35 U 147 INPUT SECTION	(Ausg. VI) (ISSUE VI)
C 11	1	Keramik-Rohrkondensator CERAMIC TUBULAR CAPACITOR 10 pF ±1 pF 500 V	38223 P 120 E 10 F
C 12,13,17	3	Elektrolytkondensator ELECTROLYTIC CAPACITOR 40 µF +50/-10 % 350 V-	Elko 40/350 B 4369-5
C 14	1	Papier-Kondensator PAPER CAPACITOR 5000 pF ±20 % 500 V-	5000/500 "d" DIN 41161
C 15	1	Elektrolytkondensator ELECTROLYTIC CAPACITOR 8 µF +50/-10 % 350 V-	Elko 8/350 B 4369-5
C 16	1	Trimmerkondensator TRIMMER CAPACITOR 10 - 60 pF 350 V-	16 K Triko 10/60 D 90
C 18,19	2	Kf-Kondensator PLASTIC FOIL CAPACITOR 10000 pF ±2,5 % 125 V	B 31143 H 10000 G 125
		Elektrolytkondensator ELECTROLYTIC CAPACITOR	
C 43	1	4 µF +50/-20 % 350 V-	Elko 4/350 B 4371-1
C 44	1	50 µF +50/-20 % 15 V-	B 41951 A 50/15
C 47	1	Trimmerkondensator TRIMMER CAPACITOR 1,3 - 5,0 pF ≦ +15 % 500 V-	Rel ko 131c
C 48	1	Keramik-Scheibenkondensator CERAMIC DISC-TYPE CAPACITOR 4 pF ±2 pF 500 V-	B 38115 N 150 A 4 G
Gl 2	1	Steckmodulator	Rel Bv 672 R 21
		oder/OR	
Gl 2a-d	1	Richtleiter-Modulator CRYSTAL DIODE MODULATOR	Rel Bv 672 R 3

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 8,14[+]	2	200 Ω ±10 % 0,1 W	200 Ω ±10 % 5 DIN 41399
R 9	1	150 Ω ±1 % 0,25 W	B 51265 A 150 Ω 1/0,5
R 10	1	10 Ω ±1 % 0,25 W	B 51265 A 10 Ω 1/0,5
R 11,16	2	200 Ω ±5 % 0,25 W	B 51263 A 200 Ω 5/2
R 12	1	10 kΩ ±5 % 2 W	10 K 2 DIN 41404 R
R 13	1	500 kΩ ±5 % 0,5 W	B 51265 A 500 K 5/2
R 15	1	160 Ω ±5 % 0,33 W	B 51264 A 160 Ω 5/2
R 17	1	1 kΩ ±1 % 0,25 W	B 51265 A 1 K 1/0,5
R 18 93	2	16 kΩ ±5 % 0,5 W	B 51265 A 16 K 5/2
R 20,22	2	1 kΩ ±5 % 1 W	B 51266 A 1 K 5/2
R 23a,24a	2	Schichtdrehwiderstand LAYER-TYPE VARIABLE RESISTOR 200 Ω lin 0,4 W	200 Ω lin Rel wd 152a
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 23b,24b	2	100 Ω ±1 % 0,25 W	B 51265 A 100 Ω 1/0,5
R 25 - 28	4	60 Ω ±1 % 0,25 W	B 51265 A 60 Ω 1/0,5
R 66	1	... kΩ ±5 % 0,33 W	B 51264 A ... K 5/2 wie eingebaut/AS MOUNTED
R 67	1	... Ω ±5 % 0,33 W	B 51264 A ... Ω 5/2 wie eingebaut/AS MOUNTED
R 94a,94b	2	20 kΩ ±5 % 1 W	B 51266 A 20 K 5/2
R 98	1	100 Ω ±5 % 0,33 W	B 51264 A 100 Ω 5/2
R 100	1	5 Ω ±5 % 0,5 W	B 51265 A 5 Ω 5/2
R 101	1	10 Ω ±5 % 1 W	B 51266 A 10 Ω 5/2
		Übertrager TRANSFORMER	
Ü 1	1	Wicklg. I (1,2) 1000 Wdg 0,20 CuL 44 Ω Wicklg. II (0,9,8,6) 1030 Wdg 0,16 CuL 76 Ω Abgriff (9): 15 Wdg Abgriff (8): 30 Wdg	Rel Bv 621 E 3166

+ an federnder Röhrenfassung Rel Bv 658 A 6 befestigt
ATTACHED TO ANTI-MICROPHONIC TUBE SOCKET Rel Bv 658 A 6

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
Ü 2	1	Wicklg. I (1b,5b) 100 Wdg 0,10 CuL 9,2 Ω Wicklg. II (5a,4a,1a) 102 Wdg 0,08 Konst 2 L Abgriff (4a): 2 Wdg 453 Ω	Rel Bv 621 D 3133
A, B, C	3	Relais RELAY 550 Wdg 0,27 CuL 4,5 Ω	T rls 162aT Bv 65405/121d

<u>Abstimmteil Rel 35 U 257</u> (Ausg. II)

<u>TUNING SECTION</u> (ISSUE II)

C 40	1	Drehkondensator VARIABLE CAPACITOR 3 x 580 pF (linksdrehend)	Rel Bv 632 A 119
	1	Antrieb DRIVE	9 Rel antr 5 f

<u>Schwingteil Rel Bv 35 U 148</u> (Ausg. V)

<u>OSCILLATOR SECTION</u> (ISSUE V)

		Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR	
C 36, 37	1	16+16 µF +50/-10% 350 V-	Elko 16+16/350 B 4373-5
C 38	1	50 µF +50/-20% 35 V-	Elko 50/35 B 4170-1
C 39, 42	2	1 µF +50/-20% 350 V-	Elko 1/350 B 4371-1
C 41	1	MP-Kondensator METALLIZED-PAPER CAPACITOR 0,5 µF ±20% 160 V-	0,5/160 "k" B 2530
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 51	1	1400 pF ±1% 500 V-	FN 1400/1/500 B 31070
C 52, 57, 62	3	780 pF ±1% 500 V-	FN 780/1/500 B 31070
C 53, 58	2	400 pF ±1% 500 V-	FN 400/1/500 B 3107
C 54, 59	2	200 pF ±1% 500 V-	FN 200/1/500 B 3107
C 56	1	... pF ±1% 500 V-	FN ... /1/500 B 3107 wie eingebaut/AS MOUNTED

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Kf-Kondensator PLASTIC-FOIL CAPACITOR	
C 61	1	1720 pF ±1 % 500 V-	FN 1720/1/500 B 31070
C 63	1	420 pF ±1 % 500 V-	FN 420/1/500 B 31070
C 64	1	240 pF ±1 % 500 V-	FN 240/1/500 B 31070
D 7	1	Drossel REACTOR 6000 Wdg (1a,5a) 0,12 CuL 850 Ω L ≧ 17 H	Rel Bv 621 E 3191
HL	1	Heißleiter THERMISTOR	R 8/0,5/10
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 53	1	800 Ω ±5 % 0,5 W	B 51265 A 800 Ω 5/2
R 54	1	8 kΩ ±5 % 2 W	8 K 2 DIN 41404 R
R 55	1	2 kΩ ±5 % 0,5 W	B 51265 A 2 K 5/2
R 56	1	100 Ω ±5 % 0,33 W	B 51264 A 100 Ω 5/2
R 57,59	2	1 kΩ ±5 % 0,25 W	B 51263 A 1 K 5/2
R 58	1	80 Ω ±5 % 0,33 W	B 51264 A 80 Ω 5/2
R 61	1	20 kΩ ±5 % 0,33 W	B 51264 A 20 K 5/2
R 62	1	10 kΩ ±5 % 0,33 W	B 51264 A 10 K 5/2
R 63	1	3 kΩ ±5 % 0,5 W	B 51265 A 3 K 5/2
R 64	1	3 kΩ ±5 % 0,33 W	B 51264 A 3 K 5/2
R 65	1	Thernewid THERNEWID RESISTOR 2 kΩ ±10 % Tk -3,5 % / °C	K 11 10 % 2 K 3,5
R 72-85	12	siehe Seite L10 SEE PAGE L10	
R 92	1	Schichtwiderstand LAYER-TYPE RESISTOR 10 Ω ±5 % 1 W	B 51266 A 10 Ω 5/2
Ü 3	1	Schalenkernspule SHELL-CORE COIL Wicklg. I (4,6) 1500 Wdg 0,09 CuL 230 Ω	Rel Bv 622 S 3041

Symb
SYMB

Ü 4

Ü 7

Ü 8

Ü 9

Ü 10

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Wicklg. IIa+b (2,1/1,8) je 150 Wdg 2x0,16 Cu2L parallel umsponnen 18,5 Ω	
Ü 4	1	Übertrager TRANSFORMER	Rel Bv 621 C 3038
		Wicklg. I (1a,4a) 140 Wdg 0,15 CuL 4,2 Ω	
		Wicklg. IIa+b (1b,3b/2b,4b) je 50 Wdg 2x0,15 CuL verdr. 3,6 Ω	
		Schalenkernspule SHELL-CORE COIL	
Ü 7	1	Wicklg. I (1 -) 134 Wdg 0,18 CuL	Rel Bv 622 P 287
		Wicklg. IIa+b+c (3,4,5,6) je 6 Wdg 3x0,18 Cu2L verdr.	
		Wicklg. III (- 2) 134 Wdg 0,18 CuL	
Ü 8	1	Wicklg. I (1 -) 77 Wdg 10x0,05 HFL S	Rel Bv 622 P 288
		Wicklg. IIa+b+c (3,4,5,6) je 5 Wdg 3x0,20 Cu2L verdr.	
		Wicklg. III (- 2) 77 Wdg 10x0,05 HFL S	
Ü 9	1	Wicklg. I (1 -) 28 Wdg 60x0,04 HFL S	Rel Bv 622 P 289
		Wicklg. IIa+b+c (3,4,5,6) je 2 Wdg 3x0,35 Cu2L verdr.	
		Wicklg. III (- 2) 23 Wdg 60x0,04 HFL S	
Ü 10	1	Wicklg. I (1-) 450 Wdg 0,13 Cu2L	Rel Bv 622 S 3116
		Wicklg. IIa,b,c (4,5,6,7) je 16 Wdg 3x0,18 Cu2L verdr.	
		Wicklg. III (- 2) 450 Wdg 0,13 Cu2L	

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Kleindrehschalter Rel Bv 661 A 116 MIDGET ROTARY SWITCH	
S 2	1	Kleindrehschalter MIDGET ROTARY SWITCH 2 polig, 26 Rast, 4 Ebenen 2-POLE, 26-POINT, 4-DECK	Rel sch 162 mi, Form M
		darin eingebaut CONTAINING	
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 72,74,78	3	250 kΩ 0,5 % 0,5 W	0,5 DIN 41402
R 73	1	300 kΩ 0,5 % 0,5 W	0,5 DIN 41402
R 75,82	2	160 kΩ 0,5 % 0,5 W	0,5 DIN 41402
R 77,79 83,84	4	200 kΩ 0,5 % 0,5 W	0,5 DIN 41402
R 80,85	2	125 kΩ 0,5 % 0,5 W	0,5 DIN 41402
		Verstärkerteil Rel Bv 35 U 149 AMPLIFIER SECTION	(Ausg. VI) (ISSUE VI)
C 20a	1	Kf-Kondensator PLASTIC-FOIL CAPACITOR 15000 pF ±2,5 % 250 V-	BN 15000/2,5/250 B 31050
C 20b	1	Styroflex-Kondensator STYROFLEX CAPACITOR ... pF ±5 % 250 V	B 31142 F ... J 250 wie eingebaut/AS MOUNTED
C 27	1	Papier-Kondensator PAPER CAPACITOR 0,01 µF ±20 % 500 V-	0,01/500 "d" DIN 41161
C 28	1	Styroflex-Kondensator STYROFLEX CAPACITOR 2000 pF ±2,5 % 125 V-	B 31141 E 2000 G 125
C 29	1	Papier-Kondensator PAPER CAPACITOR 1 µF ±10 % 160 V-	1/160 "k" B 2530
		Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR	
C 30	1	16 µF +50/-10 % 350 V-	Elko 16/350 B 4369-5
C 45	1	4 µF +50/-10 % 350 V-	4/350 B 43715

Symbol
SYMBOL
Gl 3
Gl 6
Gl 7
R 29, 38
R 30
R 31+
R 32 40
R 33, 41
R 34
R 35
R 36
R 43
R 44
R 45
R 46
+ an
AT

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
Gl 3	1	Richtleiter CRYSTAL DIODE 3 mA 40 V	G D 6 E
Gl 6	1	Flachgleichrichter FLAT-TYPE RECTIFIER 100 mA 45 V	Kc 0,6 k 21/3 V 45 C 100
Gl 7	1	Kleingleichrichter MIDGET RECTIFIER	9 Rel Bv 672 B 2
R 29, 38	2	Schichtwiderstand LAYER-TYPE RESISTOR 500 kΩ ±5 % 0,5 W	B 51264 A 500 K 5/2
R 30	1	Schichtdrehwiderstand LAYER-TYPE VARIABLE RESISTOR 500 kΩ lin +20/-30 % 0,2 W	500 K lin 9 Rel wd 10d
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 31^{+}	1	200 Ω ±10 % 0,1 W	200 Ω ±10 % 5 DIN 41399
R 32 40	2	90 Ω ±5 % 0,33 W	B 51264 A 90 Ω 5/2
R 33,39 41	3	200 Ω ±5 % 0,25 W	B 51263 A 200 Ω 5/2
R 34	1	40 kΩ ±2 % 0,5 W	B 51265 A 40 K 2/2
R 35	1	Schichtdrehwiderstand LAYER-TYPE VARIABLE RESISTOR 10 kΩ +20/-30 % 0,1 W	10 kΩ lin Rel wd 165a
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 36	1	3 MΩ ±5 % 0,33 W	B 51264 A 3 M 5/2
R 43	1	1 kΩ ±2 % 0,5 W	B 51265 A 1 K 2/2
R 44	1	Spindelwiderstand SPINDLE RESISTOR 4000 Ω 3 W	Zub wd 214 g
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 45	1	5 kΩ ±1 % 0,25 W	B 51264 A 5 K 1/0,5
R 46	1	2,5 kΩ ±5 % 0,5 W	B 51264 A 2,5 K 5/5

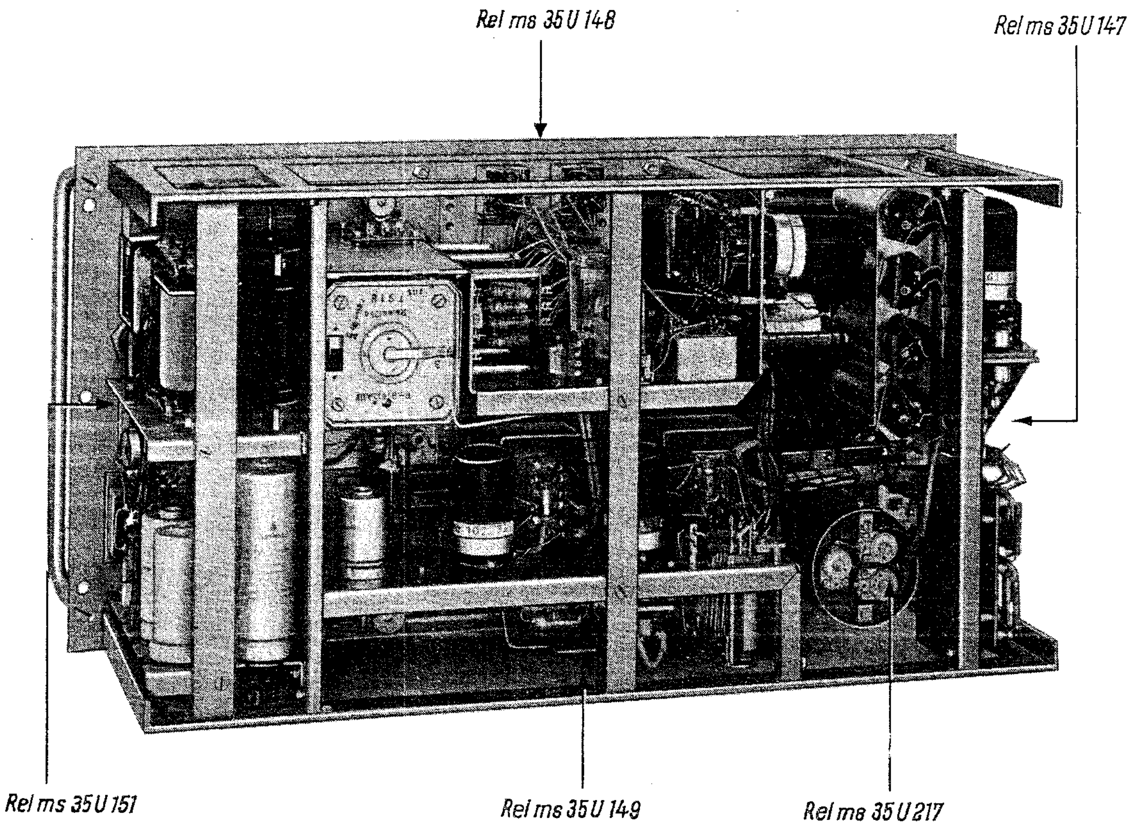
+ an Röhrenfassung Rel Bv 658 A 6 befestigt
ATTACHED TO TUBE SOCKET Rel Bv 658 A 6

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 50	1	3 kΩ ±5 % 0,5 W	B 51264 A 3 K 5/2
R 70	1	7,5 Ω ±5 % 1 W	B 51266 A 7,5 Ω 5/2
R 89	1	1 kΩ ±5 % 0,33 W	B 51264 A 1 K 5/2
R 91a, 91b	2	5 Ω ±5 % 0,33 W	B 51264 A 5 Ω 5/2
R 95	1	3 MΩ ±5 % 0,5 W	B 51265 A 3 M 5/2
R 96	1	100 kΩ ±1 % 0,25 W	B 51265 A 100 K 1/0,5
R 97	1	200 Ω ±5 % 0,33 W	B 51264 A 200 Ω 5/2
S 3	1	Kleindrehschalter MIDGET ROTARY SWITCH 3 polig 13er Rast 2 Ebenen 3-POLE,13-POINT, 2-DECK	Rel sch 163 ib, Form N
		Übertrager TRANSFORMER	
Ü 5	1	Wicklg. I (5,4a,5a,6a,7a,2) 1800 Wdg 0,10 CuL 300 Ω Abgriff (4a) 174 Wdg Abgriff (5a) 178 Wdg Abgriff (6a) 182 Wdg Abgriff (7a) 186 Wdg Wicklg. IIa (6,8) 210 Wdg Wicklg. IIb (8,0) 210 Wdg 2x0,16 CuL parallel 36 Ω	Rel Bv 621 E 3165
Ü 6	1	Wicklg. I (2,4) 5750 Wdg 0,10 CuL 1100 Ω Wicklg. II (6,8,0) 575 Wdg 0,12 CuL 90 Ω Abgriff (8) 315 Wdg	Rel Bv 621 E 1021
M	1	Relais RELAY 650 Wdg 0,32 CuL ≦ 230 mA	Rel Bv 662 P 268

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
	Filter FILTER	Rel Bv 35 U 150 (Ausg. V) (ISSUE V)	
		Styroflex-Kondensator STYROFLEX CAPACITOR	
C 21a,23a	2	4875 pF ±2,5 % 500 V-	BN 4875/2,5/500 B 31050
C 21b	1	400 pF ±2,5 % 500 V-	B 31142 F 400 G 500
C 22,23b	2	500 pF ±2,5 % 500 V-	B 31142 F 500 G 500
C 24a	1	470 pF ±2,5 % 500 V-	B 31142 F 470 G 500
C 24b	1	Trimmer-Kondensator TRIMMER CAPACITOR 10 - 60 pF 350 V-	16 K Triko 10/60 D 90 (Fa.Stettner)
		Styroflex-Kondensator STYROFLEX CAPACITOR	
C 25a	1	19500 pF ±2,5 % 250 V-	BN 19500/2,5/250 B 31050
C 25b,26	2	2000 pF ±2,5 % 500 V-	B 31142 F 2000 G 500
D 1	1	Drossel REACTOR Wicklg. I (4,2) 27 Wdg 0,70 CuL 0,08 Ω Wicklg. II (2,7,8,9) 3073 Wdg 0,16 CuL 241 Ω Abgriff (7): 578 Wdg Abgriff (8): 1523 Wdg	Rel Bv 621 E 1022
		Schalenkernspule SHELL-CORE COIL	
D 2	1	2470 Wdg (2,3) 0,17 CuL 5,6 H	Rel Bv 622 R 29
D 3	1	Wicklg. I (1,2) 22 Wdg 0,70 CuL Wicklg. II (2,3,4) 1214 Wdg 0,23 CuL Abgriff (3): 473 Wdg	Rel Bv 622 R 30
R 37	1	Thernewid THERNEWID RESISTOR 20 Ω ±10 % 3 % / °C	K 11 10 % 20 3,0
R 68	1	Schichtwiderstand LAYER-TYPE RESISTOR 60 Ω ±5 % 0,33 W	B 51264 A 60 Ω 5/2

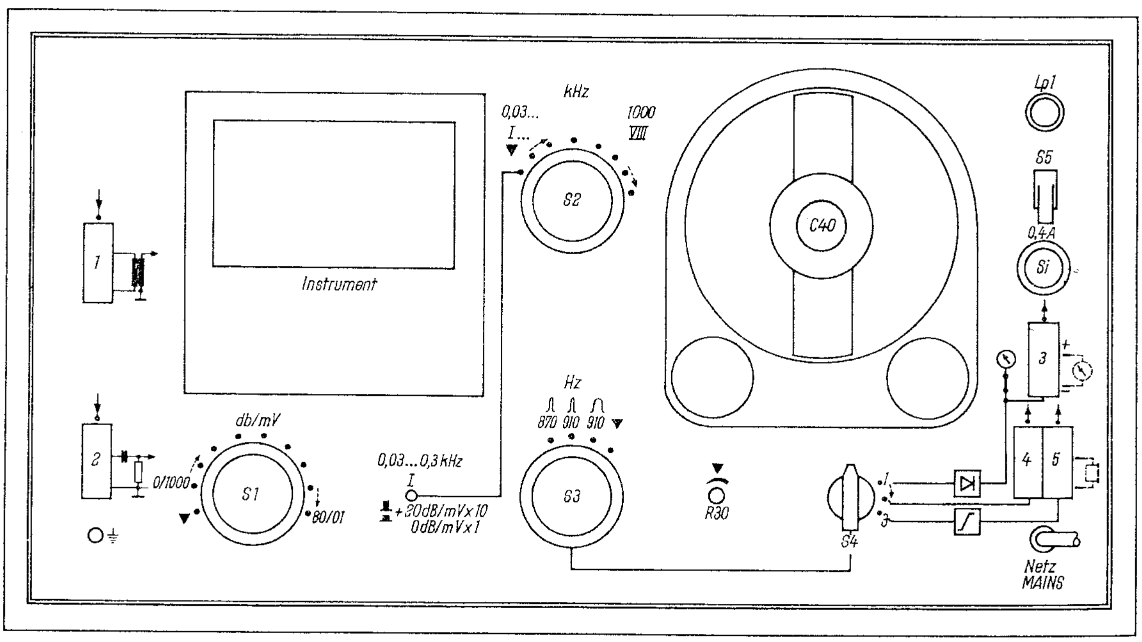
Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Netzteil Rel Bv 35 U 151 POWER SUPPLY UNIT	(Ausg. IV) (ISSUE IV)
		Elektrolyt-Kondensator ELECTROLYTIC CAPACITOR	
C 31,32	1	32+32 µF +50/-10 % 450 V-	Elko 32+32/450 B 4373-5
C 33	1	40 µF +50/-10 % 350 V-	Elko 40/350 B 4369-5
C 34,35	2	1000 µF +50/-20 % 35 V-	Elko 1000/35 B 4171-1
		Siebdrossel FILTER CHOKE	
D 4	1	5500 Wdg (3,2) 0,17 CuL L $\geqq$ 12 H	Rel Bv 621 F 182
D 5	1	4500 Wdg (4,2) 0,14 CuL L $\geqq$ 8 H	Rel Bv 621 E 1023
D 6	1	350 Wdg (1a,5a) 0,34 CuL L $\geqq$ 38 mH	Rel Bv 621 D 3127
		Flachgleichrichter FLAT-TYPE RECTIFIER	
Gl 1	1	500 mA 60 V	Kc 2,7b 22/2/B 60 C 500
Gl 5	1	170 mA 390 V	Kc 1,3a 22/13-2,5/ B 390 C 170
Lp 2	1	Regellampe REGULATING LAMP 0,07 A 3,0 V	9 Rel Bv 674 A 2
R 47	1	Drahtwiderstand WIRE-WOUND RESISTOR 6 kΩ ±5 %	GWS 20 6 kΩ ±5 % (Fa. Rosenthal)
R 48	1	Schichtwiderstand LAYER-TYPE RESISTOR 40 Ω ±2 % 0,5 W	B 51265 A 40 Ω 2/2
		Spindelwiderstand SPINDLE RESISTOR	
R 49	1	25 Ω 3 W	25 Ω Zub wd 214g
R 51	1	4000 Ω 3 W	4000 Ω Zub wd 214g
R 52,71	2	550 Ω 3 W	550 Ω Zub wd 214g

Symbol SYMBOL	Stck QTY	Gegenstand DESCRIPTION	Bestellangabe ORDERING DATA
		Schichtwiderstand LAYER-TYPE RESISTOR	
R 87	1	100 kΩ ±5 % 0,5 W	B 51265 A 100 K 5/2
R 88	1	2 kΩ ±2 % 2 W	2 K 2 % DIN 41404 R
R 90	1	NTC-Widerstand NTC RESISTOR	Type B 8-320-01 A/4 E
Tr	1	Netztransformator POWER TRANSFORMER	Rel Bv 621 K 3030
		Wicklg. I (1d,4c) 100 Wdg 0,36 CuL 2,4 Ω	
		Wicklg. II (4c,2c) 550 Wdg 0,36 CuL 20,4 Ω	
		Wicklg. III (3c,1c) 550 Wdg 0,30 CuL 22 Ω	
		Wicklg. IV (3b,4b,5b,6b) 1600 Wdg 0,17 CuL 218 Ω Abgriff (4b) 1400 Wdg Abgriff (5b) 1500 Wdg	
		Wicklg. V (1b,5c,2b) 230 Wdg 0,30 CuL 7,5 Ω Abgriff (5c) 115 Wdg	
		Wicklg. VI (2a,1a,3a) 68 Wdg 0,70 CuL 0,6 Ω Abgriff (1a) 50 Wdg	
		Wicklg. VII (4a,5a,6a) 18 Wdg 0,15 CuL 3,8 Ω Abgriff (5a) 9 Wdg	
S 6	1	Spannungswähler VOLTAGE ADJUSTER	Rel sch 268a



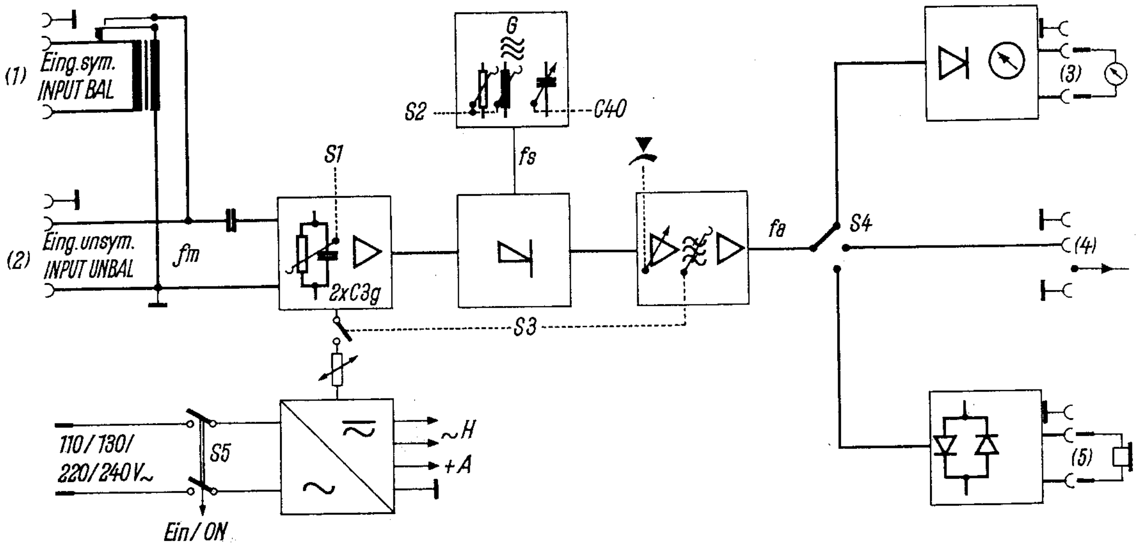
Rückansicht des geöffneten Gerätes
REAR VIEW OF CHASSIS

Bildanlage 1
ANNEXED FIG. 1



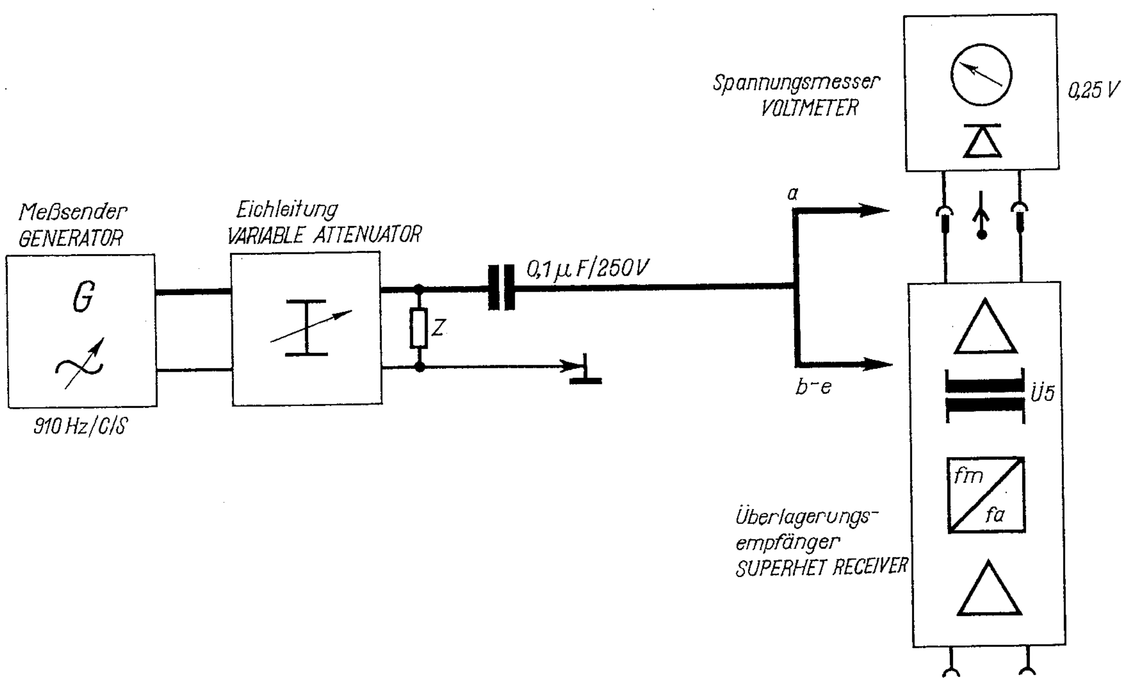
Frontansicht
PANEL VIEW

Bildanlage 2
ANNEXED FIG. 2



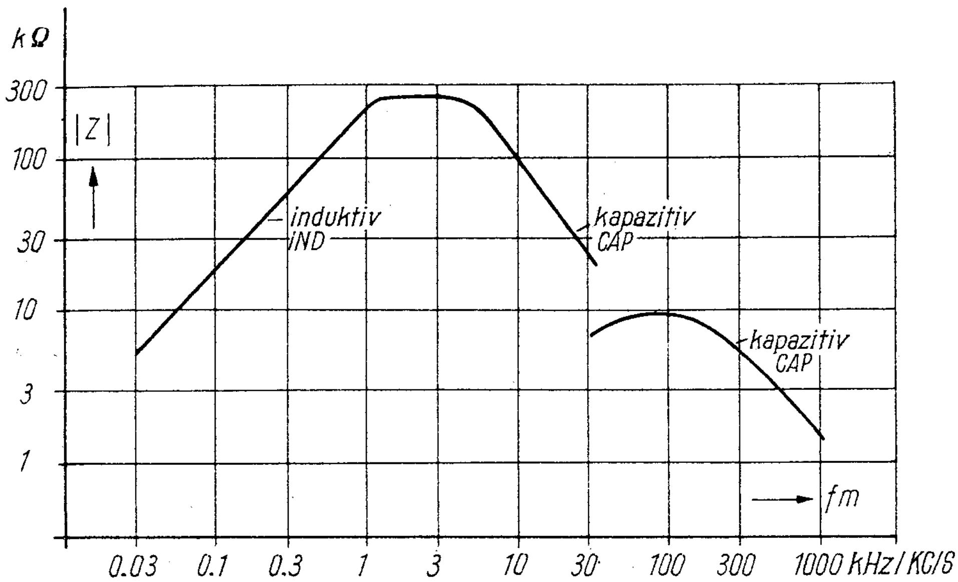
Grundschaltung
FUNCTIONAL CIRCUIT DIAGRAM

Bildanlage 3
ANNEXED FIG. 3

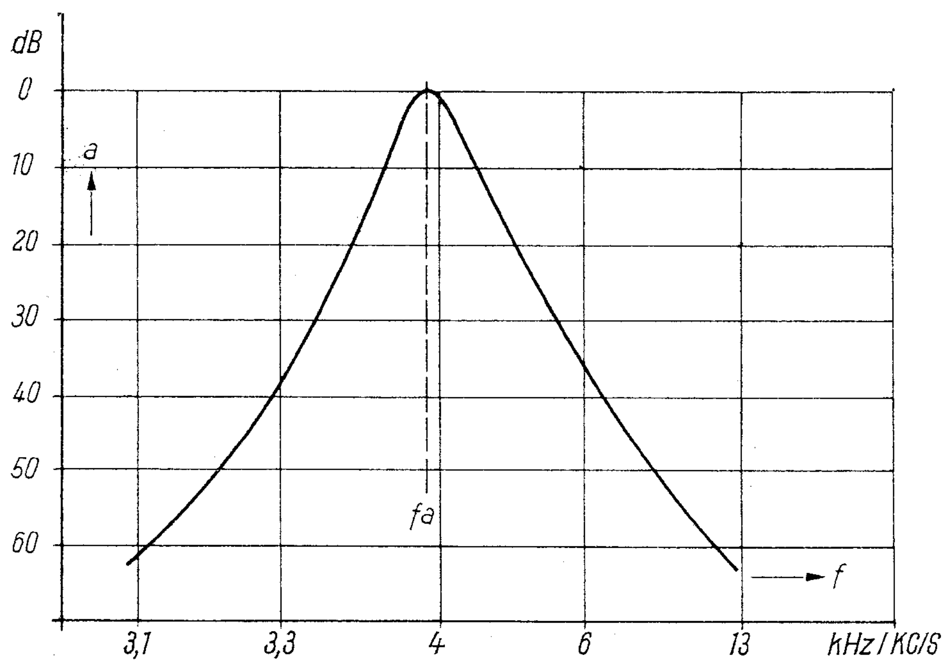


Schaltung zum Prüfen des Ausgangsverstärkers
CIRCUIT FOR CHECKING THE OUTPUT AMPLIFIER

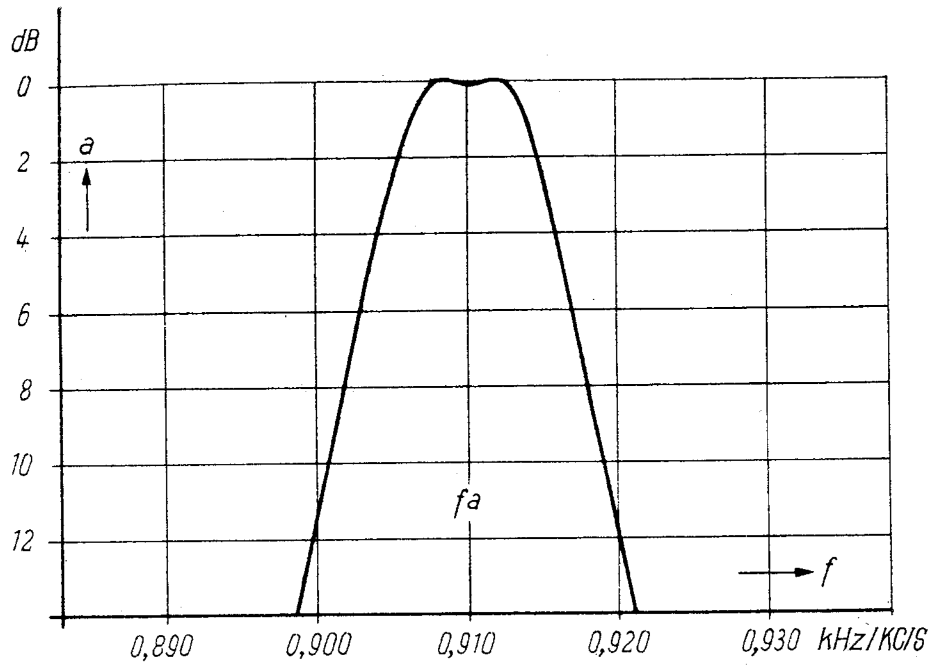
Bildanlage 4
ANNEXED FIG. 4



Eingangs-Scheinwiderstand, abhängig von der Frequenz — Bildanlage 5
INPUT IMPEDANCE AS A FUNCTION OF FREQUENCY — ANNEXED FIG. 5

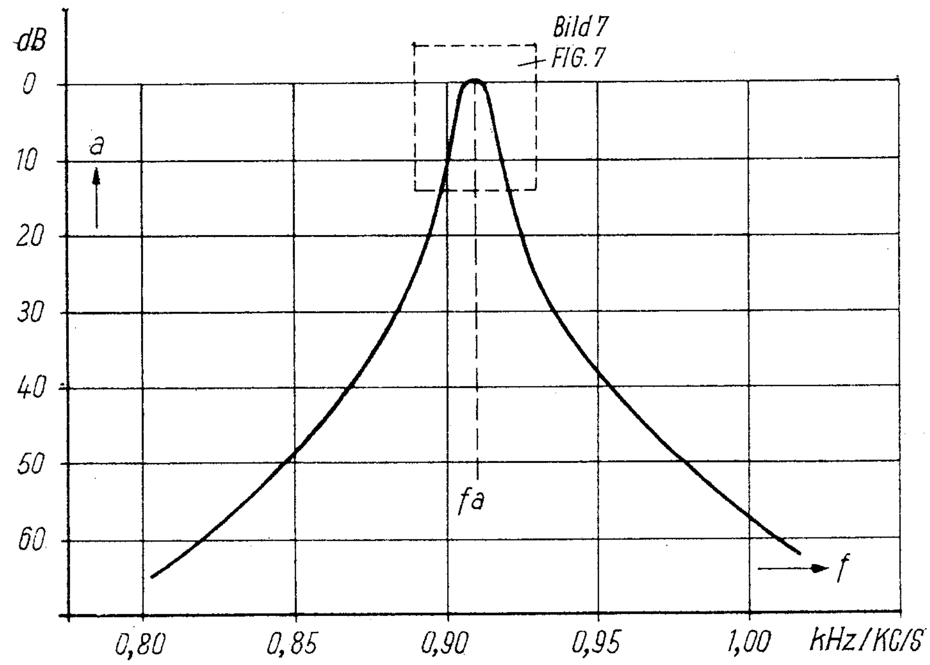


Beispiel einer Filterkurve „breites Band" — Bildanlage 6
EXAMPLE OF A FILTER CHARACTERISTIC "WIDE BAND" — ANNEXED FIG. 6



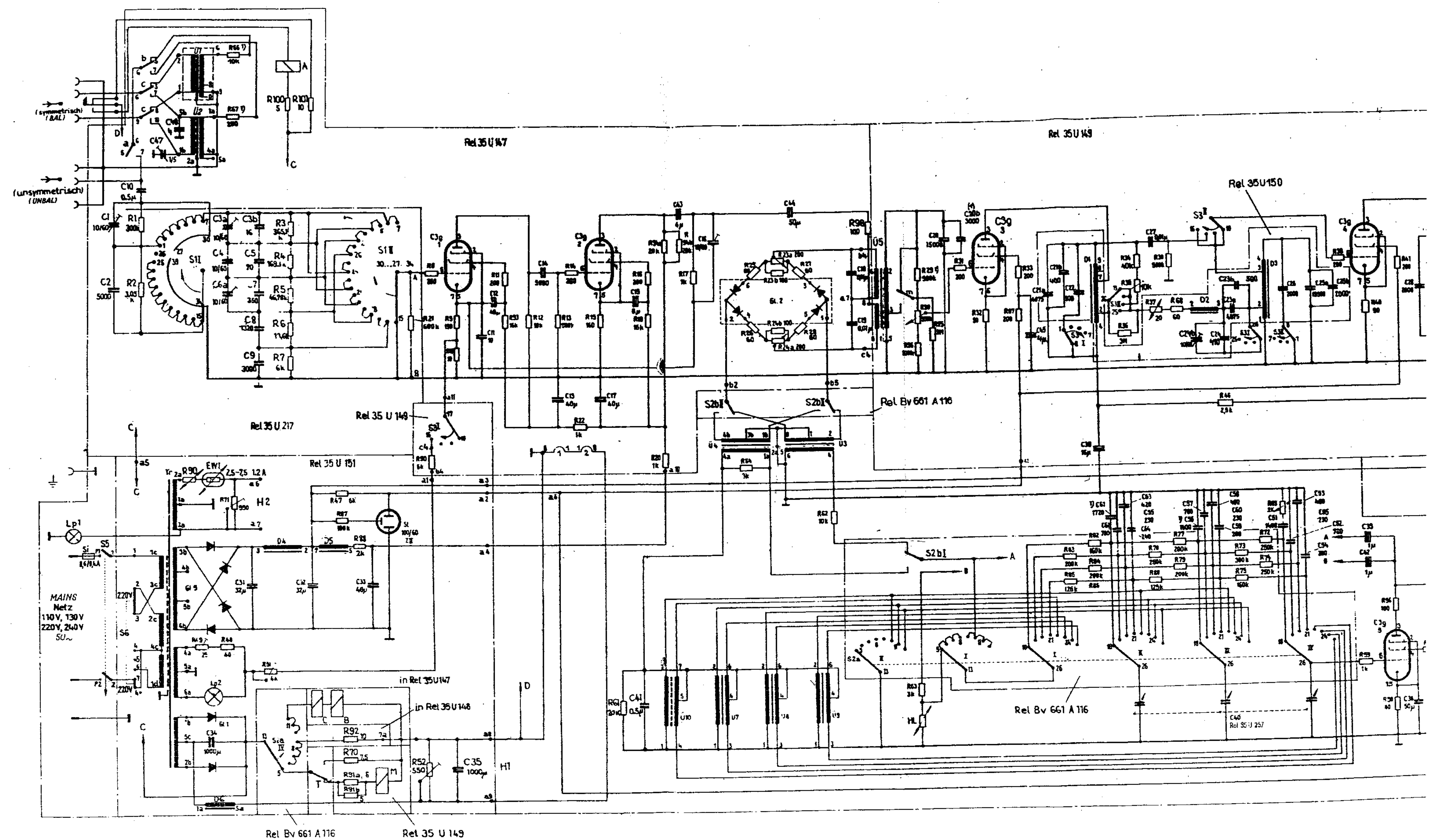
Ausschnitt „fa ±10 Hz" aus Bild 8
DETAIL "fa ±10 C/S" OF FIGURE 8

Bildanlage 7
ANNEXED FIG. 7



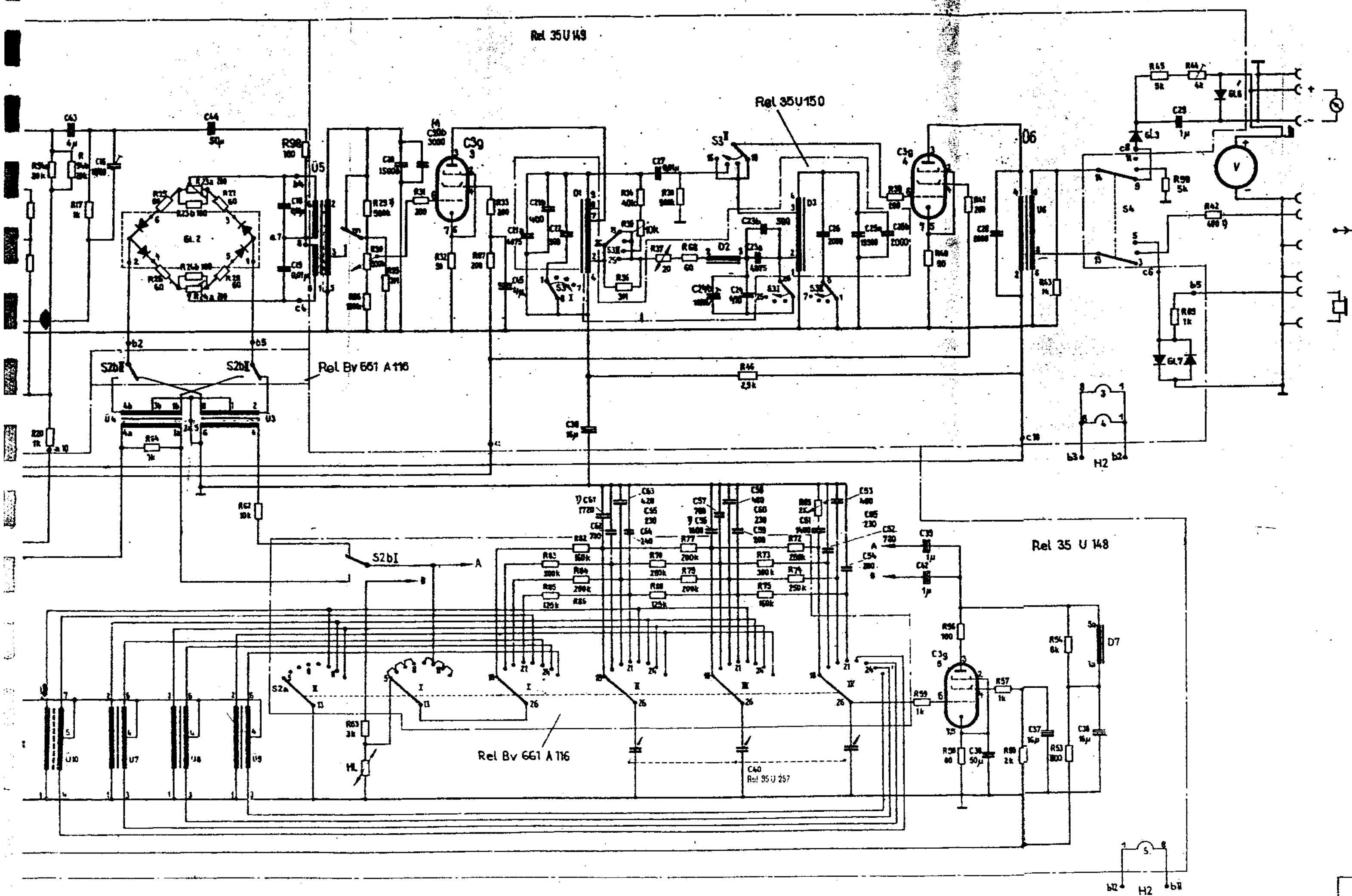
Beispiel einer Filterkurve „schmales Band"
EXAMPLE OF A FILTER CHARACTERISTIC "NARROW BAND"

Bildanlage 8
ANNEXED FIG. 8



(symmetrisch) (BAL)
(unsymmetrisch) (UNBAL)
Rel 35 U 147
Rel 35 U 149
Rel 35 U 150
Rel 35 U 217
Rel 35 U 151
Rel Bv 661 A 116
MAINS
Netz
110V, 130V
220V, 240V
50~
in Rel 35 U 147
in Rel 35 U 148
Rel 35 U 149
Rel Bv 661 A 116

SIEMENS
WEITVERKEHRS
TECHNIK



Schalter S1 / SWITCH S1	
Schaltarm / WIPER S1^I, S1^II Kontakt-Nr CONTACT-NO.	dB/mV DB/MV
15	▼
17	0 / 1000
19	-10 / 300
21	-20 / 100
23	-30 / 30
25	-40 / 10
1	-50 / 3
3	-60 / 1
6	-70 / 0,3
7	-80 / 0,1

Schalter S2 / SWITCH S2			
Schaltarm / WIPER S2a I–III Kontakt-Nr CONTACT-NO.		kHz KC/S	Federsatz SPRING SET S2b^I S2b^II
5	18	▼,I 0,03 – 0,3	
6	19	II 0,3 – 1	
7	20	III 1 – 3	
8	21	IV 3 – 10	
8	22	V 10 – 30	x
10	23	VI 30 – 100	x
11	24	VII 100 – 300	x
12	25	VIII 300 – 1000	x

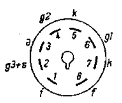
Schalter S3 / SWITCH S3		
Schaltarm / WIPER S3^I 1 S3^II Kontakt-Nr. CONTACT-NO.		Hz C/S
1 10 19	1 10	870 ⎍
3 12 21	3 12	910 ⎍
5 14 23	5 14	910 ⎍
7 16 25	7 16	▼

Schalter S4 / SWITCH S4		
Kontakt-Nr CONTACT-NO.		
3	9	
4	10	
5	11	

Spannungswähler S6
VOLTAGE ADJUSTER S6

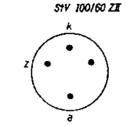
Netz MAINS	Kontakt / CONTACT 1	2	3	4	5	6	7	4*
110 V	—	—	—	—			—	—
130 V	—	—	—	—		—	—	
220 V		—	—				—	—
240 V		—	—			—	—	

C3g



(1) Prüffeldabgleich
ALIGNED IN TEST ROOM

StV 100/60 Z II



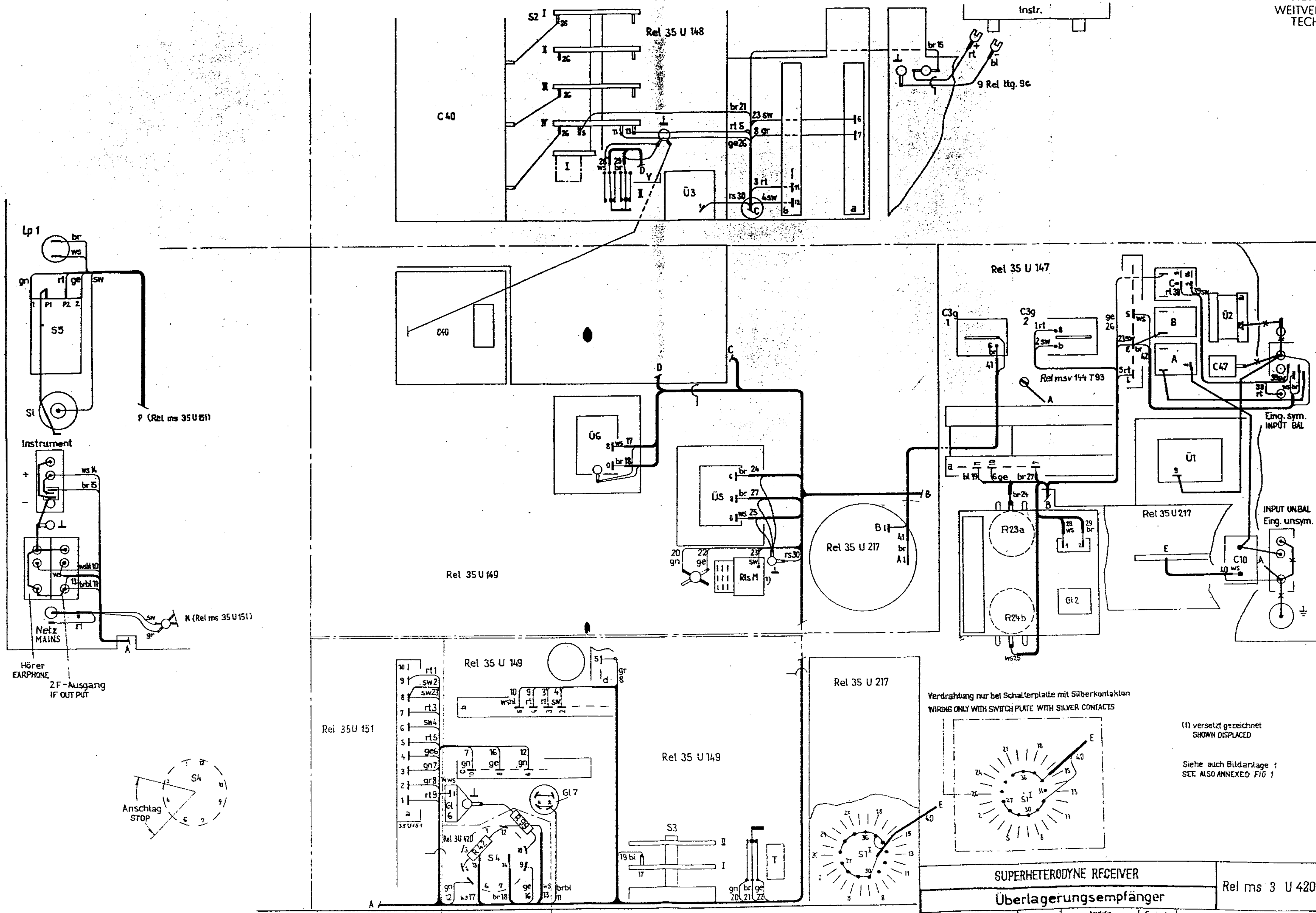
SUPERHETERODYNE RECEIVER 30 C/S – 1 MC/S	Rel str 3 U 420 c Dt/En
Überlagerungsempfänger 30 Hz – 1 MHz	

Siemens & Halske Aktiengesellschaft Wernerwerk für Fernmeldetechnik

	Vorläufig		Freigabe	Änderungen						
Ausgabe	E	F	I	II	III	IV	V	VI	VII	VIII
Datum	30.9.57	12.2.58	18.6.58	27.7.60	2.2.61	12.6.61				
Name	[signature]	[signature]	[signature]	[signature]	[signature]	[signature]				
Änd. Mitt.				03258	13104	13235				
T.R.										

Verteiler | Ursprung: | Ersatz für: | Ersetzt durch:

SIEMENS
WEITVERKEHRS
TECHNIK



SUPERHETERODYNE RECEIVER

Überlagerungsempfänger

Rel ms 3 U 420 c Dt/En

Siemens & Halske Aktiengesellschaft Wernerwerk für Weitverkehrs- und Kabeltechnik

Ausgabe	I	II	III	IV
Datum	16.6.59	27.7.60	2.2.61	12.6.61
Änd.Mittlg.		03258	13104	13235

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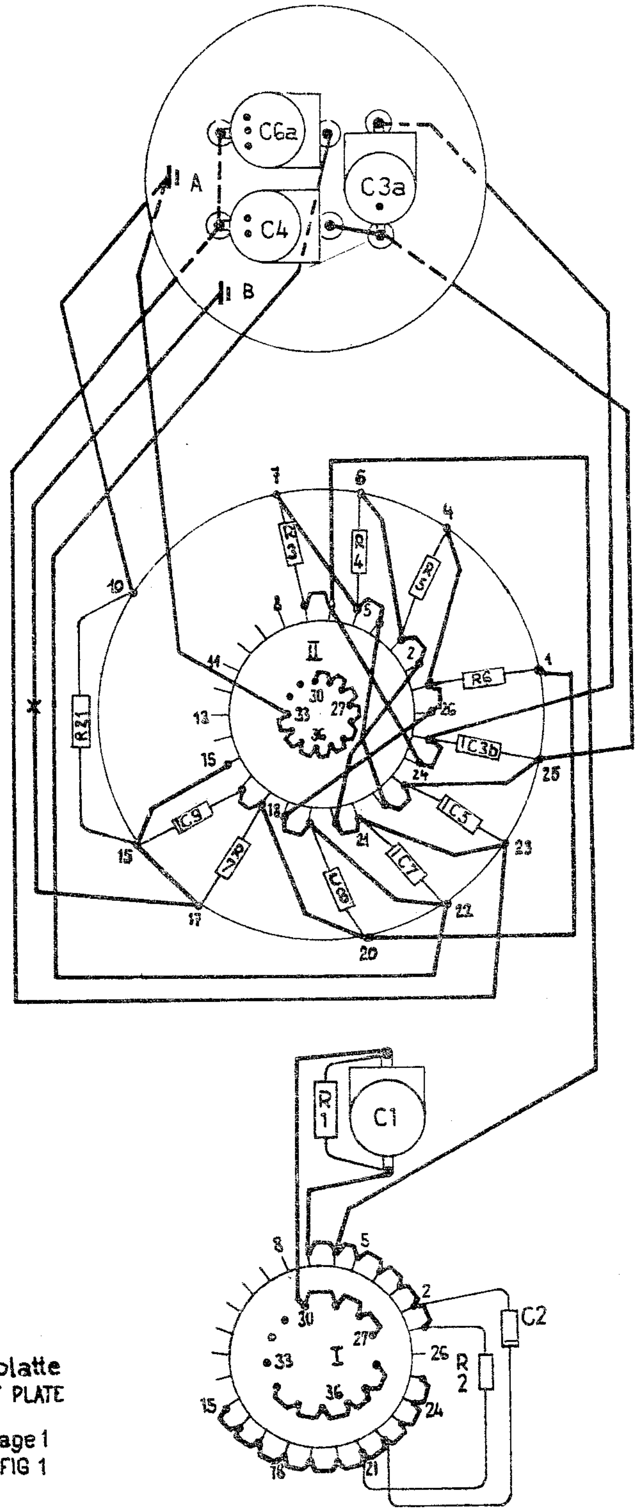
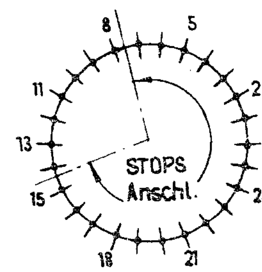
TECHNIK



S1^I nächst Rastplatte
S1^I NEXT TO DETENT PLATE

Siehe auch Bildanlage 1
SEE ALSO ANNEXED FIG 1



INPUT VOLTAGE DIVIDER (S1) SUPERHETERODYNE RECEIVER 3U420 **Eingangsspannungsteiler(S1)** Überlagerungsempfänger 3 U 420	Rel ms 35U 217 Dt/En

Siemens & Halske Aktiengesellschaft Wernerwerk für Weitverkehrs- und Kabeltechnik		Vorläufig			Freigabe	Änderungen						
	Ausgabe	A			I	II	III	IV	V	VI	VII	VIII
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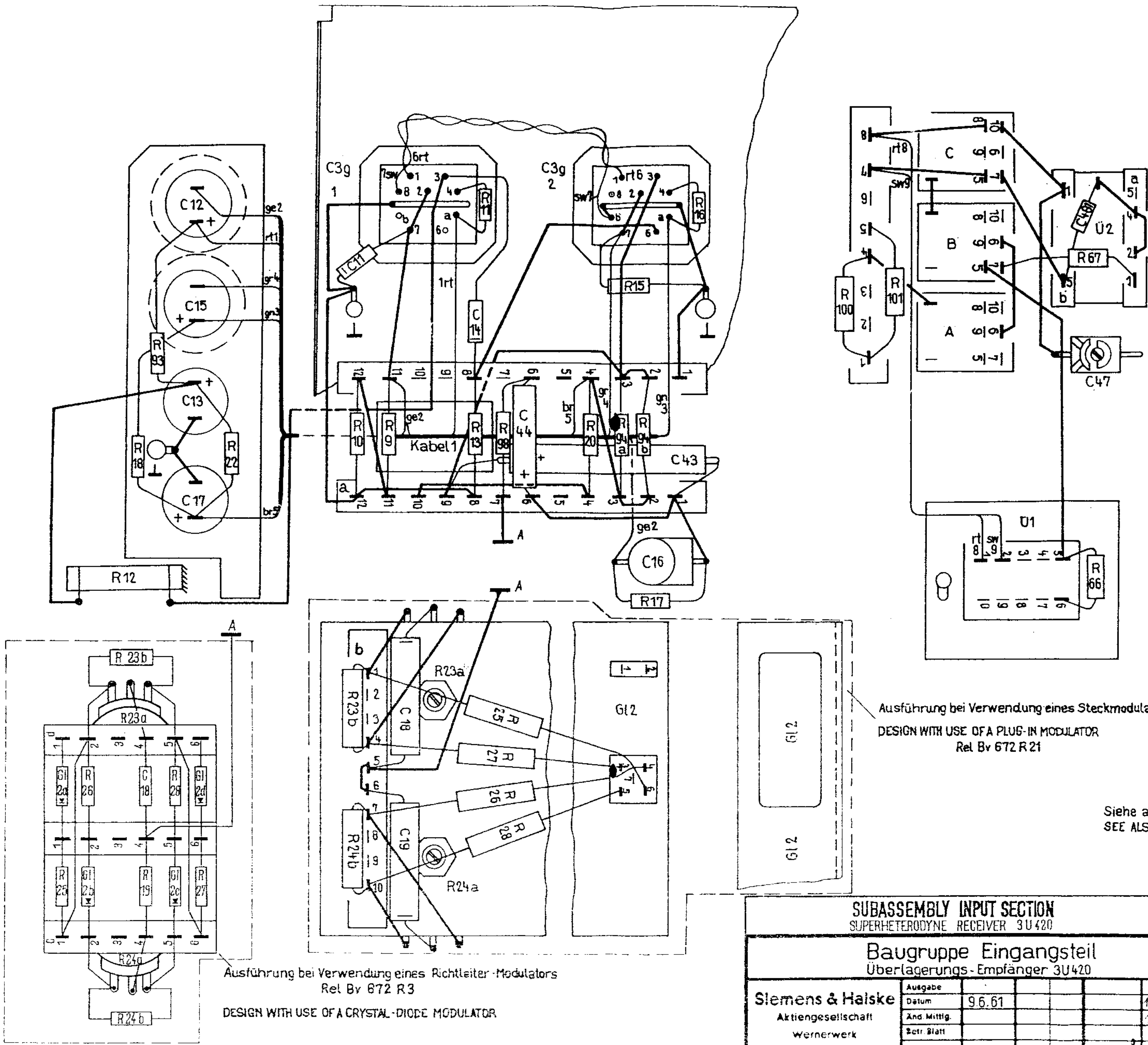
	Name											
						16.1.59	93149	13104				
	Änd Mittlg				3.6.58	93051						
	Verteiler:	Normgepr.:		Ersatz für			Ersetzt durch:					

♀ Rel OE 68 a

SIEMENS
WEITVERKEHRS
TECHNIK



Ausführung bei Verwendung eines Steckmodulators
DESIGN WITH USE OF A PLUG-IN MODULATOR
Rel Bv 672 R 21

Siehe auch Bildanlage 1
SEE ALSO ANNEXED FIG 1

Ausführung bei Verwendung eines Richtleiter-Modulators
Rel Bv 672 R3
DESIGN WITH USE OF A CRYSTAL-DIODE MODULATOR

SUBASSEMBLY INPUT SECTION SUPERHETERODYNE RECEIVER 3U420		Rel ms 35 U 147 Dt/En
Baugruppe Eingangsteil Überlagerungs-Empfänger 3U420		
Siemens & Halske Aktiengesellschaft Wernerwerk für Weitverkehrs- und Kabeltechnik	Ausgabe: — / Datum: 9.6.61 / Änd. Mittlg.: — / Zeichn. Blatt: — / Name: —	Ausgabe: II / Datum: 12.6.61 / Änd. Mittlg.: 13235
Verteiler: 9.6.61	Normgepr.:	Ersatz für: Ausg. II — Ersatzt durch:

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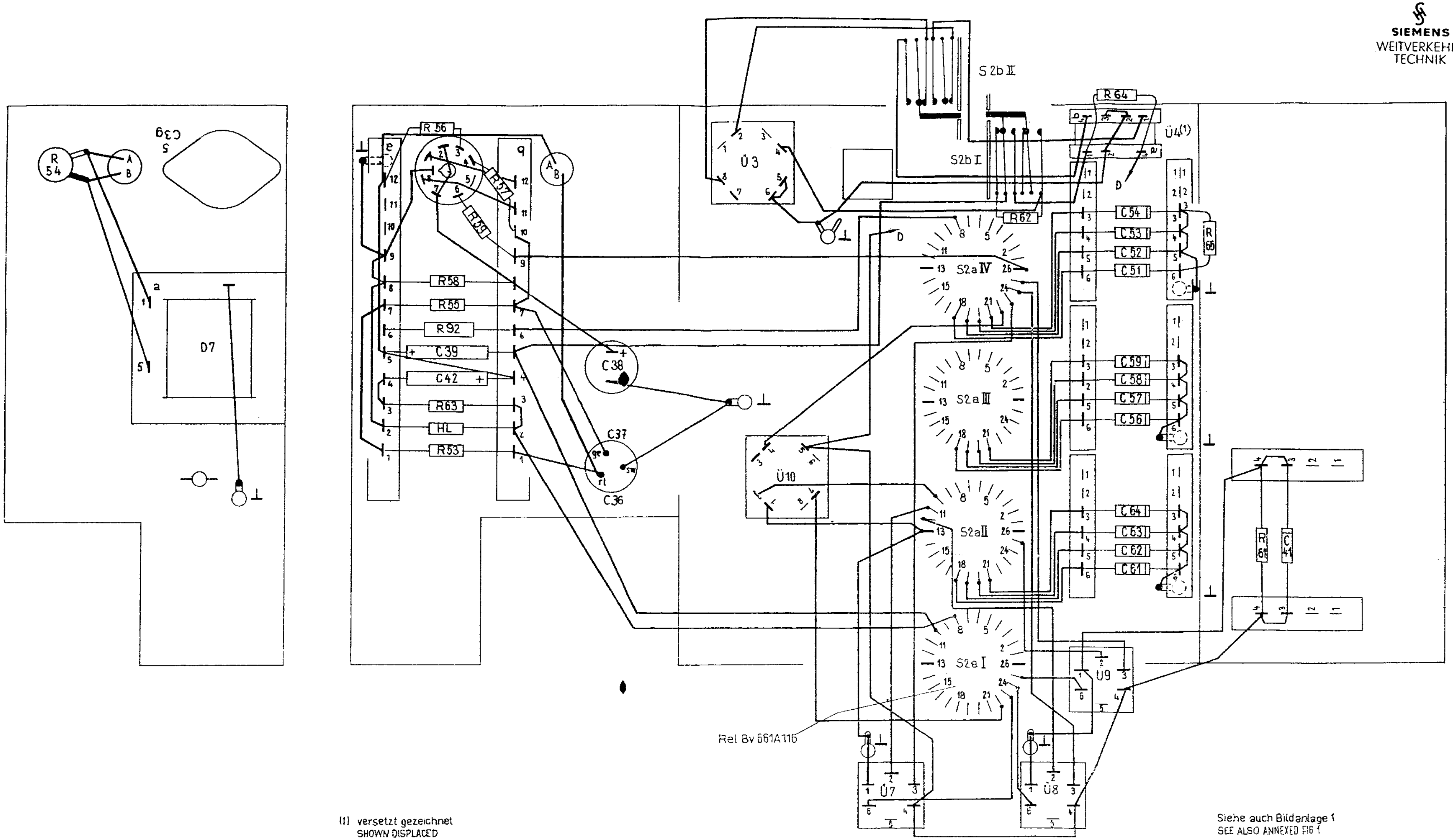

(1) versetzt gezeichnet
SHOWN DISPLACED

Siehe auch Bildanlage 1
SEE ALSO ANNEXED FIG 1

CRYSTAL SECTION
SUPERHETERODYNE RECEIVER 3U420

Schwingteil
Überlagerungsempfänger 3U420

Rel ms 35 U 148 Dt/En

Siemens & Halske
Aktiengesellschaft
Wernerwerk
für Weitverkehrs- und Kabeltechnik

	Vorläufig A	Vorläufig B	Vorläufig C	Freigabe I	Änderungen II	III	IV	V	VI	VII	VIII
Ausgabe	A	B	C	I	II	III	IV	V	VI	VII	VIII
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Änd. Mittlg.	[illegible]	[illegible]		[illegible]	93051	93 149	03258	13235			
TR				[illegible]	[illegible]	Mo					

Verteiler | Normgepr. | Ersatz für | Ersetzt durch

26.5.55

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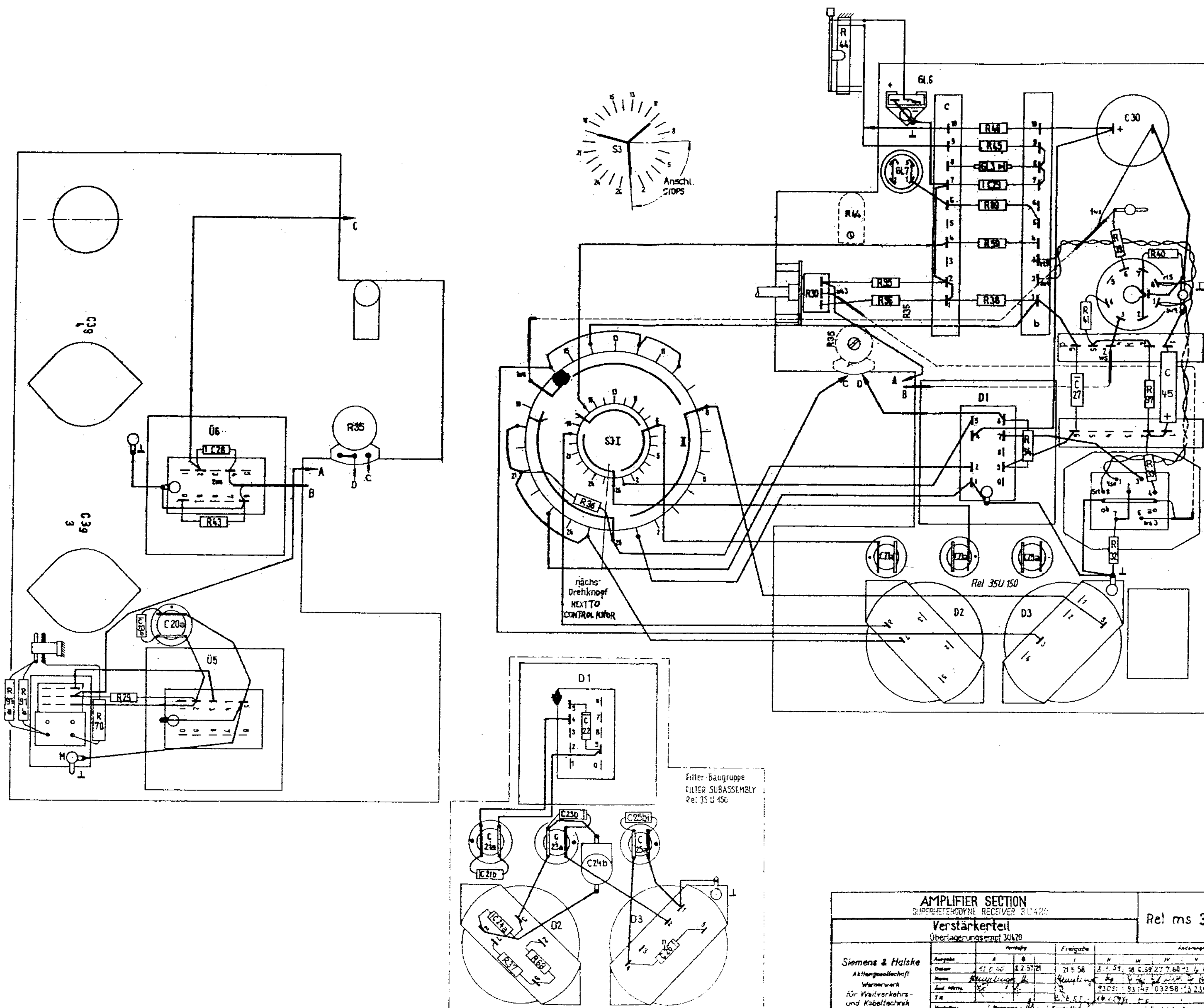

AMPLIFIER SECTION SUPERHETERODYNE RECEIVER 3 U 420	Rel ms 35 U 149 Dt/En
Verstärkerteil Überlagerungsempf 3U420	

Siemens & Halske Aktiengesellschaft Wernerwerk für Weitverkehrs- und Kabeltechnik		Verfertigt A	B	Freigabe I	Änderungen II	III	IV	V	VI	VII	VIII
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	Änd. Mittlg.				93051	93149	03258	13235			
	TÄ										
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3.6.55

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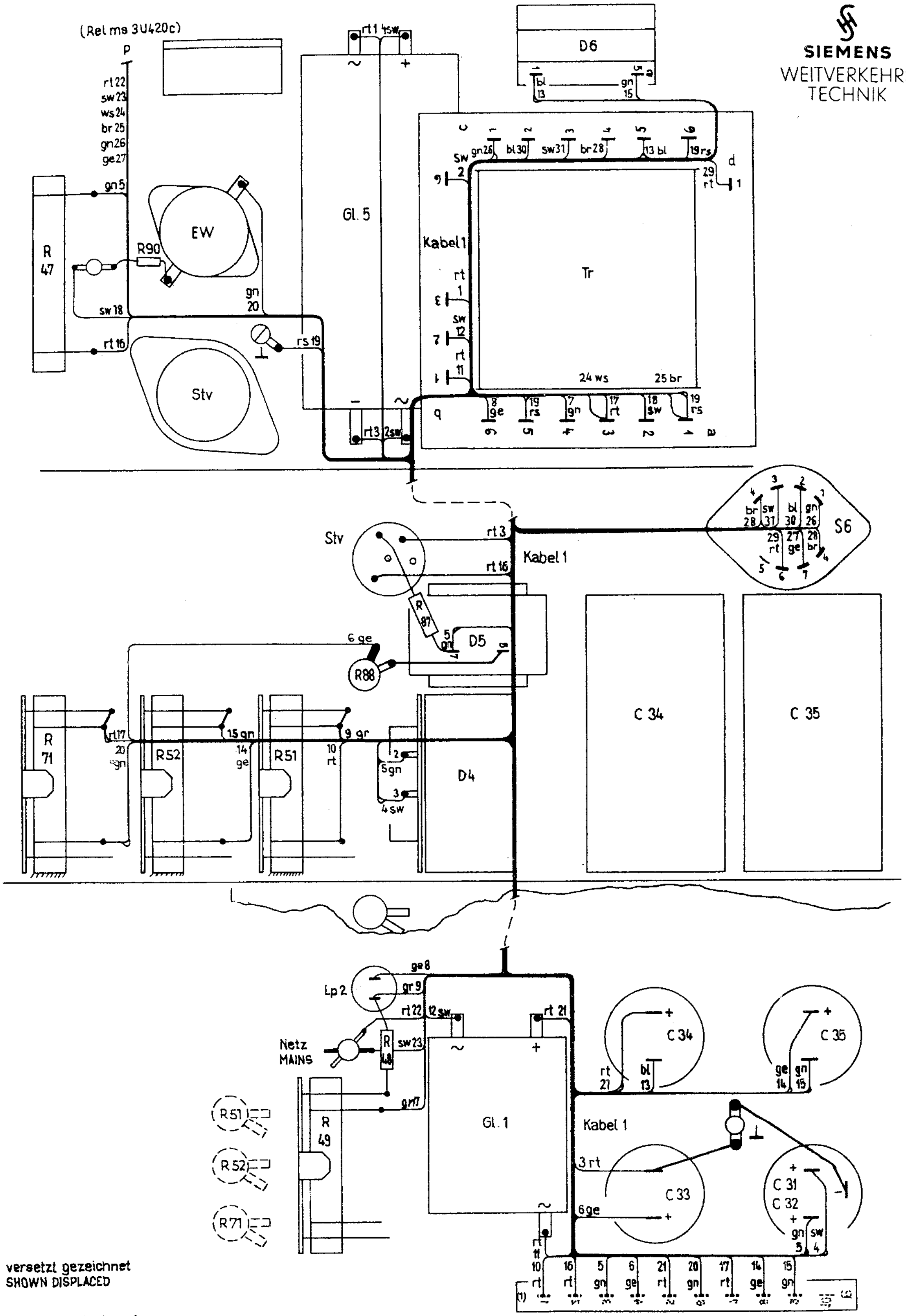

1) versetzt gezeichnet
SHOWN DISPLACED

Siehe auch Bildanlage 1
SEE ALSO ANNEXED FIG. 1

POWER SUPPLY UNIT
FOR SUPERHETERODYNE RECEIVER 3 U 420

Netzteil
für Überlagerungsempfänger 3U 420

Rel ms 35 U 151 Dt /En

Siemens & Halske
Aktiengesellschaft
Wernerwerk
für Weitverkehrs- und Kabeltechnik

	Vorläufig			Freigabe	Änderungen						
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Änd. Mittlg.					93051	93149	03258				
TR				3.6.58 [illegible]							
Verteiler:	Normgepr.:			Ersatz für:			Ersetzt durch:				